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  ▪ Electrical
  ▪ Hospitality
  ▪ Building and Construction
  ▪ Engineering
  ▪ Automotive
Southern Futures – Industry Mathematics Program

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EdServe – Maths at Work
Permission has been obtained from EdServe to reproduce the material included in this resource. Go to www.edserve.com.au for further information about this resource.

Ian Lowe – Mathematics at Work (CD-ROM)

List of useful websites
INTRODUCTION

The SA Independent Schools Targeted Programs Authority Inc administers the VET in Schools funds provided to independent schools in South Australia by the Australian Government. These funds are available to all independent schools in South Australia to promote and expand vocational education and training opportunities for senior secondary students. Some of the funds are allocated to sector wide projects and initiatives that support VET programs. VET in Schools funds have been used to develop the updated Maths for Industry 2006 resource.

The Maths for Industry 2006 project builds on the earlier Mathematics for Industry resources that were developed in 2004 in response to feedback from industry that many school students were unable to successfully complete the aptitude tests used by agencies and employers for entry to employment and New Apprenticeships. This updated resource includes new SACE Assessment Plans for two units of Stage 1 Mathematics, teaching outlines and a range of industry specific tests that focus on the vocational skills and competencies in Training Packages such as the Metal and Engineering Training Package.

The Maths for Industry 2006 resource includes the mathematical skills and knowledge included in a variety of tests currently in use and is intended for use by teachers in schools to support students in achieving success in:

- New Apprenticeship Aptitude tests
- Employment Entry Tests
- SACE Stage 1 Mathematics

While SSABSA assessment requirements stipulate the use of technology, teachers will need to include sufficient practice using traditional 'pen and paper' calculations to ensure students are competent in gaining the skills needed to successfully complete the tests required by various agencies as some tests are completed under conditions that enforce 'no calculator' rules and may be administered under strict time limits.

ACKNOWLEDGEMENTS:

- Mal Aubrey, Group Training Australia (SA)
- Heather Parrington, SSABSA
- Southern Futures Community Partnership
- Carol Moule, Consultant
- Ian Thomson, Trinity College
- Ivan Muster, Faith Lutheran Secondary School
- Helen Lambert, Program Manager, AISSA
- Linda Hilditch, VET Adviser, AISSA
- Bernie Fitzsimons, (former) VET Adviser, CESA
- Teachers of Mathematics in Independent and Catholic schools who have trialled and assisted in the development of the resource.
SECTION ONE: INDUSTRY COMPETENCIES

Metal and Engineering Industry Training Package
Competencies mapped against SACE Stage 1 Maths
METAL AND ENGINEERING INDUSTRY
COMPETENCY STANDARDS

Unit MEM2.7C10A  Perform computations - basic

Time: 19 hours

**Element 2.7C10.1**  
*Applies four basic rules of calculation*  
Criteria 2.7C10.1.1  
addition, subtraction, multiplication, division
Criteria 2.7C10.1.2  
length, perimeter, area, volume

**Element 2.7C10.2**  
*Performs basic calculations involving fractions and decimals*  
Criteria 2.7C10.2.1  
fractions and mixed numbers
Criteria 2.7C10.2.2  
decimal fractions and mixed numbers

Unit MEM2.8C10A  Perform computations

Time: 19 hours

**Element 2.8C10.1**  
*Estimates approximate answers*  
Criteria 2.8C10.1.1  
check calculated answers by estimating
Criteria 2.8C10.1.2  
perform simple rounding off when estimating

**Element 2.8C10.2**  
*Performs basic calculations involving percentages*  
Criteria 2.8C10.2.1  
simple percentage calculations in decimals or fraction form

**Element 2.8C10.3**  
*Applies the four basic rules to algebraic expression*  
Criteria 2.8C10.3.1  
simple algebra calculation involving +, -, ×, ÷

**Element 2.8C10.4**  
*Perform basic calculations involving proportions*  
Criteria 2.8C10.4.1  
ratio calculations involving whole numbers, fractions and decimals
Criteria 2.8C10.4.2  
using charts and graphs to make decisions

**Element 2.8C10.5**  
*Interpret charts and graphs*  
Criteria 2.8C10.5.1  
interpret information from charts and graphs correctly
Criteria 2.8C10.5.2  
use information from charts and graphs for decision making

**Element 2.8C10.6**  
*Produces charts and graphs from given information*  
Criteria 2.8C10.6.1  
produce simple charts and graphs from given information
### Unit MEM2.13C5A  Perform mathematical computations

**Time:** 38 hours

**Pre-requisite units:**
- 2.7C10  Perform computations - basic
- 2.8C10  Perform computations

<table>
<thead>
<tr>
<th>Element 2.13C5.1</th>
<th>Performs calculations involving the six trigonometric ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria 2.13C5.1.1</td>
<td>right-angled triangle trigonometry using ratios</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Element 2.13C5.2</th>
<th>Applies the sine and cosine rule in the solution of problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria 2.13C5.2</td>
<td>calculations involving non right-angled triangles using the sine and cosine rule</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Element 2.13C5.3</th>
<th>Performs simple algebraic operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria 2.13C5.3.1</td>
<td>simple transposition of formulae to solve equations</td>
</tr>
<tr>
<td>Criteria 2.13C5.3.2</td>
<td>construction of formulae to solve problems involving simple shapes or concepts</td>
</tr>
<tr>
<td>Criteria 2.13C5.3.3</td>
<td>solving simple linear equations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Element 2.13C5.4</th>
<th>Uses geometrical principles in the solution of problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria 2.13C5.4.1</td>
<td>using algebra to solve geometrical problems involving angles, triangles and circles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Element 2.13C5.5</th>
<th>Calculates areas and volumes of complex shapes</th>
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</thead>
<tbody>
<tr>
<td>Criteria 2.13C5.5.1</td>
<td>applying formulae for the calculation of area and volume</td>
</tr>
<tr>
<td>Criteria 2.13C5.5.2</td>
<td>areas and volumes of composite shapes, including conical sections</td>
</tr>
</tbody>
</table>
This unit is intended for students who plan to study only one unit of Mathematics, and/or for those who intend undertaking Unit B in second semester. The units are intended to prepare students for

- New Apprenticeship Aptitude tests
- Employment Entry Tests
- SACE Stage 1 Mathematics

It is assumed that students who undertake this unit will
- Have had some experience in manipulating and performing calculations with numbers in decimal, fraction and percentage form with and without a calculator;
- Have some prior knowledge of reading line and column graphs and pie charts.

Students who successfully complete Maths for Industry Unit A will be competent in the Metal and Engineering Industry Competency Standards units MEM2.7C10A and MEM2.8C10A. For students to gain recognition for these VET competencies, schools will need to have established a VET in Schools Agreement (VISA) with tafeSA.

The SACE topics and sub-topics and related units of competency for this unit of Mathematics are listed on the next page, with an indication of the length of time to be spent on developing skills.
## SACE Stage 1 *Maths for Industry*: Unit A

<table>
<thead>
<tr>
<th>SACE Topic</th>
<th>SACE Sub-topic</th>
<th>Unit of Competency</th>
<th>Length</th>
</tr>
</thead>
</table>
| 15. Open Topic   | 15.1 Basic calculations involving whole numbers, fractions, decimals and their application in worded questions. | MEM2.7C10A Element 2.7C10.1  
• Applies four basic rules of calculation  
Element 2.7C10.2  
• Performs basic calculations involving fractions and decimals |        |
|                  | 15.2 Estimating approximate answers.                                           | MEM2.8C10A Element 2.8C10.1  
• Estimates approximate answers |        |
|                  | 15.3 Basic calculations involving percentages                                   | MEM2.8C10A Element 2.8C10.2  
• Performs basic calculations involving percentages | 35 hrs |
|                  | 15.4 Ratio calculations involving whole numbers, fractions and decimals.        | MEM2.8C10A Element 2.8C10.4  
• Perform basic calculations involving proportions  
Criteria 2.8C10.4.1  
• ratio calculations involving whole numbers, fractions and decimals. |        |
|                  | 15.5 Basic algebra skills                                                      | MEM2.8C10A Element 2.8C10.3  
• Applies the four basic rules to algebraic expression |        |
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<thead>
<tr>
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<th>SACE Sub-topic</th>
<th>Unit of Competency</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Data in context</td>
<td>3.1 Recognising data and its representation or related statistics</td>
<td>MEM2.8C10A Element 2.8C10.5 • Interpret charts and graphs</td>
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</tr>
<tr>
<td>3. Data in context</td>
<td>3.2 Reading data and its representation or related statistics</td>
<td></td>
<td>20 hrs</td>
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<tr>
<td>3. Data in context</td>
<td>3.3 Identifying the purpose of the data and its representation or related statistics</td>
<td>MEM2.8C10A Element 2.8C10.4 • Perform basic calculations involving proportions Criteria 2.8C10.4.2 Using charts and graphs to make decisions Element 2.8C10.6 • Produces charts and graphs from given information</td>
<td></td>
</tr>
</tbody>
</table>
SECTION TWO:
SACE STAGE 1
ASSESSMENT EXEMPLARS

Maths for Industry Assessment Plans
Maths for Industry Unit A
Maths for Industry Unit B

SSABSA Support Materials
Assessment Plans A & G
STAGE 1 ASSESSMENT PLAN FOR 2006

School     ______________________________________________________
Maths for Industry

Other schools using this plan ________________________________________________________________________________

<table>
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<th>SSABSA School Code</th>
<th>Year</th>
<th>Enrolment Code</th>
<th>Program Variant Code (A–W)</th>
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PROGRAM RATIONALE

The program rationale must:
• describe the setting (e.g. student background and needs, resources, timetabling);
• describe the intended teaching program (e.g. scope, themes, methods, essential learnings, key competencies), and explain how it is designed to meet the needs of the particular student group;
• explain how the assessment outline (see over) is designed to provide an opportunity for the student group to succeed.

This program has been written to meet the needs of a mixed ability group of students who are predominantly interested in an industry or business career pathway. Variant A can be taken as a one unit course or can be combined with Variant B to form a two unit course. These students need to have their basic numeracy and technology skills reinforced. Vocational Education and Training Units of Competency will be considered for inclusion and this will support Units of Competency offered in other subjects. The students have access to graphic calculators and resource based learning including internet facilities. The topics to be included in this unit are: Earning and Spending, Measurement and an Open Topic. The Open Topic will be related to industry pathways such as construction, engineering, hospitality, health, sport and recreation, agriculture and marine.

Teaching and learning activities will support the contexts of the students' proposed future pathways and include applications necessary for informed decision making in everyday life. Electronic technology will be integrated where appropriate to provide students with the tools to explore patterns and make more complex calculations, so that the skills of analysis and interpretation of results become more commonplace. The learning outcomes, mathematical understandings, strategies, techniques, analysis and interpretation, and the use of electronic technology will be a focus in all components. The Essential Learnings, Identity, Interdependence, and Communication will form the focus of the contexts chosen, although Futures will be a pervading theme also.

Assessment activities will reflect the balance between the need to assess a sound sense of number and routine, automated skills, and the ability to reflect on results, analyse, interpret, draw conclusions and discuss in context. They will include tests, constructing a spreadsheet, an investigation and a project. The students will be required to be contributing and positive members of a team in the project. Students may choose to do a written or oral report.

Signature of principal/SACE coordinator ____________________________________________

Assessment plan contact teacher ____________________________________________

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SSABSA USE ONLY

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Approved/Not approved: Date __________________ Signature __________________

Assessment Field Officer

PLEASE TURN OVER
ASSESSMENT OUTLINE
This assessment outline may need to be changed during the program.

School______________________________________________________ Teacher____________________________________

Subject  Maths for Industry

<table>
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</tbody>
</table>

Program Variant Code (A–W) A

SACE Literacy Strategy

Literacy in the SACE is defined as: the ability to understand, analyse, critically respond to, and create spoken, written, and visual communications, and use information communication technologies, in different contexts.

This assessment outline must provide opportunity for students to develop literacy skills. These may be developed separately or integrated, depending on the purpose of each assessment task

Indicate in at least three of the boxes below where the opportunity is provided for students to develop their literacy skills.

- [ ] Spoken Communication
- [ ] Written Communication
- [ ] Visual Communication
- [ ] Use of ICTs

Briefly describe, in one of the assessment tasks below, how students will be given the opportunity to work critically.

<table>
<thead>
<tr>
<th>Name of Assessment Component</th>
<th>Description of Assessment Tasks</th>
<th>Weighting (%)</th>
<th>Learning Outcomes Measured</th>
<th>Criteria for Judging Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills and Applications Tasks</td>
<td>Measurement Assignment (with and without electronic technology) 60 minutes Subtopics 2.1, 2.2, 2.4, 2.5, 2.6 Find the perimeter, surface area, volume, capacity and time in a range of contexts, using appropriate conversions and estimation</td>
<td>15%</td>
<td>1, 2, 3, 4, 5, 6 &amp; 7</td>
<td>Students performance will be judged by the extent to which they demonstrate: Mathematical skills and understanding when using electronic technology. Mathematical skills and understanding when not using electronic technology. Analysis and interpretation of the results and information. Communication of mathematical information.</td>
</tr>
<tr>
<td></td>
<td>Earning and Spending Budgeting Spreadsheet 60 minutes Subtopics 1.3 Use a spreadsheet to produce a personal budget and investigate a range of different scenarios</td>
<td>15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Earning and Spending, and Open Topic Test 60 minutes Subtopics 1.1, 1.2, 1.3, 15.1, 15.2, 15.3</td>
<td>20%</td>
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<td></td>
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<tr>
<td></td>
<td>Total 50%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directed Investigation</td>
<td>Earning and Spending/Open Topic Topic 1 &amp; 15</td>
<td>20%</td>
<td>1,2,3,4,5,6 &amp; 7</td>
<td>Students performance will be judged by the extent to which they demonstrate:</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------</td>
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<td>--------------------------------------------------------------------------------</td>
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<tr>
<td></td>
<td>Investigate the wage structure of several positions in your chosen industry or business and the associated tax implications</td>
<td>2 hours</td>
<td>Total 20%</td>
<td>Mathematical skills and understanding when using electronic technology.</td>
</tr>
<tr>
<td></td>
<td><em>See attached Directed Investigation “Income and Tax”</em></td>
<td></td>
<td></td>
<td>Mathematical skills and understanding when not using electronic technology.</td>
</tr>
<tr>
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<td>Analysis and interpretation of the results and information</td>
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<td>Communication of mathematical information.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Organisation and presentation of materials.</td>
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<td></td>
<td>Ability to work independently.</td>
</tr>
<tr>
<td>Project</td>
<td>Measurement/Open Topic Topic 2 &amp; 15</td>
<td>30%</td>
<td>1,2,3,4,5,6,7, &amp; 8</td>
<td>Students performance will be judged by the extent to which they demonstrate:</td>
</tr>
<tr>
<td></td>
<td>Design and cost a major construction or project in your chosen industry or business. In order to make this project realistic and functional, students will need to actively plan, evaluate and reflect critically; as they consider aspects such as legal requirements and costing.</td>
<td>3 hours</td>
<td>Total 30%</td>
<td>Mathematical skills and understanding when using electronic technology.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mathematical skills and understanding when not using electronic technology.</td>
</tr>
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<td>Analysis and interpretation of the results and information</td>
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<td></td>
<td>Organisation and presentation of materials.</td>
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<td></td>
<td>Ability to work independently.</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>Ability to work cooperatively.</td>
</tr>
</tbody>
</table>
STAGE 1 MATHS FOR INDUSTRY

DIRECTED INVESTIGATION: INCOME AND TAX

You are asked to research the pay for jobs in your chosen industry and consider the tax implications

What to do:

✓ Choose three jobs or levels of employment connected with your chosen business or industry.

✓ For each job or level of employment research the income that would be received. Consider the following:
  
  • the amount of pay
  • the way that payment is made
  • overtime
  • tax
  • other relevant information

✓ Use a spreadsheet to organise and calculate the weekly net income for each job or level of employment for selected amounts of weekly overtime.

Employment advertisements or the internet are likely sources to help you with your research. You will find the following websites useful:


You are required to submit a report on your investigation. The outline of your report should be:

Introduction
Briefly explain in your own words what the investigation is about and how you will go about it.

Body
Describe the three jobs that you have chosen. What do people do in these jobs? Drawing on the results in your spreadsheet, give a detailed account of the calculated net incomes for each of the jobs or levels of employment investigated.

Conclusion
Summarise the main aspects of your investigation. What have you discovered?

Appendix
Spreadsheet (values and formulae); research material; bibliography
Performance will be assessed on the extent to which the following are demonstrated:

- Mathematical skills and understandings (without electronic technology)
- Mathematical skills and understandings (with electronic technology)
- Analysis and interpretation of results and information
- The communication of mathematical information
- The ability to work independently

### Achievement Level

<table>
<thead>
<tr>
<th>Criteria</th>
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<th>3</th>
<th>4</th>
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<tr>
<td>Mathematical skills &amp; understanding (without ET)</td>
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</table>

### Comments:
STAGE 1 ASSESSMENT PLAN FOR 2006

School_________________________________________________________ Subject Maths for Industry

Other schools using this plan ________________________________________________________________________________

<table>
<thead>
<tr>
<th>SSABSA School Code</th>
<th>Year</th>
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This program has been written to meet the needs of a mixed ability group of students who are predominantly interested in the engineering trades, retail, apprenticeships and small business career pathways. Variant B can be a one unit course or be combined with unit A to form a two unit course. These students need to have their basic numeracy and technology skills reinforced. Vocational Education and Training Units of Competency will be considered for inclusion and this will support Units of Competency offered in other subjects. The students have access to graphic calculators, resource based learning including internet facilities. Thus the topics to be included in this unit are: Geometry and Mensuration, Planar Geometry, Investing and Borrowing with contexts related to the following industry pathways such as: Construction, Business, Sport and Recreation, Health, Hospitality and Information Processing.

Teaching and learning activities will support the contexts of the students' proposed future pathways and include applications necessary for informed decision making in everyday life. Electronic technology will be integrated where appropriate to provide students with the tools to explore patterns and make more complex calculations, so that the skills of analysis and interpretation of results become more commonplace. The Learning Outcomes, mathematical understandings, strategies, techniques, analysis and interpretation, and the use of electronic technology will be a focus in all components. The Essential Learnings, Identity, Interdependence, and Communication will form the focus of the contexts chosen, although Futures will be a pervading theme also.

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Assessment plan contact teacher ________________________________

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Approved/Not approved: Date ____________________ Signature ____________________

Assessment Field Officer __________________

PLEASE TURN OVER
ASSESSMENT OUTLINE
This assessment outline may need to be changed during the program.

School ______________________________________________________ Teacher ________________________________

Subject Maths for Industry

SSABSA Assessment Plans – Variant B

SSABSA School Code Year

Enrolment Code

Program Variant

Code (A–W)

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<td>1</td>
<td>M</td>
<td>T</td>
</tr>
</tbody>
</table>

SACE Literacy Strategy

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This assessment outline must provide opportunity for students to develop literacy skills. These may be developed separately or integrated, depending on the purpose of each assessment task

Indicate in at least three of the boxes below where the opportunity is provided for students to develop their literacy skills.

✔ Spoken Communication  ✔ Written Communication  ✔ Visual Communication  ✔ Use of ICTs

Briefly describe, in one of the assessment tasks below, how students will be given the opportunity to work critically.

Please complete the following information in accordance with the curriculum statement.

<table>
<thead>
<tr>
<th>Name of Assessment Component</th>
<th>Description of Assessment Tasks</th>
<th>Weighting (%)</th>
<th>Learning Outcomes Measured</th>
<th>Criteria for Judging Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skills and Applications Tasks</strong></td>
<td><strong>Geometry and Mensuration</strong> <strong>45 minutes</strong> Subtopics 8.2, 8.3 and possibly 8.4 Right angle triangle geometry Areas of non-right triangles Trigonometric ratios</td>
<td>15%</td>
<td>1, 2, 4, 6, 7</td>
<td>Mathematical skills &amp; understanding (without electronic technology);</td>
</tr>
<tr>
<td></td>
<td><strong>Planar Geometry</strong> <strong>45 minutes</strong> Subtopics 13.6, 13.7 Vectors and vector operations</td>
<td>10%</td>
<td>1, 3, 4, 5, 6</td>
<td>Mathematical skills &amp; understanding (with electronic technology);</td>
</tr>
<tr>
<td></td>
<td><strong>Saving and Borrowing</strong> <strong>60 minutes</strong> Subtopics 5.1, 5.2, 5.3 Financial Institutions Interest and Cost of Borrowing</td>
<td>25%</td>
<td>1, 2, 3, 4, 7</td>
<td>Analysis and interpretation of results and information;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Communication of mathematical information</td>
</tr>
<tr>
<td></td>
<td>Total Time 2.5 Hours</td>
<td>Total 50%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Directed Investigations

**Geometry**  
Subtopics from 8.1; 8.2; 13.1; 13.2; 13.3; 13.4; 13.5

**2 Hours**  
Design promotional material for your new business. Including logo, business cards, letterhead and compliments slips. Show details of costings, quotes and measurements where appropriate. Think critically about the practicalities including, for example, colouring, reproduction and sizing.

<table>
<thead>
<tr>
<th>Total 20%</th>
<th>Mathematical skills &amp; understanding (without electronic technology);</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 4, 5, 6, 7</td>
<td>Mathematical skills &amp; understanding (with electronic technology);</td>
</tr>
<tr>
<td></td>
<td>Analysis and interpretation of results and information;</td>
</tr>
<tr>
<td></td>
<td>Communication of mathematical information</td>
</tr>
<tr>
<td></td>
<td>Organisation and presentation of material</td>
</tr>
<tr>
<td></td>
<td>Ability to work independently</td>
</tr>
</tbody>
</table>

### Project

**Saving and Borrowing**  
Subtopics from 5.1; 5.2; 5.3

**3 Hours**  
Part A: Investigate the cost of establishing a business of your choice.  
Part B: Research ways of raising the Capital to set up your business.  
Part C: Share your findings with the rest of the class. The report can be written or oral, and may be supported with ICT.

*Teacher note: There is scope in the project to consider, for example:*

- Rent versus buy versus lease
- Assets, liabilities, furnishings
- Repayments

<table>
<thead>
<tr>
<th>Total 30%</th>
<th>Mathematical skills &amp; understanding (without electronic technology);</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3, 4, 5, 6, 7, 8</td>
<td>Mathematical skills &amp; understanding (with electronic technology);</td>
</tr>
<tr>
<td></td>
<td>Analysis and interpretation of results and information;</td>
</tr>
<tr>
<td></td>
<td>Communication of mathematical information</td>
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<tr>
<td></td>
<td>Organisation and presentation of material</td>
</tr>
<tr>
<td></td>
<td>Ability to work independently</td>
</tr>
<tr>
<td></td>
<td>Ability to work cooperatively</td>
</tr>
</tbody>
</table>

*Note: The SSABSA website (www.ssabsa.sa.edu.au) provides a Word version of this form.*
## Key Ideas

**15.1 How is numeracy different from mathematics?**

**15.2 What are the fundamental skills and concepts that are required for numeracy in the workplace?**

**15.3 How should we go about revising and reinforcing these skills and understandings?**

## Teaching Strategies

Numeracy involves using mathematics in everyday contexts. The problem may not contain complex mathematics but the context brings challenges.

It is helpful to develop an understanding of the real world activity and how it relates to the mathematical problem.

Order of operations  
Fractions  
Decimals  
Ratio, proportion  
Powers, square roots  
Time

Develop a link between mathematics and the workplace:

Use industry aptitude tests to show how important employers view numeracy

Provide activities in an adult context that require an understanding of industrial terminology such as:

- quotes  
- contracts  
- consumption  
- yield  
- capital

Illustrate the value of estimation skills in the workplace and foster the necessary skills.
STAGE 1 ASSESSMENT PLAN

School ________________________________________________  Subject Mathematics

Enrolment Code  SSABSA  
School Code  SSABSA  
Year  
Enrolment Code  Stage Subject Code No. of Units (1 or 2)  Program Variant Code (A–W)
1 M T H 1  A

PROGRAM RATIONALE

The program rationale must:
• describe the setting (e.g. student background and needs, resources, timetabling);
• describe the intended teaching program (e.g. scope, themes, critical approaches, essential learnings), and explain how it is designed to meet the needs of the particular student group;
• explain how the assessment outline (see over) is designed to provide an opportunity for the student group to succeed.

This program has been written to meet the needs of 20 mixed ability students who are predominantly interested in the engineering trades, retail, and small business career pathways and intend studying Stage 2 Mathematical Applications. It is one unit of a 2-unit course. These students have a strong background in basic numeracy and spreadsheet skills. Vocational Education and Training Units of Competency will be considered for inclusion in Stage 2 and this will support Units of Competency offered in other subjects. The students have graphic calculators provided by the school on long-term loan, access to library and internet facilities outside normal school hours and access to computers in class when necessary. Thus the topics to be included in this unit are: Earning and Spending, Measurement, Data in Context and Networks and Matrices.

Teaching and learning activities will support the contexts of the students' proposed future pathways and include applications necessary for informed decision making in everyday life. Electronic technology will be integrated where appropriate to provide students with the tools to explore patterns and make more complex calculations, so that the skills of analysis and interpretation of results become more commonplace. The Learning Outcomes, mathematical understandings, strategies, techniques, analysis and interpretation, and the use of electronic technology will be a focus in all components. The Essential Learnings, Identity, Interdependence, and Communication will form the focus of the contexts chosen, although Futures will be a pervading theme also.

Assessment activities will reflect the balance between the need to assess a sound sense of number and routine, automated skills and the ability to reflect on results, analyse, interpret, draw conclusions and discuss in context. They will include tests, constructing a spreadsheet, an investigation and a project. The students will be required to be contributing and positive members of a team in the project. Students may choose to do a written or oral report.
ASSESSMENT OUTLINE
This assessment outline may need to be changed during the program.

Subject  Mathematics

<table>
<thead>
<tr>
<th>SSABSA School Code</th>
<th>Year</th>
<th>Enrolment Code</th>
<th>Program Variant Code (A–W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Stage</td>
<td>Subject Code</td>
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</tbody>
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Indicate in at least three of the boxes below where the opportunity is provided for students to develop their literacy skills.

- [ ] Spoken Communication
- [ ] Written Communication
- [ ] Visual Communication
- [ ] Use of ICTs

Briefly describe, in one of the assessment tasks below, how students will be given the opportunity to work critically. (*)

Please complete the following information in accordance with the curriculum statement.

<table>
<thead>
<tr>
<th>Name of Assessment Component</th>
<th>Description of Assessment Tasks (including time allocation*)</th>
<th>Weighting (%)</th>
<th>Learning Outcomes Measured</th>
<th>Criteria for Judging Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills and Applications Tasks</td>
<td>Earning and Spending Report Subtopics 1.1, 1.2 Open question provided for earning, research completed beforehand - report written in class. Measurement Spreadsheet Subtopics 2.1 to 2.4 Use the conversion graph spreadsheet to solve a range of problems in context Measurement Test Subtopics 2.5, 2.6 Find perimeter, area, volume and capacity in a range of contexts, applying appropriate conversions. Networks and Matrices Assignment Subtopics 4.1, 4.2 Use of software to construct a network for a problem of individual student interest, under direct supervision.</td>
<td>20%</td>
<td>1, 2, 6</td>
<td>Mathematical skills &amp; understanding (without electronic technology); Mathematical skills &amp; understanding (with electronic technology); Analysis and interpretation of results and information; Communication of mathematical information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
<td>1, 2, 6, 7</td>
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<td></td>
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<td>10%</td>
<td>1, 3, 4, 6</td>
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Total 3.3 hours  Total 50%
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<thead>
<tr>
<th>Directed Investigations</th>
<th>Mathematical skills &amp; understanding (without electronic technology);</th>
<th>Mathematical skills &amp; understanding (with electronic technology);</th>
<th>Analysis and interpretation of results and information;</th>
<th>Communication of mathematical information</th>
<th>Organisation and presentation of material</th>
<th>Ability to work independently</th>
<th>Ability to work cooperatively</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Investigation in local area</td>
<td>1, 2, 6</td>
<td>1, 2, 6, 7</td>
<td>1, 3, 4, 6</td>
<td>5</td>
<td>2, 5</td>
<td>8</td>
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<tr>
<td>Topic: 4</td>
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<td>Total 2 hours</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Project</th>
<th>Mathematical skills &amp; understanding (without electronic technology);</th>
<th>Mathematical skills &amp; understanding (with electronic technology);</th>
<th>Analysis and interpretation of results and information;</th>
<th>Communication of mathematical information</th>
<th>Organisation and presentation of material</th>
<th>Ability to work independently</th>
<th>Ability to work cooperatively</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>1, 2, 6</td>
<td>1, 2, 6, 7</td>
<td>1, 3, 4, 6</td>
<td>5</td>
<td>2, 5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Topic: 2</td>
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</tr>
<tr>
<td>Project (*)</td>
<td>30%</td>
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</tr>
<tr>
<td>Total 3 hours</td>
<td>Total 30%</td>
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</tr>
</tbody>
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STAGE 1 ASSESSMENT PLAN

School ________________________________ Subject Mathematics

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The students in this group, have not had a lot of success in mathematics in previous years. They are keen to improve their basic skills to have the ability to follow a pathway into manufacturing engineering. It is hoped that these students will develop skills to be able to successfully sit for a variety of apprenticeship entry level tests. This course is an integral part of the Engineering Pathways Program and has been written to meet the needs of students who are developing careers in the Manufacturing and Engineering Industry. It aims to assist students in reaching a level of maths expected by this industry and an opportunity to complete two Metals & Engineering competency standard units:

- MEM 2.7C10 - Perform computations – basic,
- MEM 2.8C10 - Perform computations.

Throughout the program, students will be expected to perform calculations to appropriate numbers of significant figures and to make approximations. The use of electronic technology will be used to develop conceptual understanding and will be integrated in the learning tasks where appropriate. However, students will be expected to calculate mentally and on paper as well as by calculator. Basic number skills will be assessed without access to a calculator.

Students will be expected to apply their mathematical skills and knowledge in solving problems which are relevant to the Engineering Pathways Program. Verification of solutions to problems by making comparisons with results from other methods will be emphasised. They will also be required to work as contributing and positive members of a team in some of the investigations or tasks. Geometrical ideas will be assessed through practical activities which require precision in measurement, construction and calculation. As there is a strong emphasis on the application of skills in a technical area of study, much of this will be done outside the mathematics classroom, for example in conjunction with a Technology subject teacher from the Engineering Pathways Program.

The Essential Learnings of Identity, Interdependence and Communication, will form the focus of the contexts chosen, although futures will be a pervading theme also. This course leads to some corresponding topics in Stage 2 Mathematical Applications.

Signature of principal/SACE coordinator ____________________________________________

Assessment plan contact teacher ____________________________________________________

Source: http://www.ssabsa.sa.edu.au/support/maths/1mth/documents/1mth-ap-005.doc
SSABSA Support Materials: 1mth-ap-005, last updated 16 August 2006

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<th>Learning Outcomes Measured</th>
<th>Criteria for Judging Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skills and Applications Tasks</td>
<td>Basic Operations Test Subtopics 15.1, 15.2, 15.3</td>
<td>45 minutes</td>
<td>20%</td>
<td>1, 2, 6</td>
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<tr>
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<td>Measurements Test Subtopics 2.1 to 2.3, 2.5 to 2.6, 15.4</td>
<td>30 minutes</td>
<td>10%</td>
<td>1, 2, 6, 7</td>
</tr>
<tr>
<td></td>
<td>Charts and Graphs Test Subtopics 3.1 to 3.4.</td>
<td>30 minutes</td>
<td>10%</td>
<td>1, 3, 4, 6</td>
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<tr>
<td></td>
<td>Trigonometry and Geometry Test Subtopics 8.2, 13.2, 13.5</td>
<td>30 minutes</td>
<td>10%</td>
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</tr>
<tr>
<td></td>
<td>Total 2 ¼ hours</td>
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* Please complete the following information in accordance with the curriculum statement.
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<tr>
<th>Directed Investigations</th>
<th>Charts and Graphs</th>
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<td></td>
<td>Subtopics 3.1 to 3.4</td>
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<td>1, 2, 6, 7</td>
<td>Mathematical skills &amp; understanding (with electronic technology);</td>
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<tr>
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<td></td>
<td>1, 3, 4, 6</td>
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<td>5</td>
<td>Communication of mathematical information</td>
</tr>
<tr>
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<td></td>
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<td>2, 5</td>
<td>Organisation and presentation of material</td>
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<td></td>
<td></td>
<td>8</td>
<td>Ability to work independently</td>
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</table>

Total 3 hours Total 30%

<table>
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<tr>
<th>Project</th>
<th>Measurement</th>
<th>3 hours</th>
<th>1, 2, 6</th>
<th>Mathematical skills &amp; understanding (without electronic technology);</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subtopics 2.1, 2.2, 2.3, 2.5, 2.6, 8.2, 13.2, 13.5 Landscape Garden and Watering System.</td>
<td></td>
<td>1, 2, 6, 7</td>
<td>Mathematical skills &amp; understanding (with electronic technology);</td>
</tr>
<tr>
<td></td>
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<td>1, 3, 4, 6</td>
<td>Analysis and interpretation of results and information;</td>
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<td>5</td>
<td>Communication of mathematical information</td>
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<td>2, 5</td>
<td>Organisation and presentation of material</td>
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<td></td>
<td>8</td>
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</tbody>
</table>

Total 3 hours Total 20%

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SECTION THREE:
APTITUDE ASSESSMENTS & PROGRAMS

ACER Entrance Tests – information only
Group Training Australia (SA) -
- Electrical
- Hospitality
- Building and Construction
- Engineering
- Automotive
Southern Futures – Industry Mathematics Program
ACER Test of Employment Entry Mathematics

**Purpose:** To assess basic mathematical ability. Questions cover basic problems of a type that might be encountered in a technical or trade training course or on the job in technical or trade positions.

**For:** 15+ years

**Duration:** 25 minutes

Given that existing tests of basic mathematical ability for use in personnel selection have been used heavily, and that none of these tests has been developed locally, it was decided that an Australian test of this ability should be developed. The ACER Test of Employment Mathematics is a group test of basic, numerical aspects of mathematical ability.

The test contains 32 items and has a 25-minute time limit. Reference group data are provided as percentile ranks and stanines.

The ACER Test of Employment Entry Mathematics (TEEM) was designed for use in the selection of apprentices, trainees, and any other technical and trades personnel who need an aptitude for basic mathematics to perform the duties of their position.

The test will also find application in the counselling of individuals who work within, or aspire to, such occupations.
PRACTICE APTITUDE ASSESSMENTS AND PROGRAMS

There is a wide range of entrance tests currently in use to judge students' levels of competency in the pre-requisite skills needed to successfully complete the coursework in a range of vocational training courses including Australian Apprenticeships. Some of these have been included in this resource.

1. ACER has a wide range of tests including:
   - Test of Employment Entry Mathematics
   - Mechanical Reasoning Test
   - Modern Occupational Skills Test

   For more information go to the ACER website: www.acer.edu.au

2. PREMIER'S INDUSTRY AWARDS FOR TEACHERS OF SCIENCE AND MATHEMATICS

   Practice aptitude assessments developed for specific industries by Group Training Australia (SA) with funding provided by the South Australian Government have been included in this section with the permission of GTA (SA). These aptitude tests have been evaluated and are equivalent to either Year 9 or Year 10 level of mathematics.

   They include:
   - Electrical (Year 10)
   - Hospitality (Year 9)
   - Building and Construction (Year 10)
   - Engineering (Year 10)
   - Automotive (Year 10)

3. SOUTHERN FUTURES INDUSTRY MATHEMATICS PROGRAM

   These resources were developed by Southern Futures with the cooperation of the Department of Education and Children's Services.

   The resources are of Stage 1 standard and have been reproduced with the permission of Southern Futures. The materials are copyright free. These resources should not be seen as a complete program and will require teacher input and evaluation before implementation.
Practice Aptitude Assessment

for

Electrical Industry

(Electrical/Electronics Apprentice)

Mal Aubrey
Group Training Australia (SA) Inc.
December 2005
Guidance

This assessment has been developed with the assistance of Industry and Registered Training Organisations, based on the needs and requirements of the Industry sector.

Please note that rates quoted in this assessment for various items, including pay rates, are not meant to reflect today’s values, but are used purely for mathematical purposes.

This assessment is intended to prepare people who may be required to sit an aptitude test as part of an interview and assessment process for a job vacancy, such as an apprenticeship.

The assessment can be used by a number of different organisations or people such as Group Training Organisations, Career Education Teachers, Mathematics Teachers within schools, or New Apprenticeship Centres.

The assessment can be:

- provided to individual people to enable them to practice and hone their skills before sitting an actual aptitude test.
- used by Career Education Teachers for individuals or in a class setting to provide general guidance to students on what they may expect during the interview process if they intend commencing a career as an apprentice.
- used by Mathematics Teachers as a guide to Industry mathematics requirements at the entry point of a particular apprenticeship career path.

This practice aptitude assessment has two components; Mathematics and Literacy.

You may find that this assessment differs from similar tests administered by Industry as their tests may have other elements included that other ones do not, such as:

- Mechanical Reasoning;
- Electrical Theory;
- Electrical Knowledge and reasoning;
- General Knowledge

The mathematics questions contained within this document are equivalent to Applied Mathematics at the Year 10 level in South Australia.

The assessment should be able to be completed in approximately 1 hour 45 minutes.

Calculators may be used to complete this practice assessment.
ENGLISH

1. Put the following words into alphabetical order:

- Electrical fitter
- Air conditioning
- Trainee electrician
- Electronics consumer
- Air compressors
- Components
- Electrical equipment
- Wiring diagrams
- Training coordinator
- Systems Electricians

2. The following text has 10 spelling errors. Correct those errors and list them in the order you find them in the text.

To become a Systems Electrician usually requires the completion of a New Apprenticeship in Electro-technology or Engineering - Electrical/Electronics Trade. Entry requirements may vary, but employers generally require Year 10 with good results in English, maths and science.

The length of training can vary and will involve both on-the-job and off-the-job components. The off-the-job training is provided through Registered Training Organisations to Certificate III level.

3. In each of the columns below, you are given three spellings of the same word. Circle the correct spelling in each case.

(a) Controler
(b) Controller
(c) Controla
(d) Programmable
(e) Programmible
(f) Programable
(g) Circut
(h) Circuit
(i) Cercuit

Comprehension

This is a test of how well you understand what you read. Read the following passages below then answer the questions that follow.

**Programmable Logic Controllers.**

There are three common control systems in use today, and each has its advantages and disadvantages. The oldest system is the **hard-wired relay system**, using relays as the control and logic devices, and using insulated wires for the interconnections between the relays. The system is time-consuming to set up and fault-find, and due to the large number of contacts and interconnections, may be unreliable over a long period of time. It is easy to fault-find, however, as most relays have visible contacts, and the moving parts make it simple to observe what is happening in the circuits. It is not easily damaged by slightly elevated supply voltages, and is not affected by electrical ‘noise’ and static electricity.
The second system is the **fixed logic system**. It employs hard-wired 'silicon chips' to simulate the equivalent relay circuit, and it is usually built on a printed circuit board, which uses copper 'tracks' on the circuit board instead of wires. Its reliability is very good, as it lacks the moving contacts of the relay system, but cheap units may develop faults due to poor soldering or mishandling. The 'silicon chip' circuitry can easily be destroyed by relatively low voltages or static electricity, and specialised skills and equipment may be required to repair fixed logic systems. Often, a fixed logic system printed circuit board is treated as an unrepairable module, and may be replaced (at significant expense) rather than being repaired due to this difficulty in repairing it. It may be sensitive to elevated supply voltages, may respond to electrical 'noise' and can be destroyed by static electricity.

The third system is the **Programmable Logic Controller**. The Programmable Logic Controller (PLC) is a simple computer that can accept inputs from electrical control devices such as thermostats, pressure switches, relays, and other contacts. It can also drive electrical outputs such as lamps, relays, solenoids, contactors etc. These devices are often referred to as 'Programmable Controllers'. The computer is built on a printed circuit board, like the fixed logic systems. Early models performed only logic functions, so the name 'Programmable Logic Controller' was appropriate. Recent models are capable of complex, non-logic functions, and some manufacturers have reflected this ability by dropping the 'Logic' reference. As the abbreviation for 'Programmable Controller' became 'PC', there was often confusion between these devices and the Personal Computer. Hence, although the PLC is capable of far more than simple 'logic' operations, the abbreviation usually retains the 'L' reference to differentiate the PLC from the IBM-type PC.

Although the initial cost of a PLC system may be higher than other systems, PLCs are appearing in many applications these days because of their advantages over other systems. These include:

- their flexibility in being reprogrammable to do different tasks;
- their reliability due to their lack of moving parts and contacts;
- the ease with which they can be programmed;
- their simplicity of design and installation. Like fixed logic systems, PLCs may also be sensitive to elevated supply voltages, may respond to electrical 'noise' and can be destroyed by static electricity.

Now read each of the following questions and possible answers given below, and from the previous description, indicate what you think the suitable answer or answers might be for each of the questions below. Note that there may be **more than one** suitable answer to some questions.

4. Which of the 3 systems described above is the oldest one?
   (a) Hard-wired Relay System, (b) Fixed Logic System
   (c) Programmable Logic Controller

5. Which of the above systems may develop problems due to poor soldering?
   (a) Hard-wired Relay System, (b) Fixed Logic System
   (c) Programmable Logic Controller
6. Which of the above systems may respond to electrical noise?
   (a) Hard-wired Relay System, (b) Fixed Logic System
   (c) Programmable Logic Controller

7. Which of the systems allows the operator to watch things happening in it?
   (a) Hard-wired Relay System, (b) Fixed Logic System
   (c) Programmable Logic Controller

8. How are PLCs affected by static electricity?
   (a) It has no affect on them. (b) They may respond to it normally, (c) They may be destroyed by it.

9. Why are fixed logic systems often thrown away, rather than being repaired, if faulty?
   (a) It is usually cheaper to replace them than repair them.
   (b) It is often difficult to solder their components in reliably.
   (c) They usually require special skills and equipment to work on them.

10. Why was the letter 'L' initially dropped from the 'PLC' abbreviation?
    (a) PLcs started using non-Logic functions in their operations.
    (b) PLCs stopped using Logic functions in their operation.
    (c) PLCs were being confused with the IBM PC.

11. Why was the letter 'L' re-inserted in the 'PLC' abbreviation?
    (a) PLCs stopped using non-Logic functions in their operations.
    (b) PLCs started using Logic functions in their operation.
    (c) PLCs were being confused with the IBM PC.

12. What is the main advantage of good quality fixed logic systems over relay systems?
    (a) They are less sensitive to voltage surges.
    (b) They are more reliable. (c) They are easier to fault-find.

13. Which of the following is not an advantage of a PLC system over a relay system?
    (a) Its long-term reliability. (b) Its lower overall cost.
    (c) Its flexibility in being re-programmable. (d) Its ease of installation.

14. Which of the following may be used as an electrical output for a PLC system?
    (a) A relay, (b) A thermostat, (c) A lamp, (d) A switch
    (e) A solenoid, (f) A 'silicon chip'

15. Which of the following may be used as an electrical input for a PLC system?
    (a) A lamp, (b) A solenoid, (c) A relay, (d) A 'silicon chip'
    (e) A thermostat, (f) A switch
Mathematics
Numbers (Scientific Notation, Rounding, Estimating)

1. From the list of numbers below, select the one which is a:
   a) percentage
   b) decimal number
   c) fraction
   d) mixed number
   e) ratio
   f) angle

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<table>
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<tbody>
<tr>
<td>3/8</td>
<td>35°</td>
<td>75%</td>
</tr>
<tr>
<td>5:4</td>
<td>16·37</td>
<td>3¼</td>
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</table>

2. Round
   (a) 35 · 6754 to two decimal places
   (b) 425 · 8 to the nearest tens
   (c) 248 to the nearest hundreds

3. Arrange in ascending order (from smallest to largest):

4. Write in descending order:

5. Which one of the following represents the number 27 000 000 000 in scientific notation:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>A 27 x 10^{10}</td>
<td>B 2·7 x 10^{10}</td>
</tr>
<tr>
<td>C 2·7 x 10^{-10}</td>
<td>D 27 x 10^{-10}</td>
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6. Select the best estimate for:
   (a) 4249 x 71
   (b) 800000 ÷ 38

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<tbody>
<tr>
<td>280000</td>
<td>150000</td>
<td>28000</td>
</tr>
<tr>
<td>200</td>
<td>2000</td>
<td>20000</td>
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</tbody>
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7. Evaluate the following:
   (a) 10^3
   (b) 3^3
   (c) √36
   (d) (√9)^2

Arithmetic (Addition, Subtraction, Multiplication, Division)

8. Find the total of:
   (a) $2, $21·45 and $8·23
   (b) 18·32, 471·019 and 315
9. Solve:
   (a) $5218 - 1784$
   (b) $43.18 - 29.461$

10. Multiply:
   (a) $6.87 \times 10$
   (b) $13.8 \times 3$
   (c) $46.2 \times 8.5$

11. Divide:
   (a) $3.45 \div 10$
   (b) $3024 \div 14$
   (c) $56.2 \div 0.2$

12. Simplify:
   (a) $\frac{2+3}{4}$
   (b) $\frac{4-10}{2}$
   (c) $\frac{50 + 50}{2 \times 25}$
   (d) $\frac{16-5}{3}$

13. Multiply the following:
   (a) $3 \cdot 485 \times 10^{-2}$
   (b) $16 \cdot 919 \times 10^{2}$

Fractions

14. Which fraction is between $\frac{1}{4}$ and $\frac{3}{4}$?
   \[
   \begin{array}{cccc}
   \frac{1}{2} & \frac{1}{6} & \frac{1}{8} & \frac{3}{4} \\
   \end{array}
   \]

15. Add the following:
   (a) $\frac{1}{4} \text{ and } \frac{1}{2}$
   (b) $\frac{2}{9} \text{ and } \frac{5}{6}$
   (c) $3\frac{1}{4} \text{ and } \frac{1}{8}$

16. Subtract the following:
   (a) $\frac{5}{6} - \frac{1}{4}$
   (b) $2\frac{1}{14} - \frac{4}{7}$

17. Express as a fraction in lowest terms:
   (a) $0.75$
   (b) $2.6$
   (c) $30\%$

Percentages

18. Evaluate the following:
   (a) $10\% \text{ of } $44$
   (b) $25\% \text{ of } 12 \cdot 84$

19. Michelle earns $500 a week as an apprentice electrician. She gets a pay rise of 5%. What is her new wage?
20. An article bought for $250 is sold for $375. Find:
   (a) the profit in dollars
   (b) the profit as a percentage of the cost price.

21. Jonathan the painter buys the following from a paint store:
   paint $215; rollers and brushes $95; cleaning fluids $12; and plastic covers $8. Jonathan gets 10% trade discount.
   (a) How much would he pay with no discount?
   (b) How much would he pay with discount?
   (c) How much has he saved?

22. Barry scored 80% in a TAFE exam. There were 25 questions.
   (a) How many questions did Barry get right?
   (b) How many questions did Barry get wrong?

23. What percentage is 30 out of 50?

24. Electrical goods are subject to a goods and services tax (GST) of 10% of the sale price. If a refrigerator’s pre-tax price is $850
   (a) what is the tax
   (b) selling price

25. The efficiency of a machine is rated at 70%. If the input to the machine is 200 watts, what is the output power available?

Decimals

26. Find the decimal number halfway between:
   (a) 0.6 and 0.8
   (b) 2.8 and 2.9

27. Write the following decimals in descending order.

   7.19 71.9 0.719

28. Select the correct answer to $18.642 \div 0.02$:
   A 9321  B 93.21  C 932  D 9321

Algebra

29. Remove the brackets and simplify the following:
   (a) (2x+y) - (x-4y)
   (b) (3a-b) - (2a-3b)

30. If P=F/A find P if F=60 and A=20?

31. Re-arrange the following formulae to make the letter in brackets the subject of the formula:
   (a) P=VI    (V)
   (b) P= \pi Q n   (Q)

32. The formula for working out the voltage is V=E-\epsilon R.
    Re-arrange the formula to:
    (a) make E the subject
    (b) make R the subject.
Ratio

33. Divide $24 into the ratio 3:1.

34. What is the ratio of the number of circles to squares?

35. The mass of two resistor boxes are in the ratio of 2:5. The smaller box has a mass of 20kg. What is the mass of the larger box?

Conversions

36. Convert 5 amps to milliamps.

37. Convert 12k Ohms to Ohms.

Perimeter, Area, Volume

38. A large washer has an outer radius of 10mm and a hole with a diameter of 14mm. What is the area of the top surface of the washer?

39. Calculate the area of the triangle which has a base length of 10 cm and a height of 8 cm.

Problem Solving

40. What is the average of 12 and 18?

41. An electric car is travelling at 60km/hr, how far will it travel in 3 hours?

42. Two numbers add up to 40. Find the other number if one of the numbers is 15?

43. Mary, a data-cabling technician, receives a salary of $32,500 a year. How much does she receive each fortnight?
ANSWERS

ENGLISH

1. Air compressors, Air conditioning, Components, Electrical equipment, Electrical fitter, Electronics consumer, Systems Electricians, Trainee electrician, Training coordinator, Wiring diagrams

2. Systems, requires, Apprenticeship, Electro-technology, Engineering, require, vary, both, components, through.

3. b) d) h)

4. a) 5. b) 6. b) & c) 7. a) 8. c) 9. c) 10. a) 11. c) 12. b) 13. b) 14. a) c)& e) 15. c) e) & f)

MATHEMATICS

1. a) 75%, b) 16·37, c) 3/8, d) 3/4, e) 5:4, f) 35°
2. a) 35·68, b) 430, c) 200
3. -8, -2, 0, 1/2, 3·7, 4
4. 3/5, 0·3, 3/4
5. B
6. a) 280000, b) 2000
7. a) 100, b) 27, c) 6, d) 9
8. a) $31·68 b) 804·339
9. a) 3434, b) 13·719
10. a) 68·7, b) 41·4, c) 392·7
11. a) 345, b) 216, c) 281
12. a) 14, b) -1, c) 2, d) 33
13. a) -03485, b) 1691·9
14. 1/2
15. a) 3/4, b) 1/18, c) 3/8
16. a) 3/12, b) 11/2
17. a) 3/4, b) 23/5, c) 3/10
18. a) $4·40, b) 3·21
19. $525
20. a) $125, b) 50%
21. a) $330, b) $297, c) $33
22. 60%
23. a) 20, b) 5
24. a) $85, b) $935
25. 140 watts
26. a) 0·7, b) 2·85
27. 71·9, 7·19, 0·719
28. D
29. a) x + 5y, b) a + 2b
30. 3
31. a) V=P/I, b) Q=30P/πn
32. a) E = V + i R, b) R = \(\frac{E - V}{i}\)
33. $18, $6
34. 3·2
35. 50kg
36. 5000 mA
37. 12,000 Ω (Ohms)
38. 160mm²
39. 40cm²
40. 15
41. 180km
42. 25
43. $1250·00
Practice Aptitude Assessment
for
Hospitality Industry

(Apprentice Chef)

Mal Aubrey
Group Training Australia (SA) Inc.
December 2005
Guidance

This assessment has been developed with the assistance of Industry and Registered Training Organisations, based on the needs and requirements of the Industry sector.

Please note that rates quoted in this assessment for various items, including pay rates, are not meant to reflect today’s values, but are used purely for mathematical purposes.

This assessment is intended to prepare people who may be required to sit an aptitude test as part of an interview and assessment process for a job vacancy, such as an apprenticeship.

The assessment can be used by a number of different organisations or people such as Group Training Organisations, Career Education Teachers, Mathematics Teachers within schools or New Apprenticeship Centres.

The assessment can be:

- provided to individual people to enable them to practice and hone their skills before sitting an actual aptitude test.
- used by Career Education Teachers for individuals or in a class setting to provide general guidance to students on what they may expect during the interview process if they intend commencing a career as an apprentice.
- used by Mathematics Teachers as a guide to Industry mathematics requirements at the entry point of a particular apprenticeship career path.

This practice aptitude assessment has three components: Literacy, General Knowledge and Mathematics.

You may find that this assessment differs from similar tests administrated by Industry as their tests may have other elements included, that this one does not.

The mathematics questions contained within this document are equivalent to Applied Mathematics at the Year 9 level in South Australia.

The assessment should be able to be completed in approximately 1 hour 30 minutes.

**Note, some aptitude tests administered by Industry are much shorter than this assessment and can usually be completed within 20 – 25 minutes.**

Calculators should not be used to complete this practice assessment, as Industry does not allow calculators to be used in their aptitude tests.
ENGLISH

Spelling

1. List the Following words in alphabetical order:
   Gravy               Chef de Cuisine
   Pastry Cooking     Demi Chef
   Chef de Partie     Preserve foods
   Menu               Gravies
   Presentation       Commis Chef
   Pastry cook        Sous Chef

2. There are 14 spelling errors in the text below. Correct the spelling and list them in the order they appear in the text.

   Deeling with the general publick can be stresfull at times, as everybody has there own perseptions of the service they should recieve in a given situation. Provideing considerably less than those expectations, puts you at risk of loosing a customer, and even wurz, having your employes exposed to complaints.

   What is a complaint?
   A complainte is useually and expression of dissatisfraction with service, food or drink quality and bill paying.

Comprehension

Read the passage below and answer the questions which follow.

Chefs plan and organise the preparation and cooking of food in a number of settings.

A chef may perform the following tasks: plan menus and work out food and labour costs together with the head chef

- plan staff rosters and supervise the activities of cooks and assistants
- discuss food preparation issues with managers, dieticians and other staff members
- order food, kitchen supplies and equipment
- demonstrate techniques to cooks and advise on cooking procedures
- prepare and cook food
- divide food into portions, and add gravies, sauces and garnishes
- explain and enforce hygiene regulations
- select and train staff
- freeze and preserve foods.

In larger establishments, the chef de cuisine or head chef generally does more supervision than cooking. Senior chefs have to attend staff meetings, where they discuss problems related to their areas and receive or issue instructions to other managerial staff. In small restaurants, the head chef may prepare food, assisted by other cooks or apprentices. As well as expert cooking knowledge, chefs involved in supervision need a general knowledge of the skills and activities of all their workers.

The range of duties carried out by chefs will vary depending on where they work. Chefs may be required to work shifts, including weekends and public holidays. The work may be stressful, especially at peak hours of the day.

Chefs may specialise as a:

**Chef de Cuisine** who is the head chef or first chef.

**Chef de Partie** who may be a chef specialising as a larder cook, butcher, pastry cook, sauce cook, roast cook, relief cook, side-dish cook, breakfast cook, canteen cook or fish cook.

**Commis Chef** who is a cook who has just completed an apprenticeship or has an equivalent qualification.

**Demi Chef** who is a chef specialising in a particular type of cooking as part of the kitchen brigade.

**Sous/Second Chef** who is the second-in-charge in the kitchen.
Personal Requirements:

- a high level of personal cleanliness
- enjoy cooking
- able to organise efficient work schedules
- good communication skills
- punctuality
- flexibility to perform shift work on a 24-hour rotating roster as required
- able to work under pressure and stay calm in difficult situations.

3. The Chef de Cuisine is the:
   (a) Junior Chef, (b) Head Chef, (c) Pastry Chef, (d) Second Chef

4. Chefs need to:
   (a) Enjoy cooking, (b) Have good communication skills,
   (c) Have a high level of personal cleanliness, (d) All of the above

5. Supervisory positions require the Chef to:
   (a) Have an understanding of the skills of all the employees, (b) Do a lot of food shopping, (c) Deal primarily with the customers, (d) Use the cash register

6. A Chef specialising in a particular type of cooking is known as a:
   (a) Specialist Chef, (b) Expert Chef, (c) Demi Chef, (d) Trio Chef

7. A Chef working at a restaurant such as the Hilton would do:
   a) More supervising than cooking
   b) More cooking than supervising
   c) More dealing with customers than cooking
   d) More cleaning than serving
GENERAL KNOWLEDGE

1. List the 5 main food groups:  
   ________  
   ________  
   ________  
   ________  
   ________

2. What are 4 different methods of cookery?  
   ________  
   ________  
   ________  
   ________

3. How are peeled potatoes stored?  
   ________

4. How should a frozen chicken be defrosted?  
   ________

5. When do you have to wash your chopping board/food preparation area?  
   ________

6. Name 2 different methods of preserving food.  
   ________

7. Name 3 Celebrity Chefs.  
   ________  
   ________  
   ________

8. Which one of these would you use to whip cream?  
   Whisk    Spatula    Wooden Spoon    Fork  
   ________

9. What is the recommended number of serves of fruit and vegetables that you should eat everyday?  
   ________

10. When should you wash your hands when working with food?  
    ________  
    ________  
    ________
MATHEMATICS

Number Values

1. Write as a number:
   (a) two thousand six hundred and thirty four
   (b) fifty six thousand and eighty seven.

Maths Operations

2. Work out the answers for the following:
   (a) 37 (b) 68 (c) 258 (d) 6946 (e) 78
   +41 +74 +105 +4247 -53
   (f)258 (g) 354 (h) 8527 (i) 5 x 4 (j)9 x 12
   -157 -78 -6383 _____ _____

3. Multiply
   (a) 6·87 by 10, (b) 13·2 by 3, (c) 46·2 by 2

Measurement / Estimation

4. What unit from the list below would you use to measure
   (a) distance, (b) time, (c) temperature, (d) weight, (e) speed,
   (f) volume, (g) cost, (h) discount

   kg | ml | km/hr | %  
   ---|----|-------|----
   $  | m  | min   | °C 

5. From the list of numbers below, select the one which is a
   (a) percentage, (b) decimal number, (c) fraction, (d) mixed number,
   (e) ratio, (f) cost

   3/8 | $9·00 | 25%  
   5:4 | 16·37 | 2¾ 

6. Estimate the
   (a) height of a standard door
   (b) diameter of a dinner plate
   (c) average weight of a medium sized egg
   (d) amount a cup holds
   (e) distance an adult will walk in a hour
   (f) boiling point of tap water
   (g) cost of a dozen eggs?
7. Convert the following:

(a) $2.41 to cents
(b) 500 cents to dollars
(c) 182 days to weeks
(d) 3.5 kilograms to grams
(e) 4000 grams to kilograms
(f) 120 minutes to hours
(g) 180 seconds to minutes
(h) 3 hours and 12 minutes to minutes
(i) 3 metres to millimetres
(j) 5000 millimetres to metres
(k) 2000 millilitres to litres
(l) 4 litres to millilitres
(m) 8:00pm to 24 hour time
(n) 1600 (24 hour time) to am or pm time

8. How many hours and minutes from 7:30 am to 3:00 pm?

9. What is the time:

(a) 15 minutes after 9:30am?
(b) 30 minutes before 10:00pm?

10. Choose the best estimate for the following problems from the list below:

(a) 98 + 33
(b) 34 x 18
(c) 713 ÷ 11
(d) 24.95 + 73.25
(e) 205 - 11.55

| 100 | 130 | 60 | 200 | 600 |

Problem Solving

Algebra

11. Two numbers add up to 40. Find the other number if one is 15?

Fractions

12. A recipe for a cake lists the following ingredients:

½ cup of chopped walnuts
1½ cup caster sugar
2 cups self-raising flour

What is the total number of cups of ingredients?
Percentages

14. Evaluate the following:

(a) 10% of $44
(b) 25% of 1200

15. A dinner bill was divided equally among 6 people. The total of the bill was $48.00.

(a) How much did each pay?
(b) If on Tuesday the bill is 50% off, how much will each pay?

16. Michelle earns $500 a week. She gets a pay rise of 10%.

(a) What is her pay increase?
(b) What is her new weekly wage?

17. A set of Deluxe Carving Knives are bought for $250, then re-sold for $375. Find:

(a) the profit
(b) the profit as a percentage of the cost price.

18. An egg is composed of three parts; shell, white and yolk. If an egg weighs 50 grams and 10% represents the shell, how many grams of shell are there?

Ratios

19. Which (A or B) represents the best buy?

A 3 kg for $4.00
B 12 kg for $18.00

20. A 50g serving of fish contains 250mg of sodium. How many milligrams are in a 200g packet of fish?
21. From the picture, what is the ratio of:
   (c) bottles to glasses? __________
   (d) glasses to bottles? __________

22. In a carton of fruit drink, 50% is pineapple juice, 20% orange juice and the rest is water.
   (a) What percentage is water? __________
   (b) What is the ratio of pineapple to orange juice? __________
   (c) What is the ratio of water to orange juice? __________

Problem Solving Questions
23. Donuts cost 50c each. How much would a dozen cost? __________
24. You and four other people share in a product costing $2,400. How much do you each receive? __________
25. A glass holds 200ml. How many glasses could be filled from a 1-litre bottle? __________
26. Mary receives a salary of $26,000 a year. How much does she receive each fortnight? __________
27. John earns $11.00 per hour for a 40-hour week. How much does John earn a week? __________
28. Mustaffa works at a fast food restaurant where the pay rate is $10.00 per hour. How much does he receive for working 4½ hours? __________
29. Heidi had a **Chicken, Leek and Brie Pie** for Entrée; **Chargrilled Lamb Rump with Sweet Potato Cake** for the Main course and a **White Chocolate Crème Brulee** as a Desert with **Espresso**. John ordered the **Soup of the Day, Fresh Australian Fish, Manhattan Lemon Cheese Cake** with a **Cappuccino**.

From the menu below:
(a) What is Heidi’s total for the bill? ____________
(b) How much is John’s meal? ____________
(c) What is the total bill for Heidi and John? ____________
(d) Today is Tuesday, half price day, how much does Heidi pay? ____________
(e) How much did she save by eating out on Tuesday? ____________
(f) If they decide to share Tuesdays bill, how much does each pay? ____________
(g) Heidi gave $100 for the meal she purchased on Tuesday, how much change did she get? ____________
(h) What is the cost of ½ dozen **Roasted Coorong Oysters**? ____________

<table>
<thead>
<tr>
<th>Entrée</th>
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<tbody>
<tr>
<td><strong>Soup of the Day</strong></td>
<td>$4.70</td>
</tr>
<tr>
<td><strong>Seafood Bouillabaisse with Rouille</strong></td>
<td>$8.50</td>
</tr>
<tr>
<td><strong>Chicken, Leek and Brie Pie</strong></td>
<td>$7.90</td>
</tr>
<tr>
<td><strong>Roasted Vegetable, Pesto and Haloumi Lasagna</strong></td>
<td>$7.50</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Main Course</th>
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<tbody>
<tr>
<td><strong>Slow Cooked Pork Belly with Mushrooms</strong></td>
<td>$15.90</td>
</tr>
<tr>
<td><strong>Chargrilled Lamb Rump with Sweet Potato Cake</strong></td>
<td>$15.90</td>
</tr>
<tr>
<td><strong>Roasted Coorong Oyster (1 dozen)</strong></td>
<td>$16.50</td>
</tr>
<tr>
<td><strong>Fresh Australian Fish of the Day</strong></td>
<td>$15.90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dessert</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>White Chocolate Crème Brulee</strong></td>
<td>$6.20</td>
</tr>
<tr>
<td><strong>Manhattan Lemon Cheese Cake</strong></td>
<td>$6.20</td>
</tr>
<tr>
<td><strong>Willabrand Fig and Almond Pudding</strong></td>
<td>$6.20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coffee</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Espresso</strong></td>
<td>$2.50</td>
</tr>
<tr>
<td><strong>Cappuccino</strong></td>
<td>$2.50</td>
</tr>
<tr>
<td><strong>Tea Selection</strong></td>
<td>$2.00</td>
</tr>
</tbody>
</table>

30. Phil is a cook and earns $12·00 an hour for a normal 40 hour week. For any overtime, he receives time-and-a-half thereafter.

(a) How much does he receive for working 40 hours? ____________
(b) How much does Phil get **just for the** 2 hours overtime? ____________
(c) What does he earn for the 42 hour week? ____________
ANSWERS
ENGLISH
1. Chef de Cuisine, Chef de Partie, Commis Chef, Demi Chef, Gravies, Gravy, Menu, Pastry cook, Pastry Cooking, Presentation, Preserve foods, Sous Chef
2. Dealing, public, stressful, their, perceptions, receive, Providing, losing, worse, employees, complaint, usually, an, dissatisfaction.
3. b) 4. d)
5. a) 6. c)
7. a)

GENERAL KNOWLEDGE
1. Dairy; Meat/Poultry/Eggs/Fish or Protein; Fruits and Vegetables; Grains/Cereals/Pulses or Carbohydrates; Fats and Sugars
2. Grilling; Boiling; Deep Frying; Pan Frying; Roasting; Baking; Poaching; Simmering; Steeping; Steaming
3. Completely covered in cold water in the fridge.
4. Overnight in the fridge.
5. At the completion of each separate/different task.
6. Pickling; Freezing; Salting; Drying; Marinating
7 Jamie Oliver; Bill Grainger; Stephanie Alexander; Cheong Liew; Kylie Kwong; etc...
8. Whisk
9. 2x Fruit and 5x Vegetables
10. Immediately before starting; whenever you change tasks; after touching your hair/face/any part of your body; after visiting the toilet; after doing something else other than handling food; after handling raw produce.

MATHEMATICS
1. (a) 2,634 (b) 56,087
2. (a) 78, (b) 142, (c) 363, (d) 11,193, (e) 25, (f) 101, (g) 276, (h) 2,144, (i) 20, (j) 108
3. (a) 68.7, (b) 39.6, (c) 92.4
4. (a) m, (b) min, (c) °C, (d) kg, (e) km/hr, (f) ml, (g) $, (h) %
5. (a) 25%, (b) 16.37, (c) 3/8, (d) 2 1/4, (e) 5:4, (f) $9
6. (a) 2m, (b) 2.6 to 3.0cm, (c) 60g, (d), (e) 3km, (f) 100°C, (g) $3 to $4
7. (a) 241 cents, (b) $5, (c) 26 weeks, (d) 3500g, (e) 4kg, (f) 2 hrs, (g) 3 mins, (h) 192 mins, (i) 3000mm, (j) 5m, (k) 2 litres, (l) 4000ml, (m) 2000hrs, (n) 4pm
8. 7 hrs and 30 mins
9. (a) 9:45am, (b) 9:30pm
10. (a) 130, (b) 600, (c) 60, (d) 100, (e) 200
11. 25
12. 4 cups
13. $15
14. (a) $4.40, (b) 300
15. (a) $8, (b) $4
16. (a) $50, (b) $550
17. (a) $125, (b) 50%
18. 5 grams
19. B 12 kg for $18:00
20. 1000mg
21. (a) 2:5, (b) 5:2
22. (a) 30%, (b) 50:20 or 5:2, (c) 30:50 or 3:5
23. $6
24. $480
25. 5 glasses
26. $1000
27. $440
28. $45
29. (a) $32.50, (b) $29.30, (c) $61.80, (d) $16.25, (e) $16.25, (f) $15.45, (g) $83.75
30. (a) $480, (b) $36, (c) $516
Practice Aptitude Assessment for Building and Construction Industry

Mal Aubrey
Group Training Australia (SA) Inc.
December 2005
Guidance

This assessment has been developed with the assistance of Industry and Registered Training Organisations, based on the needs and requirements of the Industry sector.

Please note that rates quoted in this assessment for various items, including pay rates, are not meant to reflect today’s values, but are used purely for mathematical purposes.

This assessment is intended to prepare people who may be required to sit an aptitude test as part of an interview and assessment process for a job vacancy, such as an apprenticeship.

The assessment can be used by a number of different organisations or people such as Group Training Organisations, Career Education Teachers, Mathematics Teachers within schools or New Apprenticeship Centres.

The assessment can be:

- provided to individual people to enable them to practice and hone their skills before sitting an actual aptitude test.
- used by Career Education Teachers for individuals or in a class setting to provide general guidance to students on what they may expect during the interview process if they intend commencing a career as an apprentice.
- used by Mathematics Teachers as a guide to Industry mathematics requirements at the entry point of a particular apprenticeship career path.

This practice aptitude assessment has two components; Literacy and Mathematics.

You may find that this assessment differs from similar tests administered by Industry as their tests may have other elements included, that this one does not, such as:

- Mechanical Reasoning;
- Building and Construction Theory;
- Building and Construction Knowledge and reasoning;

The mathematics questions contained within this document are equivalent to Applied Mathematics at the Year 10 level in South Australia.

The test should be able to be completed in approximately 1 hour 20 minutes.

Calculators may not be used to complete this practice assessment, however Industry in some cases does allow calculators to be used in their aptitude tests.
ENGLISH

Spelling

1. The following text has 12 spelling errors in it. Correct those errors and list them in the order you find them in the text.

Today the “Building and Construction Industry” is worth over $50 bilion and employs over three quarters of a million people. The industry is divided into three sectors, domestic, comercial and civil. The majority of workers are either apprentice/trainee, construction worker or tradsperson. There are over 20 trades ranging from concrete and steal workers to telecomunication technicians. There are many career pathways and opportunities available to prospective employes willing to apply themselves.

2. Write the correct form of the following words

a) Ellimination  
   b) Prefabrikated  
   c) Demolishon  
   d) Certifikate  
   e) Sprinklar  
   f) Briklaying  
   g) Vocationl  
   h) Permisson  
   i) Comites  
   j) Partisipate

Comprehension

Read the following passage and answer the questions in the spaces provided.

The construction industry, put simply, is an industry of which the purpose is to erect structures, from simple house structures to major multi-storey civil and commercial structures. A construction project begins with an idea and ends with the completion of the final structure. From beginning to end there are several stages and each stage has its own series of steps. In order for each stage of the project to be completed successfully effective communication is vital. Communication can only be considered successful when the receiver of the information understands exactly what the sender of the information intended. Feedback from the receiver of the information to the sender of the information can determine if the communication was successful. Workplace communication is how we convey or share information in the workplace. People use a wide variety of ways to communicate with each other. Sometimes these are used alone or combined together to make a message or information clearer. Methods of communication include verbal, written, electronic and non-verbal. When communicating you must be accurate, clear, concise, comprehensive and logical.
3. What is the main purpose of the construction industry?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

4. What is the most important tool that is used in the building and construction industry to ensure a project is completed successfully?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

5. Explain how you would know if someone had understood an Instruction you gave them.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

6. List three different examples used to exchange information.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

7. Do you think effective communication is important in the building and construction industry? Why?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
MATHEMATICS

Numbers (Measurement, Scales, Decimals, Rounding, Estimates, Scientific Notation)

1. What unit from the list below would you use to measure
   (a) length
   (b) time
   (c) temperature
   (d) weight
   (e) area
   (f) speed
   (g) volume
   (h) cost

<table>
<thead>
<tr>
<th>kg</th>
<th>ml</th>
<th>km/hr</th>
<th>m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>m</td>
<td>min</td>
<td>°C</td>
</tr>
</tbody>
</table>

2. From the list of numbers below, select the one which is a
   (a) percentage
   (b) decimal number
   (c) fraction
   (d) mixed number
   (e) ratio
   (f) angle

<table>
<thead>
<tr>
<th>3/8</th>
<th>35°</th>
<th>25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:4</td>
<td>16·37</td>
<td>2½</td>
</tr>
</tbody>
</table>

3. Write as a number:
   (a) two thousand six hundred and thirty four
   (b) fifty six thousand and eighty seven.

4. Round
   (a) 35·6754 to two decimal places
   (b) 425·8 to the nearest tens
   (c) 248 to the nearest hundreds

5. Estimate the
   (a) height of a standard door
   (b) length and width of A4 sized paper
   (c) average weight of a medium sized egg
   (d) amount a coffee cup will hold
   (e) distance an adult will walk in a hour
   (f) area of an adult’s shoe
   (g) boiling point of tap water
   (h) angle between the floor and wall
   (i) weight of a normal motor vehicle
6. Write the following decimals in descending (largest to smallest) order.

| 7.19 | 71.9 | 0.719 |

7. Simplify:

(a) \(2+3 \times 4\)
(b) \(4-10+2\)
(c) \(50 + 50\)
(d) \((16-5) \times 3\)
(e) \((75+5) \div (12+4)\)
(f) \(8^2\)
(g) \(\sqrt{25}\)

Operations (Addition, Subtraction, Division, Multiplication)

8. Subtract

a. 1,784 from 5,218
b. 29·461 from 43·18

9. Find the total of:

a. $2, $21·45 and $8·23
b. 18·32, 471·019 and 315.
c. 2·63m and 50cm

10. Multiply

a. 6·87 by 10
b. 13·8 by 3
c. 46·2 by 8·5

11. Divide

a. 3·45 by 10
b. 3024 by 14
c. 56.2 by 0.2

12. Select the best estimate for each of the following:

(a) \(4249 \times 71\)

| 280000 | 150000 | 28000 |

(b) \(80000 \div 38\)

| 200 | 2000 | 20000 | 4000 |
Fractions

13. Add the following
   (a) \( \frac{1}{4} \) and \( \frac{1}{2} \)
   (b) \( \frac{2}{9} \) and \( \frac{5}{6} \)
   (c) \( 3\frac{1}{4} \) and \( \frac{1}{8} \)

14. Subtract the following:
   (a) \( \frac{5}{6} \) and \( \frac{1}{4} \)
   (b) \( 2\frac{1}{14} \) and \( \frac{4}{7} \)

15. Express as a fraction in lowest terms:
   (a) 0·75
   (b) 2·6
   (c) 30%

16. Which fraction is mid-way between \( \frac{1}{4} \) and \( \frac{3}{4} \)?

17. A carpenter was making a bookcase. He hit a nail 6½ cm long through a piece of wood 2¼ cm thick and into a large piece of wood. How far did the nail go into the large piece of wood?

Percentages

18. Evaluate the following:
   (a) 10\% of \$44
   (b) 25\% of 12·84.

19. Michelle earns \$500 a week. She gets a pay rise of 5\%. What is her new wage?

20. An article bought for \$250 is sold for \$375. Find:
   (a) the profit
   (b) the profit as a percentage of the cost price.

21. Jonathan the painter buys the following from a paint store: paint \$215; rollers and brushes \$95; cleaning fluids \$12; and plastic covers \$8. Jonathan gets 10\% trade discount. How much will Jonathan pay
   (a) without discount
   (b) with discount?
   (c) How much has he saved?

22. Barry scored 80\% in a TAFE exam. There were 25 questions.
   (a) How many questions did Barry get right?
   (b) How many questions did Barry get wrong?
Decimals

23. Find the decimal number halfway between:
   (a) 0.6 and 0.8
   (b) 2.8 and 2.9

24. A plastic pipe costs $8.00 a metre. How many complete metres of pipe could I buy for $60.00?

25. A dinner bill was divided equally among 6 people. The total of the bill was $48.60.
   (a) How much did each pay?
   (b) If Tuesday is half price day, how much will each pay?

26. Phil is a plasterer and earns $12.00 an hour for a normal 40 hour week. For any overtime, he receives time-and-a-half thereafter. How much does he receive for working 42 hours?

Geometry

27. Estimate the size of the following angles by selecting the appropriate answers from the list below.

(a) 30°
(b) 110°
(c) 170°
(d) 30°
(e) 110°
(f) 170°

28. Find the value of x° in the following:
Shapes

29. Which shapes below best represents a

(a) circle
(b) triangle
(c) rectangle
(d) square
(e) semicircle
(f) parallel lines
(g) cross
(h) star
(i) cube
(j) cylinder
(k) diagonal
(l) right angle
(m) revolution
(n) right angled triangle
(o) straight angle
(p) circle and diameter
(q) circle and radius
Perimeter, area, volume

30. Find the perimeter of these shapes.

31. If each square represents 1 square centimeter, what is the area of the shape shown?

32. A bricklayer estimates there are 55 bricks to the square metre. How many bricks are needed for a 6 square metres wall?

33. A circular flowerbed with a radius of 3 metres is to be surrounded by a concrete path 1 metre wide. Calculate the area of the path?

34. In the question above, a quote to supply and lay the concrete is $10 per square metre, what is the cost of the path?

35. An oil can in the shape of a cylinder has a radius of 6 cm and a height of 20 cm. What is the volume of the can?

36. David is going to paint his ceiling in the lounge room which measures 6 metres by 3 metres. One litre of ceiling paint covers 12 square metres.
   (a) What is the area of the ceiling?
   (b) How many litres of paint will he use?

37. What is the area of these shapes?

38. Calculate the area of this circle? Use \( A = \pi r^2 \) and \( \pi = 3 \cdot 14 \).
39. If each cube represents 1 cubic centimetre, what is the total volume of the shape shown?

40. Calculate the volume of the cylinder using the formula \( V = \pi r^2 h \) and 
\( \pi = 3.14 \).

41. If the volume of this box is 24 cubic metres, how high are the sides?

42. Calculate the pitch line length of the gable roof?

43. A wooden gate 80 cm wide and 120 cm high needs a diagonal brace for support. How long will the brace be?
44. A ready-mix company uses metal, sand and cement in the ratio of 7:5:3. What amount of cement is needed for a 15 m³ job?

45. The scale on a drawing is 1:100. What length will be represented by a measurement of 8 cm on the drawing?

46. What is the ratio of the number of circles to squares?

47. Adam always mixes 8 shovels of sand with 10 shovels of metal when he makes concrete. How many shovels of sand will Adam mix with 50 shovels of metal?

**Problem Solving**

48. Calculate the cost of 40 hinges at $3.00 a pair?

49. Five litres of glue costs $65.00. How much will 1 litre cost?

50. Jeff’s yearly salary is $31,200. Calculate his:
   (a) monthly salary
   (b) fortnightly salary.

51. Peter the carpenter is paid $10.00 per hour plus time and a half for any hours over 35 hours. If he worked 42 hours, what was his pay for
   (a) the first 35 hours work
   (b) the overtime work only
   (c) total pay?

52. My car uses 10 litres of petrol every 300 kilometres. What is the rate of petrol consumption in km per litre?

53. A 3600 litre water tank is a ¼ full.
   (a) How much water is in the tank?
   (b) How much is empty space?

54. Simon is a bricklayer. He uses 50 bricks to build a 1 square metre wall. How many bricks are needed to build a wall that measures 6 metres by 3 metres?
ANSWERS
ENGLISH
1. billion, commercial, majority, either, apprentice, tradesperson, concrete, steel, telecommunication, career, opportunities, employees

2. Elimination, Prefabricated, Demolition, Certificate, Sprinkler, Bricklaying, Vocational, Permission, Committees, Participate

3. The main purpose of the industry is to build structures. These structures could range from family homes to large business structures.

4. Communication is the most important tool or skill to use to ensure a project is completed successfully. There are so many stages between the start and completion of a structure that require people to communicate with each other.

5. You can tell if someone has understood the instruction you gave them from the feedback the receiver gives you. The feedback might be given to you verbally, ie: ‘Yes I understand’, could be given to you in written form, electronic or non-verbal ie: a nod of a head.

6. Verbal: speaking to each other, Written: sending a request, Electronic: sending an email

7. Yes, it’s very important. There are so many stages between the commencement of a structure to the completion. Several tradespeople are involved and are often relying on work to be completed before they can start theirs. If there is a break down in communication, stages can become delayed, structures aren’t built properly, the building of the structures might have to start again and generally time and resources are wasted. Break down of communication can become very costly as well!!

MATHEMATICS
1. m, min, °C, kg, m², km/hr, ml, $ 2. 25%, 16·37, 3/8, 2½, 5·4, 35°

2. a) 2,634, b) 56,087 4. a) 35·68, b) 430, c) 200

3. a) 2,634, b) 56,087 5. a) 2m, b) 30cm, 20cm c) 50g, d) 250-350ml, e) 3km, f) 240cm², g) 100°C, h) 90°, i) approx 1,400kg

6. 7·1-9, 7·19, 0·719 7. a) 24, b) -1, c) 2, d) 33, e) 5, f) 64, g) 5

8. a) 3,434, b) 13·719 9. a) $31·68, b) 804·339, c) 2680cm or 2·68m

10. a) 68·7, b) 41·4, c) 392·7 11. a) 0·345, b) 216, c) 281

12. a) 28,000, b) 2,000 13. a) ¾, b) 57/54 or 11/18, c) 27/8 or 33/8

14. a) 7/12, b) 21/14 or 1½ 15. a) ¾, b) 13/5, c) 3/10

16. ½ 17. 4½cm

18. a) $4·40, b) 3·21 19. $525

20. a) $125, b) 50% 21. a) $330, b) $297, c) $33

22. a) 20, b) 5 23. a) 0·7, b) 2·85

24. 7 25. a) $8·10, b) $4·05

26. $516 27. a) 30°, e) 110°

28. a) 44°, b) 150°


30. a) 36m, b) 32 units 31. 14cm²

32. 330 Bricks 33. 21·98m²

34. $219·80 35. 2,260·8cm³

36. a) 18m², b) 1·5litres 37. a) 8m², b) 40m²

38. 314m² 39. 6cm³ 40. 628m³

41. 3m 42. 5m 43. √20·800cm

44. 3m³ 45. 800cm 46. 3·2

47. 40 48. $120 49. $13·00

50. a) $2,600, b) $1,200 51. a) $350, b) $105, c) $455

52. 30km/l 53. a) 900 litres, b) 2,700 litres

54. 900 Bricks
Practice Aptitude Assessment
For
Engineering Industry

(Apprentice Engineer)

Mal Aubrey
Group Training Australia (SA) Inc.
December 2005
Guidance

This assessment has been developed with the assistance of Industry and Registered Training Organisations, based on the needs and requirements of the Industry sector.

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The assessment can be:

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- used by Mathematics Teachers as a guide to Industry mathematics requirements at the entry point of a particular apprenticeship career path.

This practice aptitude assessment has two components; Mathematics and Literacy. You may find that this assessment differs from similar tests administrated by Industry as their tests may have other elements included, that this ones does not, such as:

- Mechanical Reasoning;
- Engineering Knowledge and reasoning;
- General Knowledge

The mathematics questions contained within this document are equivalent to Applied Mathematics at the Year 10 level in South Australia.

The assessment should be able to be completed in approximately 1 hour 30 minutes. Calculators may be used to complete this practice assessment.
ENGLISH

Spelling

1. Put the following words or group of words into alphabetical order:
   Toolmaker
   Engineering
   Computer aided manufacture
   Boilermaker
   Weighing
   Computer numerical controlled
   Computer aided design
   Welders
   Engineering patternmakers
   Design moulds

2. The following text has 10 spelling errors in it. Correct those errors and list them in the order you find them.

   Toolmackers make precision equipment and tools used to manufacture machinery. They use precision measuring equipment and may use CNC machines and computer aided manufacturing (CAM) systems to achieve very precise finishes and sizes. Any company manufacturing pressed metal or plastic items requires the service of a toolmacker.

3. The following text has 12 spelling errors in it. Correct those errors and list them in the order you find them.

   Computer Aidded Design (CAD) sistems are used by Mechaniceal Draftters to simulate the preformance of a product. They can test weather a brige will carry predicted lodes safely, or even wether tomatoe sauce will pore correctly from a newlee designed container.

Comprehension

This is a test of how well you understand what you read. You should read the following passage and answer the questions that follow.

Motoring History

"Even in recent times I've been called a conman and worse!" protests Ralph Sarich in a new biography of the most controversial man on the Australian motoring scene.

"Who have I conned? BHP, Ford and the banks who have invested in us? If so, how do they continue to do business with us?"

The fight for credibility is only part of the story told in Sarich the Man and His Machines by Pedr Davis. There is also the extraordinary financial history of the Orbital
Engine Co, two decades of engine development, the remarkable early life of the inventor and plans for the future.

Two years ago, Modern MOTOR commissioned Pedr Davis, an experienced auto engineer, to visit Sarich and evaluate the Orbital Combustion Process engine. Not surprisingly, he pursued the theme until he had enough material for his book. The new book reveals a wealth of information on the enigmatic West Australian.

It all seems to be there- the hope and hype generated by the rotary-type "Orbital engine" Sarich developed during the 1970s, the battles between Sarich and race engine guru Phil Irving and the emergence of the new and different OCP two cycle engine early in the 1980s.

The most interesting part to these eyes is the full technical appendix describing the original Orbital engine and the later OCP engine in great depth.

Sarich always seems a contradiction - on the one hand a vast amasser of funds and a man who seems to have no hesitation delivering deadlines and ultimatums to Prime Ministers and corporate presidents. On the other hand, he is donator of millions to medical foundations and a man who once could have walked away from his engine company with nearly half a billion dollars but steadfastly refused to sell a single share or cut back his 70 - 100 hour working week. This book only heightens the contradiction of Sarich - engine man, property developer, karate exponent and inventor of things as varied as an automatic garden sprinkler and self tipping trailer.

Who is the author of the book title, Sarich - the Man and his Engines?
4. 
   a) Modern Motor
   b) Phil Irving
   c) Pedr Davis
   d) Ralph Sarich

The "Orbital engine" was developed in:
5. 
   a) 1982
   b) 1970s
   c) 1980s
   d) 1975

Sarich was
6. 
   a) An engine man
   b) Karate exponent
   c) Inventor
   d) All of the above
MATHEMATICS
Numbers (Conversions, Estimation, Time)

1. Convert the following:
   (a) $2.41$ to cents
   (b) $182$ days to weeks
   (c) $3$ hours and $12$ seconds to seconds
   (d) $8$ kilometres to metres
   (e) $3 \cdot 5$ kilograms to grams

2. Arrange in ascending order (from smallest to largest):

   4  -2  ½  3.7  0  -8

3. How many hours and minutes from $7:45$ am to $3:15$ pm?

4. Select the best estimate for the following:
   (a) $4249 \times 71$

   \[
   \begin{array}{c|c|c|c|c}
   \hline
   \text{280000} & \text{150000} & \text{28000} \\
   \hline
   \end{array}
   \]
   (b) $80000 \div 38$

   \[
   \begin{array}{c|c|c|c|c}
   \hline
   \text{200} & \text{2000} & \text{20000} & \text{4000} \\
   \hline
   \end{array}
   \]

5. Round
   (a) $35.6754$ to two decimal places
   (b) $425.8$ to the nearest tens

Fractions

6. Add the following:
   (a) $\frac{1}{4} + \frac{1}{2}$
   (b) $\frac{2}{9} + \frac{5}{6}$

7. Evaluate the following:
   (a) $\frac{5}{6} - \frac{1}{4}$
   (b) $\frac{2}{14} - \frac{4}{7}$

8. Express as a fraction in lowest terms:
   (a) $0.75$
   (b) $2.6$
   (c) $30\%$

Decimals

9. Find the decimal number halfway between:
   (a) $0.6$ and $0.8$
   (b) $2.8$ and $2.9$

10. Select the correct answer to $18.642 \div 0.02$:
    A: $93.321$  B: $93.21$
    C: $932.1$   D: $9321$
Percentages

11. Michael earns $500 a week. He gets a pay rise of 5%. What is his new wage?

12. What percentage is 30 out of 50?

13. In an order of 2000 hexagonal nuts, 40 were defective. What percentage were:
   (a) defective
   (b) good

14. The price of a micrometer is normally $84. During a sale, there was a 25% reduction. Calculate the sale price?

Ratio

15. What is the ratio of the number of circles to squares?

16. A cutting wheel cuts through 0.5 cm of steel in 1 minute. How long will it take to make a cut 3.5 cm deep?

17. An air conditioning unit circulates 320 cubic metres of air per minute. How many cubic metres of air is circulated in an hour?

18. Two gears have 12 and 15 teeth respectively. What is the ratio of the number of teeth on the first gear to the number of teeth on the second gear in lowest terms?

Algebra

19. The formula for the area of a triangle is \( A = \frac{1}{2}BH \). Make \( B \) the subject of the formula.

20. The length of a metal rod is 48.6 mm ± 0.03 mm. What is the length of the smallest rod that will be accepted?

Area

21. The area of a tin plate is 15 cm². Its width is 3 cm. Find the length of the plate?

22. A piece of wire is 24 cm long and is bent in the shape of a rectangle so that the length is twice its width. Find the area of the rectangle?

23. A square is inscribed in a circle of radius 5 cm. Calculate:
   (a) the area of the circle (Correct to two decimal places)
   (b) the diameter of the circle (Correct to two decimal places)
   (c) the value of \( x \)
   (d) the area of the square.
24. The diameter of the circle is 4 cm. Work out the area of the inscribed square?

25. Find the value of x:

26. From the sheet metal shown, calculate the unmarked lengths?

27. Calculate the area of the shapes shown? For b) use $\pi = \frac{22}{7}$

28. Two numbers add up to 40. Find the other number if one is 15?

29. Peter the engineer is paid $16.00 per hour plus time and a half for any hours over 35 hours. If he worked 42 hours, what was his pay for:
   (a) the first 35 hours work
   (b) the overtime work only
   (c) total pay?

30. An engineer cut two pieces of metal rod each 10½ cm long from a rod 50 cm long. How much of the original rod was left?

31. The weight of three bolts are 52g, 49g, and 61g. What is the average weight of the bolts?

32. A 4 metre length of steel is cut into 5 sections. How long is each piece (ignoring the saw cuts)?

33. A steel ingot weighs 230 grams. How much would 6 ingots of steel weigh?

34. A truck delivers 5 loads of steel rods. If each truck load weighs 3000kg, what was the total weight of rods delivered?

35. A machinist drills a hole 65 mm into a block of steel 10 cm thick. How much further is left to drill?
36. A hacksaw blade has 4 cutting teeth every centimetre. If the blade is 30 cm long, how many teeth are there?

37. John had three quotes for a small engineering job, $124, $137 and $114. What is the average price for the quotes?

38. The following lengths were cut from a piece of angle iron: 8 cm, 27 cm, 41 cm, 37 cm, and 16 cm. What was the total length cut? (ignore the saw cuts)

39. A welder requires 8 welding rods to weld a bracket into place. How many welding rods are required to weld 12 brackets?

40. It takes 7 minutes to grind a shaft. How many shafts can be ground in 1 hour and 3 minutes?

41. The mass of 30 identical machine screws is 180 grams. What is the mass of 1 screw?

42. Nine similar pieces of sheet metal have a total thickness of 0.27 cm. What is the:
   (a) thickness of 1 piece
   (b) thickness of 4 pieces?

43. An assembly worker takes 30 seconds to build a component. How many components can be assembled in 1 hour?

44. A grinding wheel speed is 800 revolutions a minute. In half an hour, how many times has the wheel rotated?

45. The electric motor on a cement mixer rotates the drum once every 6 seconds. How many revolutions will the drum make in 12 minutes?

46. If one litre of paint covers 12 square metres, how many litres of paint is needed to paint a lounge room which has an area of 36 square metres?

47. Find the hypotenuse of a right-angled triangle with sides 6 cm and 8 cm?
ANSWERS

ENGLISH

1. Boilermaker, Computer aided design, Computer aided manufacture, Computer numerical controlled, Design moulds, Engineering, Engineering patternmakers, Toolmaker, Weighing, Welders

2. Toolmakers, equipment, machinery, aided, achieve, sizes, manufacturing, pressed, requires, toolmaker

3. Aided, systems, Mechanical, Drafters, performance, whether, bridge, loads, whether, tomato, pour, newly

4. c) 5. b) 6. d)

MATHEMATICS

1. a) 241 cents, b) 26 weeks, c) 10,812 seconds, d) 8,000m, e) 3,500g

2. -8, -2, 0, ½, 3·7, 4

3. 7 hours & 30 minutes

4. a) 280000, b) 2000

5. a) 35·68, b) 430

6. a) ¾, b) 1⅛

7. a) 7/12, b) 1 ½

8. a) ¾, b) 2⅓, c) ⅗

9. a) 0·7, b) 2·85

10. D

11. $525

12. 60%

13. a) 2%, b) 98%

14. $63

15. 3·2

16. 7 minutes

17. 19,200m³

18. 4·5

19. B = 2A

20. 48·57cm

21. 5cm

22. 32cm²

23. a) 78·5cm², b) 10cm, c) √50cm = 7·07, d) 50cm²

24. 8cm²

25. a) 63°, b) 38°, c) 30°

26. 10m, 17m

27. a) 198cm², b) 357cm²

28. 25

29. a) $560, b) $168, c) $728

30. 29cm

31. 54g

32. 0·8m

33. 1380g or 1·38kg

34. 15,000kg

35. 935mm

36. 120 teeth

37. $125

38. 129cm

39. 96 welding rods

40. 9 shafts

41. 6g

42. a) 0·03cm, b) 0·12cm

43. 120 components

44. 24,000 revolutions

45. 120 revolutions

46. 3 litres

47. 10cm
Practice Aptitude Assessment
for
Automotive Industry

(Apprentice Mechanics)

Mal Aubrey
Group Training Australia (SA) Inc.
December 2005
Guidance

This assessment has been developed with the assistance of Industry and Registered Training Organisations, based on the needs and requirements of the Industry sector.

Please note that rates quoted in this assessment for various items, including pay rates, are not meant to reflect today’s values, but are used purely for mathematical purposes.

This assessment is intended to prepare people who may be required to sit an aptitude test as part of an interview and assessment process for a job vacancy, such as an apprenticeship. The assessment can be used by a number of different organisations or people such as Group Training Organisations, Career Education Teachers, Mathematics Teachers within schools or New Apprenticeship Centres.

The assessment can be:

- provided to individual people to enable them to practice and hone their skills before sitting an actual aptitude test.
- used by Career Education Teachers for individuals or in a class setting to provide general guidance to students on what they may expect during the interview process if they intend commencing a career as an apprentice.
- used by Mathematics Teachers as a guide to Industry mathematics requirements at the entry point of a particular apprenticeship career path.

This practice aptitude assessment has three components; Literacy, General Knowledge and Mathematics.

You may find that this assessment differs from similar tests administered by Industry as their tests may have other elements included, that this one does not, such as:

- Mechanical Reasoning;
- Automotive Theory;
- Automotive Knowledge and reasoning;

The mathematics questions contained within this document are equivalent to Applied Mathematics at the Year 10 level in South Australia.

The test should be able to be completed in approximately 1 hour 45 minutes.

Calculators may be used to complete this practice assessment, however Industry in some cases does not allow calculators to be used in their aptitude tests.
ENGLISH

Spelling

1. Put the following components into alphabetical order:
   
   Timing cover  Sump
   Cam shaft  Piston
   Rocker cover  Alternator
   Valve  Bonnet
   Cam gear  Cam timing belt

2. Write the plural of the following words:
   
   Mechanic  Child
   Woman  Sheep
   Branch

3. The following sentence has a word missing; you are given 4 spellings of the missing word. Choose the correct word and insert into the sentence.

   He arrived at the embassy in a large white…
   
   (a) Limosine, (b) Limosene, (c) Limousine, (d) Limousene

4. The following text has 10 spelling errors in it. Correct those errors and list them in the order you find them in the text.

   This email and any flies transmitted with it are confidential and intended souley for the use of the individuel or entity to whoom they are addressed. If the recipiant of this message is not the intended recipant, you are hereby notified that any disemination, distribution or copying of this comunication is strictly prohibitted and may be unlawfull.

5. The following text has 5 spelling errors in it. Correct those errors and list them in the order you find them in the text.

   Maintenence schedules for cars are very important. Lubrication and the replacment of wore spark plugs need regular attenion.
Comprehension

This is a test of how you understand what you read. Read the following passages below and then answer the questions which follow.

Motoring History

"Even in recent times, I’ve been called a conman and worse!” protests Ralph Sarich in a new biography of the most controversial man on the Australian Motoring scene. "Who have I conned? BHP, Ford and the banks who have invested in us? If so, how do they continue to do business with us?"

The fight for credibility is only part of the story told in “Sarich the Man and his Engines” by Pedr Davis. There is also the extraordinary financial history of the Orbital Engine Co, two decades of engine development, the remarkable early life of the inventor and plans for the future.

Two years ago, Modern MOTOR commissioned Pedr Davis, an experienced engineer, to visit Sarich and evaluate the Orbital Combustion Process engine. Not surprisingly, he pursued the theme until he had enough material for his book. The new book reveals a wealth of information on the enigmatic West Australian.

It all seems to be there – the hope and hype generated by the rotary type “Orbital Engine” Sarich developed during the 1970’s the battles between Sarich and race engine guru Phil Irving and the emergence of the new and different OCP two cycle engine in the early 1980’s.

The most interesting part to these eyes is the full technical appendix describing the original Orbital engine and the later OCP engine in great depth.

Sarich always seems a contradiction – on one hand a vast amasser of funds and a man who seems to have no hesitation delivering deadlines and ultimatums to Prime Ministers and corporate presidents.

On the other hand, he is a donator of millions to medical foundations and a man who once could have walked away from his engine company with nearly half a billion dollars but steadfastly refused to sell a single share or cut back his 70 – 100 hour working week. This book only heightens the contradiction of Sarich – engine man, property developer, karate exponent, and inventor of things as varied as an automotive garden system and a self tippling trailer.

QUESTIONS:

   a) Modern Motor, b) Bory Lake, c) Pedr Davis, d) Ralph Sarich

7. The “Orbital Engine” was developed in:
   a) 1980’s, b) 1970’s, c) 1972, d) 1985

8. Sarich was…
   a) An engine man, b) Karate exponent, c) Inventor, d) All of the above
Comprehension (cont.)

This is a test of how you understand what you read. Read the following passage below and then answer the questions which follow.

Automotive Mechanic (Light Vehicle)

The job of the Automotive Mechanic (Light Vehicle) has certainly changed in the last decade with the introduction of computer technology. The automotive industry has become more sophisticated and high-tech, and so too have the skills of the Automotive Mechanic.

What sort of training do you need?
To become an Automotive Mechanic (Light Vehicle) usually requires the completion of a New Apprenticeship in Automotive (Mechanical – Light Vehicle). Employers usually require Year 11 with good results in English, maths and science.

The lengths of the training can vary and may involve both on-the-job and off-the-job components. The off-the-job training is provided through Registered Training Organisations to Certificate III level.

You may be able to start training for this occupation while still at school.

Automotive Mechanics (Light Vehicle) may progress to positions such as service manager, workshop foreman, service advisor, technical sales representative, technical officer or diagnostic specialist.

What sort of things do Automotive Mechanics (Light Vehicle) do?

- Discuss problems with car drivers or vehicle operators to discover faults, listen to engines, fit and operate special test and diagnostic equipment and test drive vehicles
- Repair or replace worn and faulty parts by removing and dismantling assemblies
- Reassemble, test, clean and adjust repaired or replaced parts or assemblies, use various tools and equipment to make sure they are working properly and put them back into the vehicle
- Diagnose, repair and replace engine management/fuel injection components
- Inspect vehicles and issues roadworthiness certificates or list the work required before a certificate can be issued
You may enjoy being an Automotive Mechanic if you…

- Are interested in practical and manual work
- Are able to work with hand tools
- Have a technical aptitude
- Have problem-solving skills
- Are physically fit
- Have a driver’s licence

QUESTIONS:

9. To become an Automotive Mechanic, I need to complete:
   (a) a Bachelor in Automotive,
   (b) a Diploma in Automotive
   (c) an Apprenticeship in Automotive,
   (d) a Masters in Automotive

10. Employers usually require you to have completed:
    (a) year 10,
    (b) year 11,
    (c) year 12,
    (d) year 13

11. The job of an Automotive Mechanic (Light Vehicle) is:
    (a) dirty,
    (b) noisy,
    (c) high-tech,
    (d) smelly

12. Which of these skills do you believe an Automotive Mechanic needs:
    (a) Listening,
    (b) Communication
    (c) Listening and Communication,
    (d) Writing

13. Automotive Mechanics:
    (a) Make inspections of light vehicles,
    (b) Issues roadworthiness certificates
    (c) Repairs engine components,
    (d) All of the above
GENERAL KNOWLEDGE

1. The figure is a picture of a four cylinder, four stroke, overhead camshaft engine assembly. Which number represents the:
   a. sump
   b. alternator
   c. piston
   d. rocker cover
   e. valve
   f. cylinder bore

___________
___________
___________
___________
___________
___________
MATHEMATICS

Numbers (Measurement, Scales, Decimals, Rounding, Estimates, Scientific Notation)

1. Which unit from the list below would you use to measure:
   (a) length ____ (b) time ____ (c) temperature ____ (d) weight ____
   (e) area ____ (f) speed ____ (g) volume ____ (h) cost ____
   | kg | ml | km/hr | m² | $ |
   | kg | ml | km/hr | m² | $ |

2. What are the following tape readings:
   (a) __________________
   (b) __________________

3. From the list of numbers below, select the one which represents a:
   (a) percentage ____ (b) decimal number ____ (c) fraction ____
   (d) mixed number ____ (e) ratio ____ (f) angle ____
   | 3/8 | 35° | 25% |
   | 5:4 | 16·37 | 2 ¾ |

4. Convert the following:
   (a) 8 kilometres to metres __________________
   (b) 3·5 kilograms to grams __________________

5. Write the following decimal numbers, from largest to smallest:
   __________________
   __________________
   __________________

6. Find the decimal number halfway between:
   (a) 0·6 and 0·8 __________________
   (b) 2·8 and 2·9 __________________

7. Find the value of the following:
   (a) 2¹ __________________
   (b) √36 __________________

8. Round
   (a) 35·6754 to two decimal places __________________
   (b) 425·8 to the nearest tens __________________
9. Select the best estimate for:
   (a) $4249 \times 71$
   
   \[
   \begin{array}{ccc}
   280,000 & 150,000 & 28,000 \\
   \hline
   200 & 2,000 & 20,000 & 4,000 \\
   \end{array}
   \]
   (b) $80,000 \div 38$

10. Which one of the following represents the number $27,000,000,000$ in scientific notation:
   (a) $27 \times 10^{10}$, (b) $2 \cdot 7 \times 10^{10}$
   (c) $2 \cdot 7 \times 10^{-10}$, (d) $27 \times 10^{10}$

11. Multiply the following:
   (a) $3\cdot485 \times 10^{-2}$
   (b) $16\cdot919 \times 10^{2}$

12. Find the total of:
   (a) $\$2, \$21\cdot45 \text{ and } \$8\cdot23$
   (b) $18\cdot32, \ 471\cdot019 \text{ and } 315$

13. Find the answer:
   (a) $5,218 - 1784$
   (b) $43.18 - 29.461$

14. Multiply:
   (a) $6\cdot87 \text{ by } 10$
   (b) $13\cdot8 \text{ by } 3$
   (c) $46\cdot2 \text{ by } 8$

15. Divide:
   (a) $3\cdot45 \text{ by } 10$
   (b) $3024 \text{ by } 4$
   (c) $56\cdot2 \text{ by } 0\cdot2$

16. Select the correct answer to $18\cdot642 \div 0\cdot02$:
   (a) $9\cdot321$, (b) $93\cdot21$, (c) $9321$ (d) $932\cdot1$

17. Which fraction is between $\frac{1}{4}$ and $\frac{3}{4}$?

18. Add the following:
   (a) $\frac{1}{4}$ and $\frac{1}{2}$
   (b) $\frac{2}{3}$ and $\frac{5}{6}$
   (c) $3\frac{3}{4}$ and $\frac{1}{8}$
19. Calculate:
   (a) \( \frac{5}{6} - \frac{1}{4} \)
   (b) \( \frac{21}{14} - \frac{4}{7} \)

20. Express as a fraction in lowest terms:
   (a) \( 0.75 \)
   (b) \( 2.6 \)
   (c) \( 30\% \)

**Geometry**

21. Estimate the size of the following angles by selecting the appropriate answers from the list below.

   (a) \( 30^\circ \)
   (b) \( 80^\circ \)
   (c) \( 120^\circ \)
   (d) \( 30^\circ \)
   (e) \( 80^\circ \)
   (f) \( 120^\circ \)

22. Find the value of \( x^\circ \) in the following diagrams:

   (a) \[ \text{Diagram A} \]
   (b) \[ \text{Diagram B} \]
   (c) \[ \text{Diagram C} \]

**MENSURATION**

**Perimeter**

23. Find the perimeter of this rectangle.

   \[ \text{Rectangle A} \]

24. Find the circumference of this circle to one decimal place? (Use \( \pi = 3.14 \))

   \[ \text{Circle A} \]
25. What is the area of the rectangle?

![Rectangle Diagram]

Area

26. Find the area of the triangle.

![Triangle Diagram]

27. Find the area of this circle to one decimal place.
(Use $\pi = 3.14$)

![Circle Diagram]

Volume

28. An oil can in the shape of a cylinder has a radius of 6 cm and a height of 20 cm. What is the volume of the can?

![Cylinder Diagram]

Percentages

29. Evaluate the following:
(a) 10% of $44
(b) 25% of 12.84

30. Barry scored 80% in his automotive exam. There were 25 questions.
(a) How many questions did Barry get right?
(b) How many questions did Barry get wrong?

31. Michelle, a spare parts interpreter for GTA Automotive, earns $500 a week. She gets a pay rise of 5%. What is her new weekly wage?

32. A car costs $12000. The price was reduced by 10%. Find:
(a) the amount the car was reduced by?
(b) the new cost of the car?

33. The price of a tyre is $120 each. Jamie gets 10% discount for paying cash. How much did Jamie pay for four tyres with the discount?
PROBLEM SOLVING

34. Four workers each produced the following number of oil filters on a particular day: 108, 143, 127, 134. What is the total number of oil filters produced that day? _________

35. A bolt assembly for a car’s rear spring consists of a bolt of mass 8 \cdot 34 g, a washer with mass 1 \cdot 72 g, a lock washer with mass 0 \cdot 8 g and a hexagonal nut with mass 2 \cdot 3 g. What is the total weight of this bolt assembly? _________

36. What is the average of 12 and 18? _________

37. The weight of three bolts are 52g, 49g, and 61g. What is the average weight of the bolts? _________

38. Two numbers add up to 40. Find the other number if one is 15? _________

39. After work, you and four other people share a meal and split the costs evenly at the end. If the bill totalled $168, how much did each person have to pay? _________

40. Peter the mechanic is paid $10 \cdot 00 per hour plus time and a half for any hours over 35 hours. If he worked 42 hours, what was his pay for?
   (a) the first 35 hours of work only _________
   (b) the overtime pay only _________
   (c) the total pay _________

41. Daniel is a mechanic and he uses feeler gauges to check the size of small gaps. He has six different size feeler gauges: 0 \cdot 015mm, 0 \cdot 02mm, 0 \cdot 04mm, 0 \cdot 08mm, 0 \cdot 12mm and 0 \cdot 15mm. What combination of gauges would he use to check a size of:
   (a) 0 \cdot 2mm _________
   (b) 0 \cdot 095mm? _________

Graphs

42. Use the conversion graph below to change:
   (a) 30 km/h to m/s (to the nearest whole number) _________
   (b) 10 m/s to km/h (to the nearest whole number) _________
Formulae

43. Robert drove 300 km in 6 hours. Calculate his average speed given that
   \[ \text{speed} = \frac{\text{distance}}{\text{time}}. \]
   \[ 50 \text{ km/hr} \]

44. If \( P = \frac{F}{A} \) find \( P \) if \( F = 60 \) and \( A = 20 \).
   \[ P = 3 \]

45. If \( P = \frac{F}{A} \), make \( F \) the subject of the formula.
   \[ F = PA \]

Ratio

46. A 5 litre V8 vehicle uses unleaded petrol in the ratio of 3:1 when compared with a 4 cylinder 1.2 litre vehicle. If there was 24 litres of unleaded petrol in a drum to be shared between the two vehicles, how much would you pump out for the V8 vehicle to use?
   \[ 18 \text{ litres} \]

47. The length of a trucks tray top \( A = 5 \text{ m} \). The length of a utilities tray \( B = 2 \text{ m} \). What is the ratio of the trucks tray top to that of the utilities, in simplest terms?
   \[ 5:2 \]

48. An angle grinder cuts through \( 0.5 \text{ cm} \) of steel in 1 minute. How long will it take to make a cut \( 3.5 \text{ cm} \) deep?
   \[ 2 \text{ minutes} \]

49. A car travels at a constant speed. If the car takes 30 minutes to travel 50 kilometres, how many kilometres will it travel in 1 hour?
   \[ 100 \text{ km} \]

50. A car uses 12 litres of petrol per 100 kilometres. If the tank holds 60 litres, how far will it travel on a full tank?
   \[ 500 \text{ km} \]

51. The capacity (volume) of a 6 cylinder car is \( 2.4 \text{ litres} \). What is the volume of each cylinder?
   \[ 0.4 \text{ litres} \]

52. A cars engine crankshaft revolves 2400 times each minute. How many seconds does it take to revolve 1200 times?
   \[ 2 \text{ seconds} \]

53. Tom’s car uses 10 litres of petrol every 300 kilometres. What is the rate of petrol consumption in km per litre for Tom’s car?
   \[ 30 \text{ km/litre} \]

54. An air conditioning unit circulates 320 cubic metres of air per minute. How many cubic metres of air is circulated in an hour?
   \[ 19200 \text{ cubic metres} \]

55. A mechanic cut two pieces of rubber tubing each 14cm long from a tube 50cm long. How much of the original rubber was left?
   \[ 22 \text{ cm} \]

56. Two wheels have 12 and 15 teeth respectively. What is the ratio of the number of teeth on the first wheel to the number of teeth on the second wheel in lowest terms?
   \[ 4:5 \]
ANSWERS

ENGLISH

1. Alternator, Bonnet, Cam gear, Cam shaft, Cam timing belt, Piston, Rocker cover, Sump, Timing cover, Valve
2. a. Mechanics b. women c. branches d. children e. sheep
3. c. Limousine
4. files, solely, individual, whom, recipient, recipient, dissemination, communication, prohibited, unlawful
5. maintenance, schedules, replacement, worn, attention.
6. c) 7. b) 8. d)
9. (c) 10. (b) 11. (c) 12. (c) 13. (d)

GENERAL KNOWLEDGE

1. (a) 16, (b) 20, (c) 11, (d) 6, (e) 9, (f) 10

MATHEMATICS

1. (a) m, (b) min, (c) °C, (d) kg, (e) m², (f) km/hr, (g) ml, (h) $2. (a) 48.8cm, (b) 177.4cm
3. (a) 25%, (b) 16.37, (c) 3/8, (d) 2 3/4, (e) 5:4, (f) 35°
4. (a) 8000m, (b) 3500g
5. 71.9, 7.19, 0.719
6. (a) 0.7, (b) 2.85
7. (a) 8, (b) 6
8. (a) 35.68, (b) 430
9. (a) 280.000, (b) 2,000
10. (a) 0.03485, (b) 1691.9
11. (a) 3434, (b) 13.719
12. (a) 68.7, (b) 41.4, (c) 369.6
13. (a) 0.345, (b) 756, (c) 281
14. (d) 932.1
15. 2/4 or 1/2
16. (a) 5/4, (b) 9/6 =1 1/2, (c) 27/8 = 3 3/8
17. (a) 0.7, (b) 2.85
18. (a) 3/4, (b) 6/4 =1 1/2, (c) 27/8 = 3 3/8
19. (a) 7/12, (b) 2/4 = 1 1/4 = 5
20. (a) 3/4, (b) 6/10 = 3/5, (c) 30/100 = 3/10
21. (a) 30°, (b) 120°
22. (a) 58°, (b) 20°, (c) 50°
23. 52m
24. 25·12m
25. 10m²
26. 42km²
27. 314cm²
28. 2,260.8cm³
29. (a) $4.40, (b) 3.21
30. (a) 20, (b) 5
31. $525
32. (a) $1,200, (b) $10,800
33. $432
34. 512
35. 13.16g
36. 15
37. 54g
38. 25
39. $33.60
40. (a) $350, (b) 105, (c) 455
41. (a) 0.08mm and 0.12mm, (b) 0.08mm and 0.015mm
42. (a) 8m/s, (b) 36km/h
43. 50km/h
44. 3
45. \( F = \frac{P}{A} \)
46. 18 litres
47. 2.5:1
48. 7 minutes
49. 100km
50. 500km
51. 4 litres
52. 30 seconds
53. 30km/l
54. 19200m³
55. 22cm
56. 4:5
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INDUSTRY MATHEMATICS

SACE STAGE 1 : 1 UNIT (18 weeks)

(FOR STUDENTS INTENDING TO PURSUE A CAREER IN INDUSTRY
eg. Automotive, Construction, Electrical, Engineering)

Notice to Schools

This booklet has been designed to assist and guide students through an Industry Mathematics course. It should not be seen as a complete program and will require individual school/tutor input before implementation.
INDUSTRY SKILLS MATHEMATICS

BACKGROUND

Industry Mathematics is a single unit (semester) SACE stage 1 subject. It has been produced through consultation with TAFE colleges, apprenticeship organisations and worksite employers in an attempt to address the deficiencies often found in applicants’ mathematical skills. The first 8 week block is a generic course that all students must complete, whilst the second block of 8 weeks provides a choice between the four main career pathways: Automotive, Doorways to Construction, Electrical Technology & Engineering.

The course meets SSABSA requirements and includes a program rationale and assessment outline ready for submission. The booklet can be used as a supplementary text and includes answers to all questions. Examples of all Skill and Application Tasks (tests), and Directed Investigations are provided and there is no copyright. It is hoped that Industry Mathematics can replace the traditional “Social mathematics” as the compulsory mathematics unit for stage 1 students intending to pursue a trade.

It is free of copyright (and cost) so please make use of this VET initiated program which has been produced through the cooperation of both Southern Futures and the Education Department of South Australia.

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Southern Futures (VET)
8329 5300 or 0407 227 256
INDUSTRY MATHEMATICS

This program has been written to meet the needs of students who are interested in pursuing an industry trade, eg Automotive Engineering, Doorways to Construction, Electrical Technology & Engineering.

This is a single unit of Stage 1 mathematics for mixed ability groups, targeting the industrial trade, which can also be used to fulfil their SACE certificate requirements.

The first section consists of a basic generic mathematics course to improve the skills common to all industrial areas, while the second section involves more specialised training in their intended pathway.

It has been prepared in consultation with TAFE and employers. Students will develop skills that enable them to successfully sit for a variety of apprenticeship entry-level tests. Some of the content maybe used in VET courses and is part of the Futures Connect strategy developed by the Department of Education and Children’s Services (DECS).

Computer technology will be used to develop conceptual understanding and will be integrated into the learning tasks where appropriate. However, students will be expected to calculate mentally and with pencil & paper. Some basic number skills will be assessed without access to a calculator. Students will be expected to apply their mathematical skills and knowledge in solving problems that are relevant to their chosen program. Solutions to problems will be verified by comparison with those obtained using other methods (this will be an emphasis). They will also be required to work in teams in some of the investigations and tasks. Some geometrical ideas will be assessed through practical activities, which require precision in measurement, construction and calculation. As there is a strong emphasis on the application of skills in a technical area of study, much of this will be done outside the classroom, for example in conjunction with a Technology subject teacher.

The use of Electronic Technology is an essential component of this unit. Due to the extreme variation in computer facilities & availability, it is the responsibility of individual institutions to best incorporate this technology into their program and to adjust the assessment plan accordingly. The Essential Learnings: identity, interdependence and communication, will form the focus of the framework chosen, although futures will be a pervading theme throughout. This course does not lead to a corresponding Stage 2 Mathematics subject.
### Assessment Information

To fulfil the SACE requirements for this 1-Unit course (60 hours of programmed school time), your assessment must cover at least two of the 15 topics stated in the stage 1 Mathematics curriculum statement (see structure and organisation in the 2006 edition).

In addition, students should be given between four and six summative assessment tasks with at least one task from each of the three assessment components below. (These are only suggested weightings as actual percentages can vary between 10% and 50% depending on your approach).

| Component 1: | Skills & Application Tasks. (40%) 3 tasks. |
| Component 2: | Directed Investigations. (40%) 2 tasks. |
| Component 3: | Projects. (20%) 1 task. |

For further information on Strands, Learning Outcomes, Structure & Organisation, Scope and Key Ideas, please refer to the SSABSA Mathematics Curriculum statement.
Structure and Organisation (SSABSA)

Unit 1: Earning and Spending, Subtopics 1.1 to 1.3
Unit 2: Measurement, Subtopics 2.1 to 2.7
Unit 3: Data in Context, Subtopics 3.1 to 3.4
Unit 4: Networks and Matrices, Subtopics 4.1 to 4.6
Unit 5: Saving and Borrowing, Subtopics 5.1 to 5.3
Unit 6: Simulating Random Processes, Subtopics 6.1 to 6.9
Unit 7: Statistics, Subtopics 7.1 to 7.8
Unit 8: Geometry and Mensuration, Subtopics 8.1 to 8.4
Unit 9: Models of Growth, Subtopics 9.1 to 9.6
Unit 10: Quadratic and Other Polynomials, Subtopics 10.1 to 10.3
Unit 11: Coordinate Geometry, Subtopics 11.1 to 11.8
Unit 12: Functions and Graphs, Subtopics 12.1 to 12.7
Unit 13: Planar Geometry, Subtopics 13.1 to 13.9
Unit 14: Periodic Phenomena, Subtopics 14.1 to 14.8
Unit 15: Open Topic, Subtopics 15.1 to 15.7

Subtopics that may be covered in this unit are:

2.1: Units of Measurement
2.2: Measuring Devices
2.3: Scale and Ratio
2.4: Time and Rates
2.5: Perimeter and Area
2.6: Volume and Capacity
2.7: Specialist Measurement
8.1: Measuring Instruments
8.2: Right-angled Triangle Geometry
15.1*: Basic Number Skills
15.2*: Fractions
15.3*: Decimals
15.4*: Using Formulae
15.5*: Algebra
15.6*: Basic Electrical
15.7*: General Reasoning

* Open Unit 15

Subtopics 15.1-15.7 form the Open Topic and provide opportunities for the inclusion of content other than that which is found in Topics 1 to 14 of Stage 1 Mathematics. 15.1-15.3 are revision of basic operations previously covered during years 9 & 10, whilst 15.4-15.7 deal with more complex skills and are based on Stage 1 standards.

The use of Electronic Technology is an essential component of this unit. Due to the extreme variation in computer facilities & availability, it is the responsibility of individual institutions to best incorporate this technology into their program and to adjust the assessment plan accordingly.
INDUSTRY SKILLS

MATHEMATICS

SACE STAGE 1 : SECTION 1 (8 WEEKS) - GENERIC

(FOR STUDENTS INTENDING TO PURSUE A CAREER IN INDUSTRY
eg. Automotive, Construction, Electrical, Engineering)

* IMPORTANT NOTE TO SCHOOLS/TUTORS *

The use of Electronic Technology is an essential component of this unit. Due to the extreme variation in computer facilities & availability, it is the responsibility of individual institutions to best incorporate this technology into their program and to adjust the assessment plan accordingly.
OPEN SSABSA UNIT 15
INDUSTRY SKILLS MATHEMATICS (Section 1)

(This section should take approximately 8 weeks to complete)

Unit One: Number Skills ~1wk. (15.1)

1.1 Addition
1.2 Subtraction
1.3 Multiplication
1.4 Division
1.5 Order of operations

Unit Two: Fractions ~2wks. (15.2)

2.1 Common fractions
2.2 Improper fractions
2.3 Equivalent fractions
2.4 Mixed numbers

Unit Three: Decimals ~2wks. (15.3)

3.1 Common decimals
3.2 Decimals to fractions
3.3 Fractions to decimals

** Skills & Application Task #1 (approx. 30 min.) **

Unit Four: Measurement ~2wks. (2.1,2.2,2.5,2.6)

4.1 Length
4.2 Perimeter
4.3 Area
4.4 Volume

** Directed Investigation #1 (approx. 120 min.) **

Unit Five: Formulae ~1wk. (8.1,8.2,15.4)

5.1 Pythagoras theorem
5.2 Using Formulae

** Skills & Application Task #2 (approx. 30 min.) **

* IMPORTANT NOTE TO SCHOOLS/TUTORS *

The use of Electronic Technology is an essential component of this unit. Due to the extreme variation in computer facilities & availability, it is the responsibility of individual institutions to best incorporate this technology into their program and to adjust the assessment plan accordingly.
Unit One: Number Skills

Introduction

When we prepare to carry out calculations we use the following *SIGNS* which are symbols to represent the operations.

+ **ADDITION**  
  plus, add or positive.  
  *eg.* 3 plus 4 is 3 + 4

- **SUBTRACTION**  
  minus, take or negative.  
  *eg.* 8 minus 5 is 8 – 5

X **MULTIPLICATION**  
  multiply (or *), times or product.  
  *eg.* 2 multiplied by 6 is 2 X 6 (or 2 * 6)

/ **DIVISION**  
  divide, divided by, or over  
  *eg.* 6 divided by 3 is 6 / 3

All calculations in Topics One, Two & Three must be done WITHOUT the use of CALCULATORS.

1.1 Addition

eg. 31 + 46 = 31
    + 46
    ---
    77

205 + 4038 = 205
    + 4038
    ---
    4243

Exercises:

1. 7 + 88 = 7
    + 88

2. 126 + 61 =

3. 724 + 415 =
4.  7 822 + 1 033 =

5.  1 126 + 2 222 =

6.  745 + 1 377 =

7.  3 023 + 112 348 =

8.  
   \[
   \begin{array}{c}
   345 \\
   3 388 \\
   \hline
   789
   \end{array}
   \]

9.  1 010 011
    + 202 010

### 1.2 Subtraction

eg.  46 – 31 =

\[
\begin{array}{c}
46 \\
- 31 \\
\hline
15
\end{array}
\]

Exercises:

1.  88 – 7 =

\[
\begin{array}{c}
88 \\
- 7 \\
\hline
\end{array}
\]

2.  126 – 61 =

3.  724 – 415 =

4.  7 882 – 1 033 =

5.  2 222 – 1 834 =

6.  745 – 137 =
7. \[ 1 \, 123 - 302 = \]

8. Two hundred and fifty eight take one hundred and twelve.

9. \[ 365 \, 365 - 82 \, 058 \]

10. \[ 1 \, 011 \, 101 - 202 \, 202 \]

1.3 Multiplication

eg. \[ 33 \times 8 = 264 \]
\[ 1423 \times 12 = 2846 \]
\[ 2125 \times 123 = 261375 \]

Exercises:

1. \[ 84 \times 7 = \]
2. \[ 126 \times 15 = \]
3. \[ 352 \times 46 = \]
4. \[ 3574 \times 123 = \]
5. \[ 101 \, 101 \times 2 \, 212 = \]
1.4 Division

eg. $825 \div 5 = \underline{5} \underline{825} \quad 25 \underline{50675}$

\[
\begin{array}{c}
165 \\
5 \underline{825} \\
-5 \\
32 \\
-30 \\
25 \\
-25 \\
0 \\
\end{array}
\begin{array}{c}
2027 \\
25 \underline{50675} \\
-50 \\
067 \\
-50 \\
175 \\
-175 \\
0 \\
\end{array}
\]

NB. These examples also indicate that $165 \times 5 = 825$ and $25 \times 2027 = 50,675$.

Exercises:

1. $6\underline{8232}$

2. $25\underline{10750}$

3. $20\underline{121860}$
1.5 Order of Operations

When we have a series of operations to do we must follow a set of steps called the BODMAS rule. This stands for **Brackets**, **Other**, **(D)ivision**, **(M)ultiplication**, **(A)ddition**, **(S)ubtraction**.

**STEP 1.** Always do what is inside the brackets first then...

**STEP 2.** Do any “Other” alternative form of multiplication eg. powers then...

**STEP 3.** Do any Division or Multiplication from left to right (there is no order of priority between multiplication and division) then...

**STEP 4.** Do any Addition or Subtraction from left to right (there is no order of priority between subtraction and addition).

This means that the rule could also be written as BOMDSA if you like!!!!!

Here are some examples showing all the steps to help explain the process……

eg. \(20 + 5 \times 4 - 15 / 3 + (10 - 6) + 2\)

**Step 1. is to do the brackets**
\[= 20 + 5 \times 4 - 15 / 3 + 4 + 2\]

**Step 2. is not needed as there are no powers to deal with**

**Step 3. is to do all multiplications or divisions from left to right**
\[= 20 + \boxed{20} - 5 + 4 + 2\]

**Step 4. is to do all additions and subtractions from left to right**
\[= 41\]

eg. \((20 + 5) \times 4 - 15 / 3 + 10 - (6 + 2)\)

\[= 25 \times 4 - 15 / 3 + 10 - \boxed{8}\]
\[= 100 - 5 + 10 - 8\]
\[= 97\]

Exercises:

1. \(8 + 6 + (7 - 3) \times 2 = \)

2. \(4 \times 6 - (7 - 1) \times 2 = \)
3. \[ \frac{6}{3} \times 6 + 5 - (3 + 2 \times 2) = \]

4. \[ 2 + 6 + \frac{12}{3} - (2 + 2 \times 3) \times 3 = \]

5. \[ 15 + 3 - 12 + \frac{16}{2 + 6} = \]
Unit Two: Fractions

All calculations in Topics One, Two & Three must be done WITHOUT the use of CALCULATORS.

Introduction

There are 4 basic types of Fraction that are used in industry. They are:
- Common Fractions
- Improper Fractions
- Equivalent Fractions
- Mixed Numbers

Common Fractions

These are numbers smaller than one but bigger than zero eg. ¾
This means if you divide Something into 4 equal parts that you use 3 of them…3 out of 4 or ¾

The top number in a fraction is called the NUMERATOR.

The bottom number is called the DENOMINATOR.

NOTE - In common fractions the bottom number must be bigger than the top number !!!

Improper Fractions

These numbers are bigger than one eg. 5/4
This means you have the whole thing (4/4) plus another ¼ or 5/4

NOTE - In Improper fractions the bottom number must be smaller than the top number !!!

Equivalent Fractions

This is when two fractions appear different but still have the same value eg. ½ = 2/4
If both the Numerator and Denominator of a fraction are multiplied or divided by the same number, the value of the fraction is unchanged. eg. \( \frac{5 \times 3}{7 \times 3} = \frac{15}{21} \) or \( \frac{5 \times 4}{7 \times 4} = \frac{20}{28} \)

\( \frac{5}{7}, \frac{15}{21} \) and \( \frac{20}{28} \) are equivalent fractions.

This principal is used extensively in engineering workshops for the calculation of gear trains to give a required ratio.

Mixed Numbers

This is a number that is made up of a whole number and a proper fraction eg. 2\( \frac{3}{4} \)
In some cases it is necessary to express a mixed number as an improper fraction…..

eg. \( 2 \frac{3}{4} = 1 + 1 \frac{3}{4} = \frac{4}{4} + \frac{4}{4} + \frac{3}{4} = \frac{11}{4} \)
2.1 Common Fractions

Introduction

Adding  
\[ \frac{1}{4} + \frac{2}{4} = \frac{3}{4} \]  
\[ \frac{3}{4} + \frac{1}{4} = \frac{4}{4} = 1 \]  
\[ \frac{3}{4} + \frac{1}{8} = \frac{3 \times 2}{4 \times 2} + \frac{1}{8} = \frac{6}{8} + \frac{1}{8} = \frac{7}{8} \]  
\[ \frac{2}{5} + \frac{1}{4} = \frac{2 \times 4}{5 \times 4} + \frac{1 \times 5}{4 \times 5} = \frac{8}{20} + \frac{5}{20} = \frac{13}{20} \]

Subtracting  
\[ \frac{3}{4} - \frac{2}{4} = \frac{1}{4} \]  
\[ \frac{3}{4} - \frac{1}{8} = \frac{3 \times 2}{4 \times 2} - \frac{1}{8} = \frac{6}{8} - \frac{1}{8} = \frac{5}{8} \]  
\[ \frac{2}{5} - \frac{1}{4} = \frac{2 \times 4}{5 \times 4} - \frac{1 \times 5}{4 \times 5} = \frac{8}{20} - \frac{5}{20} = \frac{3}{20} \]

Multiplying  
\[ \frac{1}{4} \times \frac{2}{4} = \frac{2}{16} = \frac{1}{8} \]  
\[ \frac{3}{4} \times \frac{1}{8} = \frac{3}{32} \]  
\[ \frac{2}{5} \times \frac{1}{4} = \frac{2 \times 1}{5 \times 4} = \frac{2}{20} = \frac{1}{10} \]

Your tutor will show you how to cancel down and make these problems easier !!!

Dividing  
NOTE: To divide by a fraction you need to invert it and then multiply by it.

\[ \frac{3}{4} \div \frac{2}{4} = \frac{3}{4} \times \frac{4}{2} = \frac{12}{8} = 1\frac{1}{2} \]  
\[ \frac{3}{4} \div \frac{1}{8} = \frac{3}{4} \times \frac{8}{1} = \frac{24}{4} = 6 \]  
\[ \frac{2}{5} \div \frac{1}{4} = \frac{2}{5} \times \frac{4}{1} = \frac{8}{5} = 1\frac{3}{5} \]
Exercises:

Complete the following exercises **without** the use of a calculator.

1. Add the fractions
   
   a) \[ \frac{1}{8} + \frac{5}{8} = \]

   b) \[ \frac{3}{8} + \frac{1}{4} = \]

   c) \[ \frac{3}{5} + \frac{1}{4} = \]

   d) \[ \frac{3}{8} + \frac{17}{32} = \]

2. Subtract the fractions
   
   a) \[ \frac{6}{7} - \frac{3}{7} = \]

   b) \[ \frac{7}{8} - \frac{3}{16} = \]

   c) \[ \frac{4}{5} - \frac{1}{4} = \]

   d) \[ \frac{7}{18} - \frac{1}{6} = \]

3. Multiply the fractions
   
   a) \[ \frac{7}{10} \times \frac{4}{5} = \]

   b) \[ \frac{3}{10} \times \frac{5}{9} = \]

   c) \[ \frac{4}{5} \times \frac{4}{9} = \]

   d) \[ \frac{2}{11} \times \frac{1}{7} = \]
4. Divide the fractions

a) \( \frac{3}{4} \div \frac{1}{4} = \)

b) \( \frac{3}{8} \div \frac{3}{4} = \)

c) \( \frac{4}{5} \div \frac{7}{10} = \)

d) \( \frac{27}{32} \div \frac{3}{16} = \)

5. Now try some of these….. (you may need help from your tutor!)

eg. \( \frac{2}{5} + \frac{7}{15} - \frac{1}{6} = \) (Hint: lowest denominator they will all divide into is 30)

\[
\frac{2 (x6)}{5 (x6)} + \frac{7 (x2)}{15 (x2)} - \frac{1 (x5)}{6 (x5)} = \frac{12}{30} + \frac{14}{30} - \frac{5}{30} = \frac{21}{30} = \frac{7}{10}
\]

a) \( \frac{1}{12} + \frac{2}{3} + \frac{3}{4} = \)

b) \( \frac{1}{3} + \frac{7}{12} - \frac{5}{6} = \)

c) \( \frac{2}{5} \times \frac{5}{7} \times \frac{1}{2} = \)

d) \( \frac{2}{5} \times \frac{5}{6} - \frac{1}{3} = \)

e) \( \frac{3}{8} - \frac{9}{10} + \frac{29}{60} = \)
2.2 Improper Fractions

eg. Converting improper fractions into mixed numbers.. eg. \( \frac{7}{6} \)

\[
\frac{7}{6} = \frac{6}{6} + \frac{1}{6} \quad \text{*note: } \frac{6}{6} = 1 \]

\[
\frac{7}{6} = 1\frac{1}{6}
\]

Convert the following improper fractions into mixed numbers in their lowest terms.

a) \( \frac{7}{5} \) =

b) \( \frac{10}{8} \) =

c) \( \frac{45}{32} \) =

d) \( \frac{97}{32} \) =

2.3 Equivalent Fractions

eg. Working out equivalent fractions.. eg. \( \frac{5}{7} \)

\[
\frac{5}{7} = \frac{2}{21}
\]

\[
\frac{5 \times 3}{7 \times 3} = \frac{15}{21} \quad \text{therefore } ? = 15
\]

so \( \frac{5}{7} \) is the same ratio or fraction as \( \frac{15}{21} \)

eg. Reducing fractions to their lowest equivalent fraction.. eg. \( \frac{12}{16} \)

\[
\frac{12}{16} \quad \text{- both numerator and denominator can be divided by 2}
\]

\[
\frac{12 \div 2}{16 \div 2} = \frac{6}{8} \quad \text{- both can still be divided by 2}
\]

\[
\frac{6 \div 2}{8 \div 2} = \frac{3}{4} \quad \text{- can’t be simplified any further}
\]

therefore \( \frac{3}{4} \) is the lowest equivalent fraction
Reduce the following fractions to equivalent fractions in their lowest terms.

a) \(\frac{12}{16} = \)

b) \(\frac{30}{32} = \)

c) \(\frac{56}{64} = \)

d) \(\frac{27}{36} = \)

\[ \text{2.4 Mixed Numbers} \]

eg. Converting mixed numbers into improper fractions.. eg. \(2 \frac{3}{4} \)

eg. \(2\frac{3}{4} = \frac{2 \times 4 + 3}{4} = \frac{8 + 3}{4} = \frac{11}{4} \)

Convert these mixed numbers into improper fractions.

a) \(\frac{1\frac{1}{4}}{4} = \)

b) \(\frac{5\frac{3}{8}}{8} = \)

c) \(\frac{1\frac{15}{32}}{32} = \)

d) \(\frac{4\frac{7}{8}}{8} = \)
Unit Three:  Decimals

All calculations in Topics One, Two & Three must be done WITHOUT the use of CALCULATORS.

Introduction

* Our number system is a Decimal System, so we use the following ten digits to make up all our numbers:
  0, 1, 2, 3, 4, 5, 6, 7, 8, 9
* When a number (or part of a number) is less than one we use a Decimal Point.

  **Example:** 76543.21 is:
  7 ten thousands, 6 thousands, 5 hundreds, 4 tens, 3 units • 2 tenths, 1 hundredth...

Exercises:

1. What does the digit 3 represent in these numbers?
   a) 23.45
   b) 328.67
   c) 560.36
   d) 23 466.82
   e) 84.503

2. Write these numbers out in digits:
   a) 4 thousands, 8 hundreds, 1 ten, 6 units
   b) 8 hundreds, 0 tens, 9 units • 4 tenths, 2 hundredths

3. Write these numbers out in words:
   a) 2 463 790
   b) 6 372.38
3.1 Common Decimals

Exercises:

1. Choose the two equivalent decimals in each set:
   a) 0.02 0.2 0.20
   b) 3.070 3.70 3.07
   c) 8.0 0.8 8
   d) 0.101 0.010 0.0100

2. Which of the numbers in each set is between 2.7 and 5.4?
   a) 1.3 9.2 4.3
   b) 2.8 5.6 1.9
   c) 8.02 3.9 2.65
   d) 2.03 5.041 3.001

3. Arrange from largest to smallest:
   a) 0.06 0.6 0.006
   b) 0.015 0.51 0.501
   c) 1.07 1.7 1.007
   d) 2.22 2.022 2.202

4. Find:
   a) 1.8 + 9.3 – 2.2 =
   b) 2.15 x 1.7 =
   c) 0.0012 x 100 =
   d) 0.09 – 0.5 =
3.2 Decimals to Fractions

Exercises:

1. Express as a fraction in simplest terms:
   a) 0.8
   b) 0.26
   c) 0.65
   d) 0.04
   e) 0.87

2. Express as a mixed number in its simplest terms:
   a) 1.8
   b) 2.25
   c) 5.85
   d) 4.22
   e) 12.35

3. Which of the three fractions in the bracket is equivalent to the decimal in its lowest terms?
   a) 0.5 (1/2 5/2 5/100)
   b) 0.55 (55/100 11/10 11/20)
   c) 0.24 (12/50 24/10 6/25)
   d) 0.37 (37/10 37/100 37/1000)
3.3 Fractions to decimals

Exercises:

1. Express as a decimal:
   a) $\frac{9}{1000} = $

   b) $\frac{1}{10} + \frac{7}{100} = $

   c) $\frac{3}{10} + \frac{2}{1000} + \frac{1}{1000} = $

   d) $2 \frac{1}{2} + \frac{1}{4} = $

2. Change each fraction to a decimal:
   a) $\frac{3}{5} = $

   b) $\frac{7}{20} = $

   c) $\frac{28}{100} = $

   d) $\frac{21}{4} = $

   e) $\frac{710}{1000} = $
Skills & Application Task #1
(approx. 30 min.)
Skills & Application Task #1

NAME: ____________________________

Answer questions in the space provided and show all working out where required.
Use of Calculators is not allowed
Time allowance is 30 minutes.
TOTAL MARKS =

Exercises:

1. a) \(234 + 666\)  
b) \(3257 - 302\)  
c) \(228 \times 16\)  
d) \(8232 \div 6\)

2. These questions are about order of operations – BODMAS. Are there some operations you should do before others?
   a) \(5 \times 2 + 3 - 8 \div 2\)  
b) \(4 \times 6 - (7 - 1) \times 3\)  
c) \((4 + 3) \times 6 \div 3 - 1\)

3. a) \(\frac{1}{4} + \frac{3}{8}\)  
b) \(\frac{2}{5} - \frac{1}{4}\)  
c) \(\frac{3}{8} \times \frac{2}{9}\)  
d) \(\frac{2}{5} \div \frac{2}{3}\)

4. a) \(\frac{2}{5} \times \frac{5}{7} - \frac{1}{14}\)  
b) \(\frac{8}{3} \div \frac{16}{3} + \frac{29}{60}\)

5. Convert these improper fractions into mixed numbers:
   a) \(\frac{5}{3}\)  
b) \(\frac{15}{4}\)  
c) \(\frac{56}{64}\)

6. Arrange these numbers from smallest to largest:
7. Convert these decimals into Mixed Numbers in simplest terms:
   a) 1.5  b) 1.8  c) 3.55

8. Change each fraction to a decimal:
   a) $\frac{5}{20}$  b) $\frac{27}{100}$  c) $\frac{21}{5}$

9. Write these numbers out in digits:
   a) 5 thousand, 2 hundred, 6 units
   b) 8 hundred, 9 tens, 3 units 3 tenths, 3 thousandths

10. Complete this table:

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<th>Example</th>
<th>Thousands</th>
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<th>Tens</th>
<th>Units</th>
<th>Tens</th>
<th>Hundredths</th>
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<td>.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Unit Four: Measurement

Introduction

There are many different types of measurement in the work place. Length, Perimeter, Area, Volume & Surface area are basic quantities that need to be calculated in most Industrial situations. As you branch out into Industry Applications next term, you may be required to learn some more specific measurement quantities.

4.1 Length

Length is measured in many different units depending on relative size. It would be pointless using millimetres (mm) to describe the distance from Adelaide to Melbourne or metres (m) to describe the size of a postage stamp. In most industrial situations, we measure length in mm.

Exercises:

Convert the following lengths:

- a) 25000m to ___________ km
- b) 1.2m to ___________ cm
- c) 320dm to ___________ m
- d) 122mm to ___________ cm
- e) 120mm to ___________ m
- f) 120m to ___________ km

4.2 Perimeter

Perimeter is the length of all the sides added together or the total distance around the outside edge of a shape. Its units are the same as for Length.

eg. square 20mm

\[ \text{Perimeter} = 80 \text{ mm} \]

eg. rectangle 50mm x 10mm

\[ \text{Perimeter} = 120 \text{ mm} \]
Exercises:

1. Calculate the Perimeter of the following shapes in mm.: Remember to use the same unit for each side length!

   a) ![Square with sides 40mm](image1)
   b) ![Rectangle with sides 8mm, 35mm](image2)
   c) ![Rectangle with sides 1.2cm, 18mm](image3)
   d) ![Triangle with sides 3.6cm](image4)
   e) ![Triangle with sides 4.6cm, 30mm, 30mm](image5)
   f) ![Irregular shape with sides 1cm, 0.5mm](image6)

2. Calculate the perimeter of the follow shapes without the use of a diagram:

   a) a square with sides of 1.3 m.

   b) a rectangle with one side of 22 cm, and another of 44 cm.

   c) an equilateral triangle with a side of 1.52 m.

   d) a hexagon (six sides) with a side of 25 mm.
### 4.3 Area

When calculating the area of flat objects, we need to apply a **Formula** which is specific to that shape. The units for area are always squared eg. mm$^2$.

- For a square, Area($A$) is equal to length($l$) times breadth($b$)

  The formula is $A = l \times b$

  ![Square Diagram](image)

  eg. $A = 6 \times 6 = 36$ mm$^2$

- For a rectangle it is the same, Area($A$) is equal to length($l$) times breadth($b$)

  The formula is $A = l \times b$

  ![Rectangle Diagram](image)

  $A = 7 \times 5 = 35$ mm$^2$

- For a circle, Area($A$) is equal to a constant called pi ($\pi$) times radius squared ($r^2$)

  The formula is $A = \pi \times r^2$  
  ( $\pi = 3.14$ and is a constant)

  ![Circle Diagram](image)

  $A = 3.14 \times 4 = 12.56$ mm$^2$

- For a triangle, Area($A$) is equal to breadth($b$) times vertical height($h$) divided by 2

  The formula is $A = \frac{b \times h}{2}$

  ![Triangle Diagram](image)

  eg. $A = \frac{7 \times 4}{2} = 14$ mm$^2$
Exercises:

1. Calculate the area of the following shapes:

   a) 
   
   b) 
   
   c) 
   
   d) 
   
   e) 
   
   f) 
   
   g) 
   
   h) 
   
   i) 
   
   j)
4.4 Volume

When calculating the volume (V) of 3 dimensional shapes, once again we must apply a Formula. The units for volume are always cubed ie. mm³, m³, cm³.

Here are the Formulae to use:

- **Cube:** \( V = l^3 \)
- **Rectangular Prism:** \( V = l \times b \times h \)
- **Triangular Prism:** \( V = \frac{l \times b \times h}{2} \)
- **Sphere:** \( V = \frac{4 \times \pi \times r^3}{3} \)

Exercises:

1. Calculate the volume of the following shapes:

   a) [Cube]

   b) [Rectangular Prism]
Exercise applying these ideas:

1. a) Imagine you have just won cross-lotto and decide to put in a swimming pool and diving platform. The pool is going to be 30m long and 10m wide. The pool will be a uniform 2m deep for the first \( \frac{2}{3} \) of its length, while the last \( \frac{1}{3} \) will be 5m deep to accommodate diving. Given that 1m\(^3\) is equal to 1000L, what is the capacity (in Litres) of the pool? Draw a scaled diagram below and show all calculations.

b) How much more water would you need to add if the pool was a uniform 5m deep all the way? (show workings)

c) Do you think it would be necessary to make it all 5m deep? Explain your answer.
DIRECTED INVESTIGATION #1

(approx. 120 min.)
Directed Investigation #1

NAME: ____________________________

DUFF BEER! What’s all the fuss about?

TOPIC: Measurement

A completed directed investigation should include:
- an introduction that demonstrates an understanding of the features of the problem or situation investigated;
- evidence that instructions have been followed;
- appropriate representation of information gathered or produced, calculations, and results;
- a summary of results or findings and conclusions drawn.

Your report should be structured to include:
- Introduction
- Mathematical Investigation
- Analysis/Discussion
- Conclusion

Note: Your report should be written in the form “The analysis ……” rather than “When I analysed……”, or “When you analyse…….”

Performance will be assessed on the extent to which the following are demonstrated:
- Mathematical skills and understandings (without electronic technology)
- Mathematical skills and understandings (with electronic technology)
- Analysis and interpretation of results and information
- The communication of mathematical information
- The organisation and presentation of material
- The ability to work independently

Introduction

Back in the early 1990’s a local South Australian brewing company used as a promotional exercise, the “DUFF” beer logo, as seen on the popular cartoon sitcom “The Simpsons”. Legal action soon followed as it was claimed that copyright had been breached. The cans were immediately withdrawn from sale and destroyed. However, some still survive and because of their rarity have become collectors’ items, which often sell for upwards of $150 a can!!!

A company has now been granted copyright, and production of the new “DUFF BEER” is about to begin. The cans are imported from the U.S. and filled in Australia. The production manager is in charge of packaging, and must solve the following problems…Doh!!!!
Solving the Problem

\[ V_{(cylinder)} = \pi r^2 h \]

1. For the above can calculate the area of the base of the can.

2. Calculate the volume of the can in cubic millimetres.

3. Calculate the volume of the can in millilitres.

4. a) It is decided that the cans will be packed in lots of 36. Design and draw a scale diagram (use a graphic design program if possible) of a carton which best holds the cans.

   b) Explain why we don’t tend to sell cartons of beer with 36 cans in them.

5. The carton is to be made from cardboard. Calculate the area of cardboard required for the carton. Assume there is no overlap of cardboard.

6. Calculate the total mass of 12 filled cartons of product, given 1L of product weighs 0.65kg and each empty can weighs 45g. (NOTE: The cardboard carton itself weighs 300g).

7. Find an empty old beer can of some sort. Record its name and volume of contents. Now measure its dimensions and determine what volume it could hold.

   a) Was the can originally full of product?...Explain the findings.

   b) Go through the same process as in question 4 and design a carton to hold 36 of these cans.
Unit Five: Formulae

Introduction

You have already been using Formulae in Topic 4 so don’t panic!

Once you have a formula all you need to do is “plug in” or substitute for the variables and work out the answer.

In this course you will be given formulae with each test or assignment you do. It is very important to remember that some trade tests may require you to memorise formulae. It is in your best interest to clarify this before undergoing any assessment…

5.1 Pythagoras Theorem

Pythagoras was an ancient Mathematician who invented a formula to find the length of any side of a right (90°) angled triangle, provided the lengths of the other two sides are known. This theorem is the basis of many calculations, and is used widely in the building trade.

The theorem states that in any right-angled triangle the square of the hypotenuse is equal to the sum of the squares on the other two sides.

NOTE: the hypotenuse is always the longest side which is opposite the right angle and is given the letter c.

\[ c^2 = a^2 + b^2 \]

eg. using the following; (a = 3 cm and b = 4 cm)

\[ c^2 = 3^2 + 4^2 \]
\[ c^2 = 9 + 16 \]
\[ \sqrt{c^2} = \sqrt{25} \]
thus; \[ c = 5 \text{ cm} \]

If you are trying to find one of the other sides, then the formula can be manipulated or rearranged to give the following:

\[ a^2 = c^2 - b^2 \quad or \quad b^2 = c^2 - a^2 \]
eg. Suppose \( b = 8 \text{ mm} \) and \( c = 10 \text{ mm} \)

\[
a^2 = 10^2 - 8^2
\]

\[
a^2 = 100 - 64
\]

\[
a^2 = 36
\]

thus; \( a = 6 \text{ mm} \)

**Exercises:**
Calculate the length of the unknown side (rounded to 2 decimal places) for each of these right-angled triangles:

- **a)**
  - \( 3 \text{ m} \)
  - \( 4 \text{ m} \)

- **b)**
  - \( 12 \text{ cm} \)
  - \( 16 \text{ cm} \)

- **c)**
  - \( 15 \text{ mm} \)
  - \( 20 \text{ mm} \)

- **d)**
  - \( 8 \text{ cm} \)
  - \( 14 \text{ cm} \)

- **e)**
  - \( 8 \text{ mm} \)
  - \( 5 \text{ mm} \)

- **f)**
  - \( 82 \text{ mm} \)
  - \( 146 \text{ mm} \)
5.2 Using Formulae

There are many types of formulae used in industry every day. A painter needs to know the area of a wall, a plumber needs to know what angles of pipe he needs, an engineer needs to know the density of metals etc.

There is just no getting away from Formulae !!!!!

We will look at some of the more common formulae, and do some calculations. In the second part of this unit you will start using these in real work site situations.

Surface Area (S.A.)

\[ S.A. = 2 (LB + LH + BH) \quad \text{for a Rectangular prism.} \]

\[ S.A. = 4 \pi r^2 \quad \text{for a sphere.} \]

** Remember \((\pi = 3.14)\)

Temperature (T)

\( \text{NB Here TF means Temperature in degrees Fahrenheit and TC means temperature in degrees Celsius} \)

\[ TF = \frac{9}{5} \times TC + 32 \quad \text{(changing from Celsius to Fahrenheit)} \]

\[ TC = \frac{5}{9} \times (TF - 32) \quad \text{(changing from Fahrenheit to Celsius)} \]

Density (D)

\[ D = \frac{\text{Mass}}{\text{Volume}} \]

Speed (S)

\[ S = \frac{\text{Distance}}{\text{Time}} \]
In all cases it is important to specify the correct units on your final answer. The exercises on the next page will give you the units but in test situations you will need to work them out...marks are awarded for correct units!!!

Exercises:

1) Find the Surface Area of the following 3 dimensional shapes:
   a) rectangular prism (in cm\(^2\))
   b) sphere (in m\(^2\))
   H = 12 cm  
   B = 15 cm
   L = 26 cm
   r = 2.6 m

2) Do the following conversions from degrees Celsius to degrees Fahrenheit:
   a) 38°C (in °F)
   b) -5°C (in °F)

3) Calculate the density of the following substances:
   a) (in kg/m\(^3\))
   b) (in gm/cm\(^3\))
   mass = 500 kg
   volume = 2.5 m\(^3\)
   mass = 40 gm
   volume = 0.8 cm\(^3\)

4) Calculate the speed of the following:
   a) distance = 42 km
   time = 2 h
   (in km/h)
   b) distance = 100 m
   t = 9.78 s
   (in m/s)

Well that’s the end of standard stuff that you all have to do now its time for you to begin your Industry Specific Applications.....good luck!!!
Skills & Application Task #2
(approx. 30 min.)
Skills & Application Task #2  

NAME:_____________________________

Answer questions in the space provided and show all working out where required. 
Use of Calculators is not allowed 
Time allowance is 30 minutes. 
TOTAL MARKS =

USEFUL FORMULAE

A(square) = L x B  
V(cube) = L^3 

Pythagoras  

\[ c^2 = a^2 + b^2 \]

A(rectangle) = L x B  
V(rect. prism) = L x B x H 
S.A.(rect.prism) = 2(LB+LH+BH)

A(circle) = \pi x r^2  
V(triangular prism) = L x \frac{B x H}{2} 
S.A.(sphere) = 4\pi r^2

A(triangle) = \frac{B x H}{2}  
V(sphere) = \frac{4 \times \pi \times r^3}{3} 
\pi = 3.14

Exercises:

1. Convert the following quantities:
   a) 2.5 km to m….._______________________________
   b) 1.2 m to cm……______________________________
   c) 450 g to kg…….______________________________
   d) 12 minutes to seconds…________________________
   e) 2375mm to m…..______________________________

2. Calculate the Perimeter of the following shapes in mm:
   a) 
      \begin{figure}[h]
      \centering
      \begin{tikzpicture}
      \draw (0,0) -- (5,0) -- (5,5) -- (0,5) -- cycle;
      \node at (2.5,0.5) {5mm};
      \node at (2.5,4.5) {5mm};
      \end{tikzpicture}
      \end{figure}
   b) 
      \begin{figure}[h]
      \centering
      \begin{tikzpicture}
      \draw (0,0) -- (8,0) -- (8,22) -- (0,22) -- cycle;
      \node at (4,0.5) {8mm};
      \node at (4,20.5) {22mm};
      \end{tikzpicture}
      \end{figure}
   c) 
      \begin{figure}[h]
      \centering
      \begin{tikzpicture}
      \draw (0,0) -- (18,0) -- (18,0.1) -- (0,0.1) -- cycle;
      \node at (9,0.05) {18mm};
      \node at (9,0.05) {0.1cm};
      \end{tikzpicture}
      \end{figure}
   d) 
      \begin{figure}[h]
      \centering
      \begin{tikzpicture}
      \draw (0,0) -- (8.6,8.6) -- (0,8.6) -- cycle;
      \node at (4,0) {8.6cm};
      \node at (4,8.6) {8.6cm};
      \node at (0,4.3) {8.6cm};
      \end{tikzpicture}
      \end{figure}
3. Draw and calculate the Perimeter of the following shapes:
   a) A rectangle with one side of 33cm and another of 22cm
   b) A square with sides of 10.25m

4. Calculate the Area of the following shapes (correct to 2 decimal places):
   a) 
   b) 
   c) 
   d) 

5. Calculate the following:
   a) Volume (V) of this rectangular prism (correct to 2 decimal places)
b) Surface Area (S.A.) of this sphere (correct to 2 decimal places)…

6. Use Pythagoras Theorem to find the length of the Unknown side (to 2 decimal places)

a)

\[
\begin{array}{c}
9m \\
?m \\
16m
\end{array}
\]

b)

\[
\begin{array}{c}
9mm \\
?mm \\
34.7mm
\end{array}
\]
ANSWERS

Unit One: Number Skills

Addition
1) 95  2) 187  3) 1 139  4) 8 855  5) 3 348  6) 2 122  
7) 115 371  8) 4 522  9) 1 212 021

Subtraction
1) 81  2) 65  3) 309  4) 6 849  5) 388  6) 608  
7) 821  8) 146  9) 283 307  10) 808 899

Multiplication
1) 588  2) 1 890  3) 16 192  4) 439 602  5) 223 635 412

Division
1) 1 372  2) 430  3) 6 093

Order of Operations
1) 22  2) 12  3) 10  4) –5  5) 8

Unit Two: Fractions

Common Fractions
1. a) \( \frac{3}{4} \)  b) \( \frac{5}{8} \)  c) \( \frac{17}{20} \)  d) \( \frac{29}{32} \)
2. a) \( \frac{4}{7} \)  b) \( \frac{11}{16} \)  c) \( \frac{11}{20} \)  d) \( \frac{2}{9} \)
3. a) \( \frac{14}{25} \)  b) \( \frac{1}{6} \)  c) \( \frac{16}{45} \)  d) \( \frac{2}{77} \)
4. a) \( \frac{3}{2} \)  b) \( \frac{1}{2} \)  c) \( \frac{11}{7} \)  d) \( \frac{41}{2} \)
5. a) \( \frac{1 \frac{1}{2}}{12} \)  b) \( \frac{1}{12} \)  c) 0  d) \( \frac{9}{10} \)

Improper Fractions
a) \( \frac{1 \frac{2}{5}}{5} \)  b) \( \frac{1 \frac{1}{4}}{4} \)  c) \( \frac{1 \frac{13}{32}}{32} \)  d) \( \frac{3 \frac{1}{32}}{32} \)

Equivalent Fractions
a) \( \frac{3}{4} \)  b) \( \frac{15}{16} \)  c) \( \frac{7}{8} \)  d) \( \frac{3}{4} \)

Mixed Numbers
a) \( \frac{5}{4} \)  b) \( \frac{43}{8} \)  c) \( \frac{47}{32} \)  d) \( \frac{39}{8} \)
Unit Three: Decimals

1. a) Three units. b) Three hundreds. c) Three tenths. d) Three thousands e) Three thousandths.

2. a) 4.816   b) 809.42

3. a) 2 millions, 4 hundred thousands, 6 ten thousands, 3 thousands, 7 hundreds, 9 tens, 0 units.  
    b) 6 thousands, 3 hundreds, 7 tens, 2 units , 3 tenths, 8 hundredths.

Common Decimals

1. a) 0.2 & 0.20  b) 3.070 & 3.07  c) 8.0 & 8  d) 0.010 & 0.0100

2. a) 4.3  
    b) 2.8 
    c) 3.9  
    d) 5.041 & 3.001

3. a) 0.6, 0.06, 0.006 
    b) 0.51, 0.501, 0.015 
    c) 8.02, 3.9, 2.65

4. a) 8.9  
    b) 3.655 
    c) 0.12  
    d) –0.41

Decimals to Fractions

1. a) \( \frac{4}{5} \)  
    b) \( \frac{13}{50} \)  
    c) \( \frac{13}{20} \)  
    d) \( \frac{1}{25} \)  
    e) \( \frac{87}{100} \)

2. a) \( \frac{14}{5} \)  
    b) \( \frac{2}{4} \)  
    c) \( \frac{5}{20} \)  
    d) \( \frac{11}{50} \)  
    e) \( \frac{12}{20} \)

3. a) \( \frac{1}{2} \)  
    b) 11/20  
    c) 6/25  
    d) 37/100

Fractions to Decimals

1. a) 0.009  
    b) 0.17  
    c) 3.201  
    d) 2.75

2. a) 0.6  
    b) 0.35  
    c) 0.28  
    d) 5.25  
    e) 0.71

Unit Four: Measurement

Length

a) 25 km  
    b) 120 cm  
    c) 32 m  
    d) 12.2 cm  
    e) 0.12 m  
    f) 0.12 km

Perimeter

1. a) 160 mm  
    b) 86 mm  
    c) 6 cm  
    d) 10.8 cm  
    e) 10.6 cm  
    f) 2.1 cm.

2. a) 5.2 m  
    b) 132 cm  
    c) 4.56 m  
    d) 150mm

Area

a) 324 mm²  
    b) 1.5 cm²  
    c) 1.44 m²  
    d) 6.1544 m²  
    e) 51.7 m²

f) 4 km²  
    g) 2 289.06 cm²  
    h) 0.04 m²

Volume

a) 1 000 cm³  
    b) 180 m³  
    c) 3 m³  
    d) 1 766.25 mm³

Unit Five: Formulae

Pythagoras Theorem

a) 5 m  
    b) 20 cm  
    c) 13.23 mm  
    d) 11.49 m  
    e) 9.43 mm

f) 120.8 m
Using Formulae

1.  
   a)  1764 cm\(^2\)  
   b)  84.91 m\(^2\)

2.  
   a)  100.4° F  
   b)  23° F

3.  
   a)  200 kg/m\(^3\)  
   b)  50 gm/cm\(^3\)

4.  
   a)  21 km/h  
   b)  10.22 m/s

Problem: 

1.  
   a)  900 000L  
   b)  add another 600 000L  
   c)  Not necessary .. various answers …
Industry skills Mathematics

I can work independently and am confident that I can complete the following calculations:

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<th>#</th>
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<th>Tick</th>
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Industry Specific Applications

I can work independently and am confident that I understand the following concepts:

<table>
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</table>
There will be a number of formative and summative assignments throughout this section. The nature of these tasks will vary depending on which of the four industry pathways you have chosen. Tasks and assessment items will reflect actual work site practices wherever possible.

* IMPORTANT NOTE TO SCHOOLS/TUTORS *

The use of Electronic Technology is an essential component of this unit. Due to the extreme variation in computer facilities & availability, it is the responsibility of individual institutions to best incorporate this technology into their program and to adjust the assessment plan accordingly.

INDUSTRY SPECIFIC APPLICATIONS (Section 2)

(Select one section which should take approximately 8 weeks to complete)
AUTOMOTIVE ENGINEERING

Topic One: General Reasoning (15.7)
Topic Two: Measurement & Conversion (2.1)
Topic Three: Costings (1.1,1.3)
Directed Investigation #2 (approx. 120 min.)
Project (approx. 180 min.)
Topic Four: Percentage & Ratios (2.3,2.6)
Topic Five: Tables & Graphs (12.3,12.4,12.6)
Skills & Application Task #3 (approx. 60min.)

OR

DOORWAYS TO CONSTRUCTION

Topic one: Measurement, shapes & Formulae (2.1,2.2,2.5,2.6)
Topic Two: Conversions (2.1)
Topic Three: Costings (1.1,1.3,2.5,2.6)
Directed Investigation #2 (approx. 120 min.)
Project (approx. 180 min.)
Topic Four: Percentage & Ratios (2.3,2.6)
Topic Five: Trigonometry (8.2)
Skills & Application Task #3 (approx. 60min.)

OR

ELECTRICAL TECHNOLOGY

Topic One: Manipulating Equations (15.4)
Topic Two: Trigonometry (8.1,8.2)
Topic Three: Percentage (2.3,2.6)
Directed Investigation #2 (approx. 120 min.)
Project (approx. 180 min.)
Topic Four: Scientific Notation (2.4,2.7)
Topic Five: Basic Electrical (15.6)
Skills & Application Task #3 (approx. 60min.)

OR

ENGINEERING

Topic One: Manipulating Formula & Equations (2.1,2.2,2.3,2.4,15.4)
Topic Two: Trigonometry (8.1,8.2)
Topic Three: Percentage & Ratios (2.3,2.6)
Directed Investigation #2 (approx. 120 min.)
Project (approx. 180 min.)
Topic Four: Algebra (15.5)
Topic Five: Tables & Graphs (12.3,12.4,12.6)
Skills & Application Task #3 (approx. 60min.)
AUTOMOTIVE ENGINEERING

SACE STAGE 1 : SECTION 2
AUTOMOTIVE ENGINEERING  (Section 2)

Unit One:  General Reasoning (15.7)

Unit Two:  Measurement & Conversion (2.1)

Unit Three:  Costings (1.1,1.3)

Unit Four:  Percentage & Ratios (2.3,2.6)

Unit Five:  Tables & Graphs (12.3,12.4,12.6)
Unit One: General Reasoning

Introduction

In the Automotive trade we are constantly required to follow sequences, whether it be to assemble an entire motor or work on a production line. Often we are presented with problems that require general or automotive reasoning to solve. The following exercises are from an old trade school aptitude test, and will hopefully give you some insight into possible General Ability type questions.

Here is a set of 4 example questions demonstrating how to fill in the answers.

Example 1. Find the next letter in the series:

P Q R S T
(1) V (2) U (3) X (4) R (5) W

The letters follow one another in alphabetical order, so the next letter in the series is U.

Example 2. Find the next number in the series:

11 9 7 5 3
(A) 4 (B) 2 (C) 6 (D) 1 (E) 0

The numbers are decreasing by 2 so the next number in the series would be 1.

Now work through examples 3, 4 and 5 for practice.

Example 3. In a certain code CNF means DOG. In the same code what does BNV mean?

(1) ACT (2) ANT (3) CAT (4) VAN
(5) COW

In this code each letter is changed to the next letter of the alphabet so that B becomes C, N becomes O, and V becomes W. BNV means COW.

Example 4.

The big circle is followed by a small circle, so the big square is followed by a small square.

The small square is answer number 4.
Answers:

Shade in the correct answers to questions 1-29 on the following page.

1. In a certain code ELIN means LINE. In the same code what does THEA mean?
   (A) AEJR  (B) HATE  (C) HEAT  (D) ATHE  (E) HEAR

2. IS TO AS IS TO

3. Find the next number in the series:
   5  12  18  23  27
   (A) 32  (B) 30  (C) 31  (D) 24  (E) 34

4. Find the next group of letters in the series:
   TL  UN  VP  WR
   (A) XS  (B) ZT  (C) XT  (D) YT  (E) TY

5. What shape comes next in the following series?

6. Find the next letter in the series:
   A  G  M  S  Y  E
   (A) J  (B) M  (C) Z  (D) K  (E) I

7. What shape comes next in the following series?
8. Find the next number in the series:
   256  64  16  4
   (A) 0  (B) 16  (C) -16  (D) 2  (E) 1

9. IS TO AS IS TO
   1  2  3  4  5

10. Find the next number in the series:
    33  32  30  27  23
    (A) 19  (B) 21  (C) 22  (D) 20  (E) 18

11. Find the next number in the series:
    7  8  10  13  17
    (A) 22  (B) 20  (C) 23  (D) 19  (E) 21

12. What shape comes next in the following series?

13. Find the next group of letters in the series:
    CYC  DAB  ECA  FEZ  GGY
    (1) HHX  (2) HJY  (3) HGX  (4) HIJ  (5) HIX

14. IS TO AS IS TO
    1  2  3  4  5

15. Find the next number in the series:
    1  3  2  3  5  4  5  7
    (A) 9  (B) 6  (C) 7  (D) 8  (E) 5

16. What shape comes next in the following series?

17. Find the next number in the series:
    7  13  8  12  9
    (A) 11  (B) 7  (C) 15  (D) 13  (E) 14

18. In a certain code DYLA is written LADY. In the same code how would the word EROV be written?
19. Find the next group of letters in the series:
   EJ  FG  GD  HA
   (1) IY  (2) IN  (3) IX  (4) IT  (5) IM

20. dkhakghpd

21. Find the next group of letters in the series:
   FGI  JKM  NOQ  RSU
   (1) WXZ  (2) VWX  (3) VWY  (4) VXY  (5) VWZ

22. In a certain code TIPF means SHOE. In the same code, what does NBUF mean?
   (1) OATE  (2) MUTE  (3) MANE  (4) OCVG  (5) MATE

23. Find the next letter in the series:
   H  I  J  J  K  L  M  M  N  O
   (1) Q  (2) P  (3) R  (4) T  (5) O

24. Find the next number in the series:
   93  73  75  55  57
   (A) 35  (B) 59  (C) 37  (D) 77  (E) 39

25. dkgaghhkd

26. Find the next group of letters in the series:
   AY  AZ  ZA  ZB  YC
   (1) XD  (2) YB  (3) CY  (4) XC  (5) YD

27. In a certain code DOUN means UNDO. In the same code, what does IDAV mean?
   (1) ADIV  (2) VADI  (3) AVID  (4) VAID  (5) DIVA

28. dhga;ghdg

29. In a certain code SVH means RUG. In the same code, what does NBU mean?
   (1) OAT  (2) PAT  (3) MAT  (4) HAT  (5) BAT
Fill in your responses to questions 1-26.
Check results in the answers section.
Unit Two: Measurement & Conversion

Introduction

Measurement is an extremely important part of any automotive career. Spark plug gaps, dwell angles, cylinder bore and compression rating etc. are just some examples of the various types of measurement used every day in the work place.

Here are some Formulae that are in commonly use :

\[
\text{Density (D)} = \frac{\text{Mass (kg)}}{\text{Volume (m}^3)} \quad \text{the unit is kg/m}^3
\]

\[
\text{Velocity (V)} = \frac{\text{Distance (km)}}{\text{Time (hrs)}} \quad \text{the unit is km/h}
\]

\[
\text{Acceleration (A)} = \frac{\text{Change in velocity (m/s)}}{\text{Time taken (s)}} \quad \text{the unit is m/s}^2
\]

\[
\text{Force (F)} = \text{Mass (kg)} \times \text{Acceleration (m/s}^2) \quad \text{the unit is kg.m/s}^2 \quad \text{or} \quad \text{N (newton)}
\]

\[
\text{Pressure (P)} = \frac{\text{Force (N)}}{\text{Area (m}^2)} \quad \text{the unit is N/m}^2 \quad \text{or} \quad \text{Pa (pascal)}
\]

** It is important to remember that if any of the quantities vary, so do the units **

eg. Velocity = \(\frac{100 \text{ (m)}}{9.8 \text{ (sec)}}\) = 10.2 m/s

Exercises:

1. Calculate the density of a 236.5 gm mass that has a volume of 12 cm\(^3\) (to 2 decimal places).

2. Calculate how many seconds there are in 2 days 8 hours and 34 minutes.
3. Calculate the velocity of an object which covers 420 m in 0.35 seconds. (to 1 decimal place)

4. Calculate the pressure if a force of 30 N is applied over an area of 1.5 m².

When using these measurements, it is important to remember that some countries still use the old fashioned Imperial System and others use the newer Metric System. Parts, instruments and machinery will use one (or if you are lucky, both) of these systems. Automotive trade personnel must be well versed in conversions from one form to another.

The most widely used conversion would be from inches to millimetres. This can be calculated using the fact that 1 inch is equal to 25.4mm or (as is more commonly done) looked up in a table. Another useful conversion is that of pressure from psi (pounds per square inch) to Pa (Pascals), which can also be found in tabular form.

**Exercises:**
(refer to Tables 1 - 4 following)

5. Referring to Table 1, convert the following Imperial dimensions to metric.
   a. 0.034” =
   b. 0.461” =

6. Referring to Table 2, convert the following metric dimensions to Imperial.
   a. 0.025mm =
   b. 18.32mm =

7. Referring to Table 3, select a preferred tapping drill size for the following metric screw threads.
   a. M6 x 1 =
   b. M10 x 1.25 =

8. Referring to Table 4, select a preferred tapping drill size and give the threads per inch (TPI) for the following Imperial screw threads.
   a. \(\frac{3}{16}\)” BSW Tapping drill size
   b. \(\frac{3}{4}\)” UNC Tapping drill size
   c. \(\frac{5}{16}\)” UNF Tapping drill size

\[
\begin{array}{ccc}
& \text{Tapping drill size} & \text{TPI} \\
\frac{3}{16} & \text{BSW} & \\
\frac{3}{4} & \text{UNC} & \text{TPI} \\
\frac{5}{16} & \text{UNF} & \text{TPI}
\end{array}
\]
## Reference Tables

### Table 1  Inches to Millimetres

| INCHES | 0.0000 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0070 | 0.0080 | 0.0090 | 0.0100 | 0.0110 | 0.0120 | 0.0130 | 0.0140 | 0.0150 | 0.0160 | 0.0170 | 0.0180 | 0.0190 | 0.0200 | 0.0210 | 0.0220 | 0.0230 | 0.0240 | 0.0250 | 0.0260 | 0.0270 | 0.0280 | 0.0290 | 0.0300 | 0.0310 | 0.0320 | 0.0330 | 0.0340 | 0.0350 | 0.0360 | 0.0370 | 0.0380 | 0.0390 | 0.0400 | 0.0410 | 0.0420 | 0.0430 | 0.0440 | 0.0450 | 0.0460 | 0.0470 | 0.0480 | 0.0490 | 0.0500 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
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Table 3  Metric Tapping Drill Sizes

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Metric ISO Coarse  
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Unit Three: Costings

Introduction

As previously mentioned, your costing of a job is as important as the work itself. Over quote and you won’t get the job, under quote and you don’t make any money!!!

In this Introductory exercise we have been asked to give a quote on the purchase and installation of a standard radiator using all new parts, hoses and coolant. We will use a Labour rate of $35.50/hr. Below is a list of the items needed with costing on single units only. Assume it will take you about 5 hours (or slightly less) to remove, install and test.

1 radiator $325/unit
2 large hoses $18.80/unit
1 small hose $12.65/unit
6 hose clamps $1.05/unit
1 thermostat $22.00/unit
7L coolant $2.50/L
8 stainless bolts $1.88/unit
1 radiator cap $11.00/unit

---

**Tom Shonky Motor Repairs**

Date: ________________ (valid for 60 days)

Quote made by: ________________

<table>
<thead>
<tr>
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<th>QUANTITY</th>
<th>and unit cost</th>
<th>COST ($)</th>
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<tr>
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</tr>
<tr>
<td>Hose clamp</td>
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<td>@ 1.05</td>
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<tr>
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<tr>
<td>Coolant</td>
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<td>@ 2.50L</td>
<td>17.50</td>
</tr>
<tr>
<td>Bolts</td>
<td>8</td>
<td>@ 1.88</td>
<td>15.04</td>
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<tr>
<td>Radiator cap</td>
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<tr>
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**TOTAL** $624.59

---

SA Independent Schools Targeted Programs Authority Inc Maths for Industry 2006 Automotive Engineering
Exercise:

Using the same hourly rate for labour, fill in and complete the following QUOTE.

1 starter motor  $800/unit
2 large hoses   $18.80/unit
1 small hose    $12.65/unit
6 hose clamps  $1.05/unit
8 spark plugs  $8.00/unit
8 graphite cables $16.50/unit
1 set of points $33.80/set
2 starter mounts $21.00/unit

Expected labour time is 8 hrs

---

**Tom Truthful Motor Repairs**

Date: _____________ (valid for 60 days)

Quote made by: ____________________.

<table>
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<tr>
<th>ITEM</th>
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<th>COST ($)</th>
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</thead>
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<td>8 graphite cables</td>
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<td></td>
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<tr>
<td>2 starter mounts</td>
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</table>

**TOTAL**

---

SA Independent Schools Targeted Programs Authority Inc  Maths for Industry 2006

Automotive Engineering  16
DIRECTED INVESTIGATION #2

(approx. 120 min.)
Directed Investigation #2

NAME: ________________________________

TASK

You are going to build a large garage around a pre-laid concrete slab for your new Crash Repair business. The diagram below shows the dimensions of the slab. It is rectangular with double sliding doors at the western end.

1. a) Find the distance around the garage.

   b) Find the floor area of the garage.

   c) Calculate the volume of the concrete used in the slab if it is 0.8m thick.

   d) Calculate the cost of the concrete if it is $880/25m³ truck load.

2. You want a security 1.8m “cyclone” fence built around the garage that is no closer than 5.5m to it. It must have a large 3m wide double gate that lines up with the garage doors.

   a) Draw a sketch illustrating your fence design.

   b) Calculate the cost of all materials for the enclosure based on a reliable source. Include details of any reliable source.

   c) You will need 8 bags of pre-mixed concrete at $11.50/bag to cement in the posts at 3m intervals. The double gate has a fixed cost of $960.00 Draw up a costing form similar to the one on the next page.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>Quantity</th>
<th>Unit cost</th>
<th>COST ($)</th>
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<td>Cement</td>
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<td>11.50</td>
<td>92.00</td>
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</table>

**TOTAL**
A suitable project will depend on the interests of your students, but some examples are available from The Mathematical Association of Mathematics Inc publication, '500 Mathematical Investigations for Stage 1 Mathematics SACE'.
A completed project should include:
- an introduction that outlines the problem to be explored, including its significance, its features, and the context;
- the method of solution in terms of the mathematical model or strategy to be used;
- the appropriate application of the mathematical model or strategy, including:
  - the generation or collection of relevant data and/or information, including details of the process of collection;
  - mathematical calculations and results, and appropriate representations;
  - the analysis and interpretation of results;
  - reference to the limitations of the original problem as well as appropriate refinements and/or extensions;
- a statement of the solution and outcome in the context of the original problem;
- appendices and bibliography as appropriate.

Your report should be structured to include:
- Introduction
- Mathematical Procedures
- Analysis/Discussion
- Conclusion

Note: Your report should be written in the form “The analysis …..” rather than “When I analysed……”, or “When you analyse…….”

Performance will be assessed on the extent to which the following are demonstrated:
- Mathematical skills and understandings (without electronic technology)
- Mathematical skills and understandings (with electronic technology)
- Analysis and interpretation of results and information
- The communication of mathematical information
- The organisation and presentation of material
- The ability to work independently

Introduction…
**Unit Four: Percentage & Ratios**

**Introduction**

Percentage is an important part of all Electrotechnology courses. We will look at how to calculate % and apply it to different situations.

Percentages can be written as decimals by simply dividing by 100

\[ \text{eg. } 25\% = \frac{25}{100} = 0.25 \quad \text{or } 6\% = \frac{6}{100} = 0.06 \]

even fractional %  \[ \text{eg. } 12\frac{1}{2}\% = \frac{12.5}{100} = 0.125 \]

so, to find 25% of $40 we just multiply it by 0.25  \[ \text{eg. } $40 \times 0.25 = $10 \]

**Exercises:**

1. a) 10% of 40kg  
   b) 35% of $80  
   c) 6\frac{1}{2}\% of 64L  
   d) 24% of $35.25  
   e) 2\frac{1}{4}\% of 80 000  
   f) 17% of 2km

2. If 52,400 Collingwood supporters went to the AFL grand final and 80% were intoxicated then how many were sober?

3. 75% of books in a book shop came under the heading General Fiction, 12% were Classics, 3% were Children’s Books and 10% Non-fiction. If there were 14 500 books in the shop, how many of each kind were there?
4. Work out the following, rounding to the nearest cent:
   a) 8% of $14.45  
   b) 42% of $364.90  
   c) 2¼% of $33.33  
   d) 24¼% of $567.88

5. When Eddie takes his annual leave he is paid one month’s salary of $12,500 plus 17½% loading (extra)
   a) How much is the loading?
   b) What is the total he receives?

6. Piper’s annual salary is $50,000. What is her weekly salary, correct to the nearest cent?

7. A big blue V8 car’s fuel consumption is 16.5 litres/100km. How much fuel is used on a journey of 900 km?

8. If Port Adelaide kicked 19.11 in a grand final against the Adelaide Crows 12.8, what percentage of Port’s score did the Crows kick? Remember 19.11 is not a decimal!
Ratios are very similar to Percentages in that they show us relative proportions. We constantly use ratios to make up things like concrete, mortar, fuel and even cakes!

Here is an example: Let’s say the mixing ratio for blue-dock concrete is 2 : 2 : 1 for cement, sand and stone. If we need to make up 5m³ of concrete, then we need:

2m³ cement : 2m³ sand : 1m³ stone.

It can become a little more difficult as the amount needed changes.

eg. say you need 3.5 m³.

step 1  add all the ratio proportions together… 2 + 2 + 1 = 5
step 2  divide the amount needed by the answer from step 1… \( \frac{3.5}{5} = 0.7 \)
step 3  finally multiply the individual proportions by the answer to step 2…

ie. 2 : 2 : 1

cement is 2 x 0.7 = 1.4m³
sand is 2 x 0.7 = 1.4m³
stone is 1 x 0.7 = 0.7m³

Exercises:

1. If 2.5m³ of a metal alloy needs to be produced by fusing together iron, tin and carbon in the ratio of 5 : 3 : 2. How many m³ of each is needed (round answers to 2 decimal places)?

Now look at this gearing example:

Gear ratio = \( \frac{\text{Teeth in driven gear}}{\text{Teeth in driving gear}} \) = \( \frac{30}{15} = 2:1 \)

**In this case, this is a reduction ratio, ie. driven gear rotates at half the speed of the driving gear.**

2. Calculate the ratio in its simplest form if the driving gear has 40 teeth and the driven gear has 20 teeth.
We can apply a similar concept to pulley systems and determine the Pulley Ratio.

\[
Pulley\ ratio = \frac{\text{Pitch} \ \text{Diameter of driven pulley}}{\text{Pitch} \ \text{Diameter of driver pulley}}
\]

or \[\frac{180}{360} = \frac{1}{2}\] This is an increasing ratio, as the driven pulley rotates at higher speed than the driver pulley.

3. If the driver pulley has a pitch of 50mm and the driven pulley has a pitch of 250mm, find the Pulley ratio. Is it an increasing or decreasing ratio? Explain.

4. Two gears are rotating at gear \#1 = 200 RPM, gear \#2 = 1400 RPM. Find the RPM ratio using the same technique.

5. Fill in the missing values in the table below:

<table>
<thead>
<tr>
<th>Driving pulley diameter</th>
<th>Driving pulley rpm</th>
<th>Driven pulley diameter</th>
<th>Driven pulley rpm</th>
<th>Driver/driven diameter ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) 60mm</td>
<td>450</td>
<td>18mm</td>
<td>1500</td>
<td>10:3</td>
</tr>
<tr>
<td>(b) 70mm</td>
<td></td>
<td></td>
<td>120</td>
<td>1:5</td>
</tr>
<tr>
<td>(c) 360mm</td>
<td>220</td>
<td></td>
<td></td>
<td>10:11</td>
</tr>
<tr>
<td>(d) mm</td>
<td></td>
<td>315mm</td>
<td>320</td>
<td>8:3</td>
</tr>
</tbody>
</table>
Unit Five: Tables & Graphs

Introduction

One of the most useful ways of presenting data is using either a table or graph. Much of industry now has computer technology and access to data is almost instantaneous. However, don’t be surprised to find workplaces that still refer to specification booklets with tables, charts and graphs. Extracting information such as melting points, cutting speeds, compression ratios and even imperial/metric conversions are common place. The following exercises are designed to assist you in developing these essential skills. Your tutor may provide you with computer based information at a later date.

TABLES

Exercises: (refer to the data found in the three tables at the back of this section)

Refer Table 1 to answer the following questions

1. Find:
   a) $15^2 =$   
   b) $77^2 =$   
   c) $9^3 =$   
   d) $34^3 =$  

2. Find $n$ if:
   a) $n^2 = 361$  
   b) $n^2 = 4489$  
   c) $n^3 = 493039$  

3. Calculate the following:
   a) $15^3 + 28^2 =$  
   b) $12^3 + 55^3 =$  
   c) $30^2 - 11^2 =$  

Refer Table 2 to answer the following questions

4. Convert the following metric dimensions to imperial:
   (eg. $0.012$mm = $0.01 + 0.002 = 0.0003937 + 0.0000787 = 0.0004724$)  
   a) $0.008$mm =  
   b) $1.5$mm =  
   c) $3.271$mm =
Refer Table 3 to answer the following questions

5. Select a preferred tapping drill size and give the threads per inch (TPI) for the following Imperial screw threads:

a) \( \frac{7}{32} \) BSW  
   Tapping drill size = TPI =

b) \( \frac{1}{4} \) UNC  
   Tapping drill size = TPI =

c) \( \frac{3}{8} \) UNF  
   Tapping drill size = TPI =

Table 5  Millimetres to Inches

<table>
<thead>
<tr>
<th>UNC</th>
<th>Tapping Drill mm</th>
<th>TPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (.099&quot;)</td>
<td>2.00</td>
<td>48</td>
</tr>
<tr>
<td>4 (.112&quot;)</td>
<td>2.25</td>
<td>40</td>
</tr>
<tr>
<td>5 (.125&quot;)</td>
<td>2.60</td>
<td>40</td>
</tr>
<tr>
<td>6 (.138&quot;)</td>
<td>2.75</td>
<td>32</td>
</tr>
<tr>
<td>8 (.164&quot;)</td>
<td>3.40</td>
<td>32</td>
</tr>
<tr>
<td>10 (.190&quot;)</td>
<td>3.30</td>
<td>24</td>
</tr>
<tr>
<td>12 (.216&quot;)</td>
<td>4.40</td>
<td>24</td>
</tr>
<tr>
<td>1/4</td>
<td>5.10</td>
<td>20</td>
</tr>
<tr>
<td>5/16</td>
<td>6.60</td>
<td>18</td>
</tr>
<tr>
<td>3/8</td>
<td>8.00</td>
<td>16</td>
</tr>
<tr>
<td>7/16</td>
<td>9.40</td>
<td>14</td>
</tr>
<tr>
<td>1/2</td>
<td>10.80</td>
<td>13</td>
</tr>
<tr>
<td>9/16</td>
<td>12.20</td>
<td>12</td>
</tr>
<tr>
<td>5/8</td>
<td>13.50</td>
<td>11</td>
</tr>
<tr>
<td>3/4</td>
<td>16.50</td>
<td>10</td>
</tr>
<tr>
<td>7/8</td>
<td>19.50</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>22.00</td>
<td>8</td>
</tr>
<tr>
<td>1 1/8</td>
<td>25.00</td>
<td>7</td>
</tr>
<tr>
<td>1 1/4</td>
<td>28.00</td>
<td>7</td>
</tr>
<tr>
<td>1 3/8</td>
<td>31.00</td>
<td>6</td>
</tr>
<tr>
<td>1 1/2</td>
<td>34.00</td>
<td>6</td>
</tr>
<tr>
<td>1 3/4</td>
<td>39.00</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>45.00</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNF</th>
<th>Tapping Drill mm</th>
<th>TPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (.099&quot;)</td>
<td>2.10</td>
<td>56</td>
</tr>
<tr>
<td>4 (.112&quot;)</td>
<td>2.35</td>
<td>48</td>
</tr>
<tr>
<td>5 (.125&quot;)</td>
<td>2.55</td>
<td>44</td>
</tr>
<tr>
<td>6 (.138&quot;)</td>
<td>2.90</td>
<td>40</td>
</tr>
<tr>
<td>8 (.164&quot;)</td>
<td>3.50</td>
<td>36</td>
</tr>
<tr>
<td>10 (.120&quot;)</td>
<td>4.10</td>
<td>32</td>
</tr>
<tr>
<td>12 (.216&quot;)</td>
<td>4.60</td>
<td>28</td>
</tr>
<tr>
<td>3/16</td>
<td>4.00</td>
<td>32</td>
</tr>
<tr>
<td>1/4</td>
<td>5.50</td>
<td>28</td>
</tr>
<tr>
<td>5/16</td>
<td>6.90</td>
<td>24</td>
</tr>
<tr>
<td>3/8</td>
<td>8.50</td>
<td>24</td>
</tr>
<tr>
<td>7/16</td>
<td>9.90</td>
<td>20</td>
</tr>
<tr>
<td>1/2</td>
<td>11.50</td>
<td>20</td>
</tr>
<tr>
<td>9/16</td>
<td>12.50</td>
<td>18</td>
</tr>
<tr>
<td>5/8</td>
<td>14.50</td>
<td>18</td>
</tr>
<tr>
<td>3/4</td>
<td>17.50</td>
<td>16</td>
</tr>
<tr>
<td>7/8</td>
<td>20.50</td>
<td>14</td>
</tr>
<tr>
<td>1</td>
<td>23.50</td>
<td>12</td>
</tr>
<tr>
<td>1 1/8</td>
<td>26.50</td>
<td>12</td>
</tr>
<tr>
<td>1 1/4</td>
<td>29.50</td>
<td>12</td>
</tr>
<tr>
<td>1 3/8</td>
<td>32.50</td>
<td>12</td>
</tr>
<tr>
<td>1 1/2</td>
<td>36.00</td>
<td>12</td>
</tr>
<tr>
<td>Nominal Diameter</td>
<td>TPI</td>
<td>Tapping Drill mm</td>
</tr>
<tr>
<td>------------------</td>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>3/32</td>
<td>48</td>
<td>1.90</td>
</tr>
<tr>
<td>1/8</td>
<td>40</td>
<td>2.55</td>
</tr>
<tr>
<td>5/32</td>
<td>32</td>
<td>3.20</td>
</tr>
<tr>
<td>3/16</td>
<td>24</td>
<td>3.70</td>
</tr>
<tr>
<td>7/32</td>
<td>24</td>
<td>4.50</td>
</tr>
<tr>
<td>1/4</td>
<td>20</td>
<td>5.10</td>
</tr>
<tr>
<td>5/16</td>
<td>18</td>
<td>6.50</td>
</tr>
<tr>
<td>3/8</td>
<td>16</td>
<td>8.00</td>
</tr>
<tr>
<td>7/16</td>
<td>14</td>
<td>9.30</td>
</tr>
<tr>
<td>1/2</td>
<td>12</td>
<td>10.50</td>
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<tr>
<td>9/16</td>
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<tr>
<td>5/8</td>
<td>11</td>
<td>13.50</td>
</tr>
<tr>
<td>3/4</td>
<td>10</td>
<td>16.50</td>
</tr>
<tr>
<td>7/8</td>
<td>9</td>
<td>19.50</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>22.00</td>
</tr>
<tr>
<td>1 1/8</td>
<td>7</td>
<td>25.00</td>
</tr>
<tr>
<td>1 1/4</td>
<td>7</td>
<td>28.00</td>
</tr>
<tr>
<td>1 1/2</td>
<td>6</td>
<td>34.00</td>
</tr>
<tr>
<td>1 3/4</td>
<td>5</td>
<td>39.00</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>45.00</td>
</tr>
</tbody>
</table>
Graphs

This is a column graph showing the number of apprentices employed by an Australian firm over a ten year period. Refer to this to answer the following questions.
From the graph determine:

1. The year when the lowest number of apprentices were employed:

2. The approximate increase in numbers of new apprentices gaining employment in 1990 compared to 1989:

3. The twelve-month period which showed the greatest decrease in apprentice employment:

4. The year of highest apprentice employment

An internal combustion engine undergoing a dynamometer test for braking power (kW), produced the following results:

<table>
<thead>
<tr>
<th>RPM</th>
<th>1400</th>
<th>1800</th>
<th>2200</th>
<th>2600</th>
<th>3000</th>
<th>3400</th>
<th>3800</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kw</td>
<td>14.25</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>26.25</td>
<td>27.75</td>
<td>28.5</td>
<td>28.75</td>
</tr>
</tbody>
</table>

Draw a best-fit line graph of the statistics, plotting the braking power (kW on Y-axis) against the Cranking speed (RPM on X-axis). Check your graph with the tutor before answering the following questions:

5. The braking power at 3600 rpm is __________________________.

6. The maximum braking power developed during the test is __________________________.

7. The cranking speed when the engine produces 22 kW is __________________________.

8. Extrapolate (make an informed estimate) of the breaking power at 1000 rpm.

The engine in the previous question underwent a torque test, the results of which are tabulated:

<table>
<thead>
<tr>
<th>RPM</th>
<th>1400</th>
<th>1800</th>
<th>2200</th>
<th>2600</th>
<th>3000</th>
<th>3400</th>
<th>3800</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque in Nm</td>
<td>96</td>
<td>95</td>
<td>92</td>
<td>86</td>
<td>81</td>
<td>78</td>
<td>70</td>
<td>65</td>
</tr>
</tbody>
</table>

Draw a best-fit line graph of the results, plotting the torque (Nm) against the cranking speed (RPM). Use the graph to answer the following questions:

9. The torque at 3200 rpm is __________________________.

10. The maximum torque the engine produced is __________________________.

11. The cranking speed at which the torque was 90 Nm is __________________________.
Skills & Application Task #3
(approx. 60 min.)
Skills & Application Task #3

Answer questions in the space provided and show working out where required.
Time allowance is 60 minutes.
TOTAL MARKS =

1. Find the next letter or number in the sequence :
   a) M O Q S U ?
   b) 17 13 16 12 15 ?
   c) GG IF KE MD OC ?

2. Use the following formulae to make calculations : (Don’t forget to include the units)
   
   Density = \frac{\text{Mass}}{\text{Volume}}
   
   Velocity = \frac{\text{Distance}}{\text{Time}}
   
   Pressure = \frac{\text{Force}}{\text{Area}}

   a) Calculate the velocity (in km/h) of a space craft which covers 45 000km every day.

   b) If a surfboard with a mass of 7.25kg has a volume of 0.8m³, what is its Density?

   c) What produces more pressure, a 2.2t (2200kg) elephant standing on one foot exerting a force of 22000N over an area of 0.04m² or a 56kg one legged women named Eileen, wearing a high heel which produces a force of 560N over a contact area of 0.001m²? Explain your answer.

   d) When my ESKI is full of ice and soft drinks, it has a total weight of 42 kg and produces a force of 420 N. Its base has the following dimensions.

   It always leaves a rectangular flat spot on the grass. Calculate the pressure it exerts.

   
   

3. If we kept statistics of temperature at hourly intervals in a heat-treatment furnace, we might obtain a table of values as follows :

<table>
<thead>
<tr>
<th>Time hours</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>300</td>
<td>550</td>
<td>640</td>
<td>690</td>
<td>820</td>
<td>850</td>
<td>850</td>
<td>670</td>
</tr>
</tbody>
</table>

   a) Looking at the table, estimate what the temperature was after 3½ hours.

   b) Would it be realistic to estimate that it took 2h 15min. to reach 555ºC? Explain.

   c) Draw a line graph of this data.

   d) Why do you think the temperature drops from the 7th hr to the 8th hr?
4. Draw up a Quote for the following Automotive repairs

- Replace 2 Ball joints at $68.00 each with 2 hrs labour
- Replace 2 Struts at $36.50 each with 1 hr labour
- Replace 4 Wheel bearings at $22.65 each with 2 hrs 45 min labour
- Replace 2 rear Shockers at $185.00 each with 1 hr labour
- Repair oil leak, 30 min labour
- Adjust Timing, 30 min labour
- Adjust Wheel alignment, 45 min labour
- Wheel balance, free service

```
Ashley Cole Motor Repairs

Date: _______________ (valid for 60 days)
Quote made by: _______________.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>COST ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball joints</td>
<td>2</td>
<td>68.00</td>
<td>136.00</td>
</tr>
<tr>
<td>Wheel balance</td>
<td>4</td>
<td>___</td>
<td>FREE</td>
</tr>
<tr>
<td>LABOUR (total)</td>
<td>35.50/hr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL
```

5. Write the Ratios in simplest form.

a) 500g to 1kg

b) $500 to $300

c) 40mm to 60mm
6. The ratio between weights are 4:3. If the larger weight is 56kg find the weight of the smaller one?

7. Calculate the following:
   a) 10% of $14.00
   b) 45% of 1.6kg
   c) 27½% of 1.6kg

8. The town of Springfield has a population of 16800. The average number of persons per car is 2.4. You are considering opening up an Automotive repair business exclusively for Fords.
   a) If Fords make up 35% of the towns cars, how many Fords are there?
   b) Figures suggest that for your business to succeed, the area must have a minimum of 1000 potential customers. Is it a viable proposition?
   c) What about if a rival Ford business started up. Would it still be viable? Explain.
   d) There are 3 150 Holdens in Springfield. What is the percentage of Holdens in the town?
   e) How many people travel in cars other than Fords or Holdens? (Careful !!!)
ANSWERS

Unit One: General Reasoning

1. 3 11. A 21. 3
2. 4 12. 3 22. 5
3. B 13. 5 23. 2
4. 3 14. 1 24. C
5. 2 15. B 25. 3
6. 4 16. 3 26. 5
7. 5 17. A 27. 3
8. E 18. 3 28. 2
9. 3 19. 3 29. 3
10. E 20. 1

Unit Two: Measurement & Conversion

1. 19.71 g/cm
2. 203 640 sec
3. 1200 m/s
4. 20 Pa
5. a) 0.8636 mm b) 11.7094 mm
6. a) 0.0009843” b) 0.7212598”
7. a) 5.1 mm b) 8.9 mm
8. a) 3.70 mm drill & 24 T.P.I.
   b) 16.5 mm drill & 10 T.P.I.
   c) 6.90 mm drill & 24 T.P.I.

Unit Three: Costings

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY and unit cost</th>
<th>COST ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starter motor</td>
<td>1 @800.00</td>
<td>800.00</td>
</tr>
<tr>
<td>Large hose</td>
<td>2 @18.80</td>
<td>37.60</td>
</tr>
<tr>
<td>Small hose</td>
<td>1 @12.65</td>
<td>12.65</td>
</tr>
<tr>
<td>Hose clamp</td>
<td>6 @1.05</td>
<td>6.30</td>
</tr>
<tr>
<td>Spark plug</td>
<td>8 @8.00</td>
<td>64.00</td>
</tr>
<tr>
<td>Graphite cable</td>
<td>8 @16.50</td>
<td>132.00</td>
</tr>
<tr>
<td>points</td>
<td>1 @33.80</td>
<td>33.80</td>
</tr>
<tr>
<td>Starter mounts</td>
<td>2 @21.00</td>
<td>42.00</td>
</tr>
<tr>
<td>labour</td>
<td>8h 35.50/h</td>
<td>284.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>$1412.35</td>
</tr>
</tbody>
</table>
Unit Four: Percentage & Ratios

1. a) 4 kg. b) $28 c) 4.16L. d) $8.46 e) 1800 f) 0.34km or 340m
2. 10 480
3. 10 875 General Fiction, 1740 Classics, 435 Children’s, 1450 Non-fiction
4. a) $1.16 b) $153.26 c) $0.83 d) $137.71
5. a) $2187.50 b) $14687.50
6. $961.54
7. 148.5L
8. 64%

Ratios

1. iron = 1.25m tin = 0.75m carbon = 0.5m
2. gear ratio is 1 : 2
3. Pulley ratio is 5 : 1. This is a decreasing ratio meaning that the driven pulley rotates at a lower speed than the driver pulley.
4. RPM ratio = 200/1400, or, 1 : 7.
5. b) 70mm 600 350mm 120 1:5
c) 360mm 220 396mm 200 10:11
d) 840mm 120 315mm 320 8:3

Unit Five: Tables & Graphs

1. a) 225 b) 5 929 c) 729 d) 39 304
2. a) 19 b) 67 c) 79
3. a) 4 159 b) 168 103 c) 779
4. a) 0.000 315 0 b) 0.059 055 1 c) 0.128 779 5
5. a) 4.50mm TPI= 24 b) 5.10mm TPI= 20 c) 8.50mm TPI= 24

Graphs

1. 1996
2. Increase of approx. 35
3. 1993-1994
4. 1993
5. ~ 28 kW
6. 28.75kW
7. ~ 22 kW
8. ~ 10kW
9. ~ 79 Nm
10. 96 Nm
11. ~ 2350 RPM
DOORWAYS TO CONSTRUCTION (Section 2)

Unit One: Measurement, Shapes & Formulae (2.1,2.2,2.5,2.6)

Unit Two: Conversions (2.1)

Unit Three: Costings (1.1,1.3,2.5,2.6)

Unit Four: Percentage & Ratios (2.3,2.6)

Unit Five: Trigonometry (8.2)
Unit One: Measurement, Shapes & Formulae

Introduction

One of the most important techniques in the construction industry is that of measurement. Some of the basic tools and equipment used are:

<table>
<thead>
<tr>
<th>MEASURING TOOL</th>
<th>GENERAL USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folding ruler</td>
<td>Measuring small to medium lengths, widths and thicknesses of various materials</td>
</tr>
<tr>
<td>Tape measures</td>
<td>Site set-out of footings, walls, ceilings and roof frames</td>
</tr>
<tr>
<td>Squares (various)</td>
<td>Setting out 90° and 45° angles</td>
</tr>
<tr>
<td>Levels</td>
<td>Transferring levels and distances</td>
</tr>
<tr>
<td>Bucket</td>
<td>Gauging liquids, cement, sand</td>
</tr>
</tbody>
</table>

These should be kept in good condition in order for them to be of any use when taking measurements. Take note:

- tapes with broken ends should be discarded
- squares need to be checked for accuracy on a regular basis
- levels also need to be checked for both horizontal and vertical accuracy

Millimetres (mm) and Metres (m) are the basic units of measurement used in the building industry (NEVER USE CENTIMETRES - cm)!!!
There are three (3) different forms of measurement used:

1. **Lineal**
   This is the perimeter or length measurement in running/lineal metres. (Identified as lm.)
   Examples of linear measurements are:
   - the length of concrete kerbing required around a carpark.
   - the length of timber skirting around a room.
   - the length of plasterboard cornice mould around a ceiling.

2. **Area**
   This is the surface area covered in square metres. (Identified as m²)
   Examples of areas are:
   - the area in metres square (m²) of a concrete floor slab.
   - the area in (m²) of brick paving for an external courtyard.
   - the area in (m²) of tiles to cover the floor.

3. **Volume**
   This is the cubic content of space occupied by the length x width x depth. (Identified as m³)
   Examples of volume are:
   - the cubic content of concrete required for a strip footing.
   - the cubic content of earth required to excavate a sloping site.
   - the cubic content of composition mortar required to lay 1,000 bricks.

**Useful Tips!!!**

The majority of buildings are either rectangular or square. However triangular, circular and other shapes are used. The typical domestic dwelling has triangular structures that give them added strength, especially in trusses. The ancient Egyptians knew of the strength of triangles many thousands of years ago, just look at the Pyramids! When costing a job it is very important to calculate all material costs accurately so we don’t have too much or too little. For instance, did you know that timber only comes in multiples of 300mm or that there is usually 15% loss due to off cuts!
Exercises:

1. Calculate the lineal metres (lm) of skirting required for the following room size.

2. Calculate the lineal metres (lm) of skirting required for the following room size.

3. Find the circumference of a circle with a radius of 950mm.  
   Note: circumference = \pi \times \text{diameter} = \pi D 
   (where \pi = 3.14 and D = 2r)
4. Find the area of a circular swimming pool with a radius of 25m.

5. Find the total floor area of the entertainment area below.

6. Calculate the area in the square metres ($m^2$) of the concrete path below.
7. Cylinder Volume Formula = Area of circle x Height = \( \pi r^2 \times H \)

How many cubic metres (m\(^3\)) of concrete are required to fill a column with a radius of 500m and a height of 5m? Make a sketch.

8. Calculate the volume (m\(^3\)) of concrete for the following footing:

![Diagram of footing with dimensions: 6000mm, 350mm, 650mm, 3000mm, 5000mm, 13000mm.]

ie. The footing is 6000mm from outside edge to outside edge. Cross section of footing Footing is 350mm wide and 650mm deep
Unit Two: Conversions

Introduction

In the building trade we are constantly required to convert quantities from one unit to another. These CONVERSIONS are essential and mistakes can become very costly indeed. The ultimate goal of each company or self owned business is to make money. You calculate the cost of materials and labour required for the job before giving a quote. If they accept your quote you are obliged to complete the task based on that quote, and if your costing is out you go broke!

Let’s start with some simple conversions and work our way up

**(Notice that we don’t use cm in the building trade)**

\[
\begin{align*}
1 \text{ km} &= 1000 \text{ m} \\
1 \text{ m} &= 1000 \text{ mm} \\
1 \text{ t} &= 1000 \text{ kg} \\
1 \text{ kg} &= 1000 \text{ gm} \\
1 \text{ kL} &= 1000 \text{ L} \\
1 \text{ L} &= 1000 \text{ ml}
\end{align*}
\]

Now for Area

\[
\begin{align*}
1 \text{ km}^2 &= 1000000 \text{ m}^2 \\
1 \text{ m}^2 &= 1000000 \text{ mm}^2
\end{align*}
\]

And Volume

\[
1 \text{ m}^3 = 1000000000 \text{ mm}^3
\]

The most commonly used units when ordering material are mm, m$^2$ & m$^3$

Exercises:

1. Convert the following quantities:
   a) 1.2 km = \text{m}
   b) 0.25 km = \text{m}
   c) 640 m = \text{km}
   d) 500 000 mm$^2$ = \text{m}^2
   e) 320mm$^3$ = \text{m}^3
Unit Three: Costings

Introduction

As previously mentioned, your costing of a job is as important as the work itself. Over quote and you won’t get the job, under quote and you don’t make any money!!!

Consider the diagram below for a simple door frame

Now the timber comes in a minimum length of 1.5m or larger in increments of 300mm up to 3.6m.

( Don’t worry about the cost of glue or nails in this introductory exercise.)

We usually allow an extra 15% for wastage, but don’t in this example.

The timber costs $9.55/ lm.

Now we will do a material costing on this job.

We need two pieces that are 2300mm. & two that are 850mm. Because of the 300mm increments we must get two at 2400mm & one at 1800mm (because we can’t get lengths under 1.5m)
Cut the two 2400mm to 2300mm & the 1800mm into two 850mm (this leaves about 5% wastage)

Lineal metres of timber = 2400 + 2400 + 1800 = 6600mm or 6.6m

Cost of timber = 6.6 x $9.55 = $63.03

It is important to know the quantities that all your materials come in. For instance, if you need to use 12 stainless steel screws and they only come in bags of 25, you may need to charge for the price of the whole bag (especially if you won’t use the left over ones).

Lots of thought needs to be put into a quote……Mathematical knowledge is essential !!!
Exercises:

1. You have been asked to give a quote on painting the front of a house (see diagram below). Now you wouldn’t paint the roof, door or windows but you will the gable end (It all needs two coats). The paint the client has chosen only comes in 10L tins and its specifications state that 1L covers 8m². Trade price for the paint is $64.50 per tin and it will take you about three days (8 hr days) to complete. Your labour is $15/hr and you add $50 to the quote to cover brushes, cleaning, etc.

Show all your working and provide an accurate quote. Don’t forget to factor in 15% wastage on paint.

2. a) There are 50 standard bricks per square metre. Calculate the number of bricks needed for a rectangular wall 30m long and 2m high.

b) The bricks can only be purchased in pallets of 800 at a cost of $1500/pallet. How much will it cost for the bricks?

c) If it was possible to order the exact number of bricks required, would this be a wise thing to do? Explain why.
DIRECTED INVESTIGATION #2

(approx. 120 min.)
Directed Investigation #2

NAME:_____________________________

MEASURE AND QUOTE FOR A POOL ENCLOSURE

TASK
You have been asked to quote on a job to put up a safety fence around a pool. The diagram below shows the dimensions of the swimming pool. It is rectangular with a semicircular end, and it has a circular “plant island”.

1. a) Find the distance around the pool.
   b) Find the area of the bottom of the pool.
   c) Calculate the volume of the pool if it is uniformly 1.8m deep.
   d) Calculate how many litres of water will be required to fill the pool.
   e) Calculate the cost of filling the pool if water costs 98 cents per kilolitre.

2. The owners have requested that the fence be built no closer than 2.5m to the pool and that a child proof gate be installed on the southern side.
   a) Draw a sketch illustrating your fence design.
   b) Calculate the cost of materials for the enclosure based on a reliable source. Include details of any reliable source.
   c) You will need 8 bags of cement at $11.50/bag and your labour is 30 hrs at $35.50/hr. Draw up a quotation form similar to the one on the next page.
**John Thorpe Constructions**

Date: _______________ (valid for 60 days)

Quote made by: ________________.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Quantity</th>
<th>Unit cost</th>
<th>COST ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>8 bags</td>
<td>11.50</td>
<td>92.00</td>
</tr>
<tr>
<td>Labour</td>
<td>30 hrs</td>
<td>35.50</td>
<td>1065.00</td>
</tr>
</tbody>
</table>

**TOTAL**
PROJECT
(approx. 180 min.)

_NB A suitable project will depend on the interests of your students, but some examples are available from The Mathematical Association of Mathematics Inc publication, '500 Mathematical Investigations for Stage 1 Mathematics SACE'
A completed project should include:
- an introduction that outlines the problem to be explored, including its significance, its features, and the context;
- the method of solution in terms of the mathematical model or strategy to be used;
- the appropriate application of the mathematical model or strategy, including:
  - the generation or collection of relevant data and/or information, including details of the process of collection;
  - mathematical calculations and results, and appropriate representations;
  - the analysis and interpretation of results;
  - reference to the limitations of the original problem as well as appropriate refinements and/or extensions;
- a statement of the solution and outcome in the context of the original problem;
- appendices and bibliography as appropriate.

Your report should be structured to include:
- Introduction
- Mathematical Procedures
- Analysis/Discussion
- Conclusion

Note: Your report should be written in the form “The analysis ……” rather than “When I analysed……”, or “When you analyse……”.

Performance will be assessed on the extent to which the following are demonstrated:
- Mathematical skills and understandings (without electronic technology)
- Mathematical skills and understandings (with electronic technology)
- Analysis and interpretation of results and information
- The communication of mathematical information
- The organisation and presentation of material
- The ability to work independently

Introduction…
Unit Four: Percentage & Ratios

Introduction

Percentage and Ratios are an important part of all trade courses. We will look at how to calculate % and apply ratios to a variety of situations.

Percentages can be written as decimals by simply dividing by 100

\[
\begin{align*}
25\% &= \frac{25}{100} = 0.25 \\
6\% &= \frac{6}{100} = 0.06 \\
12\frac{1}{2}\% &= \frac{12.5}{100} = 0.125
\end{align*}
\]

so, to find 25% of $40 we just multiply it by 0.25   eg. $40 \times 0.25 = $10

Exercises:

1. a) 10% of 40kg    b) 35% of $80
   c) 6\frac{1}{2}\% of 64L    d) 24% of $35.25
   e) 2\frac{1}{4}\% of 80 000    f) 17% of 2km

2. If 52 400 Collingwood supporters went to the AFL grand final and 80% were intoxicated then how many were sober?

3. 75% of books in a book shop came under the heading General Fiction, 12% were Classics, 3% were Children’s Books and 10% Non-fiction. If there were 14 500 books in the shop, how many of each kind were there?

4. Work out the following round to the nearest cent:
   a) 8% of $14.45    b) 42% of $364.90
   c) 2 \frac{1}{2}\% of $33.33    d) 24 \frac{1}{4}\% of $567.88
**Ratios** are very similar to Percentages in that they show us relative proportions. We constantly use ratios to make up things like concrete, mortar, fuel and even cakes!

Here is an example: Lets say the mixing ratio for blue-dock concrete is $2 : 2 : 1$ for cement, sand and stone. If we need to make up $5 \text{m}^3$ of concrete, then we need:

$$2 \text{m}^3 \text{ cement} : 2 \text{m}^3 \text{ sand} : 1 \text{m}^3 \text{ stone}.$$

It can become a little more difficult as the amount needed changes. eg. suppose you need $3.5 \text{ m}^3$.

- **step 1**  
  add all the ratio proportions together… $2 + 2 + 1 = 5$

- **step 2**  
  divide the amount needed by the answer from step 1… $\frac{3.5}{5} = 0.7$

- **step 3**  
  finally multiply the individual proportions by the answer to step 2…
  
<table>
<thead>
<tr>
<th>Component</th>
<th>Proportion</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>cement</td>
<td>2</td>
<td>$2 \times 0.7 = 1.4 \text{m}^3$</td>
</tr>
<tr>
<td>sand</td>
<td>2</td>
<td>$2 \times 0.7 = 1.4 \text{m}^3$</td>
</tr>
<tr>
<td>stone</td>
<td>1</td>
<td>$1 \times 0.7 = 0.7 \text{m}^3$</td>
</tr>
</tbody>
</table>

**Exercises:**

1. If I wish to make up $6 \text{m}^3$ of blue-dock concrete, how much of each component will I need?

2. If $2.5 \text{m}^3$ of a metal alloy needs to be produced by fusing together iron, tin and carbon in the ratio of $5 : 3 : 2$ How many $\text{m}^3$ of each is needed (round answers to 2 dp’s)?
Unit Five: Trigonometry

Introduction

Trigonometry is a branch of mathematics that deals with the relations between the angles & length of sides in a triangle. Let us consider a typical right-angled triangle:

![Right-Angled Triangle Diagram]

The longest side is the **HYPOTENUSE** and it is always directly across from the right angle. The side that is directly across from angle $\theta$ is called the **OPPOSITE**. The side that is part of the right angle & angle $\theta$ is called the **ADJACENT**.

To calculate the length of an unknown side, we must have at least the length of one other side and a known angle (other than the right angle)

**This is called the sine ratio or rule**

The formula is \( \sin \theta = \frac{\text{opposite length}}{\text{hypotenuse length}} \) or \( \sin \theta = \frac{\text{opp}}{\text{hyp}} \)

manipulating it to get length of opposite side: \( \text{opp} = \text{hyp} \times \sin \theta \)

**Here is an example showing how it can be used to calculate the length of the unknown side: (a scientific calculator with sin function is a necessity!)**

eg. \( \sin 35^\circ \) \begin{align*} \text{opp} &= 5 \times \sin 35^\circ \\
&= 2.87 \text{ (rounded to 2.d.p.)} \\
\text{thus; the opposite side is 2.87 m} \end{align*}

manipulating the sine rule, we can come up with: \( \theta = \sin^{-1} \left( \frac{\text{opp}}{\text{hyp}} \right) \)

Note: \( \sin^{-1} \) is called **inverse of sine**
**Here is an example showing how it can be used to calculate the unknown angle:**

\[
\theta^\circ = \sin^{-1}\left(\frac{100}{170}\right)
\]

\[
\theta^\circ = \sin^{-1}(0.58823)
\]

(to do this on your calculator: shift \( \sin \) 0.58823)

\[
\theta^\circ = 36^\circ
\]

Exercises:

1. Use your calculator to find the value of the following rounded to two decimal places:
   a) \( \sin 28^\circ = \)
   b) \( \sin 60^\circ = \)
   c) \( \sin 10^\circ = \)
   d) \( \sin 20^\circ = \)
   e) \( \sin 37^\circ = \)
   f) \( \sin 23^\circ = \)
   g) \( \sin 84^\circ = \)
   h) \( \sin 45^\circ = \)

2. Given the length of the hypotenuse and the angle \( \theta \), calculate the length of the opposite:
   a) 12 & 60º
   b) 36 & 40º
   c) 9 & 20º
   d) 7 & 55º

3. Find the angle \( \theta \) in the following triangles (two d.p.’s):
   a) 
   ![Diagram a]
   b) 
   ![Diagram b]
Now it's time to learn about the other two rules... COSINE & TANGENT (cos & tan)

They are similar to the sine (sin) rule but are used in different circumstances as shown below:

eg. Say you have the length of the hypotenuse and adjacent but not the opposite then we must use the cos rule

\[ \cos \theta = \frac{\text{adjacent}}{\text{Hypotenuse}} \]

\[ \cos \theta = \frac{4}{5} = 0.8 \quad \text{(apply anti-cos)} \]

Thus; \( \theta = 36.87^\circ \)

eg. If we have the length of the opposite and adjacent, we use the tan rule....

\[ \tan \theta = \frac{\text{opposite}}{\text{adjacent}} \]

\[ \tan \theta = \frac{12.5}{18} = 0.69 \quad \text{(apply anti-tan)} \]

Thus; \( \theta = 34.61^\circ \)

Exercises:

4. Use either the cos or tan rules to calculate angle \( \theta \):

a)  

\[ \begin{array}{c}
\theta \quad 12 \\
11 \\
\end{array} \]

b) 

\[ \begin{array}{c}
32 \\
26 \\
\end{array} \]

5. Use the sin, cos, tan or any manipulation of these rules to find the unknown angle or length:
Skills & Application Task #3
(approx. 60 min.)
1. Prepare a Quote for the following Job…

The quote is for supply and construction of a wire mesh “Cyclone” fence around a duck pond at the local reserve. Metal posts coat $12.50 each and must be cemented in at 3 m intervals. The cost of the mesh is $12.80 per lineal metre. You estimate it will take you and your partner 40 days to complete, you both earn $220 a day for labour. You need 20 m$^3$ of cement and approximately 80 m of wire. The wire is $3.60/m$ or $300/100m$ roll. A bag of cement costs $11.30 and makes up 0.35 m$^3$. Use the following table for your quote.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>COST ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>Labour (total days)</td>
<td></td>
<td>220.00/day</td>
<td></td>
</tr>
<tr>
<td>TOTAL QUOTE</td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>

2. Write the Ratios in simplest form.

   a) 500g to 1kg
b) $500 to $300  
c) 40mm to 60mm

3. The ratio between weights are 4:3. If the larger weight is 56kg find the weight of the smaller one?

4. Calculate the following. 
   a) 10% of $14.00
   b) 45% of 1.6kg
   c) 27½% of 1.6kg

5. The town of Springfield has a population of 25920. There are a total of 10800 houses in the town, and on average, 2% will require plumbing services at some time during the year. You are considering opening up a Plumbing business.
   a) How many houses will you have to work on during the year?
   b) Figures suggest that for your business to succeed, the area must have a minimum of 100 customers per year. Is it a viable proposition?
   c) What about if a rival business started up. Would it still be viable? Explain…
   d) What is the average number of people per house in Springfield?

6. Calculate the lineal metres (lm) of skirting required for the following room sizes:

   a)
   
   ![Diagram](image)

   b)
   
   ![Diagram](image)

7. A drinking trough for horses in the shape of a half cylinder, as shown in the sketch. Calculate: REMEMBER…\( V(\text{cylinder}) = \pi r^2 h \)
a) Its volume in cubic metres (m³) to 2dp’s.

b) Its capacity in litres (L) to the nearest whole number.

8. a) Use the tan rule to calculate the angle $\theta^\circ$: Note…$\tan \theta^\circ = \frac{\text{opposite}}{\text{adjacent}}$

b) The diagram shows a loading ramp for a truck. Using the given measurements find the height (h) to the nearest centimetre. Note..$\sin \theta^\circ = \frac{\text{opp}}{\text{hyp}}$
ANSWERS

Unit One: Measurement, Shapes & Formulas
1. 70lm
2. 78ln
3. 5 966mm or 5.966m
4. 1 962.5m²
5. 745.313m² (3dp's)
6. 96 m²
7. 3.925m³
8. Length of footing is 36 250mm(36.25m) and cross section area is 227 500mm² (0.2275m²) therefore…36.25 x 0.2275 = 8.25m³ of concrete (2dp’s). This is a tough question!

Unit Two: Conversions
1. 1 200m
2. 250m
3. 0.64km
4. 0.5m²
5. 0.00000032m³

Unit Three: Costings
1. Area = house – window – door + gable end = 14 – 1.44 – 2.88 + 2 = 11.68m²
   Needs two coats = 2 x 11.68 = 23.36m²
   Now factoring in 15% wastage (1.15 x 23.36) = 26.864…so say 27m² of paint.
   If a 10L tin covers 9m² then we need 3 tins.
   
   **QUOTE**
   Paint = 3 tins x $64.50 = $193.50
   Labour = 24hrs X $15 = $360.00
   Extras = $50.00
   TOTAL = $603.50 So Quote $600

2. a) 3 000 bricks
   b) Need 4 pallets (3 200 bricks)...4 x $1 500 = $6 000
   c) It would not be wise to order the exact number of bricks because some might arrive broken or have faults in them. Always allow for wastage/breakage.

Unit Four: Percentage & Ratios
1. a) 4kg  b) $28  c) 4.16L  d) $8.46  e) 1800
   f) 0.34km or 340m
2. 10 480 sober
3. 10 875 General fiction, 1 740 Classics, 435 Children’s, 1 450 Non-fiction.
4. a) $1.16  b) $153.26  c) $0.83  d) $137.71

Ratios:
1. 2.4m³ of cement, 2.4m³ of sand, 1.2m³ of stone.
2. 1.25 m³ of iron, 0.75m³ of tin, 0.5m³ of carbon.
Unit Five: Trigonometry

1. a) 0.47     b) 0.87     c) 0.17     d) 0.34     e) 0.60     f) 0.39     g) 0.99     h) 0.71

2. a) 10.39     b) 23.14     c) 3.08     d) 5.73

3. a) 40.83°  b) 18.41°

4. a) 42.51°  b) 35.66°  c) 41.41°  d) 15.07°

5. a) 48.59°  b) 70.53°  c) 21.20cm.  d) 24.42m  e) 82.91°  f) 40.91°
ENGINEERING

SACE STAGE 1 : SECTION 2

(FOR STUDENTS INTENDING TO PURSUE A CAREER IN INDUSTRY)
ENGINEERING  (Section 2)

Unit One:  Manipulating Formulae & Equations  (2.1,2.2,2.3,2.4,15.4)

Unit Two:  Trigonometry  (8.1,8.2)

Unit Three:  Percentage & Ratios  (2.3,2.6)

Unit Four:  Algebra  (15.5)

Unit Five:  Tables & Graphs  (12.3,12.4,12.6)
Unit One: Manipulating Formulae & Equations

Introduction

In the work place we often use formulas to find an unknown variable. Sometimes it is useful to re-arrange these formulas so that a different variable can be calculated. This is called Manipulation of Equations.

For example, we already know that for area of a triangle \( A = \frac{L \times B}{2} \) that is \( A = \frac{LB}{2} \)

What if we know the area and length but need to find the breadth (B) ?

We manipulate the equation to isolate the required variable by performing opposing operations.

eg. \( A (\times 2) = \frac{LB (\times 2)}{2} \) the opposite of divide by 2 is multiply by 2 (must do it to both sides!)

\[
2A = LB
\]

to isolate \( b \) we must do the opposite to \( L \); (that is divide by \( L \))(both sides!)

\[
\frac{2A}{L} = \frac{LB}{L} \quad \text{… this leaves} \quad \frac{2A}{L} = B
\]

Thus: \( B = \frac{2A}{L} \)

Working through the same process we also can also get \( L = \frac{2A}{B} \)

So;
\[
A = \frac{LB}{2} \quad \& \quad B = \frac{2A}{L} \quad \& \quad L = \frac{2A}{B}
\]

are the three possible manipulations

Remember PYTHAGORAS THEOREM

\[
c^2 = a^2 + b^2 \quad \& \quad a^2 = c^2 - b^2 \quad \& \quad b^2 = c^2 - a^2
\]

are the three manipulations

So you can see that manipulating equations is a very important part of mathematics !!!
Exercises:

1. Manipulate the following equations to isolate the variable in brackets:

   a) \[ A = LB \quad \text{……(L)} \]
   
   b) \[ A = \frac{BH}{2} \quad \text{……(b)} \]

   c) \[ V = LBH \quad \text{……(h)} \]

   d) \[ D = \frac{m}{V} \quad \text{……(m)} \]

   e) \[ V = \frac{LBH}{2} \quad \text{……(b)} \]

   f) \[ V = \frac{4\pi r}{3} \quad \text{……(r)} \]
Here are some formulae for common plane figures:

<table>
<thead>
<tr>
<th>TITLE</th>
<th>FIGURE</th>
<th>VOLUME</th>
<th>AREA</th>
</tr>
</thead>
</table>
| Annulus      | ![Annulus Diagram](image) | $V = \pi (D^2 - d^2)$ | $A = \frac{\pi}{4} (D^2 - d^2)$  
Or  
$A = \pi (R^2 - r^2)$ |
| Rectangular Prism | ![Rectangular Prism Diagram](image) | $V = LBH$ | Total $A = 2(LB + LH + BH)$ |
| Cube         | ![Cube Diagram](image) | $V = S^3$ | Total $A = 6S^2$ |
| Triangular Prism | ![Triangular Prism Diagram](image) | $V = L \times \frac{BH}{2}$ | Total $A = BH + L(a + b + c)$ |
### Cylinder

<table>
<thead>
<tr>
<th>Volume Formula</th>
<th>Surface Area Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V = \pi r^2 L$</td>
<td>$A = 2\pi r(L + r)$</td>
</tr>
<tr>
<td>$V = \frac{\pi d^2 L}{4}$</td>
<td>$A = \pi d\left(L + \frac{d}{2}\right)$</td>
</tr>
</tbody>
</table>

### Sphere

<table>
<thead>
<tr>
<th>Volume Formula</th>
<th>Surface Area Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V = \frac{4\pi r^3}{3}$</td>
<td>$A = 4\pi r^2$</td>
</tr>
<tr>
<td>$V = \frac{\pi d^2}{6}$</td>
<td>$A = \pi rd^2$</td>
</tr>
</tbody>
</table>

1. Calculate the annulus area.

   ![Annulus Diagram](image)

2. Calculate the surface area and volume of the sphere in mm$^2$ and mm$^3$.

   ![Sphere Diagram](image)
3. Calculate the surface area and volume of the triangular prism in m$^2$ and m$^3$.

4. Calculate the surface area and volume of the cylinder.
We use different forms of measurement for properties such as Density, Time, Speed.. etc

**Density** = \( \frac{\text{Mass (kg)}}{\text{Volume (m}^3\text{)}} \)  
the unit is kg/m\(^3\)

**Time** is obviously in **hours, minutes, seconds** etc

**Speed** = \( \frac{\text{Distance (km)}}{\text{Time (hrs)}} \)  
the unit is km/h

** It is important to remember that if any of the quantities vary, so do the units **

eg. \( \text{Speed} = \frac{100 \text{ (m)}}{9.8 \text{ (sec)}} = 10.2 \text{ m/s} \)

**Now try these exercises:**

1. Calculate the Density of a 236.5 gm mass that has a volume of 12 cm\(^3\) (to 2dp’s).

2. Calculate how many seconds there are in 2 days 8 hours and 34 minutes.

3. Calculate the speed of an object which covers 420 m in 0.35 seconds.
Unit Two: Trigonometry

Introduction

Trigonometry is a branch of mathematics that deals with the relations between the angles & length of sides in a triangle. Let us consider a typical right-angled triangle:

- Hypotenuse
- Opposite
- Adjacent

The longest side is the HYPOTENUSE and it is always directly across from the right angle. The side that is directly across from angle \( \theta \) is called the OPPOSITE. The side that is part of the right angle & angle \( \theta \) is called the ADJACENT.

To calculate the length of an unknown side, we must have at least the length of one other side and a known angle (other than the right angle).

This is called the sine ratio or rule

The formula is \( \sin \theta = \frac{\text{opposite length}}{\text{hypotenuse length}} \) or \( \sin \theta = \frac{\text{opp}}{\text{hyp}} \)

manipulating it to get length of opposite side: \( \text{opp} = \text{hyp} \times \sin \theta \)

**Here is an example showing how it can be used to calculate the length of the unknown side:**

(a scientific calculator with sin function is a necessity!)

eg. \( 5 \text{m} \) ? \( 35^\circ \)

so; \( \text{opp} = 5 \times \sin 35^\circ \)

\( \text{opp} = 2.87 \) (rounded to 2.d.p.)

thus; the opposite side is 2.87 m

manipulating the sine rule, we can come up with: \( \theta = \sin^{-1} \left( \frac{\text{opp}}{\text{hyp}} \right) \)

Note: \( \sin^{-1} \) is called inverse of sine
**Here is an example showing how it can be used to calculate the unknown angle:**

eg.

\[
\theta^\circ = \sin^{-1}\left(\frac{100}{170}\right)
\]

so; \[
\theta^\circ = \sin^{-1}(0.58823)
\]

(to do this on your calculator: shift \sin 0.58823 )

\[
\theta^\circ = 36^\circ
\]

**Exercises:**

1. Use your calculator to find the value of the following rounded to two decimal places:
   a) \(\sin 28^\circ = \)  
   b) \(\sin 60^\circ = \)  
   c) \(\sin 10^\circ = \)  
   d) \(\sin 20^\circ = \)  
   e) \(\sin 37^\circ = \)  
   f) \(\sin 23^\circ = \)  
   g) \(\sin 84^\circ = \)  
   h) \(\sin 45^\circ = \)

2. Given the length of the hypotenuse and the angle \(\theta\), calculate the length of the opposite:
   a) 12 & 60\(^\circ\)  
   b) 36 & 40\(^\circ\)  
   c) 9 & 20\(^\circ\)  
   d) 7 & 55\(^\circ\)

3. Find the angle \(\theta\) in the following triangles (two d.p.’s):
   a)  
   b)
Now it's time to learn about the other two rules... COSINE & TANGENT (cos & tan)

They are similar to the sine (sin) rule but are used in different circumstances as shown below:

**eg.** Say you have the length of the hypotenuse and adjacent but not the opposite then we must use the **cos** rule

\[
\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}
\]

\[
\cos \theta = \frac{4}{5} = 0.8 \quad \text{(apply anti-cos)}
\]

Thus, \( \theta = 36.87^\circ \)

**eg.** If we have the length of the opposite and adjacent, we use the **tan** rule...

\[
\tan \theta = \frac{\text{opposite}}{\text{adjacent}}
\]

\[
\tan \theta = \frac{12.5}{18} = 0.69 \quad \text{(apply anti-tan)}
\]

Thus, \( \theta = 34.61^\circ \)

**Exercises:**

4. Use either the cos or tan rules to calculate angle \( \theta \):

   a) ![Diagram a]
   
   b) ![Diagram b]
   
   c) ![Diagram c]
   
   d) ![Diagram d]
5. Use the sin, cos, tan or any manipulation of these rules to find the unknown angle or length:

a) 
\[ \theta^\circ \]
\[ \begin{array}{c}
20m \\
15m \\
0^\circ
\end{array} \]

b) 
\[ \theta^\circ \]
\[ \begin{array}{c}
12m \\
4m \\
0^\circ
\end{array} \]

c) 
\[ \begin{array}{c}
? \\
40cm \\
32^\circ
\end{array} \]

d) 
\[ \begin{array}{c}
55^\circ \\
20m \\
?
\end{array} \]

e) 
\[ \begin{array}{c}
30cm \\
26cm \\
20mm \\
0^\circ
\end{array} \]

f) 
\[ \begin{array}{c}
30cm \\
26cm \\
0^\circ
\end{array} \]
Unit Three: Percentage & Ratios

Introduction

Percentage is an intricate part of all Engineering courses. We will look at how to calculate % and apply it to different situations.

Percentages can be written as decimals by simply dividing by 100

\[
\begin{align*}
25\% &= \frac{25}{100} = 0.25 & \text{or} & \quad 6\% &= \frac{6}{100} = 0.06 \\
\text{even fractional } \% &= \frac{12\frac{1}{2}}{100} = 0.125
\end{align*}
\]

so, to find 25% of $40 we just multiply it by 0.25 \quad \text{eg. } 40 \times 0.25 = 10

Exercises:

1. a) 10% of 40kg 
   b) 35% of $80
   
   c) 6½% of 64L 
   d) 24% of $35.25
   
   e) 2¼% of 80 000 
   f) 17% of 2km

2. If 52,400 Collingwood supporters went to the AFL grand final and 80% were intoxicated then how many were sober?

3. 75% of books in a book shop came under the heading General Fiction, 12% were Classics, 3% were Children’s Books and 10% Non-fiction. If there were 14 500 books in the shop, how many of each kind were there?
4. Calculate the following rounded to the nearest cent:
   
a) 8% of $14.45  
b) 42% of $364.90  
c) 2½% of $33.33  
d) 24¼% of $567.88  

5. When Eddie takes his annual leave he is paid one month’s salary of $12 500 plus 17½% loading (extra)
   
a) How much is the loading?
   
b) What is the total he receives?

6. Piper’s annual salary is $50 000. What is her weekly salary, correct to the nearest cent?

7. A big blue V8 car’s fuel consumption is 16.5 litres/100km. How much fuel is used on a journey of 900 km?

8. If Port Adelaide kicked 19.11 in a grand final against the Adelaide Crows 12.8, what percentage of Port’s score did the Crows kick? Remember 19.11 is not a decimal!
**Ratios**

Ratios are very similar to percentages in that they show us relative proportions.

We constantly use ratios to make up things like concrete, mortar and fuel.

Here is an example:

Let's say the mixing ratio for blue-dock concrete is 2 : 2 : 1 for cement, sand and stone. If we need to make up 5m³ of concrete, then we need:

- 2m³ cement : 2m³ sand : 1m³ stone.

It can become a little more difficult as the amount needed changes.

eg. suppose you need 3.5 m³.

1. **Step 1** add all the ratio proportions together
   \[ 2 + 2 + 1 = 5 \]

2. **Step 2** divide the amount needed by the answer from Step 1
   \[ \frac{3.5}{5} = 0.7 \]

3. **Step 3** finally multiply the individual proportions by the answer to Step 2
   - cement is \[ 2 \times 0.7 = 1.4 \text{m}^3 \]
   - sand is \[ 2 \times 0.7 = 1.4 \text{m}^3 \]
   - stone is \[ 1 \times 0.7 = 0.7 \text{m}^3 \]

**Now try these**

1. If 2.5m³ of a metal alloy needs to be produced by fusing together iron, tin and carbon in the ratio of 5 : 3 : 2 How many m³ of each is needed (round answers to 2 dp’s)?

Now look at this gearing example:

\[
\text{Gear ratio} = \frac{\text{Teeth in driven gear}}{\text{Teeth in driving gear}}
\]

\[
= \frac{30}{15} \quad \text{or} \quad 2 : 1
\]

**In this case, this is a reduction ratio, ie. driven gear rotates at half the speed of the driving gear.**

2. Calculate the ratio in its simplest form if the driving gear has 40 teeth and the driven gear is 20 teeth.
DIRECTED INVESTIGATION #2
(approx. 120 min.)
MEASURING HEIGHTS USING A CLINOMETER

TASK
First you will need to find the length of one of your normal paces. This can be done by counting the number of paces over a 20m distance and finding the average length of one pace.

Now that you can measure lengths on the ground and angles of elevation reasonably accurately, (using a clinometer), you can use them to find estimates of the heights of some tall objects around the school. The information that you need to gather is shown in the diagram below.

OBJECTS:
Take measurements for the heights of the following six objects:-
1. School Hall
2. Small tree
3. Large tree
4. Stobie pole
6. Another reasonably tall object.

DATA:
Record your data in a table like the one below.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE</th>
<th>ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Paces</td>
<td>Metres</td>
</tr>
<tr>
<td>School hall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small tree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etc…</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
QUESTIONS:

1. With the aid of a neat, clearly labelled diagram, describe how the clinometer works.

2. Describe how you found the average length of your pace. – Show your calculations.

3. Show the measurements you took in a table as shown above.

4. Using trigonometry calculate the height of the triangle (in the diagram) for each object. Show all calculations.

5. These answers do not give the true height of the objects yet. What single last measurement must you consider? Why? How do you use it to find the heights from your results? (If you’re not sure of the answers to these questions have another good look at the diagram!)

6. Find the measurement concerned in question 5 and use it to calculate your estimate of the height of each object. Show your answers clearly.

7. How accurate do you think your answers are? Are they to the nearest cm, m, 2m, 10m? Explain your reasoning.

8. When you did your measurements you had to make sure certain conditions were satisfied. What sort of things did you have to be careful of in the practical situation so that the heights could be found using right-angled triangle methods?

9. Describe situations where you could not find the height of an object using this method.
PROJECT
(approx. 180 min.)

_NB_ A suitable project will depend on the interests of your students, but some examples are available from The Mathematical Association of Mathematics Inc publication, '500 Mathematical Investigations for Stage 1 Mathematics SACE'.
A completed project should include:

- an introduction that outlines the problem to be explored, including its significance, its features, and the context;
- the method of solution in terms of the mathematical model or strategy to be used;
- the appropriate application of the mathematical model or strategy, including:
  - the generation or collection of relevant data and/or information, including details of the process of collection;
  - mathematical calculations and results, and appropriate representations;
  - the analysis and interpretation of results;
  - reference to the limitations of the original problem as well as appropriate refinements and/or extensions;
- a statement of the solution and outcome in the context of the original problem;
- appendices and bibliography as appropriate.

Your report should be structured to include:

- Introduction
- Mathematical Procedures
- Analysis/Discussion
- Conclusion

Note: Your report should be written in the form “The analysis …..” rather than “When I analysed……”, or “When you analyse…….”.

Performance will be assessed on the extent to which the following are demonstrated:

- Mathematical skills and understandings (without electronic technology)
- Mathematical skills and understandings (with electronic technology)
- Analysis and interpretation of results and information
- The communication of mathematical information
- The organisation and presentation of material
- The ability to work independently

Introduction…
Unit Four: Algebra

Introduction

The branch of mathematics that deals with unknown quantities is called **ALGEBRA**. Values that are unknown have a letter of the alphabet substituted in their place so that they can become part of an algebraic formula.

Now for some rules!!!!

* When multiplying together algebraic terms we leave out the “X” ie the multiplication symbol

* Never put a 1 in front of a letter ie. 1a should just be a

* Only “like” terms can be added or subtracted ie. 3a + 2a = 5a

* The following applies when multiplying or dividing:

  eg. 2 x 3b = 6b or 2a x 4b = 8ab or \( \frac{8c}{2} = 4c \) or \( \frac{8c}{4c} = 2 \)

  

**Lets start with some easier one’s and work our way up!!!!**

1. a) 3c + 4c =
   
b) 5y + y =
   
c) 8b – 3b =
   
d) 4a + a – 2a =
   
e) 3x^2 + 4x^2 =
   
f) 3ak + 5 – ak =

2. Now they get harder
   
a) 6gb + 2xy – 4gb =
   
b) 7 x 4f =
   
c) w x 4y x 3z =
   
d) 3p^2 x 2p =
   
e) 2ab x 4xb =
   
f) 9ab x 3cd x 4 ac =
   
g) \( \frac{4b}{2} = \)
   
h) \( \frac{6b}{2b} = \)
   
i) \( \frac{8pq}{4q} = \)
   
j) \( \frac{21cda}{7eda} = \)
   
k) 10b – 5 x 2c =
   
l) 8kn – 4 x n =

3. Don’t forget BODMAS
   
a) 3n x 2 + 1 x 3 =
   
b) 4b x 5a – 2ab =
   
c) 12 x 4b / 3 x b =
   
d) \( \frac{4m + 6m}{3} = \)
Unit Five: Tables & Graphs

Introduction

One of the most useful ways of presenting data is using either a table or graph. Much of industry now has computer technology and access to data is almost instantaneous. However, don’t be surprised to find workplaces that still refer to specification booklets with tables, charts and graphs. Extracting information such as melting points, cutting speeds, compression ratios and even imperial/metric conversions are common place. The following exercises are designed to assist you in developing these essential skills. Your tutor may provide you with computer based information at a later date.

TABLES

Exercises: (refer to the data found in the Reference Tables at the back of this section)

Refer Table 1 to answer the following questions

1. Find:
   a) \( 15^2 = \)   b) \( 77^2 = \)   c) \( 9^3 = \)   d) \( 34^3 = \)

2. Find \( n \) if:
   a) \( n^2 = 361 \) \( n = \)   b) \( n^2 = 4489 \) \( n = \)   c) \( n^3 = 493039 \) \( n = \)

3. Calculate the following:
   a) \( 15^3 + 28^2 = \)
   b) \( 12^3 + 55^3 = \)
   c) \( 30^2 - 11^2 = \)

Refer Table 2 to answer the following questions

4. Convert the following metric dimensions to imperial:
   (eg. \( 0.012\text{mm} = 0.01 + 0.002 = 0.0003937 + 0.0000787 = 0.0004724 \))
   a) \( 0.008\text{mm} = \)
   b) \( 1.5\text{mm} = \)
   c) \( 3.271\text{mm} = \)
Refer Table 3 to answer the following questions

5. Select a preferred tapping drill size and give the threads per inch (TPI) for the following Imperial screw threads:

   a) \( \frac{7}{32} \) " BSW  
      Tapping drill size = 
      TPI =

   b) \( \frac{1}{4} \) " UNC  
      Tapping drill size = 
      TPI =

   c) \( \frac{3}{8} \) " UNF  
      Tapping drill size = 
      TPI =
### Table 1  Squares and Cubes (1 – 100)

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<tr>
<th>n</th>
<th>n²</th>
<th>n³</th>
<th>n</th>
<th>n²</th>
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SA Independent Schools Targeted Programs Authority Inc
Maths for Industry 2006
Engineering 24
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<tr>
<td>1 3/4</td>
<td>5</td>
<td>39.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>45.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal Diameter</th>
<th>TPI</th>
<th>Tapping Drill mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16</td>
<td>32</td>
<td>4.00</td>
</tr>
<tr>
<td>7/32</td>
<td>28</td>
<td>4.70</td>
</tr>
<tr>
<td>1/4</td>
<td>26</td>
<td>5.40</td>
</tr>
<tr>
<td>5/16</td>
<td>22</td>
<td>6.80</td>
</tr>
<tr>
<td>3/8</td>
<td>20</td>
<td>8.30</td>
</tr>
<tr>
<td>7/16</td>
<td>18</td>
<td>9.80</td>
</tr>
<tr>
<td>1/2</td>
<td>16</td>
<td>11.00</td>
</tr>
<tr>
<td>9/16</td>
<td>16</td>
<td>12.70</td>
</tr>
<tr>
<td>5/8</td>
<td>14</td>
<td>14.00</td>
</tr>
<tr>
<td>3/4</td>
<td>12</td>
<td>16.50</td>
</tr>
<tr>
<td>7/8</td>
<td>11</td>
<td>19.50</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>22.50</td>
</tr>
<tr>
<td>1 1/8</td>
<td>9</td>
<td>25.50</td>
</tr>
<tr>
<td>1 1/4</td>
<td>9</td>
<td>29.00</td>
</tr>
<tr>
<td>1 1/2</td>
<td>8</td>
<td>34.50</td>
</tr>
</tbody>
</table>
Graphs

This is a column graph showing the number of apprentices employed by an Australian firm over a ten year period. Refer to this to answer the following questions.
From the graph determine:

1. The year when the lowest number of apprentices were employed:

2. The approximate increase in numbers of new apprentices gaining employment in 1990 compared to 1989:

3. The twelve-month period which showed the greatest decrease in apprentice employment:

4. The year of highest apprentice employment

Statistics of braking distances required to bring a car to rest on a good dry road are shown below:

<table>
<thead>
<tr>
<th>Speed km/h</th>
<th>30</th>
<th>45</th>
<th>60</th>
<th>75</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braking distance m</td>
<td>12</td>
<td>23</td>
<td>37</td>
<td>53</td>
<td>73</td>
</tr>
</tbody>
</table>

Draw a best-fit line graph of the statistics on the next page, plotting the braking distance (on Y-axis) against the speed (on X-axis). Check your graph with the tutor before answering the following questions:

1. At what speed would the breaking distance be 40m ?

2. If the breaking distance is 20m, what would the speed be ?

3. (a) Speed limits in the metro. area have been lowered from 60km/h to 50km/h. What is the drop in braking distance?

   (b) Do you think that this drop in breaking distance supports the lowering of the speed limit?  

   YES / NO

   Please explain

4. Extrapolate (make an informed estimate) of the breaking distance at a speed of 120km/h:
Skills & Application Task #3
(approx. 60 min.)
Skills & Application Task #3

NAME:_____________________________

Answer questions in the space provided and show working out where required.
Time allowance is 60 minutes.
TOTAL MARKS =

1. Write the Ratios in simplest form…
   a) 500g to 1kg
   b) $500 to $300
   c) 40mm to 60mm

2. The ratio between weights are 4:3. If the larger weight is 56kg find the weight of the smaller one?

3. Calculate the following..
   a) 10% of $14.00
   b) 45% of 1.6kg
   c) 27½% of 1.6kg

4. The town of Springfield has a population of 16800. The average number of persons per home is 2.4. You are considering opening up an Engineering business.
   a) If 3.5% of these houses are potential customers, how many homes should you work on?
   b) Figures suggest that for your business to succeed, the area must have a minimum of 150 potential customers. Is it a viable proposition?
   c) What about if a rival business started up. Would it still be viable? Explain…
   d) There are 3150 brick houses in Springfield. What percentage of homes is this?
   e) How many people don’t live in brick houses? (Careful !!!)

5. A drinking trough for horses is in the shape of a half cylinder, as shown in the sketch.
   Calculate: REMEMBER…\( V(\text{cylinder}) = \pi r^2 h \) and \( (\pi = 3.14) \)
   a) Its volume in cubic metres (m³) to 2dp’s.
   b) Its capacity in litres (L) to the nearest whole number.
6. a) Use the tan rule to calculate the angle $\theta^\circ$ : Note... $\tan \theta^\circ = \frac{\text{opposite}}{\text{adjacent}}$

![Diagram with sides 5 and 8]

b) The diagram shows a loading ramp for a truck. Using the given measurements find the height (h) to the nearest centimetre. Note... $\sin \theta^\circ = \frac{\text{opp}}{\text{hyp}}$

![Diagram with sides 4.5m and 15º]

7. Manipulate the following equations to isolate the variable in brackets:

a) $V = LBH.....(b)$

b) $D = \frac{m}{V}$

c) $V = \frac{LBH}{2}$

d) $\cos \theta = \frac{\text{adj}}{\text{hyp}}$
8. If we kept statistics of temperature at hourly intervals in a heat-treatment furnace, we might obtain a table of values as follows:

<table>
<thead>
<tr>
<th>Time hours</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature C</td>
<td>300</td>
<td>550</td>
<td>640</td>
<td>690</td>
<td>820</td>
<td>850</td>
<td>850</td>
<td>670</td>
</tr>
</tbody>
</table>

a) Looking at the table, estimate what the Temperature was after 3½ hours.
b) Would it be realistic to estimate that it took 2h 15min. to reach 555 C? Explain..
c) Draw a line graph of this data.

9. Simplify the following Algebraic equations:

   a) \(4a + a - 2a =\)  
   b) \(3x + 4x =\)  
   c) \(3ak + 5 - ak =\)  
   d) \(8gb + 2xy - 4gb =\)  
   e) \(7 \times 4m =\)  
   f) \(w \times 5y \times 3z =\)  
   g) \(\frac{4p}{2}\)  
   h) \(\frac{6a}{3a}\)  
   i) \(\frac{4pq}{4q}\)  
   j) \(\frac{14cda}{7eda}\)  
   k) \(10b - 3 \times 2c =\)  
   l) \(8kn - 4 \times n =\)

10. Simplify these Algebraic equations …(Don’t forget BODMAS)…

   a) \(5n \times 2 + 1 \times 3 =\)  
   b) \(4b \times 2a - 2ab =\)  
   c) \(7 \times 4b - 3 \times 2b =\)  
   d) \(4m + 6m - 9 =\)
ANSWERS

Unit One: Manipulating Formula & Equations
1. a) \( L = \frac{A}{B} \)  
   b) \( B = \frac{2A}{H} \)  
   c) \( H = \frac{V}{LB} \)  
   d) \( m = DV \)  
   e) \( H = \frac{2V}{LB} \)  
   f) \( r = \frac{3V}{4\pi} \)

Common plane figure formula
1. \( A = \pi (R^2 - r^2) \)
   \( = \pi (27.5^2 - 12.5^2) \)
   \( = \pi (600) \)
   \( = 1884\text{mm}^2 \)

2. Surface Area = 2 025.80\text{mm}^2  
   Volume = 8 575.90\text{mm}^3
3. Surface Area = 159.18\text{mm}^2  
   Volume = 110.32\text{mm}^3
4. Surface Area = 443.56\text{mm}^2  
   Volume = 551 886.4\text{mm}^3

Density Speed Time
1. 19.71g/cm\(^3\) or 1.97kg/m\(^3\)
2. 203 640sec
3. 1200m/s

Unit Two: Trigonometry

1. a) 0.47  
   b) 0.87  
   c) 0.17  
   d) 0.34  
   e) 0.60  
   f) 0.39  
   g) 0.99  
   h) 0.71
2. a) 10.39  
   b) 23.14  
   c) 3.08  
   d) 5.73
3. a) 40.83°  
   b) 18.41°
4. a) 42.51°  
   b) 35.66°  
   c) 41.41°  
   d) 15.07°
5. a) 48.59°  
   b) 70.53°  
   c) 21.20cm.  
   d) 24.42m  
   e) 82.91°  
   f) 40.91°

Unit Three: Percentage & Ratios
1. a) 4 kg.  
   b) $28  
   c) 4.16\text{L.}  
   d) $8.46  
   e) 1800  
   f) 0.34\text{km} or 340\text{m}
2. 10 480
3. 10 875 General Fiction, 1740 Classics, 435 Children’s, 1450 Non-fiction
4. a) $1.16  
   b) $153.26  
   c) $0.83  
   d) $137.71
5. a) $2187.50  
   b) $14687.50
6. $961.54
7. 148.5\text{L}
8. 64%
Ratios
1. iron = 1.25m  
   tin = 0.75m  
   carbon = 0.5m
2. gear ratio is 1 : 2

Unit Four: Algebra
1. a) 7c  
   b) 6y  
   c) 5b  
   d) 3a  
   e) 7x\(^2\)  
   f) 2ak + 5
2. a) 2gb + 2xy  
   b) 28f  
   c) 12wyz  
   d) 6p\(^3\)  
   e) 8b\(^2\) ax  
   f) 108a\(^2\) c\(^2\) bd  
   g) 2b  
   h) 3  
   i) 2p  
   j) 3c
k) 4bc  
   l) 2n\(^2\) k
3. 6n + 3  
   b) 18ab  
   c) 16b  
   d) 6m
Unit Five: Tables & Graphs

1. a) 225  b) 5 929  c) 729  d) 39 304
2. a) 19  b) 67  c) 79
3. a) 4 159  b) 168 103  c) 779
4. a) 0.000 315 0  b) 0.059 055 1  c) 0.128 779 5
5. a) 4.50mm TPI= 24  b) 5.10mm TPI= 20  c) 8.50mm TPI= 24

Graphs
1. 1996
2. Increase of approx. 35
3. 1993-1994
4. 1993
5. ~ 64km/h
6. ~ 41km/h
7. a) ~ 10m  b) Yes or No, depending on the explanation
8. ~ 120m
ELECTRICAL TECHNOLOGY

SACE STAGE 1 : SECTION 2

(FOR STUDENTS INTENDING TO PURSUE A CAREER IN INDUSTRY)
ELECTRICAL TECHNOLOGY  (Section 2)

Unit One:  Manipulating Equations  (15.4)

Unit Two:  Trigonometry  (8.1,8.2)

Unit Three:  Percentage  (2.3,2.6)

Unit Four:  Scientific Notation  (2.4,2.7)

Unit Five:  Basic Electrical  (15.6)
Unit One: Manipulating Equations

Introduction

In the work place we often use formulae to find an unknown variable. Sometimes it is useful to re-arrange these formulae so that a different variable can be calculated. This is called Manipulation of Equations.

For example, we already know that for Area of a triangle, \( A = \frac{L \times B}{2} \) that is \( A = \frac{LB}{2} \)

What if we know the area and length but need to find the breadth (B) ?

We manipulate the equation to isolate the required variable by performing **INVERSE** operations.

eg. \( A \times 2 = \frac{LB \times 2}{2} \) the inverse of dividing by 2 is multiplying by 2 (must do it to both sides!)

\[
2A = LB
\]

to isolate b we must do the opposite to L ;( that is divide by L)(both sides!)

\[
\frac{2A}{L} = \frac{LB}{L}
\]

… this leaves \( \frac{2A}{L} = B \)

Thus: \( B = \frac{2A}{L} \)

Working through the same process we also can also get \( L = \frac{2A}{B} \)

So;
\[
A = \frac{LB}{2} \quad \& \quad B = \frac{2A}{L} \quad \& \quad L = \frac{2A}{B}
\]

are the three possible manipulations.

Remember **PYTHAGORAS THEOREM**

\[
c^2 = a^2 + b^2 \quad \& \quad a^2 = c^2 - b^2 \quad \& \quad b^2 = c^2 - a^2
\]

are the three manipulations.
Exercises:

1. Manipulate the following equations to isolate the variable in brackets:

   a) \( A = LB \) …..(L)                b) \( A = \frac{BH}{2} \) …..(B)

   c) \( V = LBH \) …..(H)                d) \( D = \frac{m}{V} \) …..(m)

   e) \( V = \frac{LBH}{2} \) …..(B)      f) \( V = \frac{4\pi r}{3} \) …..(r)
Unit Two: Trigonometry

Introduction

Trigonometry is a branch of mathematics that deals with the relations between the angles & length of sides in a triangle. Let us consider a typical right-angled triangle:

![Right-angled triangle diagram]

The longest side is the **HYPOTENUSE** and it is always directly across from the right angle. The side that is directly across from angle $\theta$ is called the **OPPOSITE**. The side that is part of the right angle & angle $\theta$ is called the **ADJACENT**.

To calculate the length of an unknown side, we must have at least the length of one other side and a known angle (other than the right angle)

**This is called the sine ratio or rule**

The formula is $\sin \theta = \frac{\text{opposite length}}{\text{hypotenuse length}}$ or $\sin \theta = \frac{\text{opp}}{\text{hyp}}$

manipulating it to get length of opposite side: $\text{opp} = \text{hyp} \times \sin \theta$

**Here is an example showing how it can be used to calculate the length of the unknown side:**

(a scientific calculator with sin function is a necessity!)

eg.

\[
\begin{align*}
\text{5m} & \quad \text{35°} \\
? & \quad \text{opp} = 5 \times \sin 35° \\
\end{align*}
\]

so; \quad \text{opp} = 2.87 (rounded to 2.d.p.)

thus; the opposite side is 2.87 m

manipulating the sine rule, we can come up with: $\theta = \sin^{-1} \left( \frac{\text{opp}}{\text{hyp}} \right)$

Note: $\sin^{-1}$ is called **inverse of sine**
**Here is an example showing how it can be used to calculate the unknown angle:**

\[
\theta^\circ = \sin^{-1} \left( \frac{100}{170} \right)
\]

\[
\theta^\circ = \sin^{-1} (0.58823)
\]

(to do this on your calculator: shift \(\sin\) 0.58823)

\[
\theta^\circ = 36^\circ
\]

Exercises:

1. Use your calculator to find the value of the following rounded to two decimal places:
   a) \(\sin 28^\circ =\)  
   b) \(\sin 60^\circ =\)  
   c) \(\sin 10^\circ =\)  
   d) \(\sin 20^\circ =\)  
   e) \(\sin 37^\circ =\)  
   f) \(\sin 23^\circ =\)  
   g) \(\sin 84^\circ =\)  
   h) \(\sin 45^\circ =\)

2. Given the length of the hypotenuse and the angle \(\theta\), calculate the length of the opposite:
   a) 12 & 60°  
   b) 36 & 40°  
   c) 9 & 20°  
   d) 7 & 55°

3. Find the angle \(\theta\) in the following triangles (two d.p.’s):
   a)  
   b)
Now its time to learn about the other two rules….COSINE & TANGENT (cos & tan)

They are similar to the sine (Sin) rule but are used in different circumstances as shown below:

eg. Say you have the length of the hypotenuse and adjacent but not the opposite then we must use the cos rule

\[
\cos \theta^\circ = \frac{\text{adjacent}}{\text{Hypotenuse}}
\]

\[
\cos \theta^\circ = \frac{4}{5} = 0.8 \quad \text{(apply anti-cos or cos}^{-1}\text{)}
\]

Thus; \( \theta^\circ = 36.87^\circ \)

eg. If we have the length of the opposite and adjacent, we use the tan rule…. 

\[
\tan \theta^\circ = \frac{\text{opposite}}{\text{adjacent}}
\]

\[
\tan \theta^\circ = \frac{12.5}{18} = 0.69 \quad \text{(apply anti-tan or tan}^{-1}\text{)}
\]

Thus; \( \theta^\circ = 34.61^\circ \)

Exercises:

4. Use either the cos or tan rules to calculate angle \( \theta \):

a) ![Diagram a](image)

b) ![Diagram b](image)

c) ![Diagram c](image)

d) ![Diagram d](image)
5. Use the sin, cos, tan or any manipulation of these rules to find the unknown angle or length:

a) 

\[ \theta \quad \text{º} \]

\[
\begin{array}{c}
20\text{m} \\
15\text{m} \\
0^\circ \\
\end{array}
\]

b) 

\[ \theta \quad \text{º} \]

\[
\begin{array}{c}
12\text{m} \\
4\text{m} \\
0^\circ \\
\end{array}
\]

c) 

\[ ? \]

\[
\begin{array}{c}
40\text{cm} \\
32^\circ \\
\end{array}
\]

d) 

\[ ? \]

\[
\begin{array}{c}
20\text{m} \\
55^\circ \\
\end{array}
\]

e) 

\[ \theta \quad \text{º} \]

\[
\begin{array}{c}
30\text{cm} \\
26\text{cm} \\
20\text{mm} \\
\end{array}
\]

f) 

\[ \theta \quad \text{º} \]

\[
\begin{array}{c}
30\text{cm} \\
26\text{cm} \\
162\text{mm} \\
\end{array}
\]
Unit Three: Percentage

Introduction

Percentage is an intimate and important part of all Electro. Technology courses. We will look at how to calculate % and apply it to different situations.

Percentages can be written as decimals by simply dividing by 100

\[
\text{eg. } 25\% = \frac{25}{100} = 0.25 \quad \text{or} \quad 6\% = \frac{6}{100} = 0.06
\]

\[
\text{eg. } 12\frac{1}{2}\% = \frac{12.5}{100} = 0.125
\]

so, to find 25% of $40 we just multiply it by 0.25 \quad \text{ie} \quad $40 \times 0.25 = $10

Exercises:

1. a) 10% of 40kg \hspace{2cm} b) 35% of $80
   c) 6\frac{1}{2}% \text{ of } 64\text{L} \hspace{2cm} d) 24\% \text{ of } $35.25
   e) 2\frac{1}{4}\% \text{ of } 80\ 000 \hspace{2cm} f) 17\% \text{ of } 2\text{km}

2. If 52,400 Collingwood supporters went to the AFL grand final and 80% were intoxicated then how many were sober?

3. 75% of books in a book shop are under the heading General Fiction, 12% were Classics, 3% were Children’s Books and 10% Non-fiction. If there were 14,500 books in the shop, how many of each kind were there?
4. Calculate the following, rounded to the nearest cent:
   a) 8% of $14.45  
   b) 42% of $364.90  
   c) 2½% of $33.33  
   d) 24¼% of $567.88

5. When Eddie takes his annual leave he is paid one month’s salary of $12 500 plus 17½% loading (extra)
   a) How much is the loading?
   b) What is the total he receives?

6. Piper’s annual salary is $50 000. What is her weekly salary, correct to the nearest cent?

7. A big blue V8 car’s fuel consumption is 16.5 litres/100km. How much fuel is used on a journey of 900 km?

8. If Port Adelaide kicked 19.11 in a grand final against the Adelaide Crows 12.8, what percentage of Port’s score did the Crows kick? (NB In this example 19.11 does not mean a decimal!)
DIRECTED INVESTIGATION #2

(approx. 120 min.)
Directed Investigation #2

NAME: __________________________

MEASURING HEIGHTS USING A CLINOMETER

TASK

First you will need to find the length of one of your normal paces. This can be done by counting the number of paces over a 20m distance and finding the average length of one pace.

Now that you can measure lengths on the ground and angles of elevation reasonably accurately, (using a clinometer), you can use them to find estimates of the heights of some tall objects around the school. The information that you need to gather is shown in the diagram below.

OBJECTS:
Take measurements for the heights of the following six objects:-

1. School hall
2. Small tree
3. Large tree
4. Stobie pole
6. Another reasonably tall object.

DATA:
Record your data in a table like the one below.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>DISTANCE</th>
<th>ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>School hall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small tree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etc…</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paces</td>
<td>Metres</td>
<td></td>
</tr>
</tbody>
</table>
QUESTIONS:

1. With the aid of a neat, clearly labelled diagram, describe how the clinometer works.

2. Describe how you found the average length of your pace – show your calculations.

3. Show the measurements you took in a table as shown above.

4. Using trigonometry calculate the height of the triangle (in the diagram) for each object. Show all calculations.

5. These answers do not give the true height of the objects yet. What single last measurement must you consider? Why? How do you use it to find the heights from your results? (If you’re not sure of the answers to these questions have another good look at the diagram!)

6. Find the measurement concerned in question 5 and use it to calculate your estimate of the height of each object. Show your answers clearly.

7. How accurate do you think your answers are? Are they to the nearest cm, m, 2m, 10m? Explain your reasoning.

8. When you did your measurements you had to make sure certain conditions were satisfied. What sort of things did you have to be careful of in the practical situation so that the heights could be found using right-angled triangle methods?

9. Describe situations where you could not find the height of an object using this method.
PROJECT

(approx. 180 min.)

NB A suitable project will depend on the interests of your students, but some examples are available from The Mathematical Association of Mathematics Inc publication, '500 Mathematical Investigations for Stage 1 Mathematics SACE'
A completed project should include:

- an introduction that outlines the problem to be explored, including its significance, its features, and the context;
- the method of solution in terms of the mathematical model or strategy to be used;
- the appropriate application of the mathematical model or strategy, including:
  - the generation or collection of relevant data and/or information, including details of the process of collection;
  - mathematical calculations and results, and appropriate representations;
  - the analysis and interpretation of results;
  - reference to the limitations of the original problem as well as appropriate refinements and/or extensions;
- a statement of the solution and outcome in the context of the original problem;
- appendixes and bibliography as appropriate.

Your report should be structured to include:

- Introduction
- Mathematical Procedures
- Analysis/Discussion
- Conclusion

Note: Your report should be written in the form “The analysis …..” rather than “When I analysed……”, or “When you analyse…….”

Performance will be assessed on the extent to which the following are demonstrated:

- Mathematical skills and understandings (without electronic technology)
- Mathematical skills and understandings (with electronic technology)
- Analysis and interpretation of results and information
- The communication of mathematical information
- The organisation and presentation of material
- The ability to work independently

Introduction…
Unit Four: Scientific Notation

Introduction

As you are already aware, numbers can be very large or very small. To write these numbers and save space, we use Scientific Notation.

eg. one million (1 000 000) can be written as 1.0 x 10^6 (with the 6 meaning move the decimal in the first number over to the right six times)

Here are some other examples: 3 000 is 3.0 x 10^3 or 325 000 is 3.25 x 10^5

If the number is really small, we use Scientific Notation also

eg. one millionth (0.000001) can be written as 1.0 x 10^-6 (with the − 6 meaning move the decimal in the first number over to the left six times)

Here are some other examples 0.0004 is 4.0 x 10^-4 or 0.0085 is 8.5 x 10^-3

**notice that the number at the front is always between 1 and 10**

When dealing with electricity we often use terms such as milliamps, microamps, kilovolts etc. Because of this we use scientific notation wherever possible. Eg. one milliamp is 1.0 x 10^-6 Amps.

Exercises:

1. Write the following numbers in scientific notation:
   a) 23 000 000
   b) 5 543 000
   c) 7 000 000 000 000
   d) 123 300 000
   e) 0.0004
   f) 0.0000000043

2. Write the following as actual numbers:
   a) 1.2 x 10^7
   b) 4.554 x 10^3
   c) 3.2 x 10^-4
   d) 1.0101 x 10^-3
Topic Five: Basic Electrical

Introduction:

Before we start some mathematical problems dealing with electricity, it is important that we understand some of the basic terminology used. Be aware that electrical trade exams will require a deeper understanding of electronics that should be covered in general science.

Electricity is the movement of charged particles such as electrons and protons.

A useful analogy is to think of it like water running in a pipe
If we increase the force pushing it….the current increases and more water flows.
Now if we start to block it up, there is increased resistance to flow.

The ELECTROMAGNETIC FORCE (EMF) is the force that pushes the current around the circuit. This is a bit like the pump in our pipe analogy.

The POTENTIAL DIFFERENCE supplied by the battery is measured in VOLTS (V).

The CURRENT (I) is the flow rate of electric charge and is measured in Coulombs/second, this unit is called an Ampere or AMP (A).

The extent to which a material impedes current flow is called RESISTANCE (R) and it is measured in units called OHMS (Ω).

All of these properties are inter-related and can be expressed in a formula called Ohm’s Law

Voltage = Current x Resistance

\[ V = I \times R \]

This formula can easily be manipulated to \[ I = \frac{V}{R} \] or \[ R = \frac{V}{I} \]

Example:
If we have a current of 5 A and a total resistance of 10Ω, then the voltage can be calculated

\[ V = I \times R \] thus; \[ V = 5 \times 10 = 50 \text{ volts.} \]

Exercises:

1. If we are using a 12 V battery, use Ohm’s law to calculate the current if the resistance is:
   a) 2Ω  
   b) 36Ω  
   c) 22.5Ω
2. If we apply a resistance of \( 7 \Omega \) to a circuit carrying a current of 0.5 A, what is the voltage of the battery?

3. Look at the circuit diagrams below and work out the missing value.

a) 

![Circuit Diagram A]

b) 

![Circuit Diagram B]

c) 

![Circuit Diagram C]
Skills & Application Task #3
(approx. 60 min.)
Skills & Application Task #3

NAME: _______________________________

Answer questions in the space provided and show working out where required.
Time allowance is 60 minutes.

TOTAL MARKS =

1. Write the Ratios in simplest form.
   a) 500g to 1kg
   b) $500 to $300
   c) 40mm to 60mm

2. The ratio between two weights is 4:3. If the larger weight is 56kg find the weight of the smaller one?

3. Calculate the following..
   a) 10% of $14.00
   b) 45% of 1.6kg
   c) 27½% of 1.6kg

4. The town of Springfield has a population of 16800. The average number of persons per car is 2.4. You are considering opening up an Auto-electrical business exclusively for Fords.
   a) If Fords make up 35% of the town’s cars, how many Fords are there?
   b) Figures suggest that for your business to succeed, the area must have a minimum of 1000 potential customers. Is it a viable proposition?
   c) What about if a rival Ford business started up. Would it still be viable? Explain…
   d) There are 3 150 Holdens in Springfield. What is the percentage of Holdens in the town?
   e) How many people travel in cars other than Fords or Holdens? (Careful !!!)

5. A drinking trough for horses is in the shape of a half cylinder, as shown in the sketch. Calculate: REMEMBER…\( V(\text{cylinder}) = \pi r^2 h \)

   a) Its volume in cubic metres (m\(^3\)) to 2dp’s.
   b) Its capacity in litres (L) to the nearest whole number.
6. a) Use the tan rule to calculate the angle $0^\circ$: Note...\[ \tan \theta = \frac{\text{opposite}}{\text{adjacent}} \]

\[ \begin{align*} & \quad \theta^\circ \\ \text{opp} & = 5 \\ \text{adj} & = 8 \end{align*} \]

b) The diagram shows a loading ramp for a truck. Using the given measurements find the height (h) to the nearest centimetre. Note...\[ \sin \theta = \frac{\text{opp}}{\text{hyp}} \]

7. Manipulate the following equations to isolate the variable in brackets:

a) \[ V = Lbh \ldots (b) \]

b) \[ D = \frac{m}{V} \ldots (V) \]

c) \[ V = \frac{Lbh}{2} \ldots (L) \]

d) \[ \cos \theta = \frac{\text{adj}}{\text{hyp}} \ldots (\text{hyp}) \]
8. If we kept statistics of temperature at hourly intervals in a heat-treatment furnace, we might obtain a table of values as follows:

<table>
<thead>
<tr>
<th>Time hours</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature°C</td>
<td>300</td>
<td>550</td>
<td>640</td>
<td>690</td>
<td>820</td>
<td>850</td>
<td>850</td>
<td>670</td>
</tr>
</tbody>
</table>

a) Looking at the table, estimate what the temperature was after 3½ hours.

b) Would it be realistic to estimate that it took 2h 15min. to reach 555°C? Explain.

9. Write the following numbers in scientific notation:
   a) 2 300 000
   b) 5 522 000
   c) 7 000 000 000 000
   d) 468 300 000
   e) 0.0007
   f) 0.000000053

10. Write the following as actual numbers:
    a) 5.2 x 10³
    b) 4.554 x 10⁴
    c) 3.2 x 10⁻⁴
    d) 1.0101 x 10⁸

11. If we are using a 24 V battery, use Ohm’s law (V = I R), to calculate the current if the resistance is: (2dp’s)
    a) 2Ω
    b) 36Ω
    c) 22.5Ω

12. If we apply a resistance of 14Ω to a circuit carrying a current of 0.8 A, what is the voltage of the battery? (1dp)
ANSWERS

Unit One: Manipulating Equations
1. a) \( L = \frac{A}{B} \)  
b) \( B = \frac{2A}{H} \)  
c) \( H = \frac{V}{LB} \)  
d) \( m = DV \)  
e) \( B = \frac{2V}{LH} \)  
f) \( r = \frac{3V}{4\pi} \)

Unit Two: Trigonometry
1. a) 0.47  
b) 0.87  
c) 0.17  
d) 0.34  
e) 0.60  
f) 0.39  
g) 0.99  
h) 0.71

2. a) 10.39  
b) 23.14  
c) 3.08  
d) 5.73

3. a) 40.83°  
b) 18.41°

4. a) 42.51°  
b) 35.66°  
c) 41.41°  
d) 15.07°

5. a) 48.59°  
b) 70.53°  
c) 21.20cm  
d) 24.42m  
e) 82.91°  
f) 40.91°

Unit Three: Percentage
1. a) 4 kg.  
b) $28  
c) 4.16L.  
d) $8.46  
e) 1800  
f) 0.34km or 340m

2. 10 480

3. 10 875 General Fiction, 1740 Classics, 435 Children’s, 1450 Non-fiction.

4. a) $1.16  
b) $153.26  
c) $0.83  
d) $137.71

5. a) $2187.50  
b) $14687.50

6. $961.54

7. 148.5L.

8. 64%

Unit Four: Scientific Notation
1. a) \( 2.3 \times 10^7 \)  
b) \( 5.543 \times 10^6 \)  
c) \( 7.0 \times 10^{15} \)  
d) \( 1.233 \times 10^8 \)  
e) \( 4.0 \times 10^{-4} \)  
f) \( 4.3 \times 10^{-9} \)

2. a) 12 000 000  
b) 4 554  
c) 0.00032  
d) 0.000001

Unit Five: Basic Electrical
1. a) 6A  
b) 0.33A  
c) 0.53A

2. 3.5V

3. a) 12A  
b) 3Ω  
c) 100V
SECTION FOUR:

Other Resources

EdServe - *Maths at Work*
Permission has been obtained from EdServe to reproduce the material included in this resource. Go to [www.edserve.com.au](http://www.edserve.com.au) for further information about this resource.

Ian Lowe - *Mathematics at Work* (CD-ROM)

List of useful websites
RESOURCES

Examples of resources available are:

- **Maths at Work**
  Permission has been obtained from EdServe to reproduce the following material which is available at www.edserve.com.au.

- **People Count: Numeracy for Adults**
- **Mathematics at Work**
  CD-ROMs produced by Ian Lowe

- List of useful websites:
  - EDServe www.edserve.com.au
  - The Australian Association of Mathematics Teachers Inc www.aamt.edu.au
  - The Mathematical Association of Victoria www.mav.vic.edu.au
  - The Mathematical Association of South Australia Inc. www.masa.on.net
  - Phoenix Education www.phoenixeduc.com
  - Curriculum Corporation, Maths 300 www.curriculum.edu.au/maths300/index.htm
  - Nrich www.nrich.maths.org www.nrich.maths.org/discus
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- **People Count: Numeracy for Adults**
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- **Mathematics at Work**

- List of useful websites:
  - The Australian Association of Mathematics Teachers Inc  [www.aamt.edu.au](http://www.aamt.edu.au)
  - The Mathematical Association of Victoria  [www.mav.vic.edu.au](http://www.mav.vic.edu.au)
  - The Mathematical Association of South Australia Inc.  [www.masa.on.net](http://www.masa.on.net)
  - Phoenix Education  [www.phoenixeduc.com](http://www.phoenixeduc.com)
  - Nrich  [www.nrich.maths.org](http://www.nrich.maths.org)  [www.nrich.maths.org/discus](http://www.nrich.maths.org/discus)
Resources

Teacher's Handbook

Maths at Work

Teacher's Handbook CD

Vocational Communication
Activity 66

Context

You work for a newspaper and have to understand how numerical data is listed for a number of sports.

Cricket

1. A team needs 261 to win. There are 27 overs to play. How many runs per over are needed?

2. A batter scores 66 runs off 39 balls. What is the strike rate?

3. The ball is travelling at 140 km/hr how long is the reaction time for the batsman to make a decision. The pitch is 22 yards long. To convert yards to metres, multiply by 0.9144.

Football

Rugby League

1. When New South Wales and Queensland play the State of Origin league series, many of the players for Queensland come from the one club. Complete the following table and discuss as a group the impact on the club, of playing for State of Origin before and after 2000. After 2000, the rules for interchange of players changed so that a maximum of 12 changes could occur.

<table>
<thead>
<tr>
<th></th>
<th>Before State of Origin</th>
<th>After State of Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Played</td>
<td>Won</td>
</tr>
<tr>
<td>2000</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>2001</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>2002</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>2003</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Some sports use a draft system to redistribute players and sign contracts. At the end of a season, those players released by clubs are placed on a draft list. The team that finishes last has first choice of selecting players from the draft list. The team that finishes second last has second choice and so on. The aim is to have more even competition. Some sporting bodies do not use such a system because of concerns over restraint of trade and freedom to contract. If there are 14 clubs and only 9 players on the draft list, and each club chooses one player, which clubs will not have a turn at choosing a player?

3. A football player is offered a contract of $125,000 per annum. He is expected to play 23 games in a season, plus semi finals, finals and representative games. It is estimated he will play 26 games in the year. How much, on average, does he earn per game?

4. The player has also been offered a sponsorship of $16,500 a year. He does not want to earn more than $140,000 because of salary caps. Should he accept the sponsorship?
People Count:
Numeracy for Adults

Ian Lowe
Published by Ian Lowe (Australia)
2003, 960 pp PDF on CD-R plus 327 Excel spreadsheets
Macintosh and Windows

This interactive CD-ROM provides explanations of primary and lower secondary mathematics topics for those wanting to 'brush up' on concepts and skills. Each of the 90 topics includes explanatory text followed by related practice questions (with solutions) and links to interactive activities which illustrate the ideas presented and provide opportunities for skills practice. Concept maps show links between related topics and allow on-screen navigation, and there are also links from mathematical terms to their definitions in an extensive glossary. Written with pre-service teachers in mind, this CD would also be useful as a reference resource for teachers and as a self-paced learning tool for older students and adults.

Note: requires Adobe Reader (supplied) and Microsoft Excel
Members $40.00 (rp $50.00) #LOW100
Discounts for multiple copies

Sample files are available here (580 K Zip file)
Mathematics at Work

Ian Lowe
Published by AAMT (Australia)
PDF on CD-R + spreadsheets, etc.

Years 9–12
• CD-ROM
• Modelling/ Applied mathematics
• Student material
• Technology

This classic Australian applied mathematics text has been updated and now published as PDF on CD-ROM. This substantial volume, which includes spreadsheets, contains a wealth of rich ideas, immediately useful investigations, and brilliant resource material. Its relevance to courses around the country is enhanced — you can select the sections relevant to your students. The read-only version works on-screen like any other CD-ROM. If you upgrade to a printing licence, you get a printable version that you can print as many copies as you like — plus, with a printing licence you can then purchase student copies (fully printable).

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- middle years numeracy and maths
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- VET courses
- TAFE courses and more.

Mathematics at Work (CD-ROM)
Ian Lowe, published by AAMT

This classic Australian maths text has been updated and now published as PDF on CD-ROM. This substantial volume, including spreadsheets, contains a wealth of rich ideas, immediately useful investigations, and brilliant resource material. It is very flexible and can be used for a wide range of courses and students - select what interests your students and your curriculum, whether that be VCAL, middle years numeracy, VCE Foundation maths, etc.
The read-only version works on screen only, whereas the printing version enables you to print as many copies as you like - plus with a printing licence you can then purchase student copies that are fully print versions.
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#1404 Printing licence version CD-ROM: $55.00 members, $68.75 non-members
#1405 Student version CD-ROM: $16.50 members, $20.63 non-members

Measuring Up: An interactive multimedia resource for numeracy learners. (Multimedia CD-ROM)
Beth Marr and Dave Tout, Protea Textware

Australian produced, Measuring Up is designed for teaching and applying metrics and measurement to real-life contexts through the learning areas of fractions, decimals, reading scales and metric units. Applications are based on a wide range of everyday situations, including shopping, cooking and sport. Includes both the maths in context activities and the supporting teaching exercises and explanations.
Measuring Up is self-paced with instant verbal feedback, and uses spoken instructions and a wide range of multimedia effects. It provides links from the applied assessment tasks to the teaching and practice activities.
#1461D
Single User: $126.50
5 Computers: $253.00
10 Computers: $379.50
Site Licence (10+ computers): $506.00
Additional CD-ROMs: $27.50 each
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August 8th - 25th City & Country
(please note this is a link to a SSABSA web page)

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