2001 HSC Specimen Paper

General Mathematics
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Introduction

This booklet contains the specimen examination paper for the 2001 Higher School Certificate examination in General Mathematics. A mapping grid is also included, showing how each question in the examination relates to the syllabus outcomes and content, and to the performance bands.

The specimen paper shows the format of the New HSC examination. It has been printed on A4 paper and side-stapled to make it convenient for use in schools. Actual examination papers will be produced as A4 booklets. All New HSC papers will be printed on white paper.

The 2001 HSC specimen papers have been produced in accordance with the Board’s Principles for Setting HSC Examinations in a Standards-Referenced Framework, published in Board Bulletin Volume 8 Number 9 (Nov/Dec 99). Questions are closely related to the outcomes of the course, and the paper as a whole is structured to allow for appropriate differentiation of student performance at all levels on the performance scale.

The papers have been designed so that students have a clear understanding of what they are required to do in each question and in working through the paper. Instructions have been standardised, and the demands of the questions have been made explicit. Key words in questions, such as ‘discuss’, ‘analyse’, and ‘explain’, have been used consistently in accordance with the glossary published in the Board’s Assessment Support Document.

This specimen paper is an example of the type of examination that could be prepared within the examination specifications in the General Mathematics syllabus. Examinations will be based on the syllabus, and will test a representative sample of syllabus outcomes. Therefore, the range and balance of outcomes tested in HSC examinations in 2001 and subsequent years may differ from those addressed in the specimen paper.

The mapping grid is an important feature of the development of the examination. It aids in ensuring that the examination as a whole samples a range of content and outcomes, and allows all students the opportunity to demonstrate their level of achievement. Where courses have components in the examination other than written papers, the grid indicates the wider range of outcomes that are assessed by including these other components.

There are a number of points to note in considering the General Mathematics specimen paper:

- The examination is now out of 100 marks rather than 92. The length of the paper remains two and a half hours. Section I contains 22 multiple-choice questions and Section II contains six 13-mark questions. This structure should assist students to gauge the length of time to spend on questions.
- The number of question parts and sub-parts in the questions in Section II may vary, both from question to question and from year to year.
Candidates may use a calculator, including a graphics calculator, provided it satisfies the criteria published in *Official Notice BOS 19/00, Board Bulletin Vol 9, No 3*. The General Mathematics specimen examination has been constructed so that students with scientific or graphics calculators are equally able to access all questions.
This is a mapping grid for the HSC Specimen Examination in General Mathematics. It details the marks allocated, the syllabus content, and the targeted performance bands for each item in the examination. The grid helps candidates understand the performance outcomes and the difficulty level of the questions.

<table>
<thead>
<tr>
<th>Question</th>
<th>Marks</th>
<th>Content</th>
<th>Syllabus outcomes</th>
<th>Targeted performance bands</th>
</tr>
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<tr>
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<td>1</td>
<td>AM1 : Basic algebraic skills</td>
<td>P2</td>
<td>2 – 3</td>
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<tr>
<td>2</td>
<td>1</td>
<td>M4 : Right-angled triangles</td>
<td>P6</td>
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<tr>
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<td>1</td>
<td>M7 : Spherical geometry</td>
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</tr>
<tr>
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<td>1</td>
<td>AM2 : Modelling linear relationships</td>
<td>P5</td>
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<tr>
<td>6</td>
<td>1</td>
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<td>P4</td>
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<tr>
<td>7</td>
<td>1</td>
<td>DA2 : Data collection and sampling</td>
<td>P9</td>
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</tr>
<tr>
<td>8</td>
<td>1</td>
<td>M3 : Similarity of two-dimensional figures</td>
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</tr>
<tr>
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<td>1</td>
<td>PB1 : The language of chance</td>
<td>P10</td>
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<tr>
<td>10</td>
<td>1</td>
<td>DA7 : Correlation</td>
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<td>11</td>
<td>1</td>
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<td>1</td>
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<tr>
<td>16</td>
<td>1</td>
<td>FM4 : Credit and borrowing</td>
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<td>H6</td>
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<td>18</td>
<td>1</td>
<td>DA7 : Correlation</td>
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<td>19</td>
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<td>PB3 : Multi-stage events</td>
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<td>DA6 : The normal distribution</td>
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<td>Content</td>
<td>Syllabus outcomes</td>
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<td>27(b)(ii)</td>
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<td>DA6: The normal distribution</td>
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<td>4 – 6</td>
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<tr>
<td>28(b)(i)</td>
<td>1</td>
<td>FM2: Investing money</td>
<td>P2</td>
<td>2 – 3</td>
</tr>
<tr>
<td>28(b)(ii)</td>
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<td>FM5: Annuities and loan repayments</td>
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<tr>
<td>28(b)(iv)</td>
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<td>FM5: Annuities and loan repayments</td>
<td>H5, H8, H11</td>
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</tr>
<tr>
<td>28(b)(v)</td>
<td>3</td>
<td>FM5: Annuities and loan repayments</td>
<td>H5, H8, H11</td>
<td>2 – 6</td>
</tr>
</tbody>
</table>
Sample marking guidelines for General Mathematics

The following marking guidelines have been developed for selected questions from the 2001 HSC Specimen Examination in General Mathematics. These guidelines indicate the approach that would be taken to marking questions.

For each question, the following are typically included:
1. The syllabus outcomes that are targeted by the question.
2. The assessment rubric from the specimen paper, where there is one, listing the set of general criteria that are used to assess responses.
3. The marking guidelines, which show the criteria to be applied to responses along with the marks to be awarded in line with the quality of the responses. For extended-response questions, performance is described at a number of levels of performance, each covering a range of marks.
4. A sample answer or some points that answers might include. Sample answers indicate the scope and depth of treatment expected, and are not intended to be prescriptive. Similarly, the points that could be included in answers are not intended to be an exhaustive list, but rather an indication of the considerations that students could include in their responses.

Marking guidelines will generally require some refinement at the Marking Centre to take account of unanticipated responses that students present. For essay-type questions, the standard described at each mark range will be made clear during pilot-marking by the selection of sample scripts.

In a standards-referenced framework, examination questions are closely linked to syllabus content and outcomes. Expectations of the question are to be clear in the wording of the question. Marking guidelines will be developed at the same time as the examination questions, by examination committees. The development of marking guidelines will be guided by the Board’s Principles for Developing Marking Guidelines Examinations in a Standards-Referenced Framework, published in Board Bulletin Volume 9 Number 3 (May 2000).
Sample Marking Guidelines – General Mathematics

Question 26 (13 marks)

(a) Bettina paid $20 000 for a new car in 1994. The table shows the value of the car, at the end of each year, over five years.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 500</td>
</tr>
<tr>
<td>2</td>
<td>14 500</td>
</tr>
<tr>
<td>3</td>
<td>12 500</td>
</tr>
<tr>
<td>4</td>
<td>10 400</td>
</tr>
<tr>
<td>5</td>
<td>9 000</td>
</tr>
</tbody>
</table>

(i) On the graph provided on page 27, plot the values of the car over the five years.

Outcome assessed: P4

MARKING GUIDELINES

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctly plots the required points</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:
(ii) Which of the four curves shown on the graph provided on page 27, (A or B or C or D) best models the depreciation of Bettina’s car? Give a reason for your answer.

**Outcomes assessed: H5, H8**

**MARKING GUIDELINES**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Correctly identifies curve that best models the depreciation of Bettina’s car (Curve B) and gives a valid reason</td>
<td>2</td>
</tr>
<tr>
<td>• Correctly identifies curve that best models the depreciation of Bettina’s car (Curve B)</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:

Curve B best models the depreciation of Bettina’s car as all five points are on or close to this curve.

(iii) Use the declining balance formula for depreciation, and the percentage depreciation rate from your answer to part (a) (ii), to predict the value of Bettina’s car when it is ten years old. Give your answer correct to the nearest hundred dollars.

**Outcomes assessed: H5, H8**

**MARKING GUIDELINES**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
</table>
| • Chooses the declining balance formula for depreciation and substitutes the correct values for \( V_0, r \) and \( n \)  
• Evaluates their expression for the value of Bettina’s car  
• Correctly rounds their answer for the value of Bettina’s car to the nearest hundred dollars | 3     |

Any two of the following:

- Chooses the declining balance formula for depreciation and substitutes the correct values for \( V_0, r \) and \( n \)
- Evaluates their expression for the value of Bettina’s car
- Correctly rounds their answer for the value of Bettina’s car to the nearest hundred dollars

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
</table>
| • Chooses the declining balance formula for depreciation and substitutes the correct values for \( V_0, r \) and \( n \)  
• Evaluates their expression for the value of Bettina’s car  
• Correctly rounds their answer for the value of Bettina’s car to the nearest hundred dollars | 1     |
Sample answer:
The value of Bettina’s car when it is ten years old would be

\[ S = V_0 \times (1 - r)^n \]

\[ = $20,000 \times (1 - 0.15)^{10} \]

\[ = $20,000 \times (0.85)^{10} \]

\[ = $3,937.49 \]

\[ = $3,900 \text{ (to the nearest hundred dollars)} \]
(b) The histograms and box-and-whisker plots below are based on the ages of the winners of the Best Actor and Best Actress awards for the years 1928 to 1988. Study the histograms and box-and-whisker plots carefully and then answer the questions that follow.
(i) Determine the interquartile range for the ages of the winners of the Best Actress award.

**Outcome assessed: H9**

**MARKING GUIDELINES**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gives the correct interquartile range (11) or a correct numerical expression for the interquartile range (38 – 27)</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:

Interquartile range = Q3 – Q1

= 38 – 27

= 11

(ii) Compare and contrast the displays for the Best Actress and Best Actor awards by examining:

• the shape and skewness of the distributions; and

• measures of location and spread.

**Outcomes assessed: H4, H9**

**MARKING GUIDELINES**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Identifies, using appropriate terminology, four aspects that are similar or different for the displays</td>
<td>4</td>
</tr>
<tr>
<td>• Identifies, using appropriate terminology, three aspects that are similar or different for the displays</td>
<td>3</td>
</tr>
<tr>
<td>• Identifies, using appropriate terminology, two aspects that are similar or different for the displays</td>
<td>2</td>
</tr>
<tr>
<td>• Identifies, using appropriate terminology, an aspect that is similar or different for the displays</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:

The displays have similar overall shape, as indicated by their positive skew; and similar spread, as shown by their ranges or interquartile ranges. The main difference in the displays is their measures of location. The median age for Best Actor awards is significantly higher than that for Best Actress awards.

(iii) Use your answer to part (ii) either to support or to reject the statement:

‘Essentially the two sets of data have a similar shape, spread and location and this shows that, as a group, there is little difference between the ages of the actresses and the actors receiving these awards.’
Outcomes assessed: H4, H11

MARKING GUIDELINES

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rejects the statement based on the significant differences in median (or mean or modal) ages of the actresses and actors receiving the awards</td>
<td>2</td>
</tr>
<tr>
<td>• Supports the statement, based on the similarities in the shape and spread</td>
<td>1</td>
</tr>
</tbody>
</table>

Sample answer:
This statement is not true. Although the two sets of data have a similar shape and spread, their measures of location are very different. The mean and median ages of the actors winning these awards are significantly higher than those of the actresses.
General Instructions
• Reading time – 5 minutes
• Working time – 2\frac{1}{2} hours
• Write using blue or black pen
• Calculators may be used
• Write your Centre Number and Student Number at the top of page 27
• A Formulae Sheet is provided at the back of this paper

Section I Pages 2 – 13
Total marks (22)
• Attempt Questions 1 – 22
• Allow about 30 minutes for this section

Section II Pages 14 – 27
Total marks (78)
• Attempt Questions 23 – 28
• Allow about 2 hours for this section
Section I

Total marks (22)
Attempt Questions 1 – 22
Allow about 30 minutes for this section

Use the multiple-choice answer sheet.
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample  \[ 2 + 4 = (A) 2 \quad (B) 6 \quad (C) 8 \quad (D) 9 \]

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

\[ \text{correct} \]
1  Use the formula \( v = u + at \) to find the value of \( v \) if \( u = 8 \), \( a = 10 \) and \( t = 5 \).

   (A) \( v = 42 \)
   (B) \( v = 58 \)
   (C) \( v = 90 \)
   (D) \( v = 113 \)

2  The size of a television is measured as the length of the screen’s diagonal, to the nearest centimetre.

   Use Pythagoras’ theorem to calculate the size of this television.

   \[
   \text{NOT TO SCALE}
   \]

   (A) 38 cm
   (B) 47 cm
   (C) 51 cm
   (D) 60 cm

3  Players in a sports competition are asked to write down their age last birthday.

   Which of the following best describes these data?

   (A) Discrete
   (B) Stratified
   (C) Categorical
   (D) Continuous

4  Moranbah has latitude 22°S and longitude 148°E. Mitchell is due south of Moranbah.

   Which of the following could be the latitude and longitude of Mitchell?

   (A) 18°S 148°E
   (B) 22°S 144°E
   (C) 22°S 152°E
   (D) 26°S 148°E
The graph shows tax payable against taxable income, in thousands of dollars.

Using the graph, the tax payable on a taxable income of $36 000 is closest to

(A) $8000.
(B) $8100.
(C) $8200.
(D) $8300.
The graph shows the cost of sending parcels of different masses.

Eloise wants to send four parcels each weighing 400 g to her friend.

How much would be saved by sending them together as one parcel, rather than separately?

(A) $1.00
(B) $3.00
(C) $3.50
(D) $4.50
The table shows the number of students in each Year at White High School.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>102</td>
</tr>
<tr>
<td>8</td>
<td>120</td>
</tr>
<tr>
<td>9</td>
<td>105</td>
</tr>
<tr>
<td>10</td>
<td>116</td>
</tr>
<tr>
<td>11</td>
<td>87</td>
</tr>
<tr>
<td>12</td>
<td>70</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
</tr>
</tbody>
</table>

100 students from the school are to be surveyed.

On a proportional basis, how many Year 8 students should be surveyed?

(A) 6  
(B) 20  
(C) 100  
(D) 120  

A pole 15 metres high casts a shadow 25 metres long.

In the scale diagram, which point (A or B or C or D) represents the end of the shadow?
A spinner is to be designed so that the probability of the arrowhead stopping in the blue region is twice that of stopping in the green region.

Which of the following designs meets this requirement?

(A) Blue Green
    (B) Green Blue
    (C) Blue Green
    (D) Blue Green

A line of fit, $l$, is drawn through the points as shown.

What is the correct equation for line $l$?

(A) $y = \frac{x}{4} + 3$
(B) $y = \frac{x}{4} - 3$
(C) $y = 4x - 12$
(D) $y = 4x + 3$
A field is bordered by three straight sides and a river, as shown.

Which expression for the area of this field, in square metres, would be obtained from one application of Simpson’s rule?

(A) \( \frac{130}{3} (90 + 400 + 30) \)

(B) \( \frac{260}{3} (90 + 400 + 30) \)

(C) \( \frac{100}{3} (90 + 520 + 30) \)

(D) \( \frac{130}{3} (90 + 100 + 30) \)
Which trigonometric formula would be most useful in calculating the length of side $YZ$?

(A) $A = \frac{1}{2} ab \sin C$

(B) $c^2 = a^2 + b^2 - 2ab \cos C$

(C) $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$

(D) $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

The table shows monthly repayments for various amounts borrowed, and different annual interest rates, for a term of 20 years.

<table>
<thead>
<tr>
<th>Amount borrowed</th>
<th>Monthly repayment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5% pa</td>
</tr>
<tr>
<td>$10 000$</td>
<td>$66.00</td>
</tr>
<tr>
<td>$15 000$</td>
<td>$98.99</td>
</tr>
<tr>
<td>$20 000$</td>
<td>$131.99</td>
</tr>
<tr>
<td>$25 000$</td>
<td>$164.99</td>
</tr>
</tbody>
</table>

The total interest paid over 20 years on a loan of $15 000 at 6% pa is

(A) $1289.52$

(B) $2149.20$

(C) $10 790.40$

(D) $25 790.40$
14 If 4 is added to each score in a set, which of the following statements will be true?

(A) The mean and the standard deviation will remain the same.
(B) The mean will increase by 4 and the standard deviation will increase by 4.
(C) The mean will increase by 4 and the standard deviation will increase by $\sqrt{4}$.
(D) The mean will increase by 4 and the standard deviation will remain the same.

15 Simplify $10(x + 3) - 2(4x + 2)$.

(A) $2x + 5$
(B) $2x + 26$
(C) $6x + 5$
(D) $6x + 26$

16 Ali buys a television costing $1494 on interest-free terms over 2 years.

If he pays a one-third deposit, how much will he be required to pay each month?

(A) $20.75$
(B) $41.50$
(C) $43.58$
(D) $83.00
A pipe has an outer diameter of 20 cm and an inner diameter of 14 cm.

Which expression will give the area, in square centimetres, of the cross-section (shaded) of the pipe?

(A) $\pi (10 - 7)^2$
(B) $\pi (10^2 - 7^2)$
(C) $\pi (20 - 14)^2$
(D) $\pi (20^2 - 14^2)$
18 Which graph shows a high positive correlation?

(A)  

(B)  

(C)  

(D)  

19 Fifty tickets are sold in a raffle. There are two prizes. Michael buys 5 tickets.

Which expression gives the probability that Michael wins both prizes?

(A) \( \frac{5}{50} + \frac{4}{50} \)
(B) \( \frac{5}{50} + \frac{4}{49} \)
(C) \( \frac{5}{50} \times \frac{4}{50} \)
(D) \( \frac{5}{50} \times \frac{4}{49} \)

20 A cereal packet is labelled as having a net weight of 500 grams. The production process produces packets whose weights are normally distributed about a mean of 504 grams, with a standard deviation of 2 grams.

Approximately what percentage of packets would contain less than the labelled weight?

(A) 0.5%
(B) 2.5%
(C) 5%
(D) 16%
21 James has six different-coloured pencils in his pencil case. He takes out two pencils without looking at their colours.

How many different combinations of colours are possible?

(A) 6
(B) 15
(C) 30
(D) 36

22 The stopping distance of a car is proportional to the square of the car’s speed. A car travelling at 60 km/h has a stopping distance of 40 m.

If the stopping distance is 80 m, what is the car’s speed?

(A) 30 km/h
(B) 53 km/h
(C) 85 km/h
(D) 120 km/h
Section II

Total marks (78)
Attempt Questions 23 – 28
Allow about 2 hours for this section

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

---

**Question 23** (13 marks) Use a SEPARATE writing booklet.

(a) Convert the speed of light, $3 \times 10^5$ km/s, to metres per second.  

(b) A 3-metre ladder rests against a vertical wall, making an angle of 55° with the horizontal.

\[ \text{DRAWN TO SCALE} \]

How far up the wall does the ladder reach? Give your answer correct to the nearest centimetre.

(c) A solid metal support with a right-angled groove is shown below. All measurements are in centimetres.

\[ \text{NOT TO SCALE} \]

Calculate the volume of the metal support.

---

**Question 23 continues on page 15**
Question 23 (continued)

(d) A competition draw has been arranged so that six teams, A, B, C, D, E and F, will play each other twice in the season.

<table>
<thead>
<tr>
<th></th>
<th>A plays B</th>
<th>A plays C</th>
<th>A plays D</th>
<th>A plays E</th>
<th>A plays F</th>
</tr>
</thead>
<tbody>
<tr>
<td>B plays A</td>
<td>B plays C</td>
<td>B plays D</td>
<td>B plays E</td>
<td>B plays F</td>
<td></td>
</tr>
<tr>
<td>C plays A</td>
<td>C plays B</td>
<td>C plays D</td>
<td>C plays E</td>
<td>C plays F</td>
<td></td>
</tr>
<tr>
<td>D plays A</td>
<td>D plays B</td>
<td>D plays C</td>
<td>D plays E</td>
<td>D plays F</td>
<td></td>
</tr>
<tr>
<td>E plays A</td>
<td>E plays B</td>
<td>E plays C</td>
<td>E plays D</td>
<td>E plays F</td>
<td></td>
</tr>
<tr>
<td>F plays A</td>
<td>F plays B</td>
<td>F plays C</td>
<td>F plays D</td>
<td>F plays E</td>
<td></td>
</tr>
</tbody>
</table>

(i) How many games must be played in this draw?  
(ii) A game is chosen at random from the table. What is the probability that either Team A or Team E is playing?  
(iii) If there were ten teams in the competition, how many games would have to be scheduled so that each team plays every other team twice?  
(iv) If there were $n$ teams in the competition, write an algebraic expression to represent the number of games required so that each team plays every other team twice.

Question 23 continues on page 16
Question 23 (continued)

(e) The table shows the Weekly Gross Pay \((W)\) for employees of a company. It uses the employee’s Pay Rate \((R)\), Normal Hours \((N)\) worked and the number of Overtime Hours \((V)\) worked for the week. Overtime is paid at time-and-a-half.

<table>
<thead>
<tr>
<th>Weekly Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>Mi</td>
</tr>
<tr>
<td>Tim</td>
</tr>
<tr>
<td>Mary</td>
</tr>
</tbody>
</table>

(i) Calculate Tim’s Weekly Gross Pay. 

(ii) How many Overtime Hours did Mary work? 

(iii) Weekly Gross Pay \((W)\) can be calculated using the formula

\[
W = N \times R + 1.5 \times V \times R
\]

Rearrange this formula to make \(V\) (Overtime Hours) the subject.

End of Question 23
Question 24 (13 marks) Use a SEPARATE writing booklet.

(a) An offset survey of a park was conducted, and the notebook entries are shown. (Measurements are in metres.)

<table>
<thead>
<tr>
<th>D 101</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>173</td>
<td>64 B</td>
</tr>
<tr>
<td>109</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

(i) Use these notebook entries to draw a neat sketch of the park. Mark the interval and offset measurements on your diagram. 2 marks

(ii) Calculate the distance $CD$, correct to the nearest metre. 2 marks

The following day a compass radial survey of the same park produced these notebook entries:

(iii) Find the size of angle $DOC$. 1 mark

(iv) Use the cosine rule to calculate the distance $CD$, correct to the nearest metre. 2 marks

(v) Explain why the distances calculated in parts (ii) and (iv) are slightly different. 2 marks

Question 24 continues on page 18
Question 24 (continued)

(b) A rectangular piece of metal 70 cm by 45 cm is cut to make the circular base and the side of an open cylinder, as shown.

(i) The strip of width 15 cm must be trimmed to fit around the base of diameter 20 cm, with no overlap.

Calculate the length of the strip required, to the nearest millimetre.  

(ii) Calculate the capacity of the cylinder in litres, correct to two significant figures. (1 litre = 1000 cm$^3$)

End of Question 24
Question 25 (13 marks) Use a SEPARATE writing booklet.

(a) Chris’ rule to convert temperature in degrees Celsius (C) to degrees Fahrenheit (F) is:

‘double the temperature in degrees Celsius and add thirty’.

(i) Write Chris’ rule as an algebraic expression for $F$ in terms of $C$.

(ii) From Chris’ rule, write a rule that can be used to convert temperature in degrees Fahrenheit to degrees Celsius.

(b) A regular amount is paid into an account each year and the investment is compounded annually. The table shows the expected amount in the account at the end of a number of years up to five, when $1 is regularly invested each year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Payment</th>
<th>Start of year</th>
<th>Interest</th>
<th>End of year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1.00</td>
<td>$1.00</td>
<td>$0.06</td>
<td>$1.06</td>
</tr>
<tr>
<td>2</td>
<td>$1.00</td>
<td>$2.06</td>
<td>$0.12</td>
<td>$2.18</td>
</tr>
<tr>
<td>3</td>
<td>$1.00</td>
<td>$3.18</td>
<td>$0.19</td>
<td>$A</td>
</tr>
<tr>
<td>4</td>
<td>$1.00</td>
<td>B</td>
<td>C</td>
<td>$4.63</td>
</tr>
<tr>
<td>5</td>
<td>$1.00</td>
<td>$5.63</td>
<td>$0.34</td>
<td>$5.97</td>
</tr>
</tbody>
</table>

(i) Calculate the missing amounts A, B and C.

(ii) If the annual payment was $500 and the interest rate remained at 6% pa, calculate the amount in the account at the end of two years.

(iii) An alternative to making regular yearly investments is to make one investment at the beginning of the first year.

Determine the amount of this single investment if it is to grow to a value of $5.97 at the end of five years. The rate of interest is 6% pa, and the investment is compounded annually.

Express your answer to the nearest cent.

Question 25 continues on page 20
Question 25 (continued)

(c) A car was test-driven at different speeds and the petrol consumption is recorded. The results are shown in the graph.

(i) What was the petrol consumption recorded at 60 km/h?  

(ii) During the test, the car was driven at 30 km/h for 20 km. How many litres of petrol did it consume?

The graph is modelled by the formula

\[ C = 0.01S^2 - S + 33 \]

for speeds from 20 km/h to 80 km/h, where \( C \) is the petrol consumption in litres per 100 km, and \( S \) is the speed in km/h.

(iii) Use this formula to calculate the petrol consumption at a speed of 80 km/h.  

(iv) The formula

\[ C = 0.01S^2 - S + 33 \]

is a good model for speeds between 20 km/h and 80 km/h. Why would this formula NOT be useful for \( S = 0 \)?

End of Question 25
Question 26 (13 marks) Use a SEPARATE writing booklet.

(a) Bettina paid $20 000 for a new car in 1994. The table shows the value of the car, at the end of each year, over five years.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 500</td>
</tr>
<tr>
<td>2</td>
<td>14 500</td>
</tr>
<tr>
<td>3</td>
<td>12 500</td>
</tr>
<tr>
<td>4</td>
<td>10 400</td>
</tr>
<tr>
<td>5</td>
<td>9 000</td>
</tr>
</tbody>
</table>

(i) On the graph provided on page 27, plot the values of the car over the five years.

Page 27 is to be detached, completed and attached to your writing booklet for this question.

(ii) Which of the four curves shown on the graph provided on page 27, (A or B or C or D) best models the depreciation of Bettina’s car? Give a reason for your answer.

(iii) Use the declining balance formula for depreciation, and the percentage depreciation rate from your answer to part (a) (ii), to predict the value of Bettina’s car when it is ten years old. Give your answer correct to the nearest hundred dollars.

Question 26 continues on page 22
The histograms and box-and-whisker plots below are based on the ages of the winners of the Best Actor and Best Actress awards for the years 1928 to 1988. Study the histograms and box-and-whisker plots carefully and then answer the questions that follow.

**Question 26 continues on page 23**
Question 26 (continued)

(i) Determine the interquartile range for the ages of the winners of the Best Actress award.  

(ii) Compare and contrast the displays for the Best Actress and Best Actor awards by examining:

• the shape and skewness of the distributions; and
• measures of location and spread.

(iii) Use your answer to part (ii) either to support or to reject the statement:

‘Essentially the two sets of data have a similar shape, spread and location and this shows that, as a group, there is little difference between the ages of the actresses and the actors receiving these awards.’

End of Question 26

Please turn over
Question 27 (13 marks) Use a SEPARATE writing booklet.

(a) Twenty patients were randomly chosen at two medical centres, Centre X and Centre Y. The number of minutes each patient waited until seen by a doctor was recorded in this survey. The ordered double stem-and-leaf plot displays the results.

<table>
<thead>
<tr>
<th>Centre X</th>
<th>Centre Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 4 3</td>
<td>0 3 6 7 9</td>
</tr>
<tr>
<td>7 6 6 3</td>
<td>1 0 1 2 4 5 6 8 8</td>
</tr>
<tr>
<td>5 5 5 4 1</td>
<td>2 0 0 1 3 3 3</td>
</tr>
<tr>
<td>9 9 9 9 2 0</td>
<td>3 1 2</td>
</tr>
</tbody>
</table>

(i) Write down the range, in minutes, of the waiting times for the Centre X sample. 1

(ii) One entry (represented by □ ) is missing for Centre X. 1

Give a possible number of minutes that this patient waited.

(iii) Calculate the mean and the sample standard deviation of the waiting times for the Centre Y sample, correct to one decimal place. 2

(iv) A patient is selected at random from the Centre Y sample. 2

Calculate the probability that this patient’s waiting time is within one sample standard deviation of the mean.

(v) Using the shape and other features of the double stem-and-leaf plot, explain how they show the mean and standard deviation of the Centre X data are greater than those of the Centre Y data. 2

Question 27 continues on page 25
Question 27 (continued)

(b) A number of people were tested for a disease. Some were suffering from the disease, some were not. The test does not always give accurate results.

<table>
<thead>
<tr>
<th>Test results</th>
<th>Accurate</th>
<th>Not accurate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people with the disease</td>
<td>19</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Number of people without the disease</td>
<td>171</td>
<td>9</td>
<td>180</td>
</tr>
<tr>
<td>Total</td>
<td>190</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

(i) How many people were tested?  

(ii) What percentage of test results were accurate?  

(iii) How many people did the test indicate had the disease?  

(iv) One person was selected at random from the group that the test indicated had the disease. What is the probability that this person had the disease?

End of Question 27

Please turn over
Question 28 (13 marks) Use a SEPARATE writing booklet.

(a) Students in a course are given the results of a test in the form of z-scores.

(i) Nathan receives a z-score of 2.2.

Explain what this means in terms of Nathan’s mark, the mean mark and the standard deviation.  

(ii) Calculate Nathan’s mark if the mean mark is 61 and the standard deviation is 12.7. (Answer correct to the nearest whole mark.)

(b) Gemma and Clare both started working at age 20 years.

Gemma invested $1000 at the end of each year for the first 10 years of her working life. She then stopped these regular investments, but left her money to earn interest and grow for the next 30 years. The investment earned interest of 8% pa compounded yearly, over the entire 40 years.

(i) How much did Gemma invest over the first 10 years of her working life?

(ii) Show that the total value of Gemma’s investment after 10 years was $14,486.56.

(iii) Calculate the value of this investment after a further 30 years.

Clare did not make any investments in the first 10 years of her working life. She then started investing $1000, at the end of each year, for the next 30 years, again earning 8% pa compounded yearly. After making contributions of $1000 pa for 3 times as long as Gemma, Clare thought that the value of her investment would be far more than the value of Gemma’s.

(iv) Explain why the value of Clare’s investment could never be greater than the value of Gemma’s. (Your answer to (b) (ii) above may be useful in your explanation.)

(v) Gemma’s and Clare’s saving strategies supposedly show that saving ‘smarter’ is better than saving ‘harder’.

What advice would you give, based on Gemma’s and Clare’s strategies, to another 20-year-old person starting work?

What factors might make this advice difficult to follow?
This page is to be detached, completed and attached to your writing booklet for Question 26.

**Question 26 (a) (i)**
Area of an annulus

\[ A = \pi (R^2 - r^2) \]

\( R \) = radius of outer circle
\( r \) = radius of inner circle

Area of an ellipse

\[ A = \pi ab \]

\( a \) = length of semi-major axis
\( b \) = length of semi-minor axis

Area of a sector

\[ A = \frac{\theta}{360} \pi r^2 \]

\( \theta \) = number of degrees in central angle

Arc length of a circle

\[ l = \frac{\theta}{360} 2\pi r \]

\( \theta \) = number of degrees in central angle

Surface area of a sphere

\[ A = 4\pi r^2 \]

Simpson’s rule for area approximation

\[ A \approx \frac{h}{3} (d_f + 4d_m + d_l) \]

\( h \) = distance between successive measurements
\( d_f \) = first measurement
\( d_m \) = middle measurement
\( d_l \) = last measurement

Volume

\begin{align*}
\text{Cone} & \quad V = \frac{1}{3} \pi r^2 h \\
\text{Cylinder} & \quad V = \pi r^2 h \\
\text{Pyramid} & \quad V = \frac{1}{3} Ah \\
\text{Sphere} & \quad V = \frac{4}{3} \pi r^3
\end{align*}

\( A \) = area of base
\( h \) = perpendicular height

Mean of a distribution

\[ \bar{x} = \frac{\sum x}{n} \]

\[ \bar{x} = \frac{\sum fx}{\sum f} \]

\( x \) = individual score
\( \bar{x} \) = mean

Formula for z-scores

\[ z = \frac{x - \bar{x}}{s} \]

\( s \) = standard deviation

Probability of an event

The probability of an event where outcomes are equally likely is given by:

\[ P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}} \]
Simple interest

$$I = Prn$$

$P$ = initial quantity  
$r$ = percentage interest rate per period expressed as a decimal  
$n$ = number of periods

Compound interest

$$A = P (1 + r)^n$$

$A$ = final balance  
$P$ = initial quantity  
$n$ = number of compounding periods  
$r$ = percentage interest rate per compounding period expressed as a decimal

Future value ($A$) of an annuity

$$A = M \left\{ \frac{(1 + r)^n - 1}{r} \right\}$$

$M$ = contribution per period, paid at the end of the period

Present value ($N$) of an annuity

$$N = M \left\{ \frac{(1 + r)^n - 1}{r(1 + r)^n} \right\}$$

or

$$N = \frac{A}{(1 + r)^n}$$

Straight-line formula for depreciation

$$S = V_o - Dn$$

$S$ = salvage value of asset after $n$ periods  
$V_o$ = purchase price of the asset  
$D$ = amount of depreciation apportioned per period  
$n$ = number of periods

Declining balance formula for depreciation

$$S = V_o (1 - r)^n$$

$S$ = salvage value of asset after $n$ periods  
$r$ = percentage interest rate per period, expressed as a decimal

Sine rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Area of a triangle

$$A = \frac{1}{2} ab \sin C$$

Cosine rule

$$c^2 = a^2 + b^2 - 2ab \cos C$$

or

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Gradient of a straight line

$$m = \frac{\text{vertical change in position}}{\text{horizontal change in position}}$$

Gradient–intercept form of straight line

$$y = mx + b$$

$m$ = gradient  
$b$ = $y$-intercept