

Mathematics General 2

General Instructions

- Reading time – 5 minutes
- Working time – $2\frac{1}{2}$ hours
- Write using black pen
- NESA approved calculators may be used
- A formulae and data sheet is provided at the back of this paper
- In Questions 26–30, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 25 marks (pages 2–12)

- Attempt Questions 1–25
- Allow about 35 minutes for this section

Section II – 75 marks (pages 13–36)

- Attempt Questions 26–30
- Allow about 1 hour and 55 minutes for this section

Section I

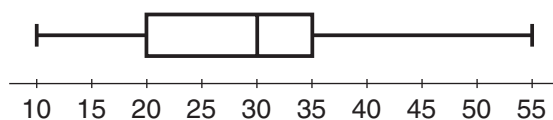
25 marks

Attempt Questions 1–25

Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–25.

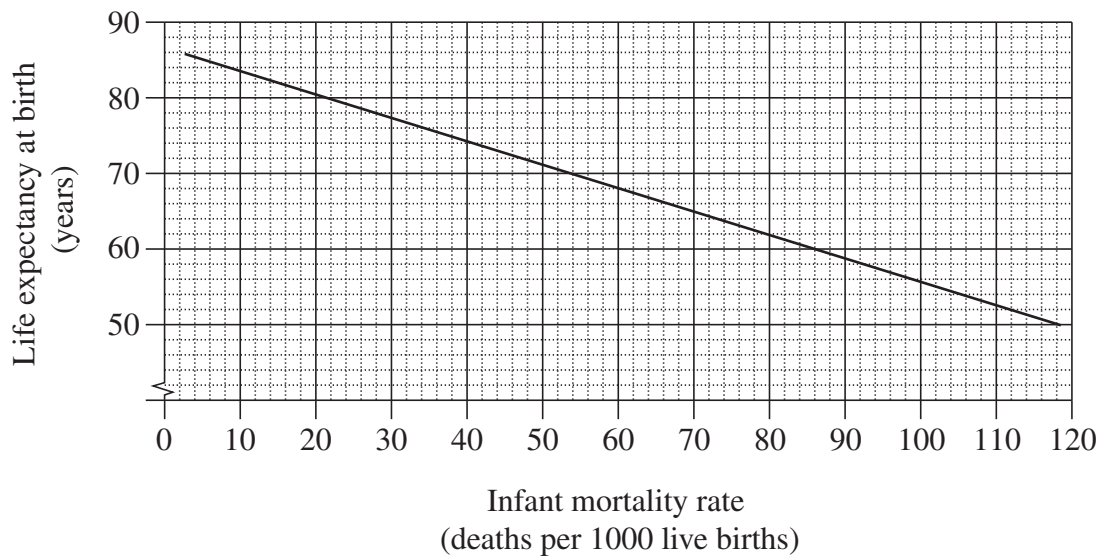
- 1** The box-and-whisker plot for a set of data is shown.



What is the median of this set of data?

- A. 15
 - B. 20
 - C. 30
 - D. 35
- 2** A car is travelling at 95 km/h.
- How far will it travel in 2 hours and 30 minutes?
- A. 38 km
 - B. 41.3 km
 - C. 218.5 km
 - D. 237.5 km

- 3 The graph shows the relationship between infant mortality rate (deaths per 1000 live births) and life expectancy at birth (in years) for different countries.



What is the life expectancy at birth in a country which has an infant mortality rate of 60?

- A. 68 years
 - B. 69 years
 - C. 86 years
 - D. 88 years
- 4 A factory's quality control department has tested every 50th item produced for possible defects.

What type of sampling has been used?

- A. Random
- B. Stratified
- C. Systematic
- D. Quantitative

- 5 In a survey of 200 randomly selected Year 12 students it was found that 180 use social media.

Based on this survey, approximately how many of 75 000 Year 12 students would be expected to use social media?

- A. 60 000
- B. 67 500
- C. 74 980
- D. 75 000

- 6 Tom earns a weekly wage of \$1025. He also receives an additional allowance of \$87.50 per day when handling toxic substances.

What is Tom's income in a fortnight in which he handles toxic substances on 5 separate days?

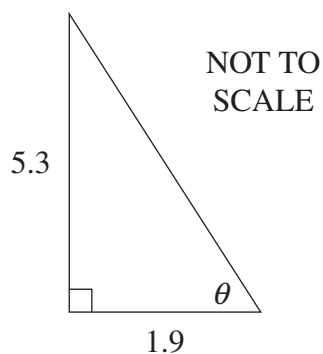
- A. \$1112.50
- B. \$1462.50
- C. \$2225.00
- D. \$2487.50

- 7 It is given that $I = \frac{3}{2}MR^2$.

What is the value of I when $M = 26.55$ and $R = 3.07$, correct to two decimal places?

- A. 375.35
- B. 3246.08
- C. 9965.45
- D. 14 948.18

- 8 The diagram shows a right-angled triangle.



What is the value of θ , to the nearest minute?

- A. $70^{\circ}16'$
 - B. $70^{\circ}17'$
 - C. $70^{\circ}27'$
 - D. $70^{\circ}28'$
- 9 What is the value of x in the equation $\frac{5-x}{3} = 6$?

- A. -13
- B. -3
- C. 3
- D. 13

- 10 A single amount of \$10 000 is invested for 4 years, earning interest at the rate of 3% per annum, compounded monthly.

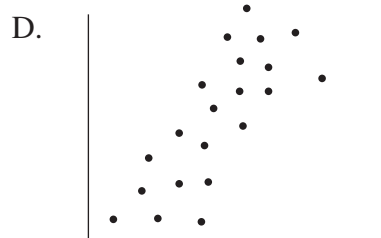
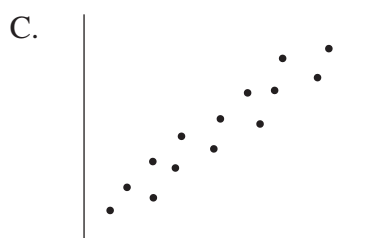
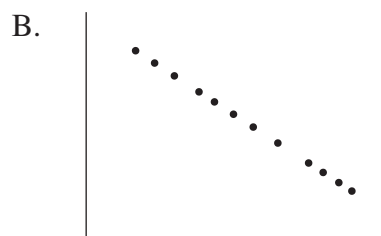
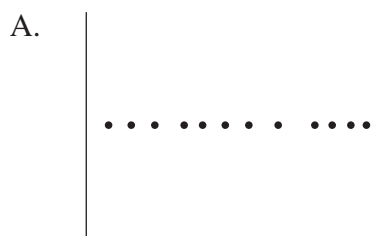
Which expression will give the future value of the investment?

- A. $10\,000 \times (1 + 0.03)^4$
- B. $10\,000 \times (1 + 0.03)^{48}$
- C. $10\,000 \times \left(1 + \frac{0.03}{12}\right)^4$
- D. $10\,000 \times \left(1 + \frac{0.03}{12}\right)^{48}$

- 11 A new car was bought for \$19 900 and one year later its value had depreciated to \$16 300.

What is the approximate depreciation, expressed as a percentage of the purchase price?

- A. 18%
B. 22%
C. 78%
D. 82%
- 12 Which of the data sets graphed below has the largest positive correlation coefficient value?



- 13** The heights of Year 12 girls are normally distributed with a mean of 165 cm and a standard deviation of 5.5 cm.

What is the z -score for a height of 154 cm?

- A. -2
- B. -0.5
- C. 0.5
- D. 2

- 14** Kate is comparing two different models of car. Car A uses fuel at the rate of 9 L/100 km. Car B uses 3.5 L/100 km.

Suppose Kate plans on driving 8000 km in the next year.

How much less fuel will she use driving car B instead of car A ?

- A. 280 L
- B. 440 L
- C. 720 L
- D. 1000 L

- 15** The faces on a twenty-sided die are labelled \$0.05, \$0.10, \$0.15, ..., \$1.00.

The die is rolled once.

What is the probability that the amount showing on the upper face is more than 50 cents but less than 80 cents?

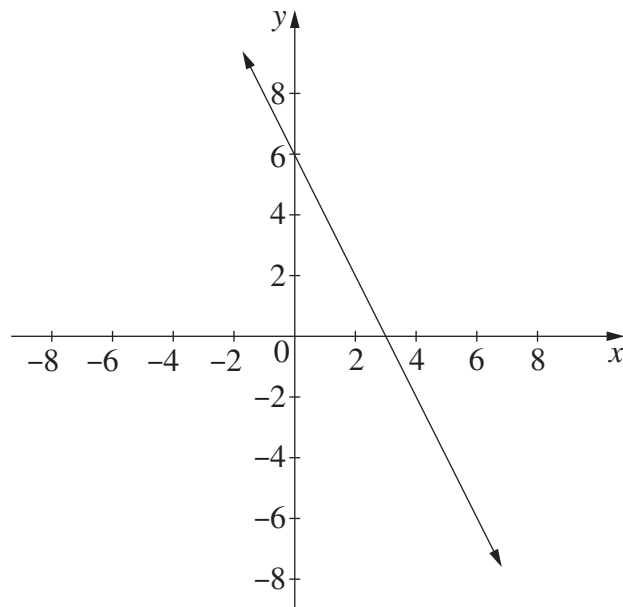
- A. $\frac{1}{4}$
- B. $\frac{3}{10}$
- C. $\frac{7}{20}$
- D. $\frac{1}{2}$

- 16** The benchmark for annual greenhouse gas emissions from the residential sector is 3292 kg of carbon dioxide per person per year.

A new building, planned to house 6 people, has been designed to achieve a 25% reduction on this benchmark.

What is the maximum amount of carbon dioxide per year, to the nearest kilogram, that this building is designed to emit when fully occupied?

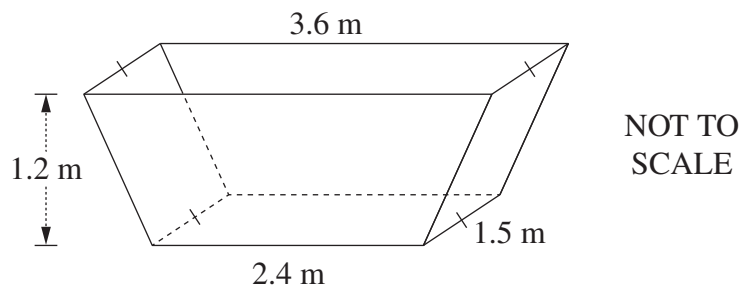
- A. 823 kg
B. 2469 kg
C. 4938 kg
D. 14 814 kg
- 17** The graph of the line with equation $y = 6 - 2x$ is shown.



When the graph of the line with equation $y = x + 3$ is also drawn on this number plane, what will be the point of intersection of the two lines?

- A. (0, 6)
B. (1, 4)
C. (2, 2)
D. (3, 0)

- 18 A skip bin is in the shape of a trapezoidal prism, with dimensions as shown.



What is the volume of the skip bin?

- A. 5.4 m^3
 - B. 7.776 m^3
 - C. 10.8 m^3
 - D. 15.552 m^3
- 19 Young's formula, shown below, is used to calculate the dosage of medication for children aged 1–12 years based on the adult dosage.

$$D = \frac{yA}{y + 12}$$

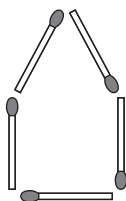
where D = dosage for children aged 1–12 years
 y = age of child (in years)
 A = adult dosage

A child's dosage is calculated to be 20 mg, based on an adult dosage of 40 mg.

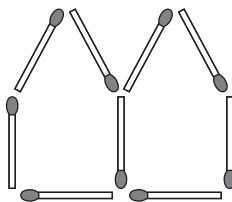
How old is the child in years?

- A. 6
- B. 8
- C. 10
- D. 12

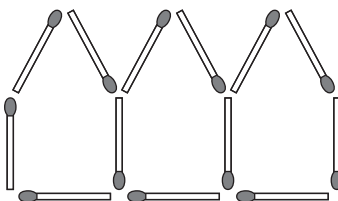
- 20** A pentagon is created using matches.



By adding more matches, a row of two pentagons is formed.



Continuing to add matches, a row of three pentagons can be formed.



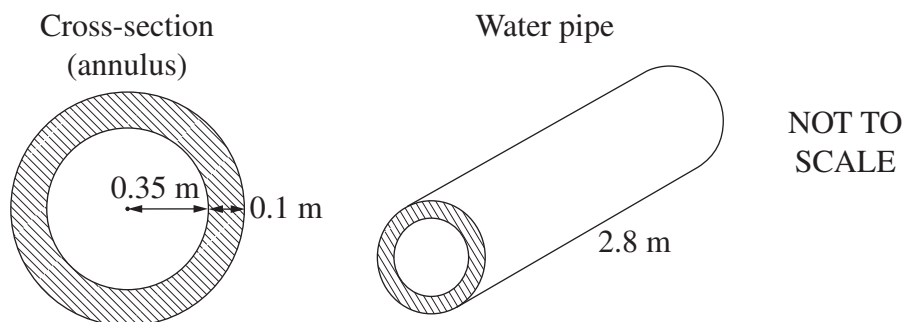
Continuing this pattern, what is the maximum number of complete pentagons that can be formed if 100 matches in total are available?

- A. 25
 - B. 24
 - C. 21
 - D. 20
- 21** The length of a netball court is measured to be 30.50 metres, correct to the nearest centimetre.

What is the lower limit for the length of the netball court?

- A. 30.45 m
- B. 30.49 m
- C. 30.495 m
- D. 30.499 m

- 22** A concrete water pipe is manufactured in the shape of an annular cylinder. The dimensions are shown in the diagrams.



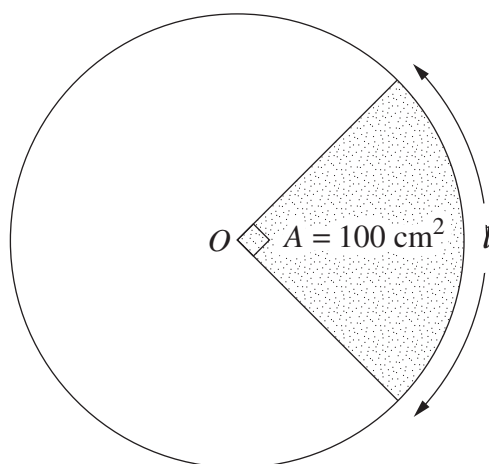
What is the approximate volume of concrete needed to make the water pipe?

- A. 0.06 m^3
B. 0.09 m^3
C. 0.70 m^3
D. 0.99 m^3
- 23** How many bits are there in 2 terabytes?
- A. 2^{40}
B. 2^{41}
C. 2^{43}
D. 2^{44}
- 24** A deck of 52 playing cards contains 12 picture cards. Two cards from the deck are drawn at random and placed on a table.

What is the probability, correct to four decimal places, that exactly one picture card is on the table?

- A. 0.0498
B. 0.1810
C. 0.3550
D. 0.3620

- 25 In the circle, centre O , the area of the quadrant is 100 cm^2 .



What is the arc length l , correct to one decimal place?

- A. 8.9 cm
- B. 11.3 cm
- C. 17.7 cm
- D. 25.1 cm

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HIGHER SCHOOL CERTIFICATE
EXAMINATION

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Centre Number

Mathematics General 2

Section II Answer Booklet

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Student Number

75 marks**Attempt Questions 26–30****Allow about 1 hour and 55 minutes for this section**

Instructions

- Write your Centre Number and Student Number at the top of this page.
 - Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
 - Your responses should include relevant mathematical reasoning and/or calculations.
 - Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.
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Please turn over

Question 26 (15 marks)

- (a) Electricity costs \$0.27 per kWh.

1

How much does 20 kWh cost?

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- (b) Toby's mobile phone plan costs \$20 per month, plus the cost of all calls. Calls are charged at the rate of 70 cents per 30 seconds, or part thereof. There is also a call connection fee of 50c per call.

2

Here is a record of all his calls in July.

<i>Date</i>	<i>Call duration</i>
5 July	20 seconds
12 July	40 seconds
23 July	2 minutes 15 seconds

How much is Toby's mobile phone bill for July?

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- (c) A farmer needed to estimate the number of goats on his property. He tagged 80 of his goats. Later, he collected a random sample of 45 goats and found that 16 of these had tags.

2

Estimate the number of goats the farmer has on his property.

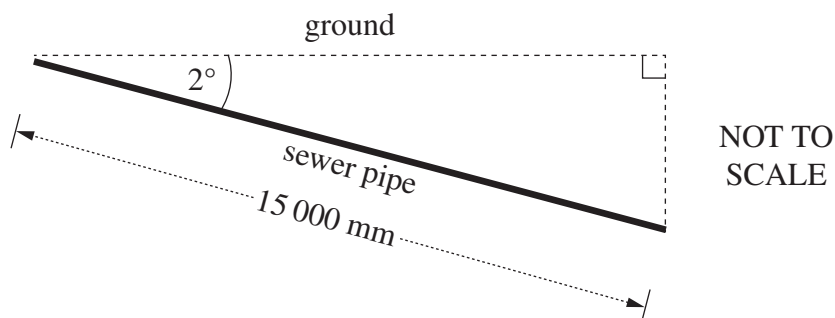
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Question 26 continues on page 15

Question 26 (continued)

- (d) A sewer pipe needs to be placed into the ground so that it has a 2° angle of depression. The length of the pipe is 15 000 mm.

2



How much deeper should one end of the pipe be compared to the other end?
Answer to the nearest mm.

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- (e) Sam purchased 500 company shares at \$3.20 per share. Brokerage fees were 1.5% of the purchase price.

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Sam is paid a dividend of 26 cents per share, then immediately sells the shares for \$4.80 each.

If he pays no further brokerage fees, what is Sam's total profit?

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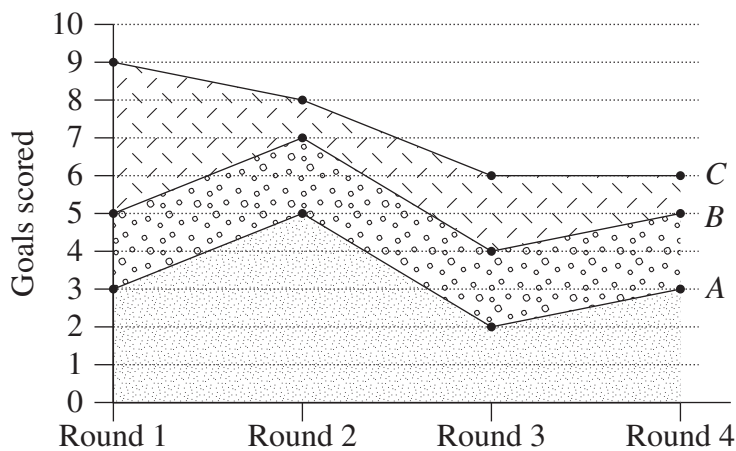
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Question 26 continues on page 16

Question 26 (continued)

- (f) The area chart shows the number of goals scored by three hockey teams, *A*, *B* and *C*, in the first 4 rounds.



- (i) How many goals were scored by team *C* in round 1? 1

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- (ii) In which round did all three teams score the same number of goals? 1

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Question 26 continues on page 17

Question 26 (continued)

- (g) Rachel bought a motorcycle advertised for \$7990. She paid a \$500 deposit and took out a flat-rate loan to repay the balance. Simple interest was charged at a rate of 7% per annum on the amount borrowed. She repaid the loan over 2 years, making equal weekly repayments.

3

Calculate the weekly repayment.

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End of Question 26

Question 27 (15 marks)

- (a) Jamal surveyed eight households in his street. He asked them how many kilolitres (kL) of water they used in the last year. Here are the results.

220, 105, 101, 450, 37, 338, 151, 205

- (i) Calculate the mean of this set of data. 1

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- (ii) What is the standard deviation of this set of data, correct to one decimal place? 1

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- (b) How many 20 megabyte files can fit on a 3 terabyte external hard disc? 2

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Question 27 continues on page 19

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Question 27 (continued)

- (c) A table of future value interest factors for an annuity of \$1 is shown.

Table of future value interest factors					
Period	Interest rate per period				
	1%	2%	3%	4%	5%
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019

An annuity involves contributions of \$12 000 per annum for 5 years. The interest rate is 4% per annum, compounded annually.

- (i) Calculate the future value of this annuity. 1

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- (ii) Calculate the interest earned on this annuity. 1

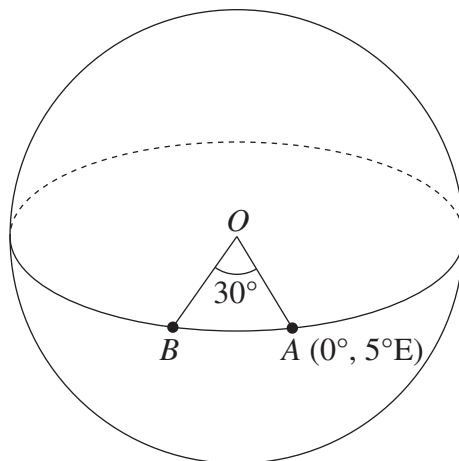
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Question 27 continues on page 20

Question 27 (continued)

- (d) Island A and island B are both on the equator. Island B is west of island A . The longitude of island A is 5°E and the angle at the centre of Earth (O), between A and B , is 30° .



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|-------|--|---|
| (i) | What is the longitude of island B ? | 1 |
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| (ii) | What time is it on island B when it is 10 am on island A ? | 1 |
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| (iii) | A ship leaves island A and travels west along the equator to island B . It travels at a constant speed of 40 km/h. | 3 |

How long will the ship take to arrive at island B ? Give your answer in days and hours to the nearest hour.

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Question 27 continues on page 21

Question 27 (continued)

- (e) Rhys is drinking low alcohol beer at a party over a five-hour period. He reads on the label of the low alcohol beer bottle that it is equivalent to 0.8 of a standard drink.

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Rhys weighs 90 kg.

What is the maximum number of complete bottles of the low alcohol beer he can drink to remain under a Blood Alcohol Content (BAC) of 0.05?

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End of Question 27

Question 28 (15 marks)

- (a) Temperature can be measured in degrees Celsius (C) or degrees Fahrenheit (F).
The two temperature scales are related by the equation $F = \frac{9C}{5} + 32$.

- (i) Calculate the temperature in degrees Fahrenheit when it is -20 degrees Celsius. **1**

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- (ii) Solve the following equations simultaneously, using either the substitution method or the elimination method. **2**

$$F = \frac{9C}{5} + 32$$

$$F = C$$

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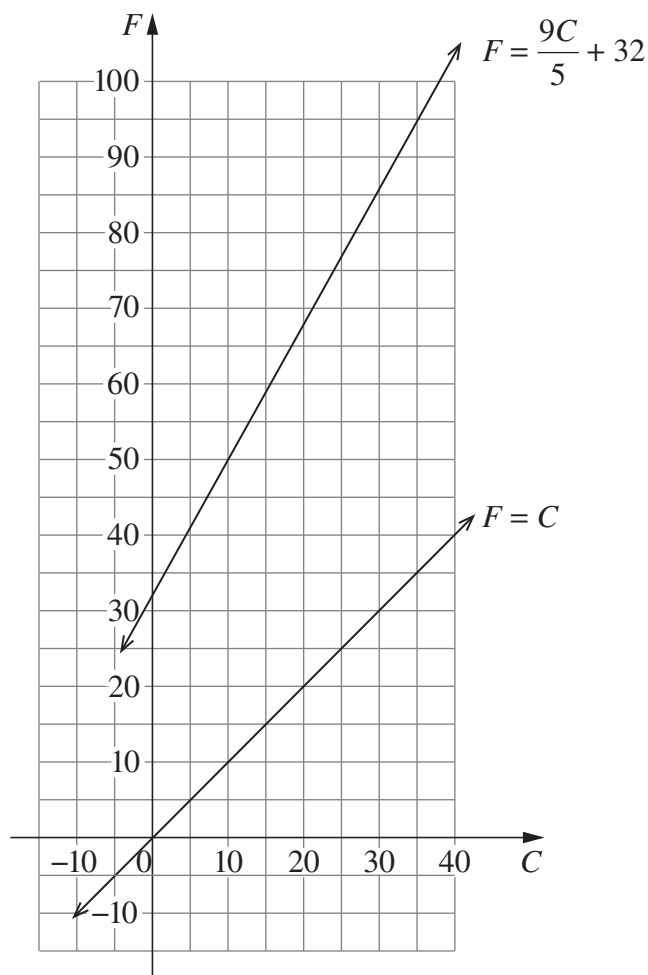
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Question 28 continues on page 23

Question 28 (continued)

- (iii) The graphs of $F = \frac{9C}{5} + 32$ and $F = C$ are shown below.

1



What does the result from part (ii) mean in the context of the graph?

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Question 28 continues on page 24

Question 28 (continued)

- (b) Five people are in a team. Two of them are selected at random to attend a competition.

- (i) How many different groups of two can be selected?

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- (ii) If Mary is one of the five people in the team, what is the probability that she is selected to attend the competition?

1

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Question 28 continues on page 25

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Question 28 (continued)

- (c) Michelle borrows \$100 000. The interest rate charged is 12% per annum compounded monthly. The monthly payment is \$1029 and the first repayment is made after one month. 3

What is the amount outstanding immediately after the SECOND monthly repayment is made?

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- (d) Make y the subject of the equation $x = \sqrt{yp - 1}$. 2

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Question 28 continues on page 26

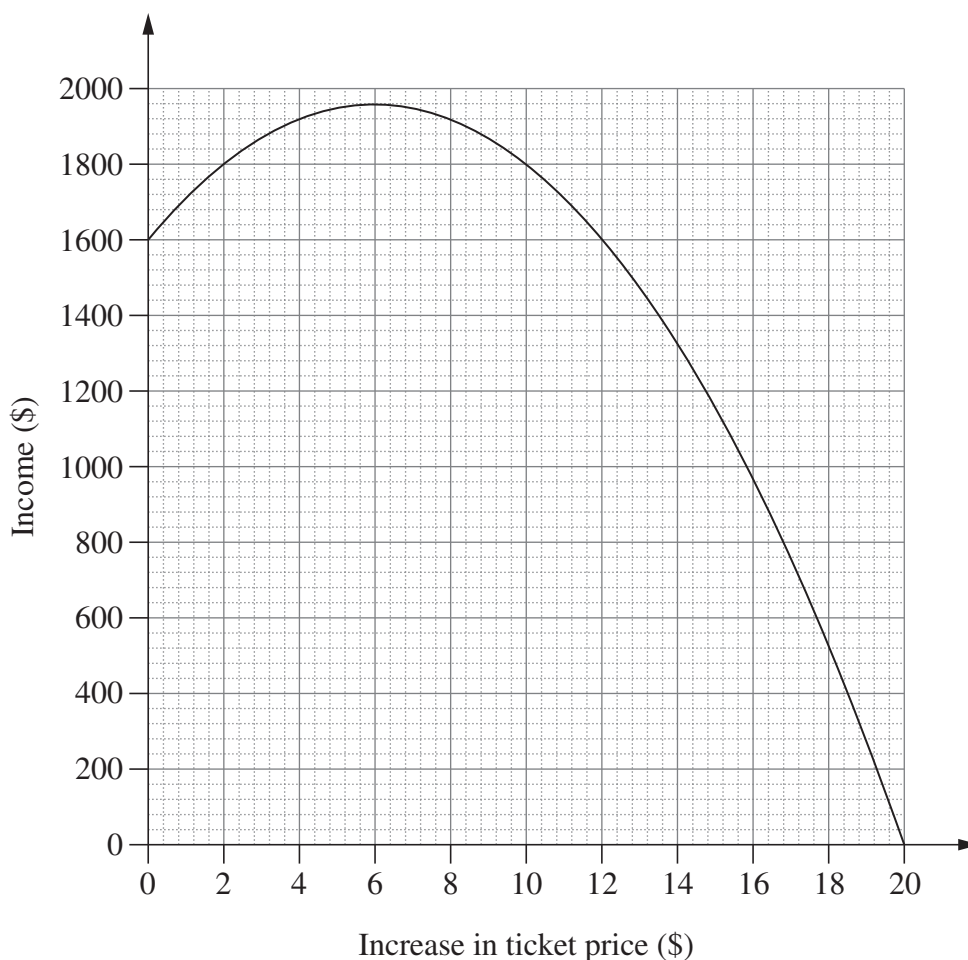
Question 28 (continued)

- (e) A movie theatre has 200 seats. Each ticket currently costs \$8.

The theatre owners are currently selling all 200 tickets for each session. They decide to increase the price of tickets to see if they can increase the income earned from each movie session.

It is assumed that for each one dollar increase in ticket price, there will be 10 fewer tickets sold.

A graph showing the relationship between an increase in ticket price and the income is shown below.



Question 28 continues on page 27

Question 28 (continued)

- (i) What ticket price should be charged to maximise the income from a movie session? **1**

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- (ii) What is the number of tickets sold when the income is maximised? **1**

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- (iii) The cost to the theatre owners of running each session is \$500 plus \$2 per ticket sold. **2**

Calculate the profit earned by the theatre owners when the income earned from a session is maximised.

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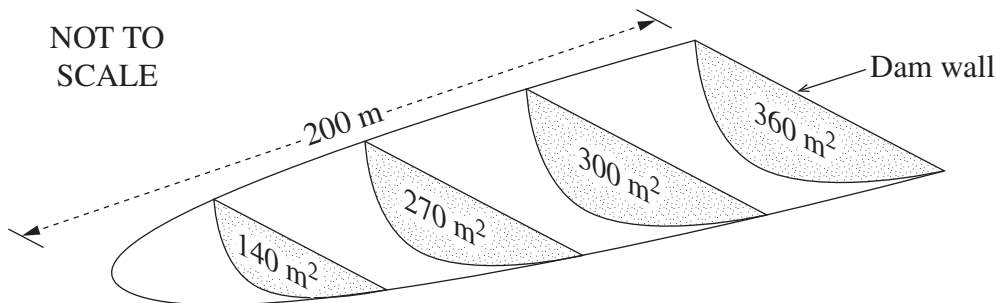
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End of Question 28

Question 29 (15 marks)

- (a) A new 200-metre long dam is to be built.

The plan for the new dam shows evenly spaced cross-sectional areas.



- (i) Using TWO applications of Simpson's rule, show that the volume of the dam is approximately 44 333 m³.

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- (ii) It is known that the catchment area for this dam is 2 km².

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Calculate how much rainfall is needed, to the nearest mm, to fill the dam.

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Question 29 continues on page 29

Question 29 (continued)

- (b) Sabrina's taxable income is \$86 725 in a particular year.

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The table below is used to calculate her tax payable. In addition, she pays the Medicare levy, which is 2% of her taxable income.

<i>Taxable income (\$)</i>	<i>Tax payable</i>
\$0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$87 000	\$3572 plus 32.5c for each \$1 over \$37 000
\$87 001 – \$180 000	\$19 822 plus 37c for each \$1 over \$87 000
\$180 001 and over	\$54 232 plus 45c for each \$1 over \$180 000

Calculate Sabrina's net income in that year.

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Question 29 continues on page 30

Question 29 (continued)

- (c) A group of Year 12 students was surveyed. The students were asked whether they live in the city or the country. They were also asked if they have ever waterskied.

The results are recorded in the table.

	Have waterskied	Have never waterskied
Live in the city	150	2500
Live in the country	70	800

- (i) A person is selected at random from the group surveyed. 2

Calculate the probability that the person lives in the city and has never waterskied.

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- (ii) A newspaper article claimed that Year 12 students who live in the country are more likely to have waterskied than those who live in the city. 2

Is this true, based on the survey results? Justify your answer with relevant calculations.

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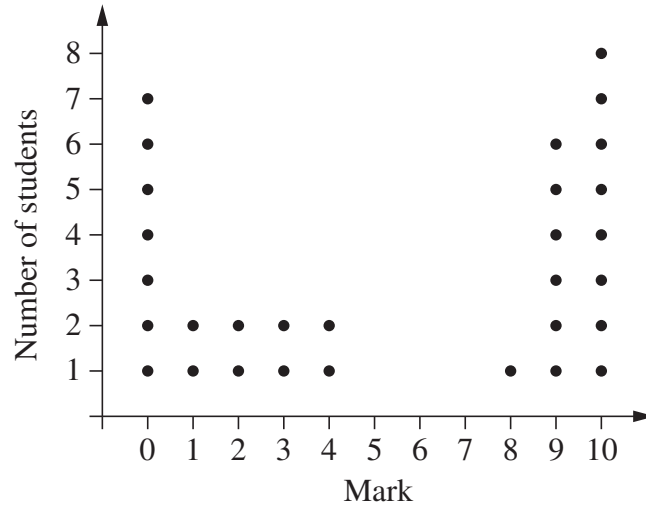
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Question 29 continues on page 31

Question 29 (continued)

- (d) All the students in a class of 30 did a test.

The marks, out of 10, are shown in the dot plot.



- (i) Find the median test mark. 1

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- (ii) The mean test mark is 5.4. The standard deviation of the test marks is 4.22. 2

Using the dot plot, calculate the percentage of the marks which lie within one standard deviation of the mean.

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- (iii) A student states that for any data set, 68% of the scores should lie within one standard deviation of the mean. 1

With reference to the dot plot, explain why the student's statement is NOT relevant in this context.

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End of Question 29

Question 30 (15 marks)

- (a) A set of data has a lower quartile (Q_L) of 10 and an upper quartile (Q_U) of 16. 2

What is the maximum possible range for this set of data if there are no outliers?

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- (b) The cost of a jewellery box varies directly with the cube of its height. 2

A jewellery box with a height of 10 cm costs \$50.

Calculate the cost of a jewellery box with a height of 12 cm.

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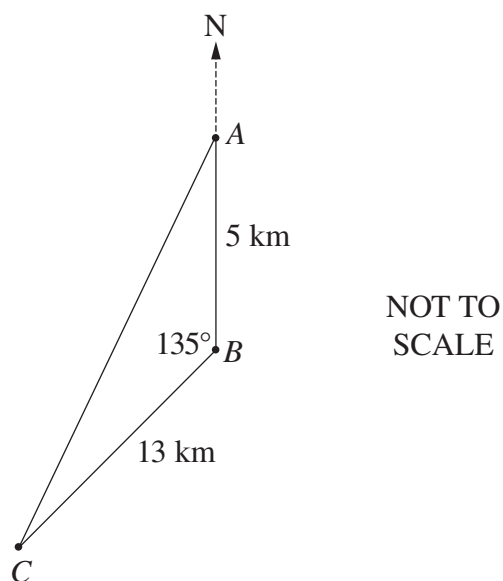
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Question 30 continues on page 33

Question 30 (continued)

- (c) The diagram shows the location of three schools. School A is 5 km due north of school B , school C is 13 km from school B and $\angle ABC$ is 135° .



- (i) Calculate the shortest distance from school A to school C , to the nearest kilometre. 2

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- (ii) Determine the bearing of school C from school A , to the nearest degree. 3

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Question 30 continues on page 34

Question 30 (continued)

- (d) In an investigation, students used different numbers of identical small solar panels to power model cars. The cars were then tested and their speed measured in km/h. The results are summarised in the table.

	<i>Mean</i>	<i>Standard deviation</i>
Number of solar panels (x)	2.9	0.8
Speed (y)	8.2	2

The equation of the least-squares line of best fit, relating the speed and the number of solar panels, has been calculated to be

$$y = 2.125x + 2.0375.$$

- (i) What would be the speed of a car powered by 5 solar panels, based on this equation? 1

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- (ii) Calculate the correlation coefficient, r , between the number of solar panels and the speed of a car. 2

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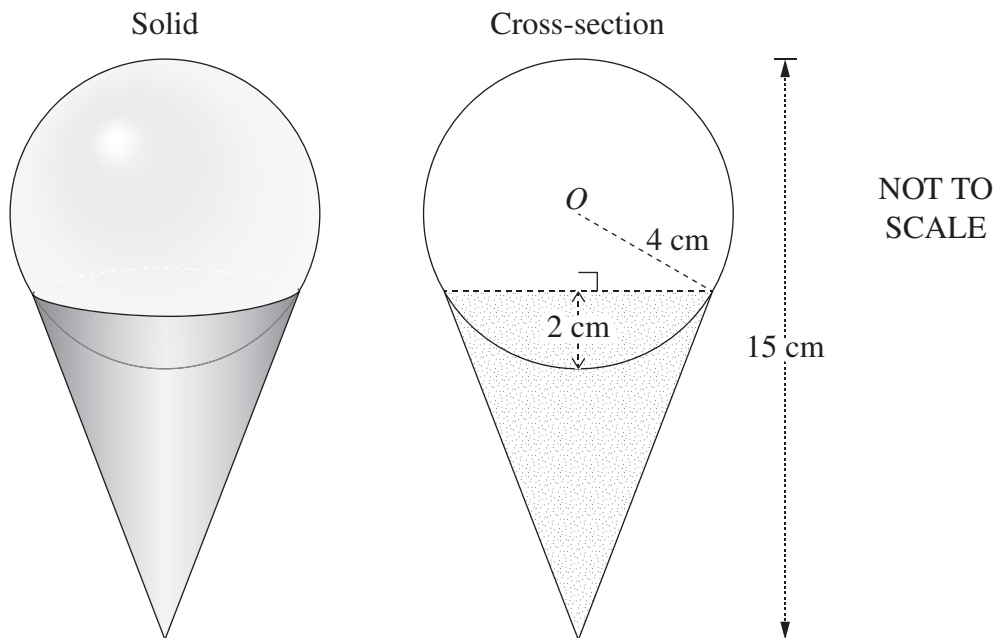
Question 30 continues on page 35

Question 30 (continued)

- (e) A solid is made up of a sphere sitting partially inside a cone.

3

The sphere, centre O , has a radius of 4 cm and sits 2 cm inside the cone. The solid has a total height of 15 cm. The solid and its cross-section are shown.



What is the volume of the cone, correct to the nearest cm^3 ?

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End of paper

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Do NOT write in this area.

Mathematics General 2

FORMULAE AND DATA SHEET

Financial Mathematics

Simple interest

$$I = Prn$$

P is initial amount

r is interest rate per period, expressed as a decimal

n is number of periods

Compound interest

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

A is final amount

P is initial amount

r is interest rate per period, expressed as a decimal

n is number of compounding periods

Present value and future value

$$PV = \frac{FV}{(1 + r)^n}, \quad FV = PV(1 + r)^n$$

r is interest rate per period, expressed as a decimal

n is number of compounding periods

Straight-line method of depreciation

$$S = V_0 - Dn$$

S is salvage value of asset after n periods

V_0 is initial value of asset

D is amount of depreciation per period

n is number of periods

Declining-balance method of depreciation

$$S = V_0(1 - r)^n$$

S is salvage value of asset after n periods

V_0 is initial value of asset

r is depreciation rate per period, expressed as a decimal

n is number of periods

Data Analysis

Mean of a sample

$$\bar{x} = \frac{\text{sum of scores}}{\text{number of scores}}$$

z-score

For any score x ,

$$z = \frac{x - \bar{x}}{s}$$

$\bar{x}$ is mean

s is standard deviation

Outlier(s)

score(s) less than $Q_L - 1.5 \times IQR$

or

score(s) more than $Q_U + 1.5 \times IQR$

Q_L is lower quartile

Q_U is upper quartile

IQR is interquartile range

Least-squares line of best fit

$$y = \text{gradient} \times x + y\text{-intercept}$$

$$\text{gradient} = r \times \frac{\text{standard deviation of } y \text{ scores}}{\text{standard deviation of } x \text{ scores}}$$

$$y\text{-intercept} = \bar{y} - (\text{gradient} \times \bar{x})$$

r is correlation coefficient

$\bar{x}$ is mean of x scores

$\bar{y}$ is mean of y scores

Normal distribution

- approximately 68% of scores have z -scores between -1 and 1
- approximately 95% of scores have z -scores between -2 and 2
- approximately 99.7% of scores have z -scores between -3 and 3

Spherical Geometry

Circumference of a circle

$$C = 2\pi r \quad \text{or} \quad C = \pi D$$

r is radius

D is diameter

Arc length of a circle

$$l = \frac{\theta}{360} 2\pi r$$

r is radius

θ is number of degrees in central angle

Radius of Earth

(taken as) 6400 km

Time differences

For calculation of time differences using longitude:

$15^\circ = 1$ hour time difference

Area

Circle

$$A = \pi r^2$$

r is radius

Sector

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

r is radius

θ is number of degrees in central angle

Annulus

$$A = \pi(R^2 - r^2)$$

R is radius of outer circle

r is radius of inner circle

Trapezium

$$A = \frac{h}{2}(a + b)$$

h is perpendicular height

a and b are the lengths of the parallel sides

Area of land and catchment areas

unit conversion: $1 \text{ ha} = 10\,000 \text{ m}^2$

Surface Area

Sphere

$$A = 4\pi r^2$$

r is radius

Closed cylinder

$$A = 2\pi r^2 + 2\pi rh$$

r is radius

h is perpendicular height

Volume

Prism or cylinder

$$V = Ah$$

A is area of base

h is perpendicular height

Pyramid or cone

$$V = \frac{1}{3}Ah$$

A is area of base

h is perpendicular height

Volume and capacity

unit conversion: $1 \text{ m}^3 = 1000 \text{ L}$

Approximation Using Simpson's Rule

Area

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

h is distance between successive measurements

d_f is first measurement

d_m is middle measurement

d_l is last measurement

Volume

$$V \approx \frac{h}{3}\{A_L + 4A_M + A_R\}$$

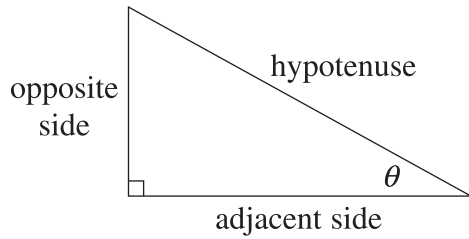
h is distance between successive measurements

A_L is area of left end

A_M is area of middle

A_R is area of right end

Trigonometric Ratios



$$\sin \theta = \frac{\text{opposite side}}{\text{hypotenuse}}$$

$$\cos \theta = \frac{\text{adjacent side}}{\text{hypotenuse}}$$

$$\tan \theta = \frac{\text{opposite side}}{\text{adjacent side}}$$

Sine rule

In $\triangle ABC$,

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

Area of a triangle

In $\triangle ABC$,

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

Cosine rule

In $\triangle ABC$,

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

or

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

Units of Memory and File Size

$$1 \text{ byte} = 8 \text{ bits}$$

$$1 \text{ kilobyte} = 2^{10} \text{ bytes} = 1024 \text{ bytes}$$

$$1 \text{ megabyte} = 2^{20} \text{ bytes} = 1024 \text{ kilobytes}$$

$$1 \text{ gigabyte} = 2^{30} \text{ bytes} = 1024 \text{ megabytes}$$

$$1 \text{ terabyte} = 2^{40} \text{ bytes} = 1024 \text{ gigabytes}$$

Blood Alcohol Content Estimates

$$BAC_{\text{male}} = \frac{10N - 7.5H}{6.8M}$$

or

$$BAC_{\text{female}} = \frac{10N - 7.5H}{5.5M}$$

N is number of standard drinks consumed

H is number of hours of drinking

M is person's mass in kilograms

Distance, Speed and Time

$$D = ST, \quad S = \frac{D}{T}, \quad T = \frac{D}{S}$$

$$\text{average speed} = \frac{\text{total distance travelled}}{\text{total time taken}}$$

$$\text{stopping distance} = \left\{ \begin{array}{c} \text{reaction-time} \\ \text{distance} \end{array} \right\} + \left\{ \begin{array}{c} \text{braking} \\ \text{distance} \end{array} \right\}$$

Probability of an Event

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

$$P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$$

Straight Lines

Gradient

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

Gradient-intercept form

$$y = mx + b$$

m is gradient

b is y-intercept

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2017 HSC Mathematics General 2 Marking Guidelines

Section I

Multiple-choice Answer Key

Question	Answer
1	C
2	D
3	A
4	C
5	B
6	D
7	A
8	B
9	A
10	D
11	A
12	C
13	A
14	B
15	A
16	D
17	B
18	A
19	D
20	B
21	C
22	C
23	D
24	D
25	C

Section II

Question 26 (a)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$\begin{aligned} & \$0.27 \times 20 \\ & = \$5.40 \end{aligned}$$

Question 26 (b)

Criteria	Marks
• Provides correct answer or CNE	2
• Makes progress towards correct answer	1

Sample answer:

$$\begin{aligned} \text{Cost} &= \$20 + \$0.50 \times 3 + \$0.70 + \$1.40 + \$3.50 \\ &= \$27.10 \end{aligned}$$

Question 26 (c)

Criteria	Marks
• Provides correct solution	2
• Makes progress towards correct solution	1

Sample answer:

Let N be the number of goats.

$$\begin{aligned} \frac{16}{45} &= \frac{80}{N} \\ N &= \frac{80 \times 45}{16} \\ &= 225 \end{aligned}$$

$\therefore$ The estimated number of goats the farmer has on his property is 225.

Question 26 (d)

Criteria	Marks
• Provides correct solution	2
• Uses correct trig equation or equivalent merit	1

Sample answer:

Let x be the required depth.

$$\begin{aligned}
 \sin 2^\circ &= \frac{x}{15000} \\
 &= 15000 \sin 2^\circ \\
 &= 523.4\dots \\
 &= 523 \text{ mm (to the nearest mm)}
 \end{aligned}$$

Question 26 (e)

Criteria	Marks
• Provides correct solution	3
• Makes significant progress towards the correct solution	2
• Provides correct cost or income, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Share cost} &= 500 \times 3.20 \\
 &= \$1600 \\
 \text{Brokerage} &= 1.5\% \times 1600 \\
 &= \$24 \\
 \text{Total cost} &= \$1624 \\
 \text{Share selling price} &= 500 \times 4.80 \\
 &= \$2400 \\
 \text{Dividend} &= 0.26 \times 500 \\
 &= \$130 \\
 \text{Total proceeds} &= 2400 + 130 \\
 &= \$2530 \\
 \text{Total profit} &= 2530 - 1624 \\
 &= \$906
 \end{aligned}$$

Question 26 (f) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

4 goals

Question 26 (f) (ii)

Criteria	Marks
• Provides correct answer	1

Sample answer:

Round 3

Question 26 (g)

Criteria	Marks
• Provides correct solution	3
• Makes significant progress towards the correct solution	2
• Uses the simple interest formula correctly, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Amount borrowed} &= 7990 - 500 \\
 &= \$7490 \\
 \text{Interest} &= 7490 \times 0.07 \times 2 \\
 &= \$1048.60 \\
 \text{Repayment} &= \frac{7490 + 1048.60}{2 \times 52} \\
 &= \$82.10 \text{ per week}
 \end{aligned}$$

Question 27 (a) (i)

Criteria	Marks
• Provides correct answer or CNE	1

Sample answer:

Mean = 200.875 kL

Question 27 (a) (ii)

Criteria	Marks
• Provides correct answer	1

Sample answer:

Standard deviation = 127.35...
= 127.4 kL (1 decimal place)

Question 27 (b)

Criteria	Marks
• Provides correct solution	2
• Calculates a correct conversion of units	1

Sample answer:

3 terabytes = 3×2^{40} bytes
20 megabytes = 20×2^{20} bytes
Number of files = $\frac{3 \times 2^{40}}{20 \times 2^{20}}$
= 157 286.4

∴ 157 286 files can fit.

Question 27 (c) (i)

Criteria	Marks
• Provides correct answer or CNE	1

Sample answer:

$$\begin{aligned}\text{Future value} &= 12\,000 \times 5.4163 \\ &= \$64\,995.60\end{aligned}$$

Question 27 (c) (ii)

Criteria	Marks
• Provides correct answer or CNE	1

Sample answer:

$$\begin{aligned}\text{Interest earned} &= 64\,995.60 - (5 \times 12\,000) \\ &= \$4\,995.60\end{aligned}$$

Question 27 (d) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

25°W

Question 27 (d) (ii)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$\begin{aligned}\text{Time difference} &= \frac{30}{15} \\ &= 2 \text{ hours} \\ \therefore \text{Time on island } B &= 10 \text{ am} - 2 \text{ hours} \\ &= 8 \text{ am}\end{aligned}$$

Question 27 (d) (iii)

Criteria	Marks
• Provides correct solution	3
• Provides correct answer in hours, or equivalent merit	2
• Calculates distance, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Distance} &= \frac{30}{360} \times 2\pi \times 6400 \\
 &= 3351.0... \text{ km} \\
 \text{Time} &= \frac{3351.0...}{40} \text{ hours} \\
 &= 83.7... \text{ hours} \\
 &= \frac{83.7...}{24} \text{ days} \\
 &= 3.490658504 \text{ days} \\
 &= 3 \text{ days} + (0.490658504 \times 24) \text{ hours} \\
 &= 3 \text{ days} + 11.7... \text{ hours} \\
 &= 3 \text{ days } 12 \text{ hours (nearest hour)}
 \end{aligned}$$

Question 27 (e)

Criteria	Marks
• Provides correct solution	4
• Attempts to determine the maximum number of bottles based on the number of standard drinks (N)	3
• Solves for N , or equivalent merit	2
• Substitutes into correct formula, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 BAC_{\text{male}} &= \frac{10N - 7.5H}{6.8M}, & BAC_{\text{male}} &= 0.05, H = 5, M = 90 \\
 0.05 &= \frac{10N - 7.5 \times 5}{6.8 \times 90} \\
 6.8 \times 90 \times 0.05 &= 10N - 7.5 \times 5 \\
 10N &= 7.5 \times 5 + 6.8 \times 90 \times 0.05 \\
 N &= 6.81 \quad \text{ie } 6.81 \text{ standard drinks} \\
 \text{Number of bottles} &= \frac{6.81}{0.8} \\
 &= 8.5125
 \end{aligned}$$

$\therefore$ Rhys can drink a maximum of 8 complete bottles.

Question 28 (a) (i)

Criteria	Marks
• Provides correct answer, or CNE	1

Sample answer:

$$F = \frac{9C}{5} + 32, C = -20$$

$$F = \frac{9 \times (-20)}{5} + 32$$

Temperature = -4 degrees Fahrenheit

Question 28 (a) (ii)

Criteria	Marks
• Provides correct solution for C or F	2
• Makes progress towards correct solution	1

Sample answer:

$$C = \frac{9C}{5} + 32$$

$$5C = 9C + 160$$

$$-160 = 4C$$

$$C = -40$$

$$F = -40$$

Question 28 (a) (iii)

Criteria	Marks
• Provides correct explanation	1

Sample answer:

The two lines intersect at $(-40, -40)$.

Question 28 (b) (i)

Criteria	Marks
• Provides correct answer or CNE	1

Sample answer:

$$\frac{5 \times 4}{2} = 10 \text{ groups of two}$$

Question 28 (b) (ii)

Criteria	Marks
• Provides correct answer or CNE	1

Sample answer:

Four of the ten possible groups include Mary (ie a group including Mary and one of the other 4 team members).

$$\begin{aligned} \text{The probability} &= \frac{4}{10} \\ &= 0.4 \end{aligned}$$

Question 28 (c)

Criteria	Marks
• Provides correct solution	3
• Provides balance after one month, or equivalent merit	2
• Calculates interest, or equivalent merit	1

Sample answer:

$$\begin{aligned} \text{Amount owing after first month, } A_1 &= 100\,000 \times \left(1 + \frac{0.12}{12}\right) - 1029 \\ &= \$99\,971 \end{aligned}$$

$$\begin{aligned} \text{Amount owing after second month, } A_2 &= 99\,971 \times \left(1 + \frac{0.12}{12}\right) - 1029 \\ &= \$99\,941.71 \end{aligned}$$

Question 28 (d)

Criteria	Marks
• Provides correct solution	2
• Provides one correct step, or equivalent merit	1

Sample answer:

$$x^2 = yp - 1$$

$$x^2 + 1 = yp$$

$$y = \frac{x^2 + 1}{p}$$

Question 28 (e) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

From the graph, the income is maximised when the increase in ticket price is \$6.

∴ the ticket price should be \$8 + \$6 = \$14

Question 28 (e) (ii)

Criteria	Marks
• Provides correct answer	1

Sample answer:

$$200 - 10 \times 6 = 140 \text{ tickets}$$

Question 28 (e) (iii)

Criteria	Marks
• Provides correct solution	2
• Calculates cost or income, or equivalent merit	1

Sample answer:

$$\begin{aligned}\text{Income} &= 140 \times \$14 \\ &= \$1960\end{aligned}$$

$$\begin{aligned}\text{Cost} &= 140 \times \$2 + \$500 \\ &= \$780\end{aligned}$$

$$\begin{aligned}\text{Profit} &= \$1960 - \$780 \\ &= \$1180\end{aligned}$$

Question 29 (a) (i)

Criteria	Marks
• Provides correct solution	2
• Makes progress towards correct solution	1

Sample answer:

$$\begin{aligned}
 h &= \frac{200}{4} \\
 &= 50 \\
 V &\approx \frac{50}{3}(0 + 4 \times 140 + 270) + \frac{50}{3}(270 + 4 \times 300 + 360) \\
 &= 44\,333\frac{1}{3} \text{ m}^3 \\
 &= 44\,333 \text{ m}^3 \text{ (nearest m}^3\text{)}
 \end{aligned}$$

Question 29 (a) (ii)

Criteria	Marks
• Provides correct solution	2
• Makes progress towards correct solution	1

Sample answer:

$$\begin{aligned}
 2 \text{ km}^2 &= 2 \times 1000 \times 1000 \\
 &= 2\,000\,000 \text{ m}^2 \\
 V &= Ah \\
 44\,333 &= 2\,000\,000 \times h \\
 h &= \frac{44\,333}{2\,000\,000} \\
 &= 0.0221\ldots \text{ m} \\
 &= 22 \text{ mm (nearest mm)}
 \end{aligned}$$

Question 29 (b)

Criteria	Marks
• Provides correct solution	3
• Makes significant progress towards correct solution	2
• Makes progress towards correct solution	1

Sample answer:

$$\begin{aligned}
 \text{Tax payable} &= 3572 + 0.325(86\,725 - 37\,000) \\
 &= \$19\,732.63 \\
 \text{Medicare levy} &= 2\% \times 86\,725 \\
 &= \$1734.50 \\
 \text{Total payable} &= 19\,732.63 + 1734.50 \\
 &= \$21\,467.13 \\
 \therefore \text{Net income} &= 86\,725 - 21\,467.13 \\
 &= \$65\,257.87
 \end{aligned}$$

Question 29 (c) (i)

Criteria	Marks
• Provides correct solution	2
• Provides correct numerator or denominator, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Number of students surveyed} &= 3520 \\
 \text{Probability} &= \frac{2500}{3520} \\
 &= \frac{125}{176}
 \end{aligned}$$

Question 29 (c) (ii)

Criteria	Marks
• Provides correct justification with calculations	2
• Identifies correct numbers from table, or equivalent merit	1

Sample answer:

$$\begin{aligned}
 \text{Country students who have water skied: } &\frac{70}{870} \times 100 = 8.04\ldots\% \\
 \text{City students who have water skied: } &\frac{150}{2650} \times 100 = 5.66\ldots\% \\
 \therefore \text{The claim in the newspaper article is true.}
 \end{aligned}$$

Question 29 (d) (i)

Criteria	Marks
• Provides correct answer	1

Sample answer:

15th mark is 4.

16th mark is 8.

$$\begin{aligned}\text{Median} &= \frac{4 + 8}{2} \\ &= 6\end{aligned}$$

Question 29 (d) (ii)

Criteria	Marks
• Provides correct solution	2
• Calculates correct boundaries, or equivalent merit	1

Sample answer:

$$\begin{aligned}\text{Mean minus standard deviation} &= 5.4 - 4.22 \\ &= 1.18\end{aligned}$$

$$\begin{aligned}\text{Mean plus standard deviation} &= 5.4 + 4.22 \\ &= 9.62\end{aligned}$$

$$\begin{aligned}\text{Percentage of marks between 1.18 and 9.62} &= \frac{2 + 2 + 2 + 1 + 6}{30} \\ &= \frac{13}{30} \\ &= 43.3\% \text{ (1 decimal place)}\end{aligned}$$

Question 29 (d) (iii)

Criteria	Marks
• Provides correct explanation	1

Sample answer:

The dot plot does not show a normally distributed data set, so the statement is not relevant.

Question 30 (a)

Criteria	Marks
• Provides correct solution	2
• Makes progress towards correct solution	1

Sample answer:

$$\begin{aligned}
 \text{Interquartile range (IQR)} &= Q_U - Q_L \\
 &= 16 - 10 \\
 &= 6 \\
 \text{Lower bound} &= Q_L - 1.5 \times \text{IQR} \\
 &= 10 - 1.5 \times 6 \\
 &= 1 \\
 \text{Upper bound} &= Q_U + 1.5 \times \text{IQR} \\
 &= 16 + 1.5 \times 6 \\
 &= 25 \\
 \therefore \text{Range} &= 25 - 1 \\
 &= 24
 \end{aligned}$$

Question 30 (b)

Criteria	Marks
• Provides correct solution	2
• Writes a correct equation, or equivalent merit	1

Sample answer:

Let C be the cost of the jewellery box.
 Let h be the height of the jewellery box.

$$C = kh^3 \text{ where } k \text{ is a constant.}$$

$$50 = k \times 10^3$$

$$\therefore k = 0.05$$

When $h=12$

$$\begin{aligned}
 \text{cost, } C &= 0.05 \times 12^3 \\
 &= \$86.40
 \end{aligned}$$

Question 30 (c) (i)

Criteria	Marks
• Provides correct solution	2
• Substitutes correctly into cosine rule, or equivalent merit	1

Sample answer:

$$AC^2 = 13^2 + 5^2 - 2 \times 5 \times 13 \times \cos 135^\circ$$

$$= 285.92\dots$$

$$AC = \sqrt{285.92\dots}$$

$$= 16.9\dots$$

$$= 17 \text{ km (nearest kilometre)}$$

Question 30 (c) (ii)

Criteria	Marks
• Provides correct solution	3
• Calculates an angle in the triangle, or equivalent merit	2
• Substitutes correctly into sine rule or cosine rule, or equivalent merit	1

Sample answer:

$$\frac{\sin A}{13} = \frac{\sin 135^\circ}{17}$$

$$\sin A = \frac{13 \sin 135^\circ}{17}$$

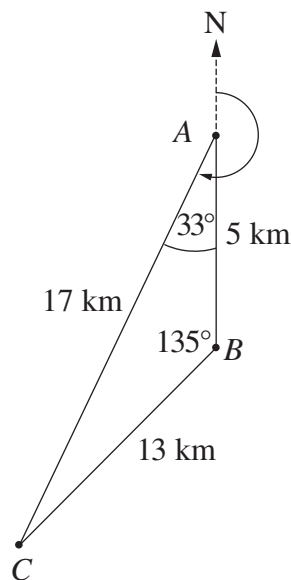
$$= 0.5407$$

$$A = 32.7\dots^\circ$$

$$= 33^\circ \text{ (nearest degree)}$$

The bearing of school C from school A is

$$180^\circ + 33^\circ = 213^\circ.$$



Question 30 (d) (i)

Criteria	Marks
• Provides correct answer, or CNE	1

Sample answer:

$$\begin{aligned}\text{Speed (y)} &= 2.125 \times 5 + 2.0375 \\ &= 12.6625 \text{ km/h}\end{aligned}$$

Question 30 (d) (ii)

Criteria	Marks
• Provides correct solution	2
• Identifies correct formula, or equivalent merit	1

Sample answer:

$$\begin{aligned}\text{gradient} &= r \times \frac{\text{standard deviation of } y \text{ scores}}{\text{standard deviation of } x \text{ scores}} \\ 2.125 &= r \times \frac{2}{0.8} \\ \therefore r &= 0.85\end{aligned}$$

Question 30 (e)

Criteria	Marks
• Provides correct solution	3
• Makes significant progress towards correct solution	2
• Calculates the height of the cone, or equivalent merit	1

Sample answer:

$$\begin{aligned}\text{Radius of cone, } r &= \sqrt{4^2 - 2^2} \\ &= \sqrt{12} \text{ cm} \\ \text{Height of cone, } h &= 15 - (4 + 2) \\ &= 9 \text{ cm} \\ \text{Volume of cone, } V &= \frac{1}{3} \pi r^2 h \\ &= \frac{1}{3} \pi (\sqrt{12})^2 \times 9 \\ &= 113.09 \dots \\ &= 113 \text{ cm}^3 \text{ (to nearest cm}^3\text{)}\end{aligned}$$

2017 HSC Mathematics General 2

Mapping Grid

Section I

Question	Marks	Content	Syllabus outcomes
1	1	DS4 (•5) Find median from a box-and-whisker plot p80	MG2H-2
2	1	FSDr3 (•1) Calculate distance, given speed and time p68	MGP-5
3	1	FSHe3 (•1) Life expectancy from a graph p112	MG2H-2
4	1	DS1 (•5) Distinguish between different sample types p32	MGP-10
5	1	DS6 (•6) Expected number p84	MG2H-2
6	1	FM1 (•2) Calculating fortnightly wage p24	MGP-6
7	1	AM1 (•4) Substitution into a formula to find the subject p52	MGP-3
8	1	MM5 (•2) Trigonometric ratios to find an angle with rounding p90	MG2H-5
9	1	AM3 (•6) Solving linear equations p100	MG2H-3
10	1	FM2 (•5) Using the compound interest formula p26	MGP-6
11	1	FSDr1 (•1) Percentage decrease in car value p64	MGP-6
12	1	FSHe1 (•7) Interpret the size of correlation coefficient from a graph p108	MG2H-2
13	1	DS5 (•2) Calculate z-score p82	MG2H-7
14	1	FSDr2 (•3) Compare fuel consumption of various vehicles p66	MGP-5
15	1	PB1 (•8) Determine theoretical probability p48	MGP-8
16	1	FSRe3 (•9) Reducing energy use p120	MG2H-2
17	1	AM4 (•9) Identifying point of intersection of graphs p102	MG2H-3
18	1	MM2 (•5) Volume of a prism p42	MGP-4
19	1	FSHe2 (•5) Calculate required child dosage p110	MG2H-5
20	1	AM2 (•13) Generalisation of linear number patterns p54	MGP-3
21	1	MM1 (•2) Degree of accuracy of a measurement p40	MGP-5
22	1	MM4 (•10) Volume of an annular cylinder p88	MG2H-4
23	1	FSCo2 (•2) Convert units of data storage p60	MGP-5
24	1	PB2 (•7) Calculate multi-stage probability p96	MG2H-8
25	1	MM6 (•1) Calculate arc length p92	MG2H-4

Section II

Question	Marks	Content	Syllabus outcomes
26 (a)	1	FSRe3 (•4) Electricity cost p120	MG2H-5
26 (b)	2	FSCo1 (•3) Cost of a phone bill p58	MGP-6
26 (c)	2	DS6 (•4) Capture–recapture p84	MG2H-3
26 (d)	2	MM3 (•6) Angle of depression p44	MGP-4
26 (e)	3	FM2 (•10) Shares p26	MGP-6
26 (f) (i)	1	DS4 (•15) Area chart p80	MG2H-7
26 (f) (ii)	1	DS4 (•15) Area chart p80	MG2H-7
26 (g)	3	FM4 (•2) Flat-rate loan p74	MG2H-6
27 (a) (i)	1	FSRe1 (•2) Mean of water use p116	MGP-1
27 (a) (ii)	1	FSRe1 (•2) Standard deviation of water use p116	MG2H-7
27 (b)	2	FSCo2 (•3) Number of files on a disc p60	MGP-5
27 (c) (i)	1	FM5 (•2) FV annuity p76	MG2H-6
27 (c) (ii)	1	FM5 (•6) Interest on an annuity p76	MG2H-6
27 (d) (i)	1	MM6 (•4) Longitude value p92	MG2H-4
27 (d) (ii)	1	MM6 (•7) Time calculation p92	MG2H-4
27 (d) (iii)	3	MM6 (•5) Using speed to calculate time	MG2H-5
27 (e)	4	FSDr3 (•4) Male BAC, number of drinks in given time p68	MGP-3
28 (a) (i)	1	AM1 (•4) Substitution to convert from C to F p52	MGP-3
28 (a) (ii)	2	AM4 (•10) Solving simultaneous equations p102	MG2H-3
28 (a) (iii)	1	AM4 (•9) Interpreting a solution p102	MG2H-3
28 (b) (i)	1	PB2 (•5) Combinations p96	MG2H-8
28 (b) (ii)	1	PB2 (•7) Probability p96	MG2H-8
28 (c)	3	FM4 (•3) Reducible loan without repayment table p74	MG2H-6
28 (d)	2	AM3 (•8) Change the subject of equation p100	MG2H-3
28 (e) (i)	1	AM5 (•1) Location of maximum value from quadratic graph p104	MG2H-3
28 (e) (ii)	1	AM5 (•1) Interpreting written information p104	MG2H-3
28 (e) (iii)	2	AM5 (•1) Calculating profit p104	MG2H-3
29 (a) (i)	2	FSRe2 (•7) Simpson’s rule (volume) p118	MG2H-4
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Question	Marks	Content	Syllabus outcomes
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29 (c) (i)	2	DS4 (•18) Probability with two-way table p80	MG2H-2
29 (c) (ii)	2	DS4 (•18) Justifying opinion with calculations p80	MG2H-2
29 (d) (i)	1	DS3 (•1) Median p36	MGP-7
29 (d) (ii)	2	DS5 (•2) Using mean and standard deviation p82	MG2H-7
29 (d) (iii)	1	DS5 (•4) Normal distribution explanation p82	MG2H-7
30 (a)	2	DS4 (•5) Outliers p80	MG2H-7
30 (b)	2	AM5 (•6) Variation p104	MG2H-3
30 (c) (i)	2	MM5 (•7) Cosine rule p90	MG2H-4
30 (c) (ii)	3	MM5 (•11) Calculate bearing p90	MG2H-4
30 (d) (i)	1	AM1 (•4) Substitution p52	MGP-3
30 (d) (ii)	2	FSHe1 (•5) Correlation from least-squares equation p108	MG2H-7
30 (e)	3	MM4 (•8) Volume of a cone p88	MG2H-4