
Student Number

Caringbah High School

2024 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 2–7)

- Attempt Questions 1–15
- Allow about 25 minutes for this section

Section II – 85 marks (pages 9–30)

- Attempt Questions 16–39
- Allow about 2 hours and 5 minutes for this section

Section I	Section II	Total
/15	/85	/100

Section I – 15 marks

Attempt Questions 1 – 15
Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 15

1. What is 34 827 368.12 expressed in standard form with two significant figures?

A. 3.48×10^{7}
B. 3.48×10^{-7}
C. 3.5×10^{7}
D. 3.5×10^{-7}

2. Amie was studying the butterfly population at a park. She caught and marked 20 butterflies and released them back into the park. Later, she caught 40 butterflies, of which 5 were already marked.

Based on the number of butterflies Amie has caught and marked, what is the most likely estimate for the butterfly population in the park?

A. 160 butterflies
B. 100 butterflies
C. 1000 butterflies
D. 200 butterflies

3. Deborah needs to share 140 grams of birdseed equally between five canaries.
One of Deborah's birdcages has two canaries in it.
How much birdseed should she place in the feeder in that birdcage?

A. 28 grams
B. 56 grams
C. 84 grams
D. 112 grams

4. Kabir earns an hourly rate of $32.46, before he gets a 3.2% pay rise.
What is Kabir's new hourly rate?

A. $33.50
B. $34.50
C. $35.66
D. $42.85

5. The weather forecast for a particular week states that each day has a 45% chance of rain one day that week.

What is the probability that it does NOT rain over the weekend?

A. 0.2025
B. 0.2475
C. 0.3025
D. 0.7975

6. An electrician charges a call-out fee of $120, as well as $1.50 per minute while working. Suppose the electrician works for *t* hours.

Which equation expresses the amount the electrician charges, $C, as a function of time, *t*, hours?

A. $C = 120t + 90$

B. $C = 120t + 1.5$

C. $C = 90t + 120$

D. $C = 1.5t + 120$

7. Anna bought a car for $44 000 in 2013 and sold it after 10 years in 2023. It was depreciated using the declining-balance method, at a rate of 7% per annum.
By how much had the car depreciated when Anna sold it?

A. $13 200

B. $21 295

C. $21 795

D. $22 705

8. Joe bought 430 shares in a biomedical company at a total cost of $5600. The dividend yield was 8.7%.

What was the value of the dividend per share?

A. $0.11

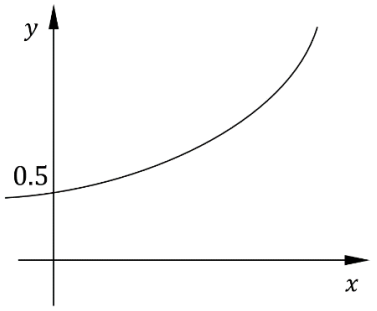
B. $1.13

C. $1.50

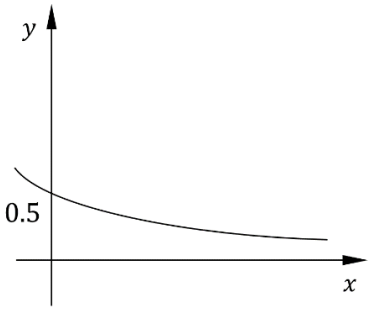
D. $4.87

9. Which of the following could represents the graph of $y = k(a^x)$, where k is greater than 1, and a is between 0 and 1?

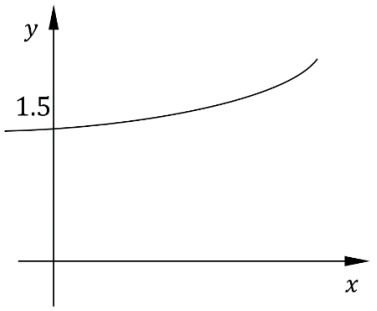
A.



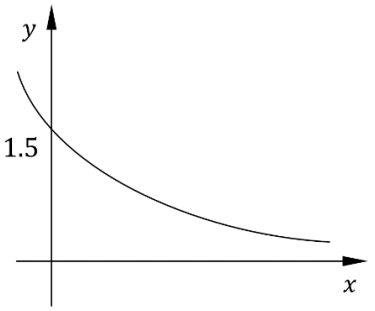
C.



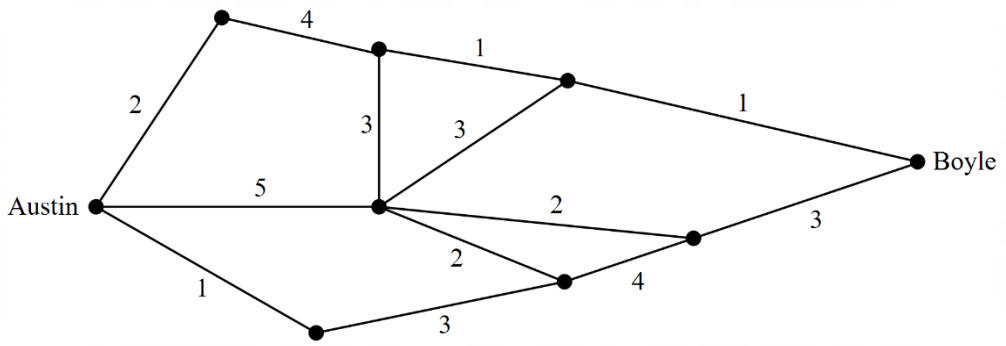
B.



D.



10. The network shows the distances, in kilometres, along roads that connect the cities of Austin and Boyle.



The shortest distance, in kilometres, from Austin to Boyle is:

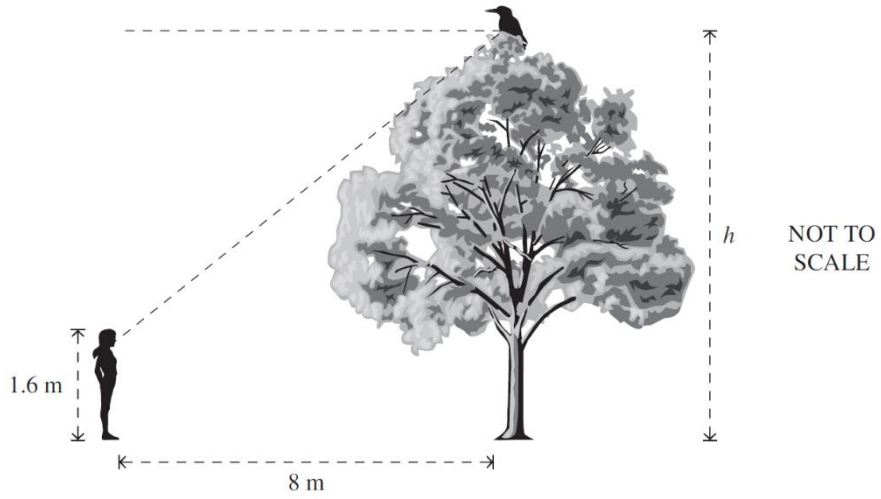
A. 8

B. 9

C. 10

D. 11

11. Nadia is watching a bird at the top of a tree. Nadia is 1.6 m tall and is standing 8 metres away from the tree, as shown in the diagram.



If the angle of depression of Nadia from the bird is 73°, what is the height of the tree?

A. 2.45 m

B. 4.05 m

C. 26.17 m

D. 27.77 m

12. A teacher is interested in the relationship between the age of students and the size of the groups they choose to sit in at lunch time in the playground. The teacher gathers data and plots the average age of students sitting in a group, x, and the number of students in that group, y. When they have gathered enough data, they construct a scatterplot and draw a line of best fit by eye. The equation of the line of best fit is:

$$y = 2.4 + 0.3x$$

Which of the following statements is FALSE?

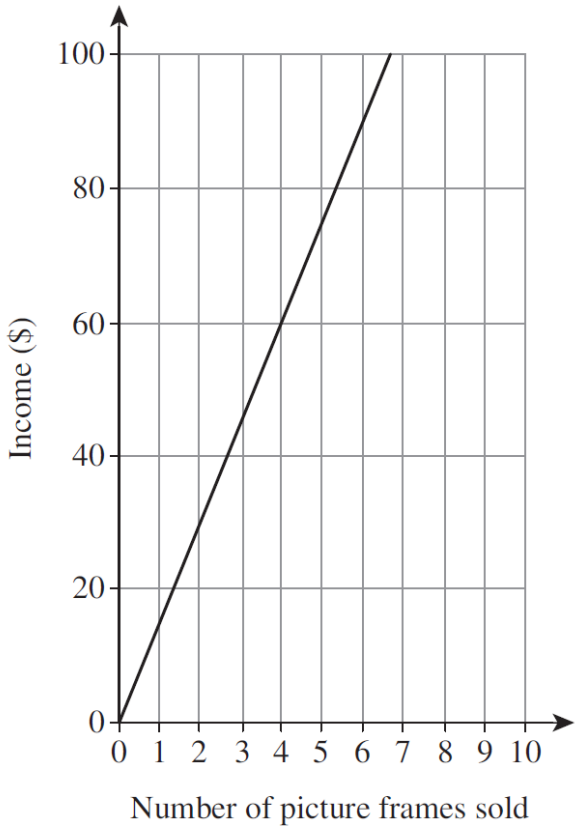
A. If the average age of a group is 12, then the line of best fit predicts the group size will be 6 students.

B. If there is a group with 7 students, then the line of best fit predicts the group will have an average age of 15.3 years.

C. The students in smaller groups tend to be younger than those in larger groups.

D. The equation for the line of best fit shows that the correlation coefficient is 0.3, which indicates a weak positive linear relationship.

13. The graph shows the income, in dollars, for a small business that makes and sells picture frames.



The cost to make the picture frames is given by the formula

$$C = 10n + 20,$$

where C is the cost and n is the number of picture frames sold.

If 6 picture frames are made and sold, which of the following statements is CORRECT?

A. There is a profit of $10

B. There is a loss of $10

C. There is a profit of $90

D. There is a loss of $80

14. Macy and Kassidy share a sum of money. Kassidy receives 60% more money than Macy.

If Kassidy receives $176, what is the total amount of money that they share between them?

A. $246.40

B. $286.00

C. $457.60

D. $616.00

15. A sports store sells jerseys priced at $169.95, including 10% goods and services tax (GST).

What is the amount of GST included in the price?

A. $15.45

B. $17.00

C. $152.96

D. $154.50

End of Section

Mathematics Standard 2

Section II

Section II

85 marks

Attempt Questions 16–39

Allow about 2 hours and 5 minutes for this section

Instructions

- Write your 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 on pages 31-32. If you use this space, clearly indicate which question you are answering.

Question 16 (2 marks)

A new dryer is being sold for $599. The dryer uses 315 kWh of electricity per year, and electricity is charged at 28.66 cents per kWh.

How much will it cost to purchase and then run the dryer for three years?

2

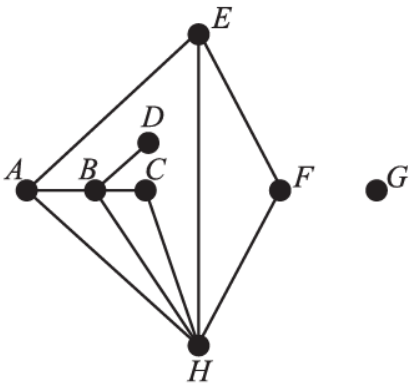
……

……

Question 17 (3 marks)

The map of Australia shows the six states, the Northern Territory and the Australian Capital Territory (ACT).

In the network diagram below, each of the vertices to **A** to **H** represents one of the states or territories shown on the map of Australia. The edges represent a border shared between two states or between a state and a territory.



(a) In the network diagram, what is the order of the vertex that represents the Australian Capital Territory (ACT)?

…… **1**

(b) In the network diagram, Queensland is represented by which letter? Explain why.

…… **2**

……

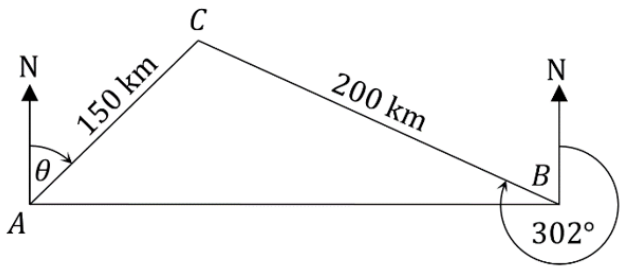
……

……

Question 18 (3 marks)

The following information is known about three towns, A, B and C, and shown on the diagram below.

- Town A is due west of town B.
- Town C is 150 kilometres from town A, and 200 kilometres from town B.
- The bearing of town C from town B is $302°$.



What is the bearing, θ, of town C from town A, correct to the nearest minute?

3

……

……

……

……

……

……

……

……

……

……

……

……

Question 19 (4 marks)

The child dosage of a particular pain medicine can be calculated using the formula

$$C = \frac{aD}{a + 12}$$

where C is the child dosage in mL, a is the age of the child in years and D is the adult dosage in mL. For this particular pain medicine, the adult dosage is 15 mL.

(a) What is the dosage for a five-year-old child? Give your answer correct to the nearest mL. **1**

…….

…….

(b) At what age will the child dosage be exactly half the adult dosage? **3**

…….

…….

…….

…….

…….

Question 20 (2 marks)

Ariel purchased a printer for her office three years ago.

It depreciated by $260 each year based on the straight-line method of depreciation. The salvage value of the printer is now $120.

Find the initial value of the printer. **2**

…….

…….

…….

Question 21 (2 marks)

The nutrition information for a box of cupcakes is shown.

Nutrition information	
12 servings per container	
Serving size: 58 g	
Calories per serve: 80	
Nutrients	**Daily value**
Total fat: 1g	1%
Saturated fat: 0 g	
Trans fat: 0 g	
Cholesterol: 15 mg	5%
Sodium: 150 mg	7%
Total carbohydrate: 16 g	6%
Dietary fibre: 1 g	4%
Total sugars: 6 g	
Protein: 3 g	
Calcium: 33 mg	2%
Iron: 2 mg	10%
Potassium: 31 mg	0%

If 1 calorie is equal to 4.184 joules, what is the total number of kilojoules in the box of cupcakes?

2

……

……

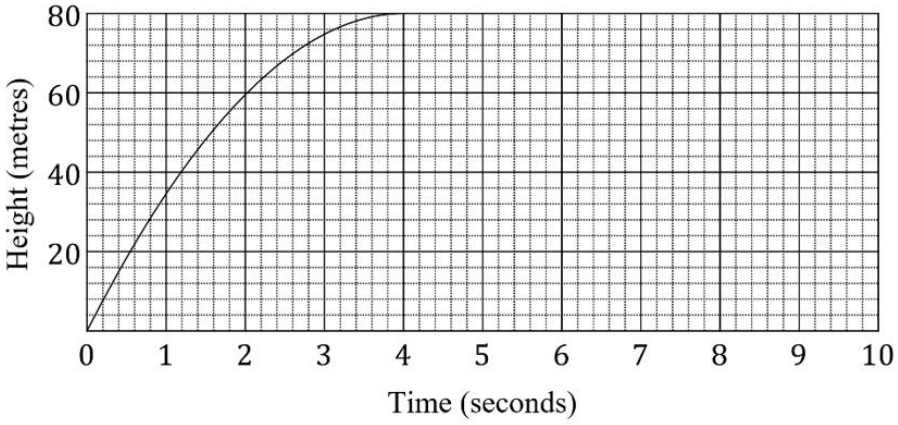
……

……

Question 22 (4 marks)

A ball is shot vertically into the air from the ground.

The height of the ball above the ground, h metres, can be modelled using the function, $h = 40t - 5t^2$ where t is measured in seconds. The first half of the graph of the function is shown.



(a) Based on the graph, or otherwise, at what time does the ball return to the ground? **1**

……

(b) How high is the ball above the ground after 1 second? **1**

……

(c) Ben is looking out his window and sees the ball pass the window on its way up, then four seconds later sees it pass the window again on its way down. **2**
How high is Ben's window above the ground? Justify your answer.

……

……

……

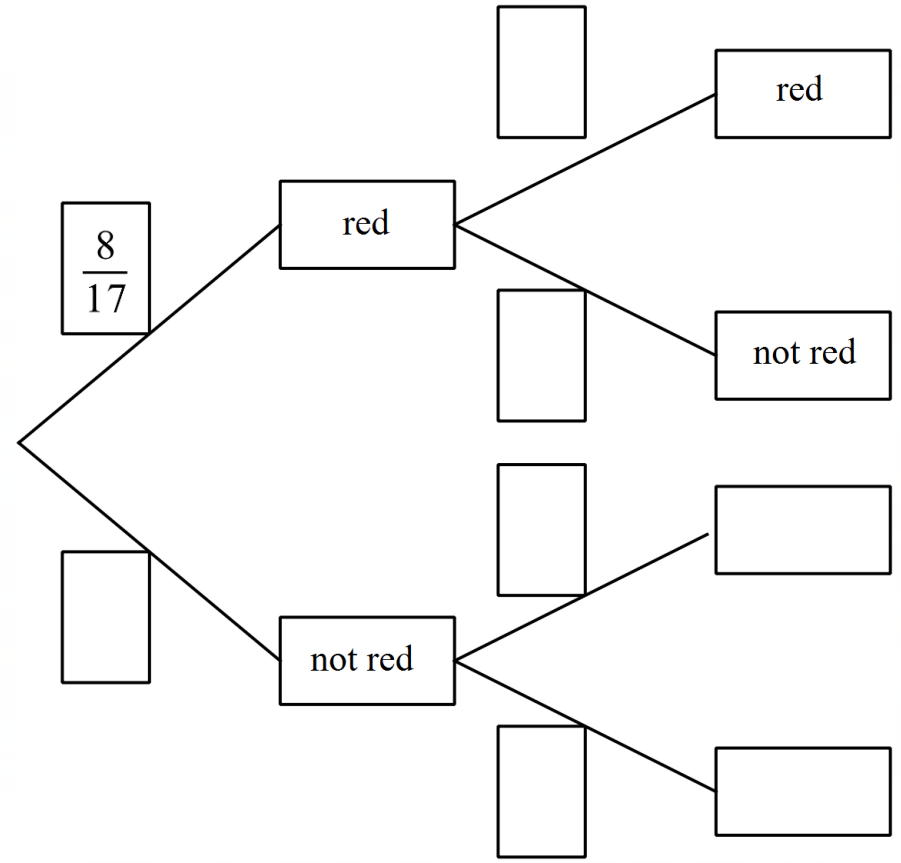
……

……

……

Question 23 (4 marks)

A bag contains 5 white, 8 red and 4 purple marbles. Sarah takes two marbles from the bag and records the outcomes in the tree diagram, as shown.



(a) Complete the tree diagram. Include all appropriate outcomes and probabilities. **2**

(b) Find the probability that at least ONE of the marbles is RED. **2**

……

……

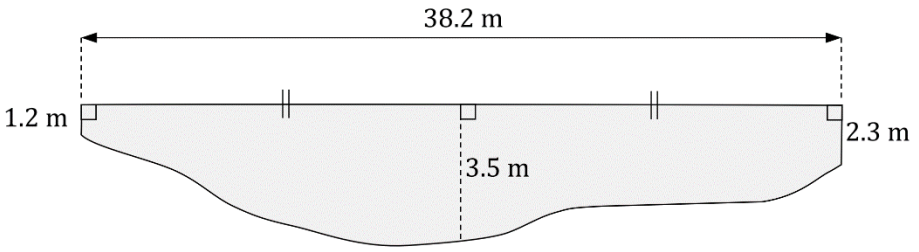
……

……

……

Question 24 (4 marks)

The diagram shows the cross-section of the bed of a river as it flows under a bridge.



NOT TO SCALE

(a) Use two applications of the trapezoidal rule to estimate the area of the cross-section of the river, correct to the nearest square metre. **2**

……

……

……

(b) The water in the river is moving at a rate of 0.4 metres per second.
What is the volume of water that flows under the bridge in an hour? **2**

……

……

Question 25 (3 marks)

Andrew spent a total of $131.98 at the supermarket, which included 10% GST on some of the items he bought. The total value of the items which did NOT have GST added was $40.35.
What was the amount Andrew paid at the supermarket excluding GST? **3**

……

……

……

……

……

Question 26 (3 marks)

The table shows the individual tax rates for the 2023-24 financial year.

Taxable income	*Tax payable*
$0–$18 200	Nil
$18 201–$45 000	19 cents for each $1 over $18 200
$45 001–$120 000	$5092 plus 32.5 cents for each $1 over $45 000
$120 001–$180 000	$29 467 plus 37 cents for each $1 over $120 000
$180 001 and over	$51 667 plus 45 cents for each $1 over $180 000

Georgina has a gross annual salary of $113 700. She is able to claim $3050 in tax deductions for work-related expenses. She is required to pay the Medicare levy, which is 2% of her taxable income.

Calculate Georgina's tax payable, including the Medicare levy. Give your answer correct to the nearest dollar. **3**

……

……

……

……

……

……

……

……

……

Question 27 (3 marks)

Hunter bought 20 000 shares in KSH Mining for $0.31 each, and 100 000 shares in PSK Mining for 0.2 cents each. While he owned the shares, Hunter received total dividends from the two companies of $590. When Hunter sold all of the shares, he received $0.26 per share for the KSH Mining shares and 1.1 cents per share for the PSK Mining shares. Hunter did not have to pay any other fees when he bought or sold the shares.

What percentage profit or loss did Hunter make from owning the shares? Answer as a percentage correct to 2 decimal places. **3**

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Question 28 (3 marks)

Mackenzie has a credit card with the following conditions:

- There is no interest-free period.
- Interest is charged at the end of each month at 19.5% per annum, compounded daily, from the purchase date (included) to the last day of the month (included).

Mackenzie's credit card statement for October is shown, with some figures missing.

Statement period: 1 October to 31 October

Date	**Details**	**Amount ($)**
1 October	Opening balance	$245.62
21 October	Monitor	$699.00
31 October	Interest charged	***
31 October	Closing balance	***

What is Mackenzie's closing balance? **3**

……

……

……

……

……

……

……

……

……

……

……

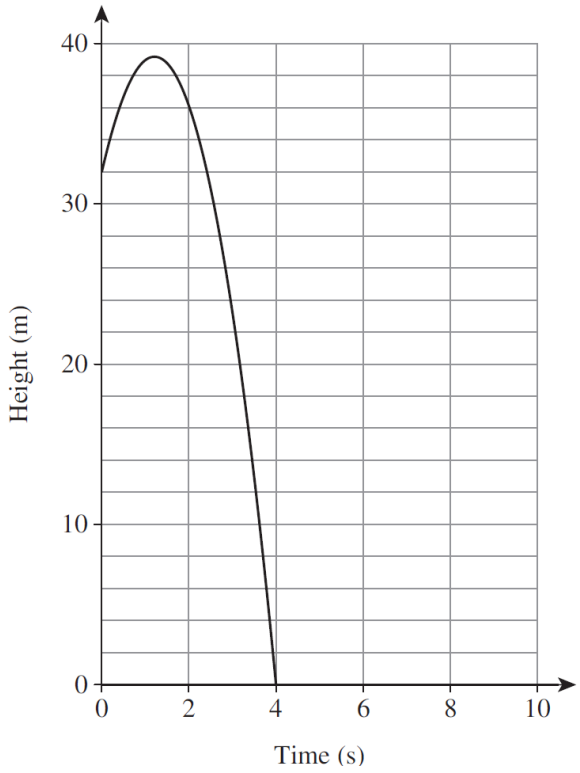
Question 29 (3 marks)

An object is thrown upwards from a cliff that overlooks the sea. The object's motion can be modelled using the function

$$h = 32 + 12t - 5t^2$$

where h is the object's height above the sea in metres and t is the time in seconds.

The graph of the function is shown.



(a) Find the height of the cliff

…… **1**

(b) State the time it takes for the object to land in the sea

…… **1**

(c) Given that the axis of symmetry of the parabola shown is at $t = 1.2$ s, find the maximum height that the object reaches after being thrown.

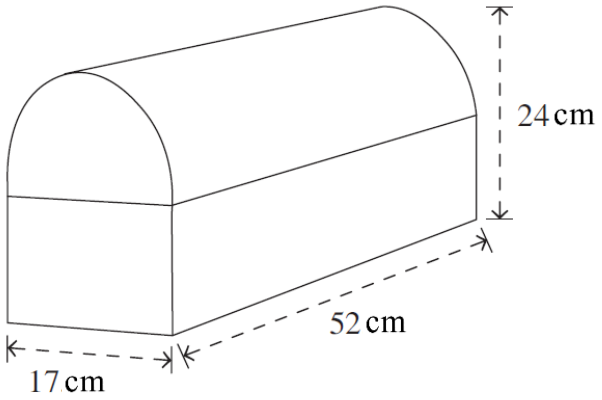
…… **1**

……

……

Question 30 (3 marks)

A closed mailbox, composed of half a cylinder on top of a rectangular prism, is shown.



NOT TO SCALE

What is the surface area, in cm^2, of the closed mailbox? Give your answer to the nearest whole number. **3**

……

……

……

……

……

……

……

……

……

……

……

……

……

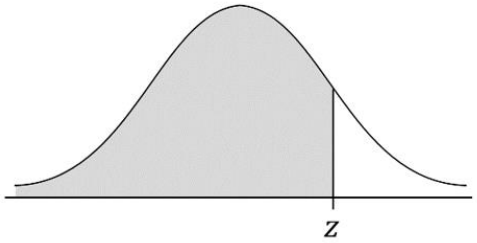
……

Question 31 (5 marks)

A random variable is normally distributed with a mean of 0 and a standard deviation of 1. The table gives the probability that this random variable lies below z from some positive values of z.

z	2.20	2.21	2.22	2.23	2.24	2.25	2.26	2.27	2.28	2.29
Probability	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890

The probability values given in the table are represented by the shaded area in the following diagram.



The heights of fourteen-year-old girls in Australia are normally distributed with a mean of 151.2 centimetres and a standard deviation of 7.4 centimetres.

(a) In a group of 1000 fourteen-year-old Australian girls, how many would be expected to be over 168 centimetres in height? **4**

……

……

……

……

……

……

……

(b) In the same group of 1000 fourteen-year-old Australian girls, how many would be expected to be less than 134.4 centimetres in height? **1**

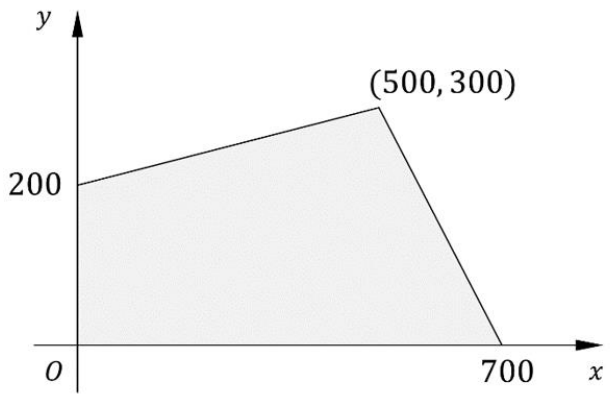
……

……

……

Question 32 (3 marks)

A block of land is represented by the shaded region on the number plane. All measurements are in metres.



NOT TO SCALE

The owner needs to cover the block of land with 50g of fertiliser per square metre.

How many tonnes of fertiliser will they need?

3

……

……

……

……

……

……

……

……

……

……

……

Question 33 (5 marks)

The time taken for a student to ride between their home and school at a constant speed varies inversely with their speed. It takes the student 36 minutes to travel from home to school if they are travelling at 20 kilometres per hour.

(a) Calculate the distance between the student's home and school. **2**

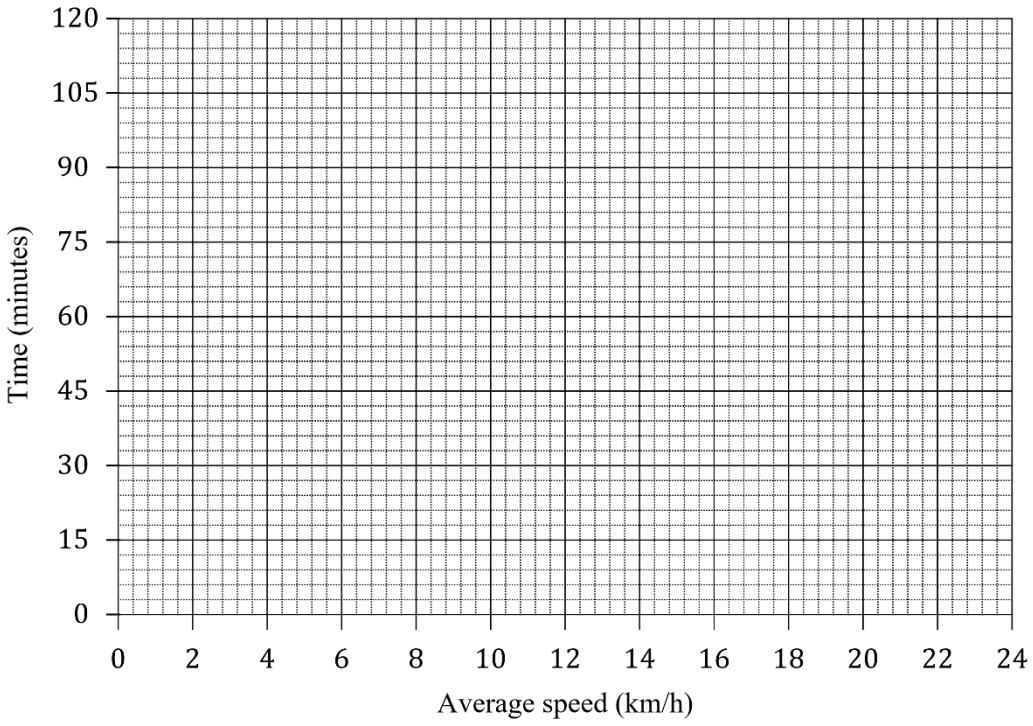
……

……

……

(b) The student can ride to school at average speeds varying from 6 kilometres per hour to 24 kilometres per hour.

By first plotting at least four relevant points, draw the curve that shows the time taken to travel from home to school at different average speeds. **3**



……

……

……

Question 34 (5 marks)

Businesses often collect data on the total amount of money spent on advertising and total revenue. The table shows information about six consecutive sales quarters for a particular business.

Sales quarter	*Money spent on advertising ($)*	*Total revenue ($)*
1	15 500	61 000
2	18 000	62 000
3	23 400	81 000
4	32 000	94 000
5	32 000	102 000
6	40 000	150 000

(a) Find the equation of the least-squares regression line by calculating the gradient and *y*-intercept. Give these values correct to two decimal places. **3**

……

……

……

(b) The manager of the business believes that the data shows a strong and positive correlation.

Is the manager correct? Justify your answer using appropriate statistical measure(s) and mathematical reasoning. **2**

……

……

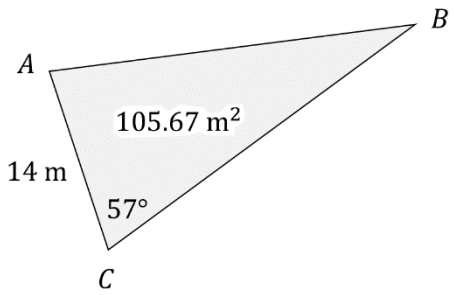
……

……

……

Question 35 (3 marks)

The diagram shows triangle ABC.



The triangle has an area of 105.67 m^2, $AC = 14$ m and $\angle ACB = 57°$.

Find the length of AB, correct to 2 decimal places.

3

……

……

……

……

……

……

……

……

……

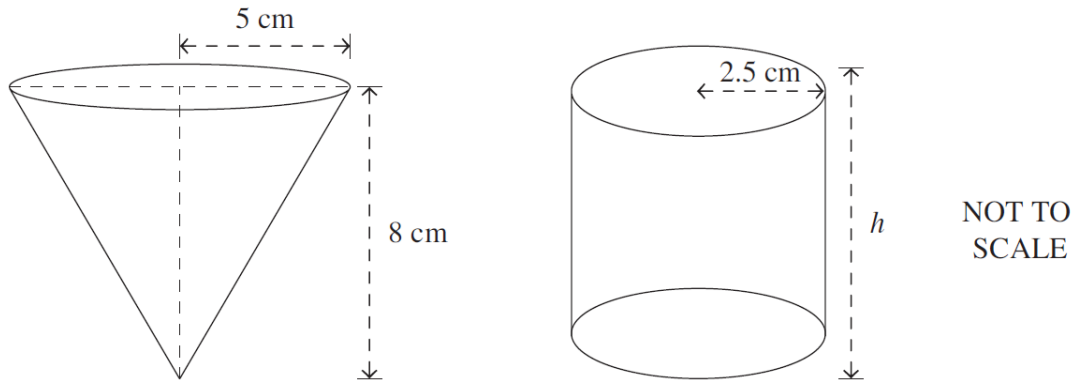
……

……

……

Question 36 (3 marks)

Jordan wanted to investigate the capacities of different three-dimensional objects. She used two containers: one in the shape of a cone and one in the shape of a cylinder. The containers and their dimensions are shown.



When Jordan completely filled the conical container with water and then poured the water into the cylindrical container, she found that the containers had equal volumes.

What is the height (h) of the cylindrical container, correct to two decimal places? **3**

……

……

……

……

……

……

……

……

……

……

……

Question 37 (4 marks)

The table below shows the monthly repayments on loans of various amounts over a number of different loan periods.

	Monthly repayment amount		
Principal	*Loan period (years)*		
	2	5	7
$10 000	$480	$228	$187
$20 000	$960	$455	$374
$30 000	$1439	$683	$561

(a) Spiro is borrowing $30 000, to be repaid with monthly repayments over 5 years.
How much interest will be paid on the loan? **2**

……

……

……

……

(b) Calculate the percentage flat rate of interest per annum on this loan. **2**

……

……

……

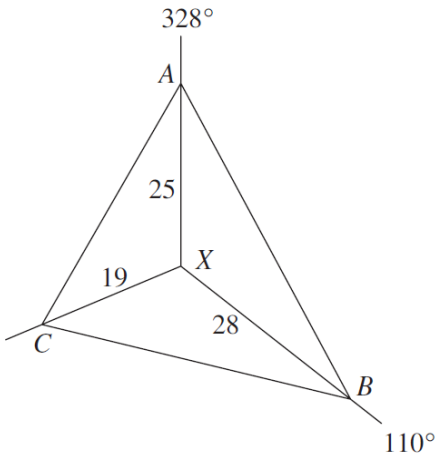
……

……

……

Question 38 (4 marks)

The compass radial survey shows the position of four towns: *A*, *B*, *C* and *X*. Towns *A* and *B* lie at a true bearing of 328° and 110° degrees from town *X*, respectively. All distances between the towns are given in metres.



(a) Find the distance between towns *A* and *B*, correct to the nearest metre. **2**

……

……

……

……

……

(b) If the area of triangle *XCB* is 265 m^2, find the true bearing of town *C* from town *X*. **2**

Give your answer correct to the nearest degree.

……

……

……

……

……

……

……

……

……

Question 39 (7 marks)

Elena takes out a loan of $150 000 with Westpac bank, which has an interest rate of 6.14% per annum. She makes regular monthly repayments of $1000. Elena uses the table shown to calculate her interest.

n	P	I	$P+I$	$P+I-R$
1	$150 000	$767.50	$150 767.50	$149 767.50
2				A_2

In the table:

- n is the number of months
- P is the outstanding balance of the loan
- I is the monthly interest charged
- R is the monthly repayment.

(a) Complete the table to find the value of A_2 **2**

……

……

……

(b) Let *An* be the value of Elena's loan after n months.
Complete the recurrence relation to model the value of this loan over time. Give your answers correct to three decimal places. **2**

$$A_0 = \_\_\_\_\_,\ A_{n+1} = \_\_\_\_\_ \times A_n - 1000$$

……

……

Question 39 continues on page 31

After the second month, Elena realises that the interest she pays is very high. She decides to switch her loan and repayments to Commonwealth Bank for the remaining 142 months, which offers an interest rate of 6% per annum.

The table shows the present value for an annuity of $1.

Period	*Interest rate per period*						
	0.5%	1%	2%	3%	4%	5%	6%
90	72.331	59.161	41.587	31.002	24.267	19.752	16.579
100	78.543	63.029	43.098	31.599	24.505	19.848	16.618
120	90.073	69.701	45.355	32.373	24.774	19.943	16.651
132	96.460	73.111	46.338	32.660	24.859	19.968	16.659
142	101.497	75.658	46.996	32.832	24.905	19.98	16.665
144	102.475	76.137	47.112	32.861	24.912	19.982	16.663
165	112.173	80.637	48.095	33.079	24.961	19.994	16.666
168	113.477	81.206	48.205	33.101	24.966	19.994	16.666
180	118.504	83.322	48.584	33.170	24.979	19.997	16.666

Using the table, calculate the total interest that Elena will pay to Commonwealth Bank if she repays the loan in full after 12 years. **3**

……

……

……

……

……

……

……

……

……

……

……

……

END OF EXAM

Student Number

* Solution
Final

Caringbah High School

2024 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided at the back of this paper
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 2–7)

- Attempt Questions 1–15
- Allow about 25 minutes for this section

Section II – 85 marks (pages 9–30)

- Attempt Questions 16–39
- Allow about 2 hours and 5 minutes for this section

Section I	Section II	Total
/15	/85	/100

Section I – 15 marks

Attempt Questions 1 – 15
Allow about 25 minutes for this section

Use the multiple-choice answer sheet for Questions 1 – 15

1. What is 34 827 368.12 expressed in standard form with two significant figures?

A. 3.48×10^{7}
B. 3.48×10^{-7}
C. 3.5×10^{7}
D. 3.5×10^{-7}

2. Amie was studying the butterfly population at a park. She caught and marked 20 butterflies and released them back into the park. Later, she caught 40 butterflies, of which 5 were already marked.

Based on the number of butterflies Amie has caught and marked, what is the most likely estimate for the butterfly population in the park?

A. 160 butterflies
B. 100 butterflies
C. 1000 butterflies
D. 200 butterflies

$\frac{20}{5} \times 40 = 160$ butterflies

3. Deborah needs to share 140 grams of birdseed equally between five canaries.

One of Deborah's birdcages has two canaries in it.

How much birdseed should she place in the feeder in that birdcage?

A. 28 grams

(B.) 56 grams

C. 84 grams

D. 112 grams

$\frac{140}{5} = 28g$

28×2

$= 56$

4. Kabir earns an hourly rate of $32.46, before he gets a 3.2% pay rise.

What is Kabir's new hourly rate?

(A.) $33.50

B. $34.50

C. $35.66

D. $42.85

32.46×1.032

$= \$33.50$

5. The weather forecast for a particular week states that each day has a 45% chance of rain one day that week.

What is the probability that it does NOT rain over the weekend?

A. 0.2025

B. 0.2475

(C.) 0.3025

D. 0.7975

$P(\text{no rain on weekend}) = (1 - 0.45)^2$

$= 0.3025$

6. An electrician charges a call-out fee of \$120, as well as \$1.50 per minute while working.

Suppose the electrician works for t hours.

Which equation expresses the amount the electrician charges, \$C, as a function of time, t, hours?

A. $C = 120t + 90$

B. $C = 120t + 1.5$

C. $C = 90t + 120$

D. $C = 1.5t + 120$

7. Anna bought a car for \$44 000 in 2013 and sold it after 10 years in 2023. It was depreciated using the declining-balance method, at a rate of 7% per annum.

By how much had the car depreciated when Anna sold it?

A. \$13 200

B. \$21 295

C. \$21 795

D. \$22 705

$44\,000 - 44\,000(1 - 0.07)^{10}$

$= \$22\,705$

8. Joe bought 430 shares in a biomedical company at a total cost of \$5600. The dividend yield was 8.7%.

What was the value of the dividend per share?

$DY = \frac{D}{MV} \times 100$

$8.7 = \frac{D}{MV} \times 100$

$D = MV \times 0.087$

$= \frac{5600}{430} \times 0.087$

$= \$1.13$

A. \$0.11

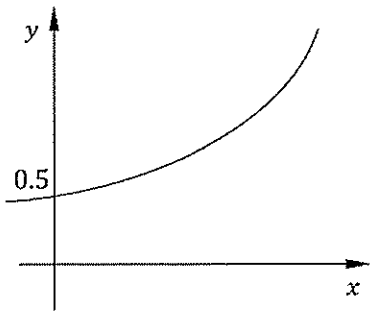
B. \$1.13

C. \$1.50

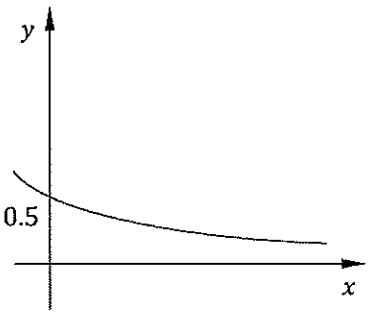
D. \$4.87

9. Which of the following could represents the graph of $y = k(a^x)$, where k is greater than 1, and a is between 0 and 1?

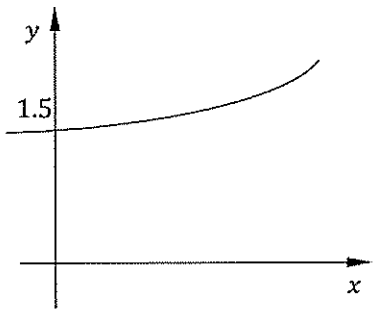
A.



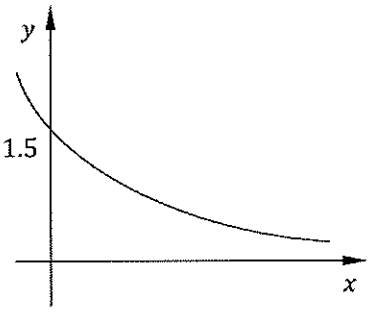
C.



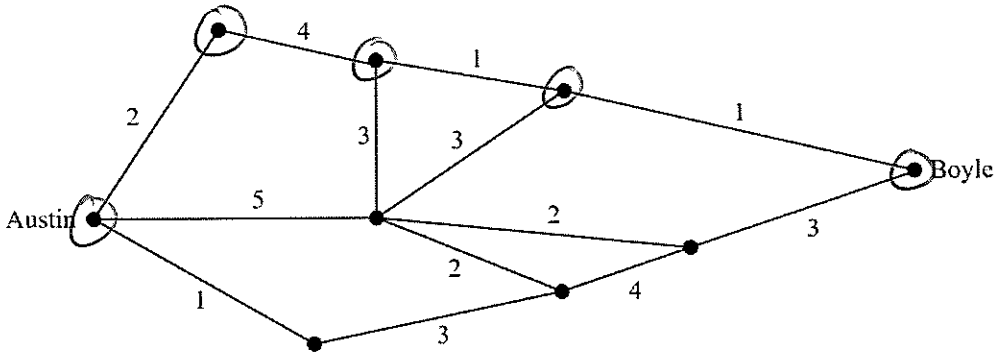
B.



(D.)



10. The network shows the distances, in kilometres, along roads that connect the cities of Austin and Boyle.



The shortest distance, in kilometres, from Austin to Boyle is:

(A) 8

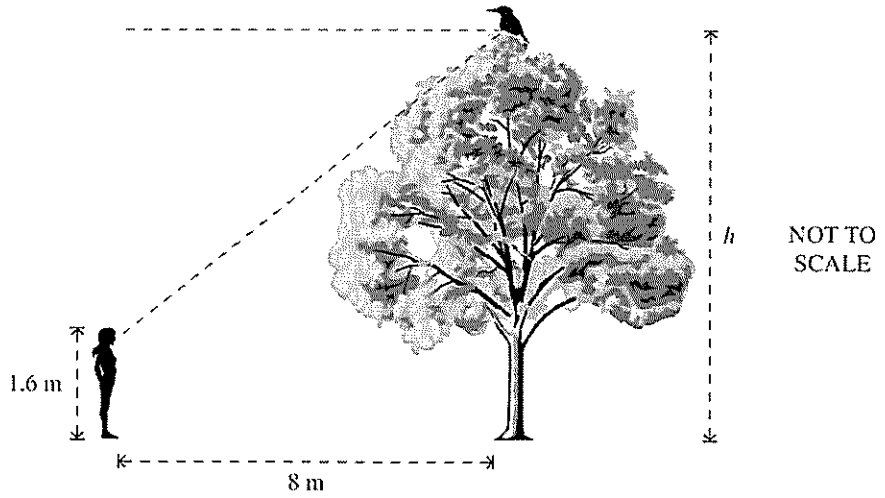
$2+4+1+1$

B. 9

C. 10

D. 11

11. Nadia is watching a bird at the top of a tree. Nadia is 1.6 m tall and is standing 8 metres away from the tree, as shown in the diagram.



If the angle of depression of Nadia from the bird is 73°, what is the height of the tree?

A. 2.45 m

B. 4.05 m

C. 26.17 m

(D.) 27.77 m

$\tan 73 = \frac{y}{8}$

$y = 8 \tan 73$

$h = y + 1.6$

$= 27.77\text{m}$

12. A teacher is interested in the relationship between the age of students and the size of the groups they choose to sit in at lunch time in the playground. The teacher gathers data and plots the average age of students sitting in a group, x, and the number of students in that group, y. When they have gathered enough data, they construct a scatterplot and draw a line of best fit by eye. The equation of the line of best fit is:

$$y = 2.4 + 0.3x$$

Which of the following statements is FALSE?

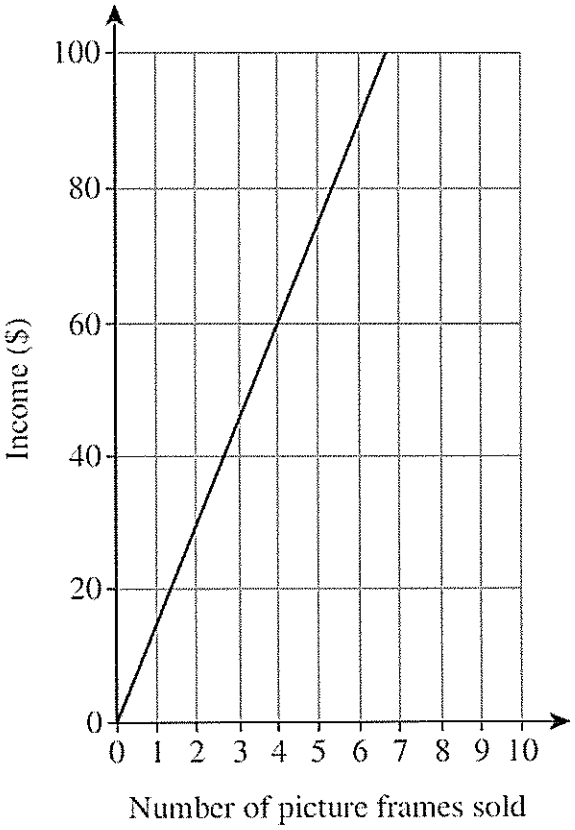
A. If the average age of a group is 12, then the line of best fit predicts the group size will be 6 students.

B. If there is a group with 7 students, then the line of best fit predicts the group will have an average age of 15.3 years.

C. The students in smaller groups tend to be younger than those in larger groups.

(D.) The equation for the line of best fit shows that the correlation coefficient is 0.3, which indicates a weak positive linear relationship.

13. The graph shows the income, in dollars, for a small business that makes and sells picture frames.



The cost to make the picture frames is given by the formula

$$C = 10n + 20,$$

where C is the cost and n is the number of picture frames sold.

If 6 picture frames are made and sold, which of the following statements is CORRECT?

$I = 15n$

$I = 15 \times 6$

$= \$90$

$C = 10 \times 6 + 20$

$= \$80$

A. There is a profit of $10

B. There is a loss of $10

C. There is a profit of $90

D. There is a loss of $80

14. Macy and Kassidy share a sum of money. Kassidy receives 60% more money than Macy.

If Kassidy receives $176, what is the total amount of money that they share between them?

160% × Macy = $176

1% × Macy = $1.10

100% × Macy = $110

Share: 176 + 110 = $286.00

A. $246.40

B. $286.00

C. $457.60

D. $616.00

15. A sports store sells jerseys priced at $169.95, including 10% goods and services tax (GST).

What is the amount of GST included in the price?

110% = 169.95

1% = 1.545

10% = 15.45

A. $15.45

B. $17.00

C. $152.96

D. $154.50

End of Section

Mathematics Standard 2

Section II

Section II

85 marks

Attempt Questions 16–39

Allow about 2 hours and 5 minutes for this section

Instructions

- Write your 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 on pages 31-32. If you use this space, clearly indicate which question you are answering.

Question 16 (2 marks)

A new dryer is being sold for $599. The dryer uses 315 kWh of electricity per year, and electricity is charged at 28.66 cents per kWh.

How much will it cost to purchase and then run the dryer for three years?

2

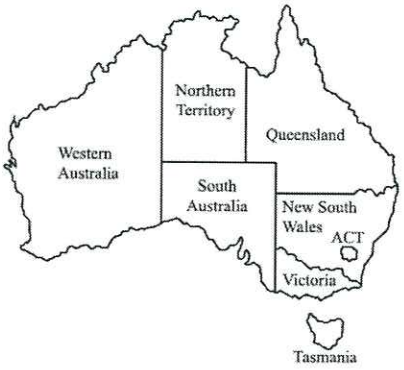
$599 + 315 \times 0.2866 \times 3$ (1)

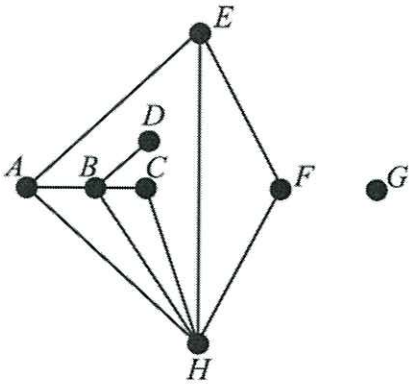
$= \$869.84$ (1)

Question 17 (3 marks)

The map of Australia shows the six states, the Northern Territory and the Australian Capital Territory (ACT).

In the network diagram below, each of the vertices to **A** to **H** represents one of the states or territories shown on the map of Australia. The edges represent a border shared between two states or between a state and a territory.





(a) In the network diagram, what is the order of the vertex that represents the Australian Capital Territory (ACT)?

ACT has one border ∴ Degree = 1 **1**

(b) In the network diagram, Queensland is represented by which letter? Explain why.

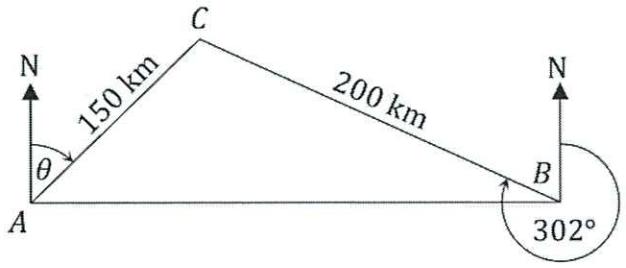
NSW = B, VIC = C **2**

∴ QLD is vertex A as it is connected to B and has degree 3.

Question 18 (3 marks)

The following information is known about three towns, A, B and C, and shown on the diagram below.

- Town A is due west of town B.
- Town C is 150 kilometres from town A, and 200 kilometres from town B.
- The bearing of town C from town B is 302°.



What is the bearing, θ, of town C from town A, correct to the nearest minute?

3

$\angle CBA = 302 - 270 = 32^\circ$ (1)

$\frac{\sin \angle CBA}{200} = \frac{\sin 32}{150}$

$\angle CBA = \sin^{-1}\left(\frac{200 \sin 32}{150}\right)$

$= 44^\circ 57'$ (1)

$\theta = 90 - 44^\circ 57'$

$= 45^\circ 3'$ (1)

Question 19 (4 marks)

The child dosage of a particular pain medicine can be calculated using the formula

$$C = \frac{aD}{a + 12}$$

where C is the child dosage in mL, a is the age of the child in years and D is the adult dosage in mL. For this particular pain medicine, the adult dosage is 15 mL.

(a) What is the dosage for a five-year-old child? Give your answer correct to the nearest mL. **1**

4 mL

(b) At what age will the child dosage be exactly half the adult dosage? **3**

$D = 15$ mL $\quad C = 7.5$ mL (1) $\quad 7.5 = \frac{a \times 15}{a+12}$ (1)

$15a = 7.5(a+12)$

$7.5a = 90$

$a = 12$ year old (1)

Question 20 (2 marks)

Ariel purchased a printer for her office three years ago.

It depreciated by \$260 each year based on the straight-line method of depreciation. The salvage value of the printer is now \$120.

Find the initial value of the printer. **2**

$120 = V_0 - 3 \times 200$ (1)

$V_0 = 120 + 3 \times 200$

$= \$900$ (1)

Question 21 (2 marks)

The nutrition information for a box of cupcakes is shown.

Nutrition information	
12 servings per container	
Serving size: 58 g	
Calories per serve: 80	
Nutrients	**Daily value**
Total fat: 1g	1%
Saturated fat: 0 g	
Trans fat: 0 g	
Cholesterol: 15 mg	5%
Sodium: 150 mg	7%
Total carbohydrate: 16 g	6%
Dietary fibre: 1 g	4%
Total sugars: 6 g	
Protein: 3 g	
Calcium: 33 mg	2%
Iron: 2 mg	10%
Potassium: 31 mg	0%

If 1 calorie is equal to 4.184 joules, what is the total number of kilojoules in the box of cupcakes? **2**

$12 \times 80 = 960$ cal

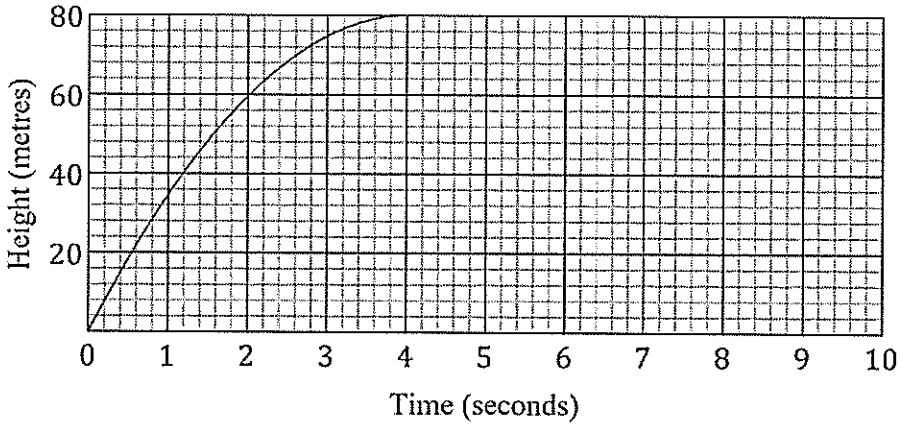
$960 \times 4.184 = 4016.64$ J (1)

$\frac{4016.64}{1000} = 4.01664$ kJ (1)

Question 22 (4 marks)

A ball is shot vertically into the air from the ground.

The height of the ball above the ground, h metres, can be modelled using the function, $h = 40t - 5t^2$ where t is measured in seconds. The first half of the graph of the function is shown.



(a) Based on the graph, or otherwise, at what time does the ball return to the ground? **1**

8 secs

(b) How high is the ball above the ground after 1 second? **1**

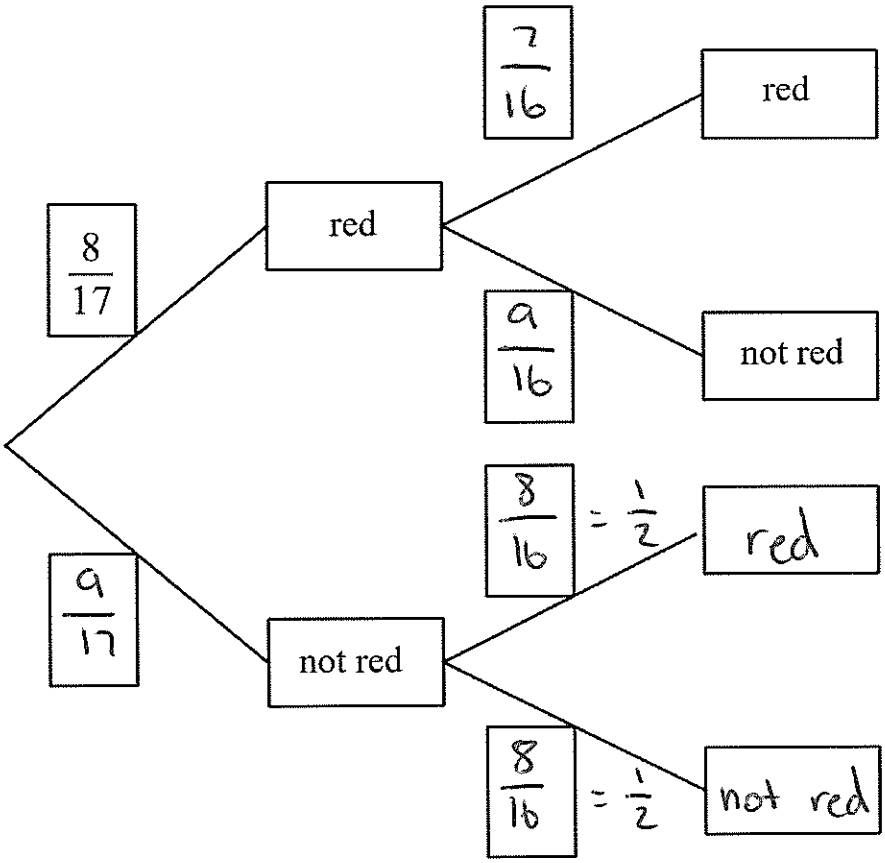
h = 35m or 34m

(c) Ben is looking out his window and sees the ball pass the window on its way up, then four seconds later sees it pass the window again on its way down. **2**
How high is Ben's window above the ground? Justify your answer.

The ball must pass Ben's window 2 secs either side of the time it reaches the top of its motion ∴ t = 2 & t = 6
When t = 2, h = 60
∴ window is 60m above ground level

Question 23 (4 marks)

A bag contains 5 white, 8 red and 4 purple marbles. Sarah takes two marbles from the bag and records the outcomes in the tree diagram, as shown.



(a) Complete the tree diagram. Include all appropriate outcomes and probabilities. **2**

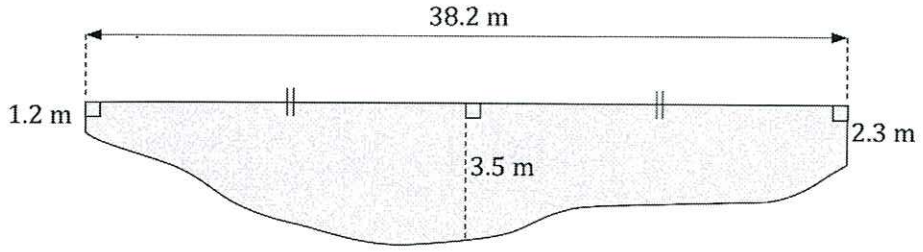
(b) Find the probability that at least ONE of the marbles is RED. **2**

$P(\text{at least one red}) = 1 - \frac{9}{17} \times \frac{8}{16}$

$= \frac{25}{34}$

Question 24 (4 marks)

The diagram shows the cross-section of the bed of a river as it flows under a bridge.



NOT TO SCALE

(a) Use two applications of the trapezoidal rule to estimate the area of the cross-section of the river, correct to the nearest square metre. **2**

$A \approx \frac{19.1}{2}(1.2 + 3.5) + \frac{19.1}{2}(3.5 + 2.3)$

$\approx 100\ m^2$

(b) The water in the river is moving at a rate of 0.4 metres per second.

What is the volume of water that flows under the bridge in an hour? **2**

3600 sec in 1 h : $V = 100 \times 0.4 \times 3600$ (1)

$= 140\ 000\ m^3$ or $144\ 396\ m^3$

$= 140\ 000$ kL (1)

Question 25 (3 marks)

Andrew spent a total of \$131.98 at the supermarket, which included 10% GST on some of the items he bought. The total value of the items which did NOT have GST added was \$40.35.

What was the amount Andrew paid at the supermarket excluding GST? **3**

Total cost including GST: $131.98 - 40.35 = \$91.63$

Total GST: $\frac{10}{110} \times 91.63 = \$8.33$

Total w/ no GST: $131.98 - 8.33$

$= \$123.65$

Question 26 (3 marks)

The table shows the individual tax rates for the 2023-24 financial year.

Taxable income	*Tax payable*
\$0–\$18 200	Nil
\$18 201–\$45 000	19 cents for each \$1 over \$18 200
\$45 001–\$120 000	\$5092 plus 32.5 cents for each \$1 over \$45 000
\$120 001–\$180 000	\$29 467 plus 37 cents for each \$1 over \$120 000
\$180 001 and over	\$51 667 plus 45 cents for each \$1 over \$180 000

Georgina has a gross annual salary of \$113 700. She is able to claim \$3050 in tax deductions for work-related expenses. She is required to pay the Medicare levy, which is 2% of her taxable income.

Calculate Georgina's tax payable, including the Medicare levy. Give your answer correct to the nearest dollar. **3**

Taxable income: 113 700 - 3050

= \$110 650

Tax: 5092 + 0.325(110 650 - 45 000)

= \$26 428.25 (1)

Medicare: 0.02 × 110 650

= \$2213 (1)

Total: 2213 + 26 428.25

= \$28 641.25 (1)

Question 27 (3 marks)

Hunter bought 20 000 shares in KSH Mining for $0.31 each, and 100 000 shares in PSK Mining for 0.2 cents each. While he owned the shares, Hunter received total dividends from the two companies of $590. When Hunter sold all of the shares, he received $0.26 per share for the KSH Mining shares and 1.1 cents per share for the PSK Mining shares. Hunter did not have to pay any other fees when he bought or sold the shares.

What percentage profit or loss did Hunter make from owning the shares? Answer as a percentage correct to 2 decimal places. **3**

Total cost of shares: $20\,000 \times 0.31 + 100\,000 \times 0.002$

$= \$6400$

Total sale: $20\,000 \times 0.26 + 100\,000 \times 0.011$

$= \$6300$

Profit: $6300 + 590 - 6700$

$= \$490$

$\% = \frac{490}{6400} \times 100 = 7.66\%$

Question 28 (3 marks)

Mackenzie has a credit card with the following conditions:

- There is no interest-free period.
- Interest is charged at the end of each month at 19.5% per annum, compounded daily, from the purchase date (included) to the last day of the month (included).

Mackenzie's credit card statement for October is shown, with some figures missing.

Statement period: 1 October to 31 October		
Date	**Details**	**Amount ($)**
1 October	Opening balance	$245.62
21 October	Monitor	$699.00
31 October	Interest charged	***
31 October	Closing balance	***

What is Mackenzie's closing balance? **3**

31 days for opening balance

Interest charged on monitor: 31 - 20 = 11 days

Interest on opening balance: $245.62 \times \left(1 + \frac{0.195}{365}\right)^{31} - 245.62$

$= \$4.10$

Interest on monitor: $699 \times \left(1 + \frac{0.195}{365}\right)^{11} - 699$

$= 4.12$

Total interest = $8.22

closing balance = 245.62 + 699 + 8.22

= $952.84

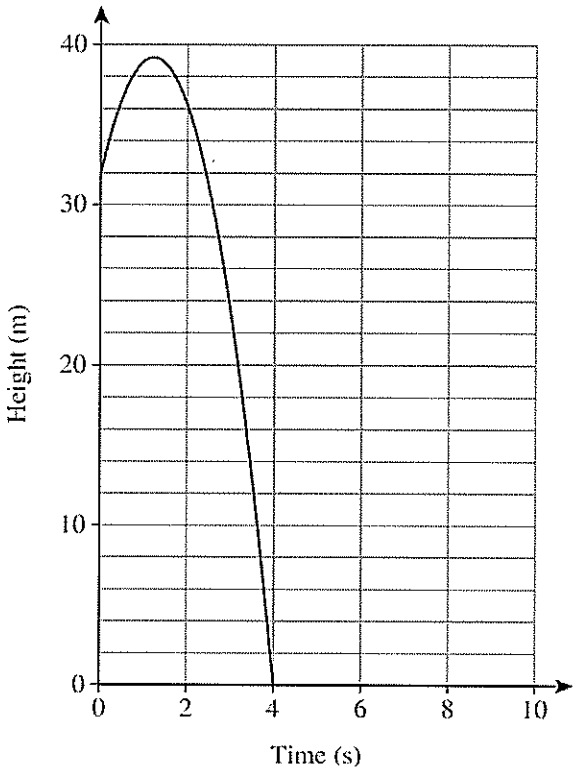
Question 29 (3 marks)

An object is thrown upwards from a cliff that overlooks the sea. The object's motion can be modelled using the function

$$h = 32 + 12t - 5t^2$$

where h is the object's height above the sea in metres and t is the time in seconds.

The graph of the function is shown.



(a) Find the height of the cliff

32m **1**

(b) State the time it takes for the object to land in the sea

4 sec **1**

(c) Given that the axis of symmetry of the parabola shown is at $t = 1.2$ s, find the maximum height that the object reaches after being thrown.

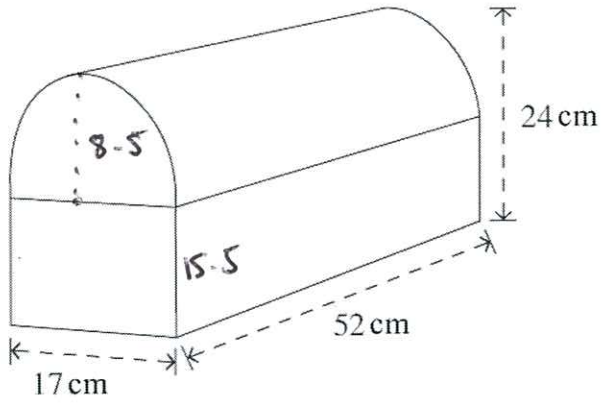
..... **1**

$h = 32 + 12(1.2) - 5(1.2)^2$

$= 39.2$ m

Question 30 (3 marks)

A closed mailbox, composed of half a cylinder on top of a rectangular prism, is shown.



NOT TO SCALE

What is the surface area, in cm^2, of the closed mailbox? Give your answer to the nearest whole number. **3**

$SA_1 = \frac{1}{2}(2\pi r^2 + 2\pi rh)$

$= \frac{1}{2}((2)(\pi)(8.5)^2 + (2)(\pi)(8.5)(52))$

$= 1615.564$ (1)

$SA_R = (17 \times 15.5 \times 2) + (52 \times 15.5 \times 2) + (17 \times 52)$

$= 3023$ (1)

$SA_{Total} = SA_1 + SA_R$

$= 1615.564 + 3023$

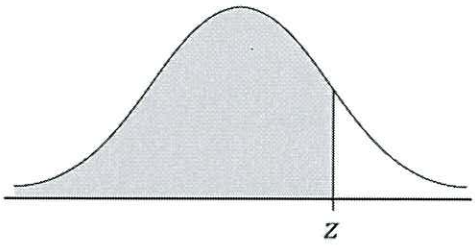
$= 4639$ (1)

Question 31 (5 marks)

A random variable is normally distributed with a mean of 0 and a standard deviation of 1. The table gives the probability that this random variable lies below z from some positive values of z.

z	2.20	2.21	2.22	2.23	2.24	2.25	2.26	2.27	2.28	2.29
Probability	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890

The probability values given in the table are represented by the shaded area in the following diagram.



The heights of fourteen-year-old girls in Australia are normally distributed with a mean of 151.2 centimetres and a standard deviation of 7.4 centimetres.

(a) In a group of 1000 fourteen-year-old Australian girls, how many would be expected to be over 168 centimetres in height? **4**

$Z = \frac{168 - 151.2}{7.4} = 2.27$ (1)

$P(Z < 2.27) = 0.9884$ (1)

$P(Z > 2.27) = 1 - 0.9884$ (1)

$= 0.0116$ (1)

$0.0116 \times 1000 = 11.6 = 11$ or 12 expected

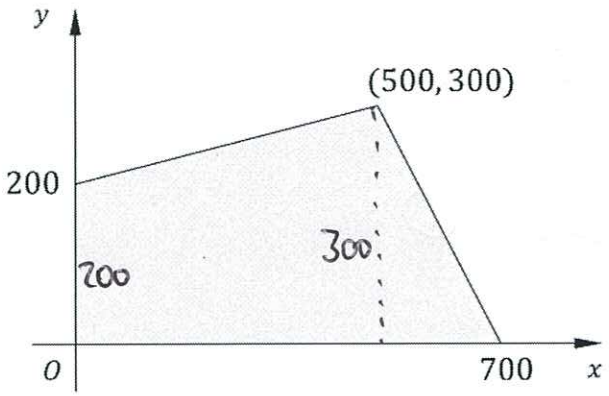
(b) In the same group of 1000 fourteen-year-old Australian girls, how many would be expected to be less than 134.4 centimetres in height? **1**

$Z = \frac{134.4 - 151.2}{7.4} = -2.27$

$\therefore$ Same answer as (a) (1)

Question 32 (3 marks)

A block of land is represented by the shaded region on the number plane. All measurements are in metres.



NOT TO SCALE

The owner needs to cover the block of land with 50g of fertiliser per square metre.

How many tonnes of fertiliser will they need?

3

$A = \frac{1}{2} \times 500 \times (200 + 300) + \frac{1}{2} \times 200 \times 300$

$= 155\,000\ m^2$ (1)

Tonnes of fertiliser $= 155\,000 \times 0.05$

$= 7750\ kg$ (1)

$= 7.75\ T$ (1)

Question 33 (5 marks)

The time taken for a student to ride between their home and school at a constant speed varies inversely with their speed. It takes the student 36 minutes to travel from home to school if they are travelling at 20 kilometres per hour.

(a) Calculate the distance between the student's home and school. **2**

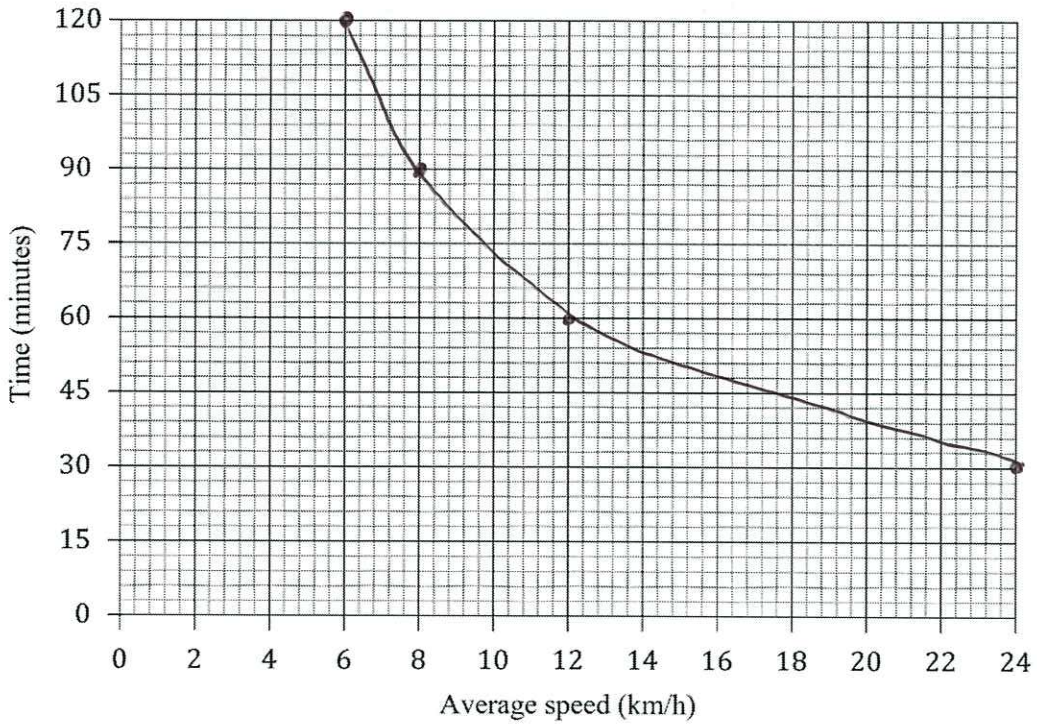
$t = \frac{k}{s} \Rightarrow \frac{36}{60} = \frac{k}{20}$ (1)

$k = 12$

$\therefore$ 12 km from school (1)

(b) The student can ride to school at average speeds varying from 6 kilometres per hour to 24 kilometres per hour.

By first plotting at least four relevant points, draw the curve that shows the time taken to travel from home to school at different average speeds. **3**



(2) = 4 points

(1) = curve

Question 34 (5 marks)

Businesses often collect data on the total amount of money spent on advertising and total revenue. The table shows information about six consecutive sales quarters for a particular business.

Sales quarter	*Money spent on advertising ($)*	*Total revenue ($)*
1	15 500	61 000
2	18 000	62 000
3	23 400	81 000
4	32 000	94 000
5	32 000	102 000
6	40 000	150 000

(a) Find the equation of the least-squares regression line by calculating the gradient and y-intercept. Give these values correct to two decimal places. **3**

Using Calc: $m = 3.33$ (1)

$c = 2496.39$ (1)

$y = 2496.39 + 3.33x$ (1)

(b) The manager of the business believes that the data shows a strong and positive correlation.

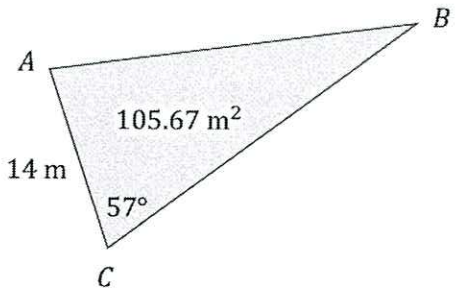
Is the manager correct? Justify your answer using appropriate statistical measure(s) and mathematical reasoning. **2**

Using Calc: $r = 0.95$ (1)

manager is correct because r is positive and close to 1, indicating strong correlation (1)

Question 35 (3 marks)

The diagram shows triangle ABC.



The triangle has an area of 105.67 m^2, $AC = 14$ m and $\angle ACB = 57°$.

Find the length of AB, correct to 2 decimal places.

3

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

$105.67 = \frac{1}{2} \times 14 \times BC \times \sin 57$ (1)

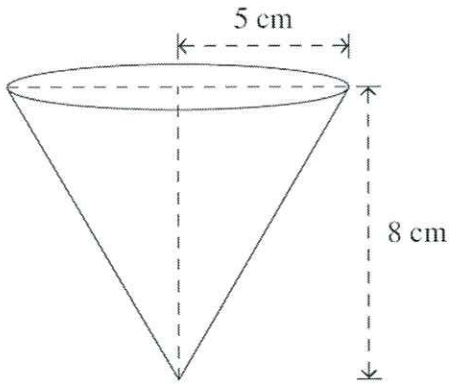
$BC = \frac{105.67}{7\sin 57} = 18$ m (1)

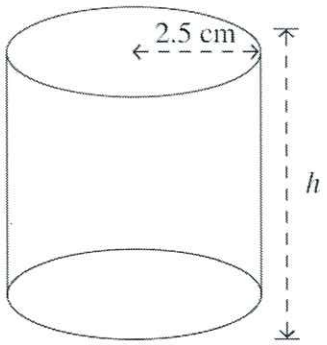
$AB^2 = 14^2 + 18^2 - 2 \times 14 \times 18 \times \cos 57$

$AB = 15.67$ (1)

Question 36 (3 marks)

Jordan wanted to investigate the capacities of different three-dimensional objects. She used two containers: one in the shape of a cone and one in the shape of a cylinder. The containers and their dimensions are shown.





NOT TO SCALE

When Jordan completely filled the conical container with water and then poured the water into the cylindrical container, she found that the containers had equal volumes.

What is the height (h) of the cylindrical container, correct to two decimal places? **3**

$V_{cone} = \pi r^2 \frac{h}{3} = \pi \times 5^2 \times \frac{8}{3}$

$= 209.4 \text{ cm}^3$ (1)

$V_{cylinder} = V_{cone}$

$V_{cyl} = \pi r^2 h$

$209.4 = \pi r^2 h$

$209.4 = \pi \times (2.5)^2 \times h$ (1)

$h = 10.67$ (1)

Question 37 (4 marks)

The table below shows the monthly repayments on loans of various amounts over a number of different loan periods.

	Monthly repayment amount		
Principal	*Loan period (years)*		
	2	5	7
\$10 000	\$480	\$228	\$187
\$20 000	\$960	\$455	\$374
\$30 000	\$1439	\$683	\$561

(a) Spiro is borrowing \$30 000, to be repaid with monthly repayments over 5 years.
How much interest will be paid on the loan? **2**

Repayment = \$683 × 5 × 12 = \$40 980 (1)

Interest = \$40 980 − \$30 000

= \$10 980 (1)

(b) Calculate the percentage flat rate of interest per annum on this loan **2**

$I = PRN$

$10\,980 = 30\,000 \times r \times 5$ (1)

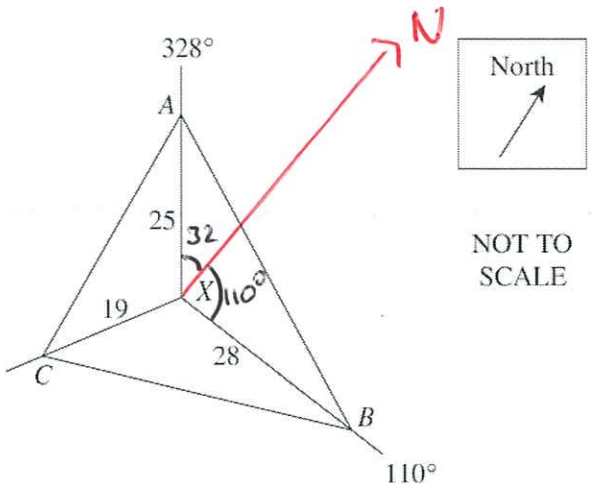
$r = \frac{10\,980}{30\,000 \times 5}$

$r = 0.0732$

$= 7.32\%$ (1)

Question 38 (4 marks)

The compass radial survey shows the position of four towns: A, B, C and X. Towns A and B lie at a true bearing of 328° and 110° degrees from town X, respectively. All distances between the towns are given in metres.



(a) Find the distance between towns A and B, correct to the nearest metre. **2**

$360 - 328 = 32^\circ \quad \therefore \angle AXB = 72 + 110 = 142^\circ$ (1)

$\therefore AB = \sqrt{25^2 + 28^2 - 2 \times 25 \times 28 \times \cos 142}$

$= 50\text{m}$ (1)

(b) If the area of triangle XCB is 265 m^2, find the true bearing of town C from town X. **2**

Give your answer correct to the nearest degree.

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

$265 = \frac{1}{2} \times 19 \times 28 \times \sin \angle CXB$

$\sin \angle CXB = \frac{265}{\frac{1}{2} \times 19 \times 28}$

$\angle CXB = 85^\circ$

$\therefore$ True bearing: $85^\circ + 110^\circ = 195^\circ$

Question 39 (7 marks)

Elena takes out a loan of $150 000 with Westpac bank, which has an interest rate of 6.14% per annum. She makes regular monthly repayments of $1000. Elena uses the table shown to calculate her interest.

n	P	I	$P+I$	$P+I-R$
1	$150 000	$767.50	$150 767.50	$149 767.50
2	149 767.50	766.31	150533.81	A_2

In the table:

- n is the number of months
- P is the outstanding balance of the loan
- I is the monthly interest charged
- R is the monthly repayment.

(a) Complete the table to find the value of A_2 **2**

$I = 149\,767.50 \times \frac{0.0614}{12} = \$766.31$ (1)

$P+I = 150\,533.81$

$A_2 = P+I-1000 = \$149\,533.81$ (1)

(b) Let An be the value of Elena's loan after n months.

Complete the recurrence relation to model the value of this loan over time. Give your answers correct to three decimal places. **2**

$A_0 = 150\,000$, $A_{n+1} = 1.005 \times A_n - 1000$

$A_2 = A_1 \times \frac{0.0614}{12} + A_1 - 1000$

$= A_1 \times 1.005 - 1000$

$A_0 = 150\,000$

Question 39 continues on page 31

After the second month, Elena realises that the interest she pays is very high. She decides to switch her loan and repayments to Commonwealth Bank for the remaining 142 months, which offers an interest rate of 6% per annum.

The table shows the present value for an annuity of $1.

Period	*Interest rate per period*						
	0.5%	1%	2%	3%	4%	5%	6%
90	72.331	59.161	41.587	31.002	24.267	19.752	16.579
100	78.543	63.029	43.098	31.599	24.505	19.848	16.618
120	90.073	69.701	45.355	32.373	24.774	19.943	16.651
132	96.460	73.111	46.338	32.660	24.859	19.968	16.659
142	101.497	75.658	46.996	32.832	24.905	19.98	16.665
144	102.475	76.137	47.112	32.861	24.912	19.982	16.663
165	112.173	80.637	48.095	33.079	24.961	19.994	16.666
168	113.477	81.206	48.205	33.101	24.966	19.994	16.666
180	118.504	83.322	48.584	33.170	24.979	19.997	16.666

Using the table, calculate the total interest that Elena will pay to Commonwealth Bank if she repays the loan in full after 12 years. **3**

number of remaining months = 142

$I = \frac{0.06}{12} \times 0.5\%$

(1) = Table

PV = 149 533.81

repayment = $\frac{149\,533.81}{101.497}$

= $1473.28 (1)

∴ Total interest = $1473.28 \times 142 + 1000 \times 2 - 150\,000$

= $61 206.19 (1)

END OF EXAM