2024 **Year 12 Trial Examination**

Mathematics Standard 2

12/08/2024

General Instructions
- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using blue or black pen
- Calculators approved by NESA may be used
- A reference sheet is provided
- For questions in Section II, show relevant mathematical reasoning and/or calculations
- No white-out may be used

Total Marks: 100

Section I - 15 marks (pages 2–10)
- Allow about 25 minutes for this section

Section II - 85 marks (pages 11–45)
- Allow about 2 hours and 5 minutes for this section

This question paper must not be removed from the examination room.

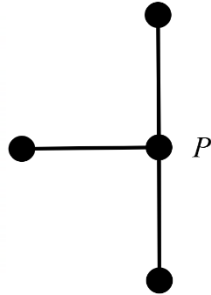*This assessment task constitutes 30% of the course.*

Section I

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

Use the multiple-choice sheet for Question 1–15.

1   In the following network, what is the degree of vertex *P*?

    A.   3

    B.   4

    C.   90°

    D.   180°

2   A laptop computer cost $3500. It depreciates by 20% of its value each year using the declining-balance method of depreciation.

What is its salvage value after 3 years?

    A. $700

    B. $1400

    C. $1792

    D. $2240

3 Which graph is negatively skewed?

A.
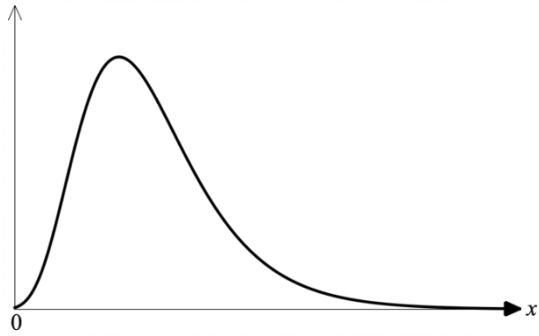
B.
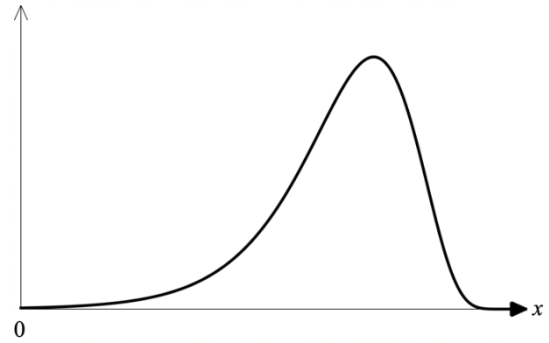
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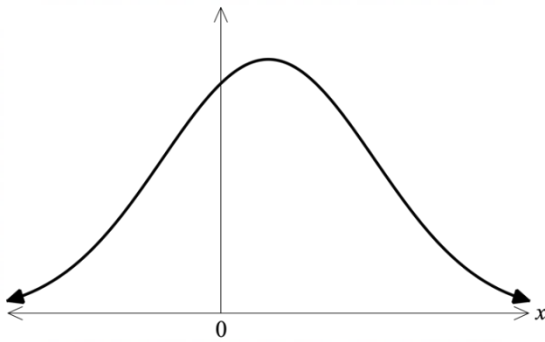
D.
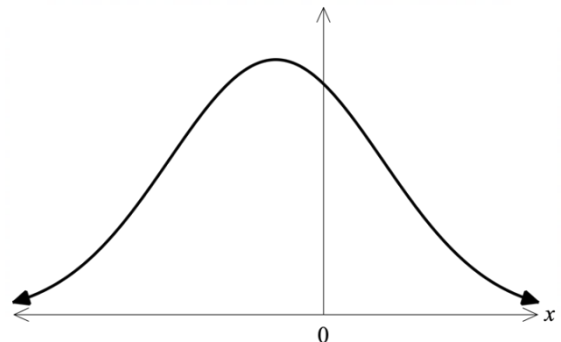
4 Which compass bearing is the same as a true bearing of 305°T?

A. S35°W

B. S55°W

C. N35°W

D. N55°W

5   Lily wanted to estimate the number of fish in a lake.

She randomly captured 30 fish, then tagged and released them.

One week later she randomly captured 40 fish from the same lake. She found that 12 of these 40 fish were tagged.

What is the best estimate for the total number of fish in the lake?

A.   58

B.   70

C.   82

D.   100

6   Jonah bought a camera while holidaying in Australia. On the way out he is applying to have the GST he paid be refunded.

If the cost of the camera was $1100 including GST, how much should be refunded?

A. $100

B. $110

C. $990

D. $1000

7 Which of the following is most likely to have a negative correlation?

A. The number of children in a city, and the number of schools in the city.

B. The size of a file, and the time taken to download the file.

C. The amount of alcohol a person consumes, and the person's reaction time.

D. The amount of rainfall on a road, and the number of cyclists on the road.

8 Young's formula for calculating medication dosage for children is

$$\text{Dosage for child} = \frac{\text{age of child (in years)} \times \text{adult dosage}}{\text{age of child (in years)} + 12}$$

The dosage for a 6 year old child is 14 mg from Young's formula.

What is the adult dosage?

A. 12 mg

B. 26 mg

C. 42 mg

D. 168 mg

9 What is the median of the dataset represented in the following stem-and-leaf plot?

Stem	Leaf
0	3
1	1 5 5 5 5 5 5 8
2	2 5 5 7 8
3	3 4 4
4	7

A.   15

B.   18

C.   20

D.   22

10 Which of the following statements about critical paths in networks is always true?

A.   The critical path is the shortest path in the network.

B.   There may be multiple critical paths through a network.

C.   Activities on the critical path may have a non-zero float time.

D.   Reducing the time of any activity on a critical path for a project will always reduce the minimum completion time for the project.

11 The following graph shows the relationship between the braking distance of a car (in metres) for different speeds (in km/h).
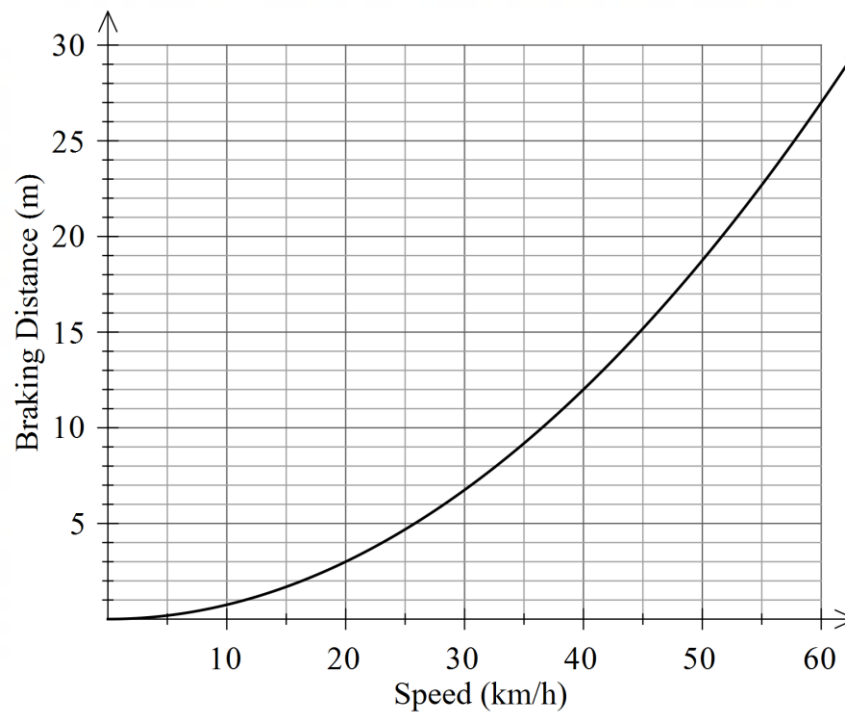
Which equation represents the graph shown?

A. Braking distance $= 0.3 \times$ speed

B. Braking distance $= 0.45 \times$ speed

C. Braking distance $= 0.086 \times (\text{speed})^2$

D. Braking distance $= 0.0075 \times (\text{speed})^2$

12 The circumference (C) of a circle varies directly with its radius (r).

Which graph represents this relationship?

A.

B.

C.

D.
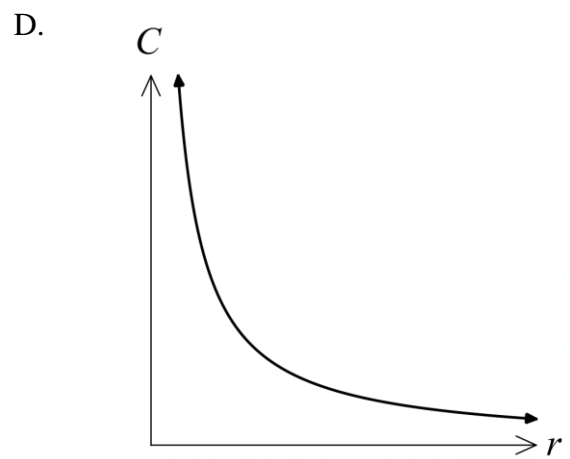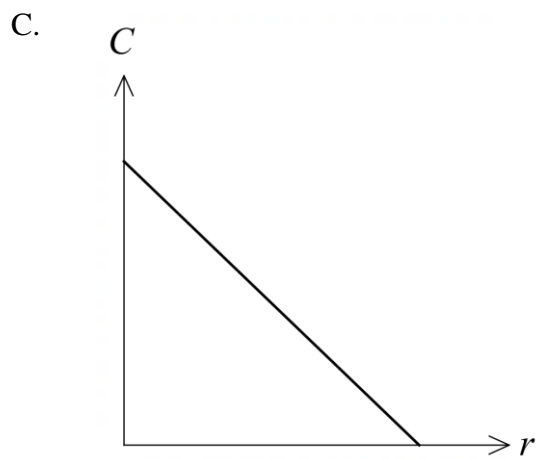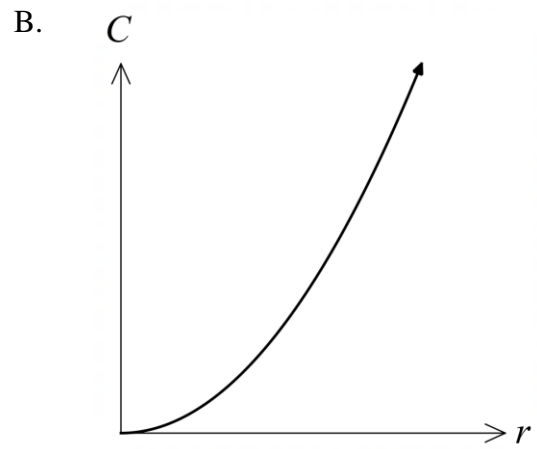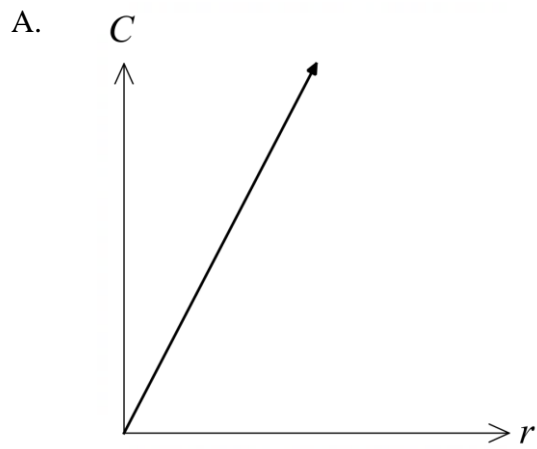
13 A random variable is normally distributed with mean 0 and standard deviation 1. The table gives the probability that this random variable lies between 0 and *z* for different values of *z*.

z	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Probability	0.040	0.079	0.118	0.155	0.192	0.226	0.258	0.288	0.316

The probability values given in the table for different values of z are represented by the shaded area in the following diagram.
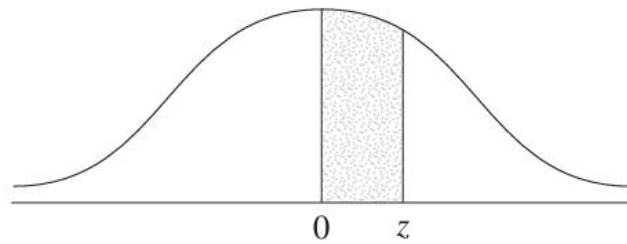
What is the probability that a normally distributed random variable with mean 0 and standard deviation 1 lies between -0.4 and 1?

A.   0.185

B.   0.34

C.   0.35

D.   0.495

14 The area of the following sector is 6 cm².
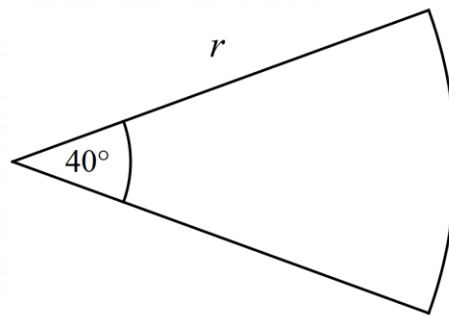
What is its radius, correct to 3 significant figures?

A. $r = 4.146$ cm

B. $r = 4.15$ cm

C. $r = 8.59$ cm

D. $r = 8.594$ cm

15 A total of 13 000 people entered a running race. The ratio of professional runners to amateurs was 1:49.

95% of all the professional runners completed the race, while 390 of the amateurs did not complete the race.

Which represents the ratio of professional runners to amateurs who finished the race?

A. 1:47

B. 1:48

C. 1:49

D. 1:50

End of Section I

Question 16 (2 marks)

A hemispherical bowl has a diameter of 20 cm. It is open at the top.
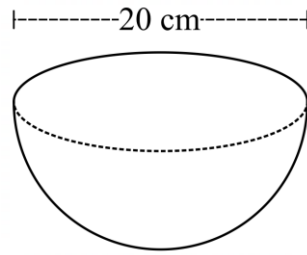
2

├---------20 cm---------┤

What is the surface area of the outside of the open bowl, correct to the nearest square centimetre?

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Question 17 (3 marks)

The scatter plot below represents the relationship between the flying distance between two cities and the cost of the plane ticket.
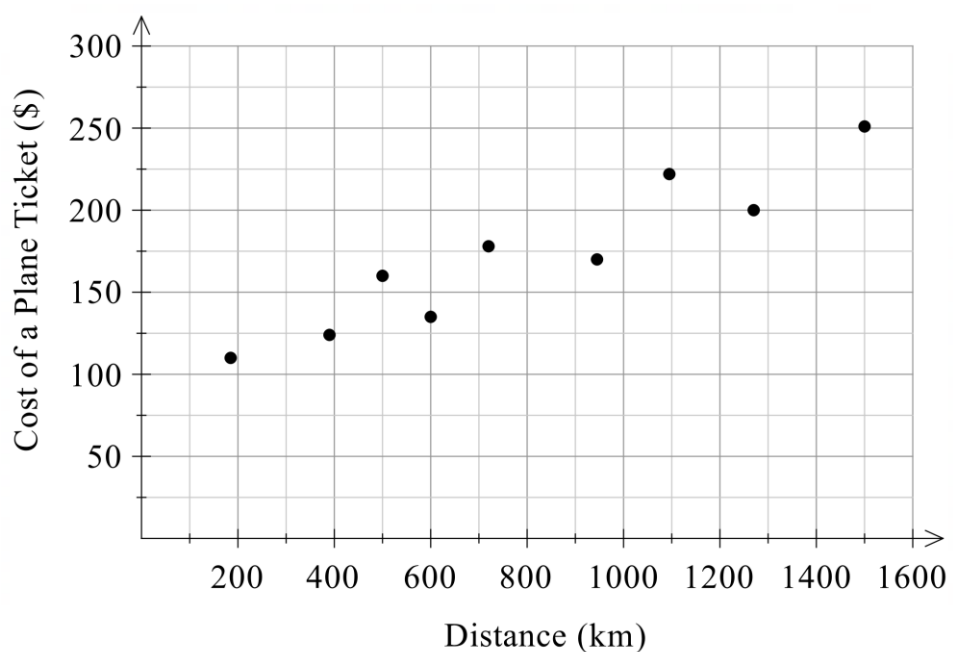
(a)   Draw a line of best fit by eye.   **1**

(b)   From your line of best fit, estimate the cost of a plane ticket for traveling 800 km.   **1**

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(c)   Explain why your line of best fit would not be appropriate to estimate the cost of   **1**
      travelling more than 2000 km.

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Question 18 (3 marks)

A business makes puzzles and sells them.

The graphs below show the revenue and cost of the business for n puzzles.
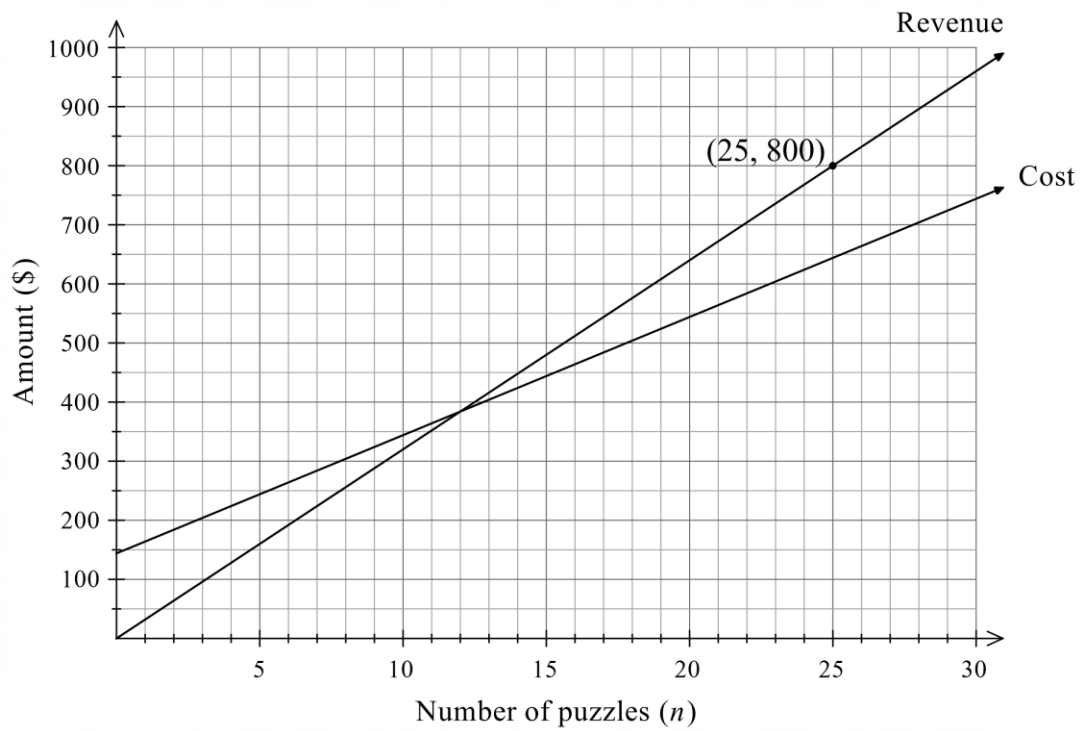
(a) The coordinate $(25, 800)$ lies on the revenue line.   **1**

Calculate the revenue made per puzzle sold.

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(b) Calculate the coordinates of the break-even point.   **2**

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Question 19 (2 marks)

18-year-old Sam exercises at the gym and wants his target heart rate to sit at 80% of his maximum heart rate. **2**

The following formula can be used to estimate the maximum heart rate (in beats per minute):

$$\text{Maximum Heart Rate } = \ 220 - \text{ age in years}$$

How many beats should he count in a 10 second period when he has achieved this target heart rate? Round your answer to the nearest whole number of beats.

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Question 20 (2 marks)

Isaac has made a table for his results in several subjects. **2**

Complete the table by filling in the blank boxes.

Subject	Raw Mark	Mean	Standard Deviation	z-score
Economics	70	63	8	
Music	67		5.5	−2
PDHPE	84	75		1.2

Question 21 (2 marks)

In a jar of 21 lollies, 6 are red (R) and the rest are green (G).   **2**

Gerrard takes two lollies at random, without replacement.
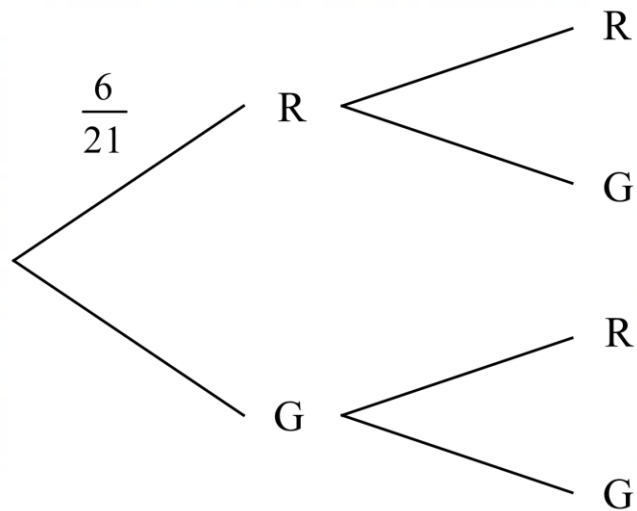
By completing the tree diagram above, determine the probability that Gerrard takes two green lollies.

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Question 22 (3 marks)

A radial survey of a local park is shown in this diagram.

(a) R is south-west of P.   **1**

What is the bearing of R from P?

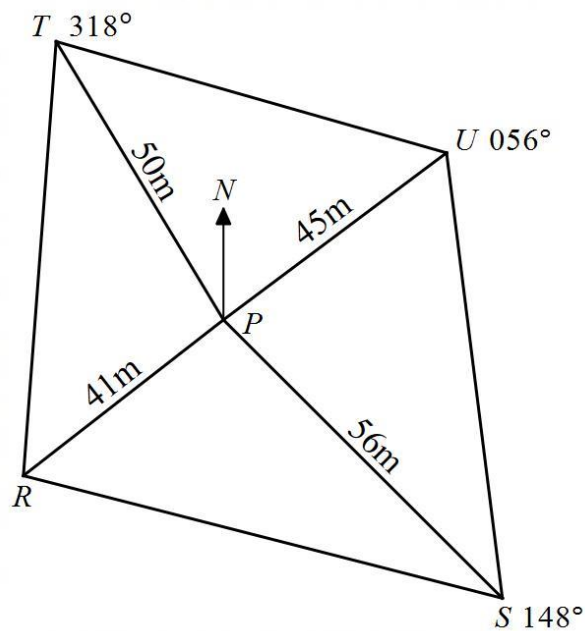...

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(b) Find the area of triangle RPS to the nearest square metre.   **2**

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Question 23 (2 marks)

What amount must be invested for 8 years at 4.95% p.a. compounded quarterly to grow to a future value of $15 000? Leave your answer to the nearest dollar.

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Question 24 (3 marks)

Ursula owns a computer, which consumes on average 100 watts of power. It is run 24 hours per day.

Electricity is charged at the following rates:

Time	Tariff	Cost per kWh
6am – 10pm	Peak	$0.55 / kWh
All other times	Off-peak	$0.225 / kWh

(a) Calculate Ursula's cost of running the computer for a week. **2**

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(b) Ursula allocates $2000 per year to electricity. **1**

What percentage of her allocation does this computer use, correct to 2 decimal places?

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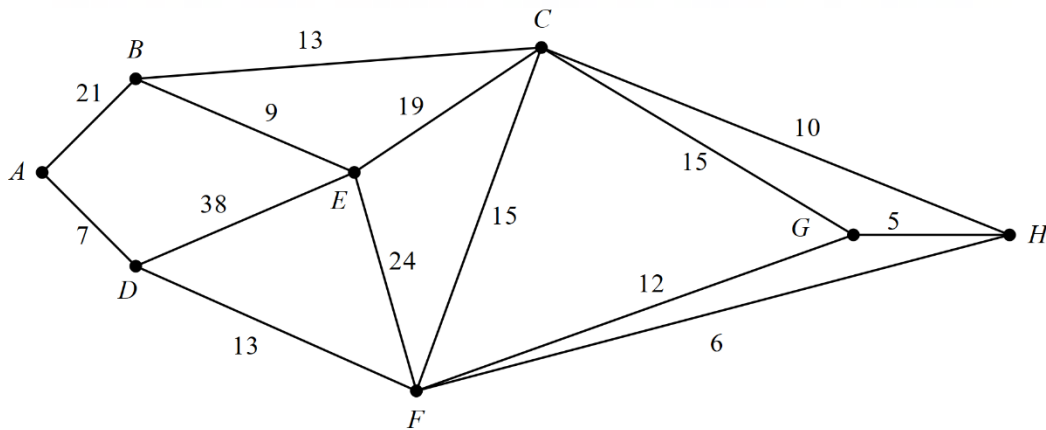
Question 25 (3 marks)

The water authority wants to lay water pipes along the roads to put a fire hydrant at every **3**
vertex on the network shown. The numbers represent the length, in metres, of the pipe
that connects any two vertices.

To minimise the cost of the operation, the water authority wants to minimise the length of
the pipes.

Construct the minimum spanning tree to achieve this and calculate its total length.
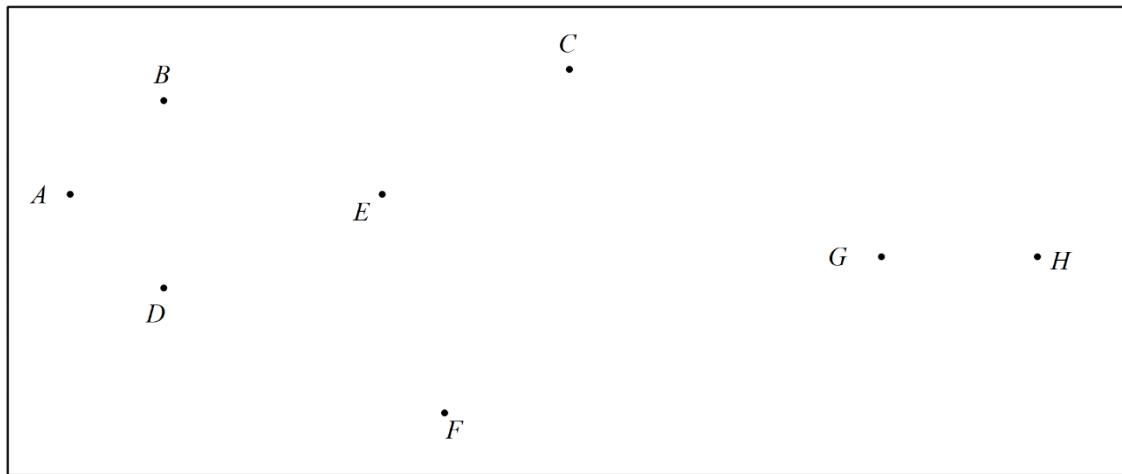
Total length: _____

Question 26 (2 marks)

A man weighs 89 kg and consumes 6 standard drinks.

2

How many hours will it take from the first drink until his blood alcohol concentration falls below the legal driving limit of 0.05?

Use the following formula to estimate his BAC:

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

Where:

- BAC is blood alcohol concentration
- N is number of standard drinks consumed
- H is hours from the first drink
- M is mass in kilograms

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Question 27 (3 marks)

The table of interest factors below shows the future value of a $1 annuity.

Future value of an annuity of $1

Time periods	Interest rate per period					
	0.15%	0.16%	0.17%	0.18%	0.19%	0.20%
6	6.0225	6.0241	6.0256	6.0271	6.0286	6.0301
12	12.0995	12.1062	12.1128	12.1195	12.1262	12.1329
18	18.2313	18.2469	18.2625	18.2781	18.2937	18.3093
24	24.4186	24.4468	24.4751	24.5034	24.5318	24.5602
30	30.6617	30.7065	30.7514	30.7963	30.8413	30.8865
36	36.9613	37.0265	37.0919	37.1575	37.2232	37.2890

(a) Nia deposits $1500 into an account at the end of each month for 2 years. The account pays 1.8% interest p.a., compounding monthly. **2**

Use the table to find the value of Nia's investment after 2 years.

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(b) Calculate the interest earned on Nia's investment. **1**

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Question 28 (2 marks)

A large sample of people were asked about their weekly household income, and the box plot of the dataset is shown below:

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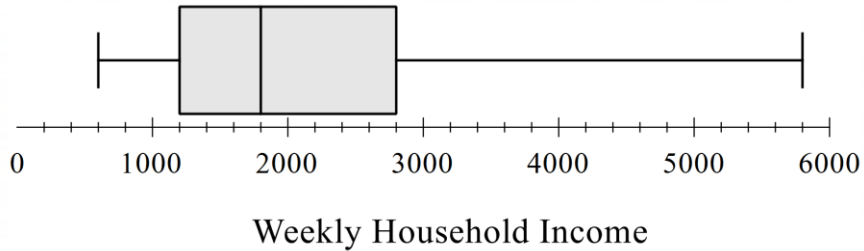
Weekly Household Income

The maximum weekly income earned by a household is $5800.

Using calculations to justify your answer, determine whether the income of $5800 can be considered an outlier.

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Question 29 (3 marks)

The table shows the current income tax rates for the 2024 – 2025 financial year. **3**

Taxable income	Tax on this income
0 – $18,200	Nil
$18,201 – $45,000	16 cents for each $1 over $18,200
$45,001 – $135,000	$4,288 plus 30 cents for each $1 over $45,000
$135,001 – $190,000	$31,288 plus 37 cents for each $1 over $135,000
$190,001 and over	$51,638 plus 45 cents for each $1 over $180,000

Theo has a taxable income of $104 600 per annum. Theo also pays the Medicare levy, which is 2% of his taxable income.

Calculate the total tax Theo pays, including the Medicare levy.

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Question 30 (3 marks)

A tourist spot has several attractions which can be visited. The network diagram below shows the various paths tourists can travel to visit the attractions (labelled A to G).

Tourists start at point A and finish at point G.

The numbers on the edges represent the number of tourists that can travel along the path per hour.
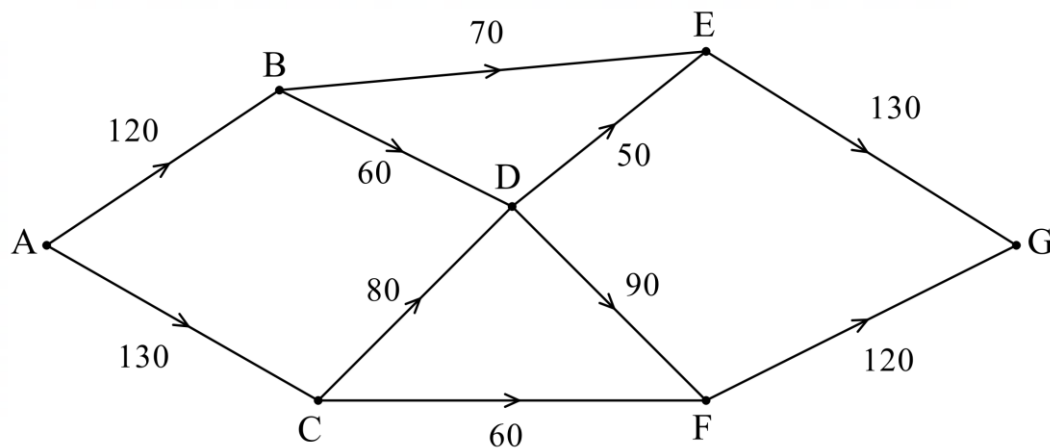
(a)   By showing a suitable cut on the diagram above, explain why the maximum flow of the tourist spot is less than 250 visitors per hour.   **2**

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(b)   The tourist spot can increase one path by 10 visitors per hour. Which path should be increased so that 250 can pass through each hour?   **1**

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Question 31 (2 marks)

A company has a net profit of $10.5 million. The company has chosen to distribute its profits evenly to the owners of its 87.5 million shares. **2**

Calculate the dividend yield if the share price is $7.50.

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Question 32 (3 marks)

A traveller takes off from Hervey Bay in Queensland at 11:10 am.   **3**

The traveller lands in Midland, Texas at 10:48 am the same day, local time. Neither city is using daylight savings time.

The longitude of Hervey Bay, Queensland is 152.9°E, and the longitude of Midland, Texas is 102.1°W.

What is the duration of the trip from initial take-off until final landing?

You may assume the fact that each 15° difference in longitude corresponds to a time difference of 1 hour.

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A pizza shop takes on average 22 minutes to deliver a pizza.

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If the delivery takes more than 30 minutes, the customer gets the pizza for free. The pizza shop ends up giving 2.5% of their pizzas away for free.

Assuming delivery times follow a normal distribution, what percentage of the pizzas are delivered in under 18 minutes?

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Question 34 (3 marks)

Eliza owns a credit card that charges 19.2% p.a. interest, compounding daily, on all
purchases made. The interest is charged from the day of purchase, including the day of
purchase and the date the payment is made.

3

On the 28th of October, Eliza bought a mobile phone for $899 using her credit card. Eliza
paid her credit card account on the 8th November.

What was the interest charged on the mobile phone by using the credit card?

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Question 35 (3 marks)

A farmer is building 3 small paddocks against a wall using 30 metres of fencing. The paddocks are equal in size.

The fencing is used to make 4 parallel sides of length x metres, and one long side of length $30 - 4x$ metres, as shown below.

Wall

x x x x

$\vdash$----------------$30 - 4x$----------------$\dashv$
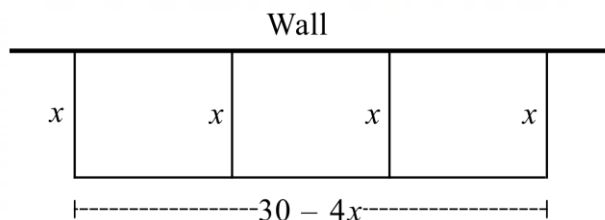
The combined area of the paddocks for different x values is given by the quadratic equation $A = 30x - 4x^2$, graphed below.
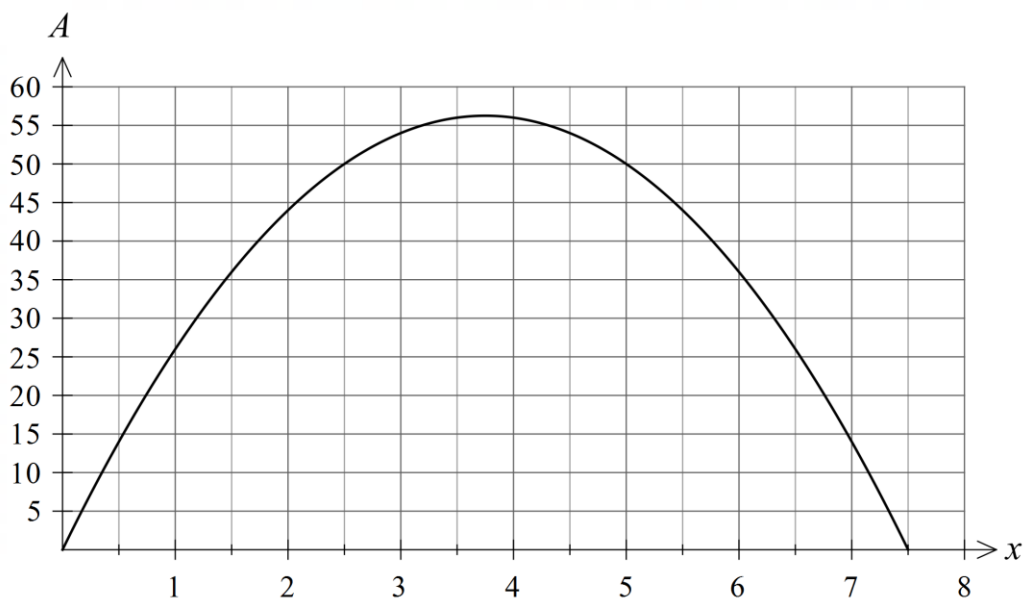
(a) State the values of x which make the combined area of 50 m^2.   **1**

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(b) Find the dimensions of a single paddock when its area is at a maximum.   **2**

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Question 36 (4 marks)

The network below shows the activities that are needed to finish a particular project and their completion times (in days).

H, 3

E, 5

B, 4   K, 6

D, 3   I, 2

Start   A, 7   L, 9   Finish

F, 8

C, 6   J, 4

M, 3

G, 9
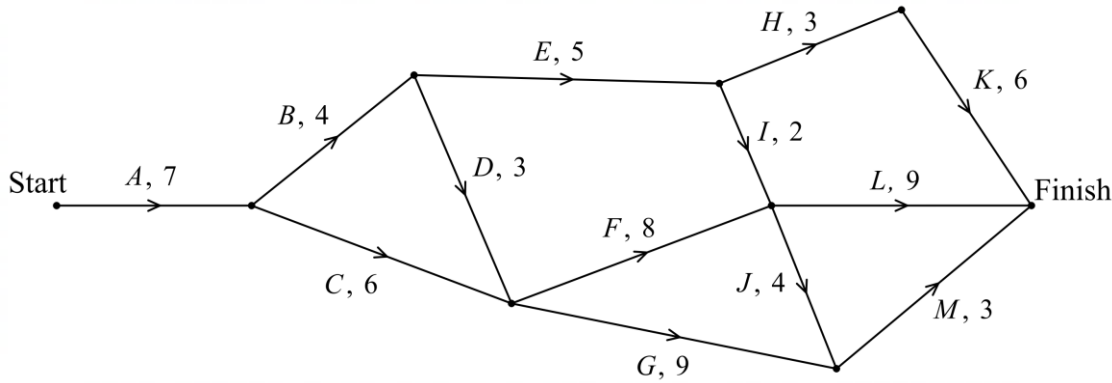
(a)   By stating the critical path, determine the minimum completion time for this project.   **2**

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(b)   What is the earliest start time for activity M?   **1**

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(c)   Activity E is being delayed. What is the maximum duration that activity E can be without delaying the overall completion time of the project?   **1**

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Question 37 (6 marks)

Samantha owns a company that produces candles. Her candles have a diameter of 8 cm and a height of 10 cm.
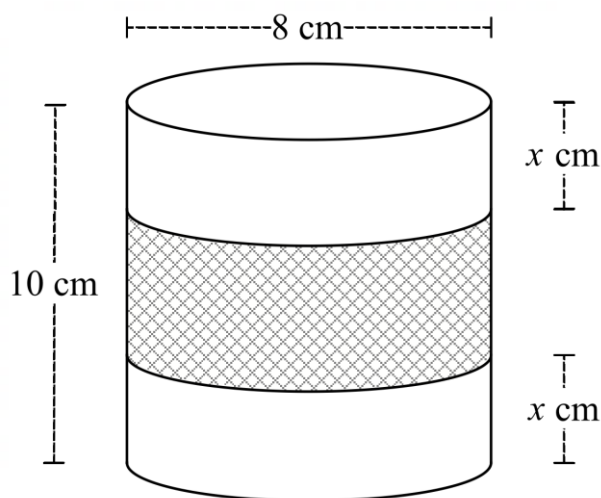
(a) Baking paper is used as a label on the candle, indicated by the shaded area on the diagram.   **3**

The label wraps around the middle of the candle with no overlap. The area of the baking paper used is 90.5 cm^2.

The distance between the label and the end of the candle is given by x cm on both sides of the label, as shown in the diagram. Calculate the value of x, correct to 1 decimal place.

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(b)   The company wants the candles to burn for a minimum of 60 hours. The candle   **3**
      currently burns at a rate of 1.3 cubic centimetres every ten minutes.

      Do the given dimensions allow the candle to burn for 60 hours? Justify your answer
      with calculations.

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End of Question 36

Question 38 (3 marks)

Present value interest factors for an annuity of $1 for various interest rates and time periods are given in the table below.

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Table of present value interest factors

Time periods	Interest rate per period				
	0.50%	0.55%	0.60%	0.65%	0.70%
180	118.5035	114.0753	109.8845	105.9163	102.1569
240	139.5808	133.0721	127.0084	121.3539	116.0760
300	155.2069	146.7418	138.9683	131.8193	125.2349
360	166.7916	156.5781	147.3214	138.9139	131.2616

Dean takes out a loan of $430 000. The interest charged on the loan is 0.55% per month, and he intends to repay the loan over 20 years by making equal monthly repayments.

Calculate how much Dean pays back in total over the 20 years.

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Question 39 (2 marks)

A lighthouse keeper observes a boat from two observation windows. The angle of depression from upper window to the boat is 33°. The angle of depression from lower window to the boat is 28°. The distance between two windows is 8 m.

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33°

8 m

28° L

U

B

d
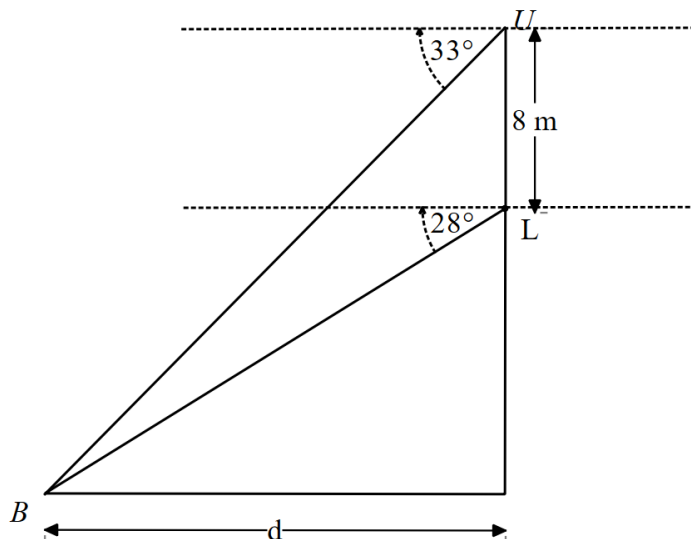
Calculate the distance d between the boat and the bottom of the lighthouse. Leave your answer to the nearest metre.

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Question 40 (5 marks)

A park in the shape of a trapezium is shown below, with corners at A, B, C and D. It has been drawn to scale on a 1-cm grid.
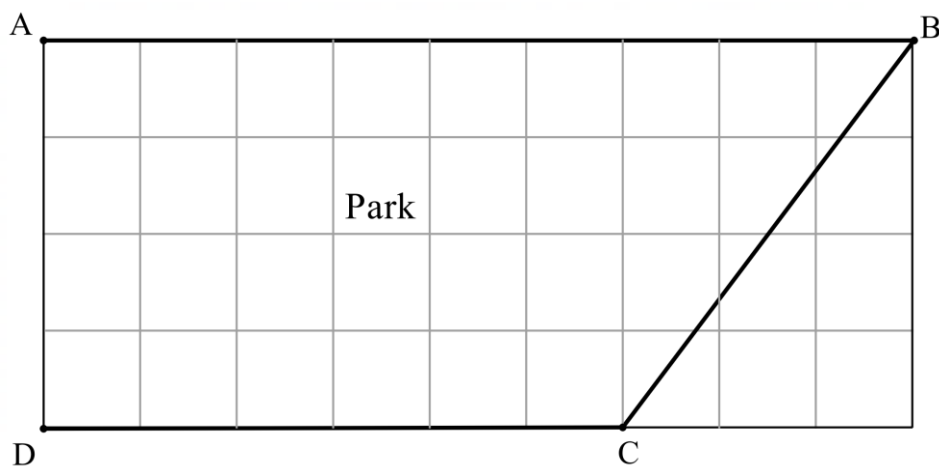
(a) Elise is running along three edges of a park. She starts at A, runs to B, then C, and finishes at D. **3**

She runs at an average speed of 8 km/h and runs the three edges in 6 minutes

Show that the scale used above is 1:4000.

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(b) In one day, 0.5 cm of rain falls on the trapezium park. **2**

How many kilolitres of water falls on the park on this day?

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Question 41 (4 marks)

Some friends are planning to go on a popular trail from point A to point C. Starting at point A, they plan to walk 6.5 km directly west to point B, and then walk 5.3 km on a bearing of 195°T.

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B ———— 6.5 km ———— A

5.3 km

C
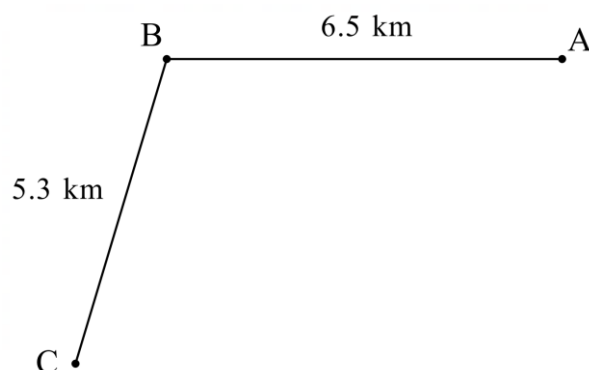
After walking 4.1 km from A to B, there is a blockage on the path. They choose to walk directly from the blockage to the destination at C.

Find the true bearing they must walk on to reach point C, correct to the nearest degree.

Question 42 (3 marks)

A group of 10 people were given tests to determine their reaction time. Their results are plotted against the number of hours of sleep they had the night before in the scatter plot below.
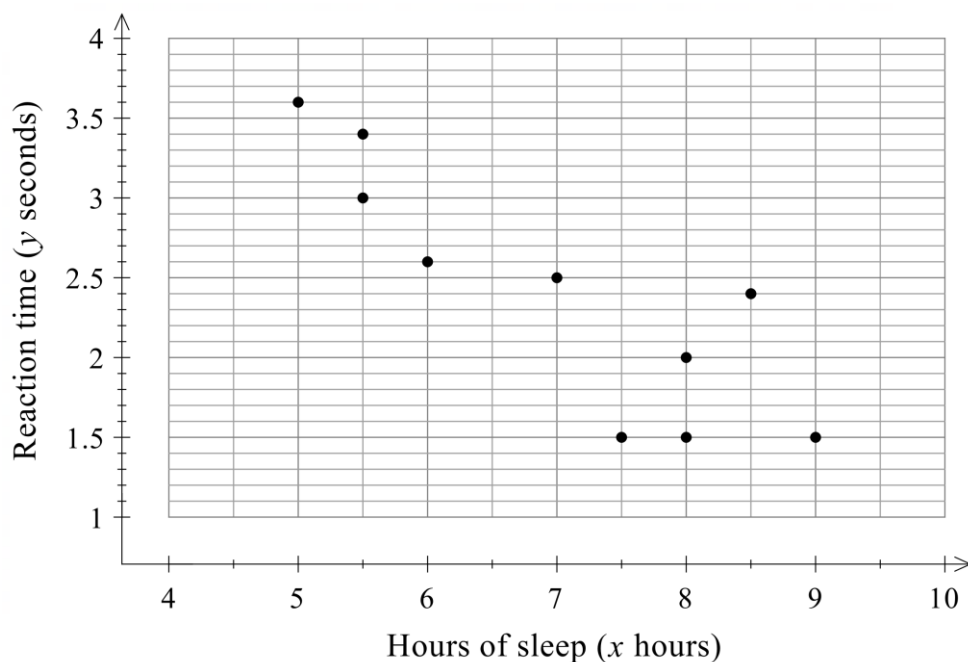
The least-squares regression line for this data is $y = 5.725 - 0.475x$.

(a) Interpret the value of the gradient for this line in the context of the data.　　**2**

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(b) A new person is tested, and gets a reaction time of 2.4 seconds, after having 7 hours of sleep. This point lies exactly on the least-squares regression line.　　**1**

How would the correlation coefficient change after the new person is added?

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Question 43 (4 marks)

Chris takes out a loan of $400 000 in 2025, to be paid back over 30 years. He pays back **4**
$2796 at the end of each month, after interest has been added.

At the end of the first month, Chris owes $399 704. (You may use this to calculate the
interest rate).

The table shows the monthly repayment needed per $1000 borrowed.

Interest Rate (per annum)	Term of Loan (years)				
	10	15	20	25	30
7%	11.61	8.99	7.75	7.07	6.65
7.5%	11.87	9.27	8.06	7.39	6.99
8%	12.13	9.56	8.36	7.72	7.34
8.5%	12.40	9.85	8.69	8.05	7.69

After 5 years of paying off the loan, Chris still owes $378 532. (Do not show this)

He then decides to increase his monthly payment so that he can pay back the loan in 2050.

Calculate the total amount of interest Chris has paid on the loan in total after making this
change, correct to the nearest whole number.

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Question 44 (3 marks)

For a normal distribution with a mean of 0 and standard deviation of 1, it is known that approximately 90% of the data lies below the z-score of 1.28.

3

A company sells chocolate bars. Currently, the mass of the chocolate bars is normally distributed with a mean of 150.6 g and a standard deviation σ. It is known that 10% of these bars weigh less than 149 g.

The bars cannot fit in their packaging if their mass exceeds 153 g.

The company is changing the mean mass of their chocolate bars so that only 2.5% of them weigh less than 149 g. The standard deviation of the masses is staying the same.

By making this change, determine whether at least 90% of the chocolate bars produced will still fit in their packaging. Justify your answer with appropriate calculations.

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End of paper

Mathematics Standard 2
Year 12 2024
Trial Solutions & Feedback

General Feedback

- Doing past trials/HSC exams is the best way to prepare from now on, and it was clear that a number had not been doing this consistently.
- The key topics that many students need to review are **Non-right-angled Trigonometry**, **Perimeter, Area and Volume**, as well as **The Normal Distribution**.
- Students need to make sure they are confident and quick with the routine questions, which will give them more time to try the harder problems.
- Critical paths and float times needs to be reviewed.
- Working with time zones (from year 11) needs to be refreshed.
- Working with annuity tables needs to be more confident.

Section 1 – Multiple Choice

Question	Answer
1	A
2	C
3	B
4	D
5	D
6	A
7	D
8	C
9	C
10	B
11	D
12	A
13	D
14	B
15	D

Section 2 – Short Answer

Sample Solutions

Marking Criteria

Question 16

A hemispherical bowl has a diameter of 20 cm. It is open at the top.
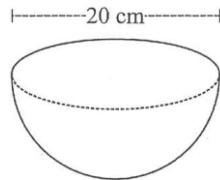
|---------20 cm---------|

What is the surface area of the outside of the open bowl, correct to the nearest square centimetre?

$$SA = 4\pi r^2 \div 2$$
$$= 2\pi (10)^2$$
$$\approx 628 \, cm^2$$

Criteria	Marks
Correct solution (rounding not important)	2
Attempting to use the correct SA formula	1

Feedback:
Done pretty well. An <u>open</u> bowl does not have a top.

Question 17

The scatter plot below represents the relationship between the flying distance between two cities and the cost of the plane ticket.
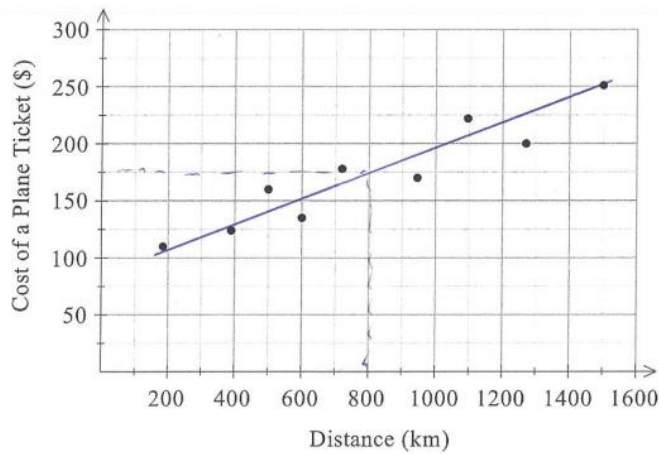
(a) Draw a line of best fit by eye.

(b) From your line of best fit, estimate the cost of a plane ticket for traveling 800 km.

~$175

(c) Explain why your line of best fit would not be appropriate to estimate the cost of travelling more than 2000 km.

The highest data value on the graph is 1500km. Using the line would be unreliable for anything beyond this point

Feedback:
Mostly done well.

Question 18

A business makes puzzles and sells them.

The graphs below show the revenue and cost of the business for n puzzles.
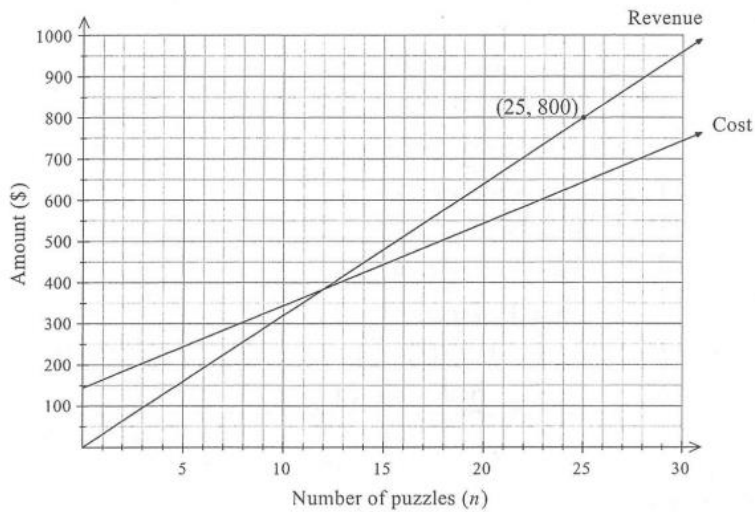
(a) The coordinate $(25, 800)$ lies on the revenue line.

Calculate the revenue made per puzzle sold.

$$\frac{800}{25} = 32$$

$32 per puzzle

(b) Calculate the coordinates of the break-even point.

$n = 12$

$32 \times 12 = 384$

Break-even point: $(12, 384)$

Part (a)

Criteria	Marks
Calculates the revenue with working	1

Part (b)

Criteria	Marks
Calculates the coordinate of the break-even point	2
Indicates that 12 puzzles need to be sold to break-even	1

Feedback:
Part (b) was often done by eye, when calculations were needed. Part (a) lets you calculate the value for part (b).

Question 19

18-year-old Sam exercises at the gym and wants his target heart rate to sit at 80% of his maximum heart rate.

The following formula can be used to estimate the maximum heart rate (in beats per minute):

$$\text{Maximum Heart Rate} = 220 - \text{age in years}$$

How many beats should he count in a 10 second period when he has achieved this target heart rate? Round your answer to the nearest whole number of beats.

$$MHR = 220 - 18$$
$$= 202 \, bpm$$
$$THR = 80\% \times 202$$
$$= 161.6 \, bpm$$
$$Beat/10\,sec = 161.6 \div 6$$
$$\approx 27 \, beats$$

Criteria	Marks
Calculates the correct number of beats (rounding not important)	2
▪ Finds target heart rate OR ▪ Finds the number of beats from the maximum heart rate	1

Feedback:
Mostly done well.

Question 20

Isaac has made a table for his results in several subjects.

Complete the table by filling in the blank boxes.

Subject	Raw Mark	Mean	Standard Deviation	z-score
Economics	70	63	8	0.875
Music	67	78	5.5	−2
PDHPE	84	75	7.5	1.2

Criteria	Marks
All three values correct	2
One value is correct	1

Feedback:
A bit mixed. Some students skipped this question.

Question 21

In a jar of 21 lollies, 6 are red (R) and the rest are green (G).

Gerrard takes two lollies at random, without replacement.
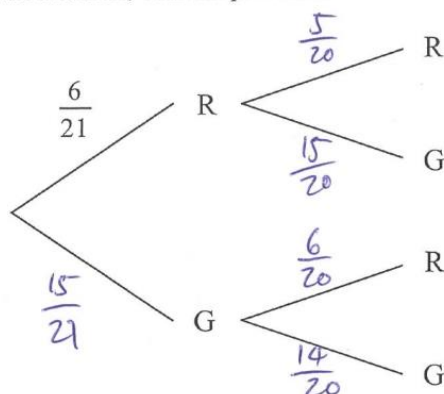
By completing the tree diagram above, determine the probability that Gerrard takes two green lollies.

$$P(GG) = \frac{15}{21} \times \frac{14}{20}$$

$$= \frac{1}{2}$$

Criteria	Marks
Correct working from a correct tree diagram	2
▪ A correct tree diagram OR ▪ Correctly multiplying the GG branch, but an incorrect tree diagram	1

Feedback:
This question was poorly done and needs to be a focus for revision. Students should know how to complete tree diagrams and use the probabilities from the branches.

Question 22

A radial survey of a local park is shown in this diagram.
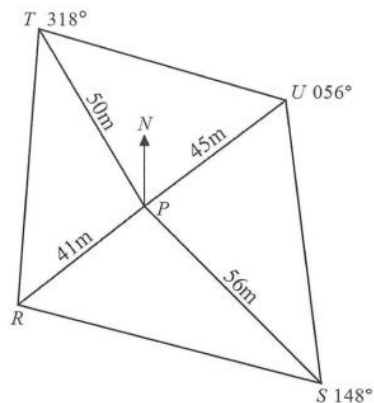
(a)   R is south-west of P.

What is the bearing of R from P?

$225°T$

(b)   Find the area of triangle RPS to the nearest square metre.

$\angle RPS = 225 - 148$
$= 77°$

$Area = \frac{1}{2}(56)(41) \sin 77°$

$\doteq 1119 m^2$

Feedback:
Part (a) caused a lot of confusion, which made part (b) a bit difficult.

Question 23

What amount must be invested for 8 years at 4.95% p.a. compounded quarterly to grow to a future value of $15 000? Leave your answer to the nearest dollar.

$$15000 = PV\left(1 + \frac{4.95\%}{4}\right)^{32}$$

$$PV = \frac{15000}{\left(1 + \frac{4.95\%}{4}\right)^{32}}$$

$$= \$10170$$

Criteria	Marks
Correct answer form incorrect working	2
▪ Working backwards using the future value formula OR ▪ Correctly substituting into the FV formula and adjusting the rate and time periods	1

Feedback:
Many students did not make both changes to the FV formula (dividing the rate by 4 and multiplying the time period by 4).

Question 24

0.1kW
Ursula owns a computer, which consumes on average 100 watts of power. It is run 24 hours per day.

Electricity is charged at the following rates:

	Time	Tariff	Cost per kWh
16h	6am – 10pm	Peak	$0.55 / kWh
8h	All other times	Off-peak	$0.225 / kWh

(a) Calculate Ursula's cost of running the computer for a week.

Daily cost = 16 × 0.1 × 0.55 + 8 × 0.1 × 0.225
= $1.06

Weekly cost = 7 × 1.06
= $7.42

(b) Ursula allocates $2000 per year to electricity.

What percentage of her allocation does this computer use, correct to 2 decimal places?

$$\text{Allocation \%} = \frac{7.42 \times 52}{2000}$$

$$= 19.29\%$$

Part (a)

Criteria	Marks
Finding the weekly cost	2
Converting watts into kilowatts, and multiplying by an hour amount	1

Part (b)

Criteria	Marks
Correct working to find the percentage (rounding not important)	1

Feedback:
This question was not well done and needs to be reviewed by students. Students need to know how to use units of energy, and when to convert watts to kilowatts. Some students also did not read the questions carefully, and didn't find the weekly cost.

Question 25

The water authority wants to lay water pipes along the roads to put a fire hydrant at every vertex on the network shown. The numbers represent the length, in metres, of the pipe that connects any two vertices.

To minimise the cost of the operation, the water authority wants to minimise the length of the pipes.

Construct the minimum spanning tree to achieve this and calculate its total length.
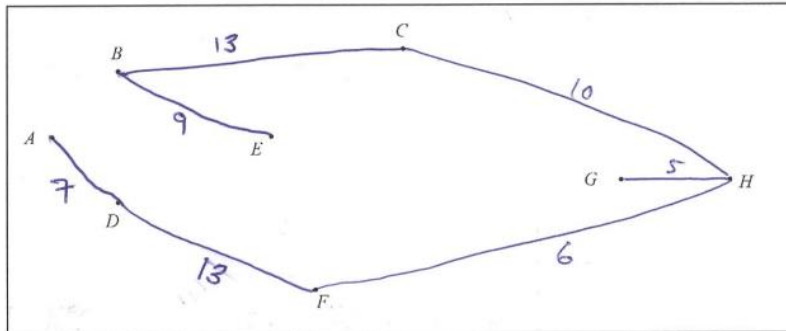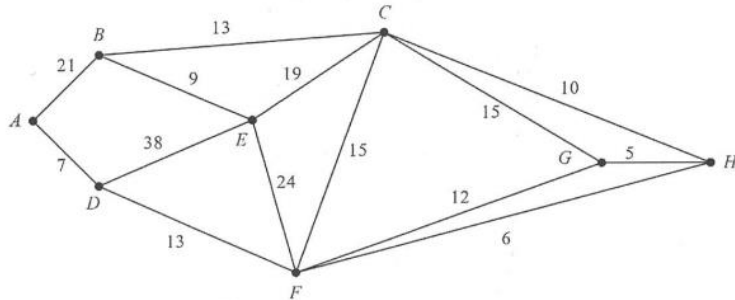
Total length: _____ 63m .

Criteria	Marks
Finds the correct total length with a correct minimum spanning tree drawn (don't need to show adding the numbers)	3
▪ Finds a correct minimum spanning tree OR ▪ Finding a total length from an incorrect spanning tree OR ▪ Finds the correct length, but tree is unlabelled	2
Draws a spanning tree	1

Feedback:
Some students need to review the process for finding the minimum spanning tree. Students need to remember the units for their final answer.

Question 26

A man weighs 89 kg and consumes 6 standard drinks.

How many hours will it take from the first drink until his blood alcohol concentration falls below the legal driving limit of 0.05?

Use the following formula to estimate his BAC:

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

Where:

- BAC is blood alcohol concentration
- N is number of standard drinks consumed
- H is hours from the first drink
- M is mass in kilograms

Criteria	Marks
Finds the correct time from correct working (either 3.96… or 4 hours is fine)	2
Correctly substitutes into the formula	1

$$0.05 = \frac{10(6) - 7.5(H)}{6.8(89)}$$

$$30.26 = 60 - 7.5H$$
$$7.5H = 29.74$$

$$H \approx 4 \text{ hours}$$

Feedback:
Many students knew to let the BAC equal 0.05 but found solving the equation difficult. Solving equations should be something students review as it is helpful for many topics in the course.

Question 27

The table of interest factors below shows the future value of a $1 annuity.

Future value of an annuity of $1

Time periods	Interest rate per period					
	0.15%	0.16%	0.17%	0.18%	0.19%	0.20%
6	6.0225	6.0241	6.0256	6.0271	6.0286	6.0301
12	12.0995	12.1062	12.1128	12.1195	12.1262	12.1329
18	18.2313	18.2469	18.2625	18.2781	18.2937	18.3093
24	24.4186	24.4468	24.4751	24.5034	24.5318	24.5602
30	30.6617	30.7065	30.7514	30.7963	30.8413	30.8865
36	36.9613	37.0265	37.0919	37.1575	37.2232	37.2890

(a) Nia deposits $1500 into an account at the end of each month for 2 years. The account pays 1.8% interest p.a., compounding monthly. **2**

Use the table to find the value of Nia's investment after 2 years.

$r = 1.8\% \div 12 = 0.15\%$, $n = 24$

$FV = 1500 \times 24.4186$

$= \$36627.90$

(b) Calculate the interest earned on Nia's investment. **1**

$Interest = 36627.90 - (1500 \times 24)$

$= \$627.90$

Part (a)

Criteria	Marks
Finds the correct future value from correct working	2
Uses the wrong interest factor (24.5034)	1

Part (b)

Criteria	Marks
A correct solution to find the interest amount	1

Feedback:
Too many students were using the future value formula here. Annuities questions will give a table, and if one is given, then it should be used. Students need to review Annuities, as this question was very stock-standard and should have been done better.

Question 28

A large sample of people were asked about their weekly household income, and the box plot of the dataset is shown below:
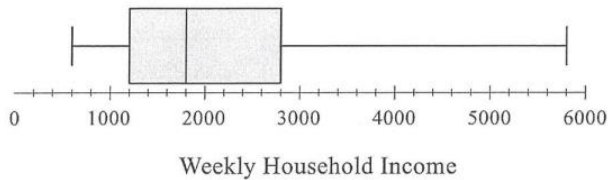
Weekly Household Income

The maximum weekly income earned by a household is $5800.

Using calculations to justify your answer, determine whether the income of $5800 can be considered an outlier.

$IQR = 2800 - 1200$
$= 1600$

Upper fence $= 2800 + 1.5(1600)$
$= 5200$

$5800 > 5200$, so it is an outlier

Criteria	Marks
A correct justification from correct working	2
Finds the IQR and attempts to find the upper fence	1

Feedback:
Many students did well here and executed the process to justify an outlier correctly.

Question 29

The table shows the current income tax rates for the 2024 – 2025 financial year.

Taxable income	Tax on this income
0 – $18,200	Nil
$18,201 – $45,000	16 cents for each $1 over $18,200
$45,001 – $135,000	$4,288 plus 30 cents for each $1 over $45,000
$135,001 – $190,000	$31,288 plus 37 cents for each $1 over $135,000
$190,001 and over	$51,638 plus 45 cents for each $1 over $180,000

Theo has a taxable income of $104 600 per annum. Theo also pays the Medicare levy, which is 2% of his taxable income.

Calculate the total tax Theo pays, including the Medicare levy.

Tax on income = (104 600 − 45000) × 0.3 + 4288
= $22168.

ML = 2% × 104 600
= $2092

Total tax = 22168 + 2092
= $24260

Feedback:
Tax table questions are common and should come naturally to students. It was clear that some student knew how to do this comfortably, and a number did not. If you are not sure with these types of questions, you should make sure you practise these.

Question 30

A tourist spot has several attractions which can be visited. The network diagram below shows the various paths tourists can travel to visit the attractions (labelled A to G).

Tourists start at point A and finish at point G.

The numbers on the edges represent the number of tourists that can travel along the path per hour.
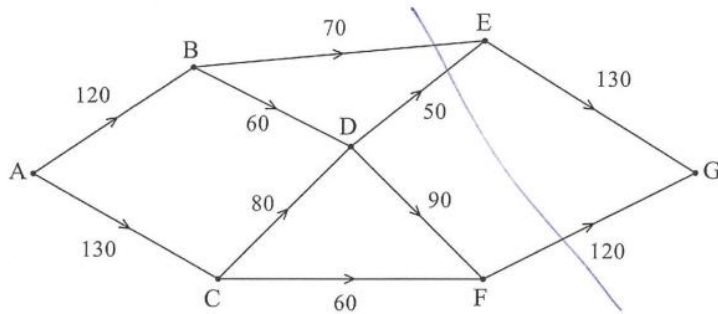
(a) By showing a suitable cut on the diagram above, explain why the maximum flow of the tourist spot is less than 250 visitors per hour.

Min cut = 240
So max flow is 250

(b) The tourist spot can increase one path by 10 visitors per hour. Which path should be increased so that 250 can pass through each hour?

Increase BE

Feedback:
This question was mixed. A number of students found the minimum cut, but did not <u>explain</u> this in the context of the maximum flow. Part (a) needed more than just saying what the minimum cut was,

Question 31

A company has a net profit of $10.5 million. The company has chosen to distribute its profits evenly to the owners of its 87.5 million shares.

Calculate the dividend yield if the share price is $7.50.

$$\text{Div/share} = \frac{10.5}{87.5}$$

$$= \$0.12$$

$$\text{Div yield} = \frac{0.12}{7.50}$$

$$= 1.6\%$$

Criteria	Marks
Finding the dividend yield, expressed as a percentage	2
▪ Finding the dividends/share OR ▪ Correct working to find the dividend yield as a decimal	1

Feedback:
This question was done reasonably well – a big improvement from task 3. A number were still not sure how to find dividend yield and need to review shares.

Question 32

A traveller takes off from Hervey Bay in Queensland at 11:10 am.

The traveller lands in Midland, Texas at 10:48 am the same day, local time. Neither city is using daylight savings time.

The longitude of Hervey Bay, Queensland is 152.9°E, and the longitude of Midland, Texas is 102.1°W.

What is the duration of the trip from initial take-off until final landing?

You may assume the fact that each 15° difference in longitude corresponds to a time difference of 1 hour.

$$\text{longitude diff} = 152.9 + 102.1$$
$$= 255$$
$$\text{time diff} = 255 \div 15$$
$$= 17h$$

11:10 am in QLD is 6:10 pm in Tx

$$6:10 pm \rightarrow 10:48 am \text{ is}$$
$$6h + 10h + 28 min = 16h \ 38 min$$

Criteria	Marks
A correct solution	3
▪ Finding the time difference and adding/subtracting from a given time	2
▪ Calculates the longitude difference	1

Feedback:
Quite a few students did subtraction between two longitudes, instead of addition for finding the time difference. Working with time zones needs to be an area of review for quite a number of students.

Question 33

A pizza shop takes on average 22 minutes to deliver a pizza.

If the delivery takes more than 30 minutes, the customer gets the pizza for free. The pizza shop ends up giving 2.5% of their pizzas away for free.

Assuming delivery times follow a normal distribution, what percentage of the pizzas are delivered in under 18 minutes?

$$\sigma = 4$$

$$Z = \frac{18-22}{4}$$

$$= -1$$

So 16% is delivered in under 18 min

Criteria	Marks
A correct solution to give the correct percentage	2
Finding a standard deviation of 4	1
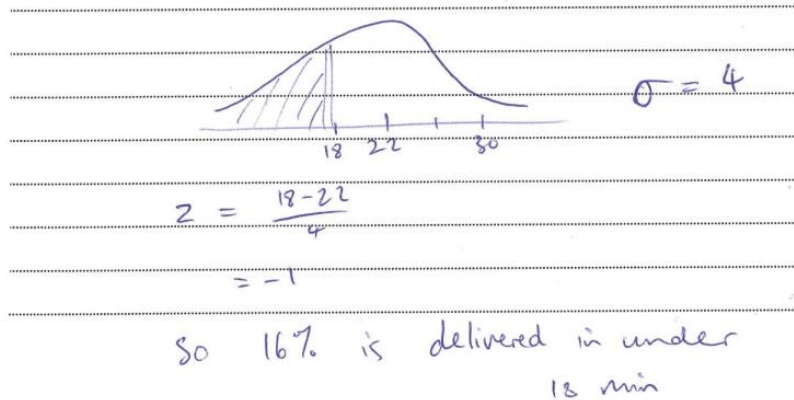
Feedback:
Done quite well. One mark was given for using a normal distribution graph to find 16% as part of the working.

Question 34

Eliza owns a credit card that charges 19.2% p.a. interest, compounding daily, on all purchases made. The interest is charged from the day of purchase, including the day of purchase and the date the payment is made.

On the 28th of October, Eliza bought a mobile phone for $899 using her credit card. Eliza paid her credit card account on the 8th November.

What was the interest charged on the mobile phone by using the credit card?

4 days (oct) + 8 days = 12 days

$$FV = 899\left(1 + \frac{19.2\%}{365}\right)^{12}$$

$$= 904.69$$

Interest = $5.69

Criteria	Marks
Finding the interest using the future value formula correctly	3
▪ Finding the future value using the correct number of days OR ▪ Finding the interest using 11 days instead of 12	2
▪ Finding the interest using the simple interest formula OR ▪ Finding the future value using 11 days OR ▪ Stating that 12 days is used for the charge	1

Feedback:
A few students did not convert interest rate as daily interest rate.

Question 35

A farmer is building 3 small paddocks against a wall using 30 metres of fencing. The paddocks are equal in size.

The fencing is used to make 4 parallel sides of length x metres, and one long side of length $30 - 4x$ metres, as shown below.

Wall
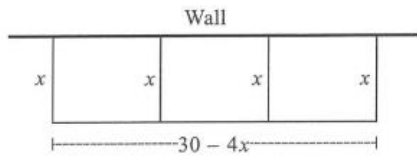
The combined area of the paddocks for different x values is given by the quadratic equation $A = 30x - 4x^2$, graphed below.
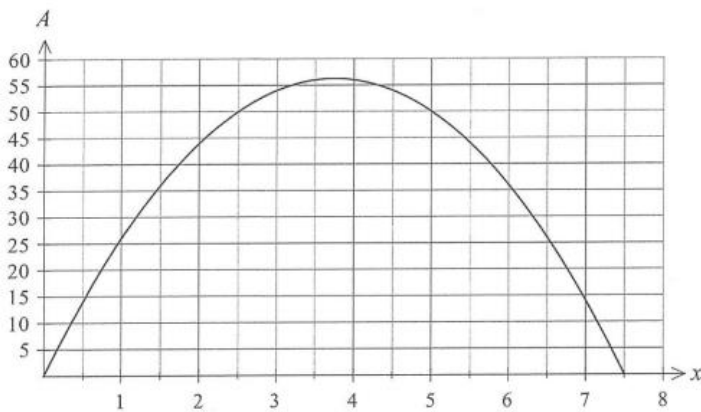
(a) State the values of x which make the combined area of 50 m².

$$x = 2.5, \ 5$$

(b) Find the dimensions of a single paddock when its area is at a maximum.

Max at $x = 3.75$

Total length $= 30 - 4(3.75) = 15$

length of 1 is $15 \div 3 = 5m$

dimensions : $3.75m \times 5m$

Feedback:
a) A few students only have one x value as 2.5m, instead of two of two values.
b) A lot of students finding the area of the paddocks, instead of dimensions of a single paddock.

Question 36

The network below shows the activities that are needed to finish a particular project and their completion times (in days).
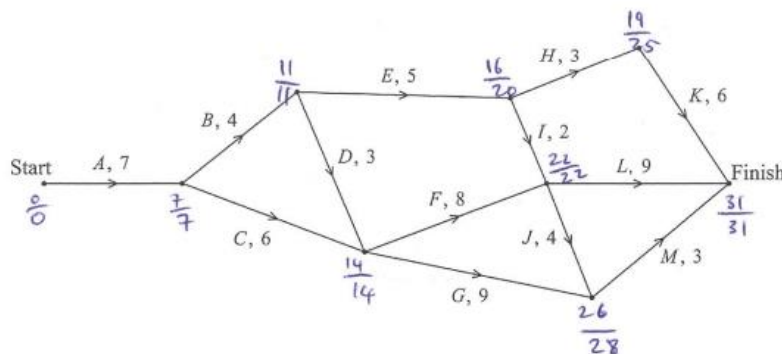
(a) By stating the critical path, determine the minimum completion time for this project.

Critical path : ABDFL

Min compl time = 31 days

(b) What is the earliest start time for activity M?

26 days

(c) Activity E is being delayed. What is the maximum duration that activity E can be without delaying the overall completion time of the project?

Float time = 20 - 11 - 5
= 4 days.

Part (a)

Criteria	Marks
Finds the minimum completion time and states the critical path	2
Finds the minimum completion time OR states the critical path	1

Part (b)

Criteria	Marks
Stating the correct number of days	1

Part (c)

Criteria	Marks
Calculating the float time with working	1

Feedback:
A few students did not correctly calculate EST and LST, as a result leads to the incorrect critical path.

Question 37

Samantha owns a company that produces candles. Her candles have a diameter of 8 cm and a height of 10 cm.
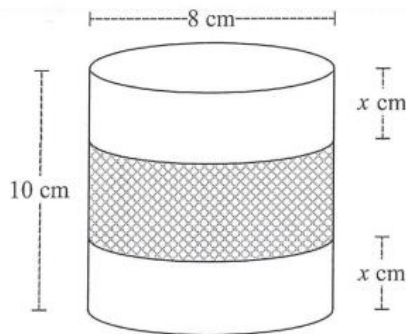
(a) Baking paper is used as a label on the candle, indicated by the shaded area on the diagram.

The label wraps around the middle of the candle with no overlap. The area of the baking paper used is 90.5 cm².

The distance between the label and the end of the candle is given by x cm on both sides of the label, as shown in the diagram. Calculate the value of x, correct to 1 decimal place.

$$2\pi(4)h = 90.5$$
$$h = 90.5 \div (8\pi)$$
$$\doteq 3.6$$

$$2x = 10 - 3.6$$
$$= 6.4$$
$$x = 3.2$$

(b) The company wants the candles to burn for a minimum of 60 hours. The candle currently burns at a rate of 1.3 cubic centimetres every ten minutes.

Do the given dimensions allow the candle to burn for 60 hours? Justify your answer with calculations.

$$1.3 \text{ cm}^3 / 10\min \rightarrow 7.8 \text{ cm}^3/h$$

$$V = \pi(4)^2 10$$
$$= 502.654\dots \text{ cm}^3$$

$$\text{time} = \frac{502.654\dots}{7.8}$$

$$= 64.44\dots$$

So yes, it will burn for more than 60 h.

Part (a)

Criteria	Marks
A correct solution for the value of x	3
Finding the height of the label	2
Using the surface area of a cylinder formula	1

Part (b)

Criteria	Marks
A correct justification based on correct calculations	3
▪ Calculating the volume of the candle and attempting to use the rates to find the time OR ▪ Use the rate to find the volume being burnt in 60 hours	2
▪ Calculating the volume of the candle OR ▪ Calculating the burn rate per hour	1

Feedback: - next page

For part (a), some students included the ends of the candle in their surface area calculation. These students got a mark for a correct calculation, however if they didn't adjust for this in their subsequent calculations then they didn't earn further marks.

For part (b) some students used surface area instead of volume. Quite a few students used formula for volume of a cone or a sphere. The formula reference sheet is not comprehensive, and picking formulas from that sheet without understanding what they are for can lead to losing marks.

Question 38

Present value interest factors for an annuity of $1 for various interest rates and time periods are given in the table below.

Table of present value interest factors

Time periods	Interest rate per period				
	0.50%	0.55%	0.60%	0.65%	0.70%
180	118.5035	114.0753	109.8845	105.9163	102.1569
240	139.5808	133.0721	127.0084	121.3539	116.0760
300	155.2069	146.7418	138.9683	131.8193	125.2349
360	166.7916	156.5781	147.3214	138.9139	131.2616

Criteria	Marks
Finding the paid back amount with units (Either $775519.44 or 775519.20 – this depends on rounding earlier)	3
Finding the monthly repayments	2
Identifying the interest factor	1

Dean takes out a loan of $430 000. The interest charged on the loan is 0.55% per month, and he intends to repay the loan over 20 years by making equal monthly repayments.

Calculate how much Dean pays back in total over the 20 years.

$$430\,000 \div 133.0721 = \$3231.33$$

$$3231.33 \times 240 = \$775519.20$$

Feedback:
Most students correctly identified the interest factor.

Some students attempted to use the compound interest formula – this cannot be used with annuities.

Many students multiplied by the interest factor instead of dividing. Remember
$PV = aX$, so $a = PV/X$

Question 39

A lighthouse keeper observes a boat from two observation windows. The angle of depression from upper window to the boat is 33°. The angle of depression from lower window to the boat is 28°. The distance between two windows is 8 m.
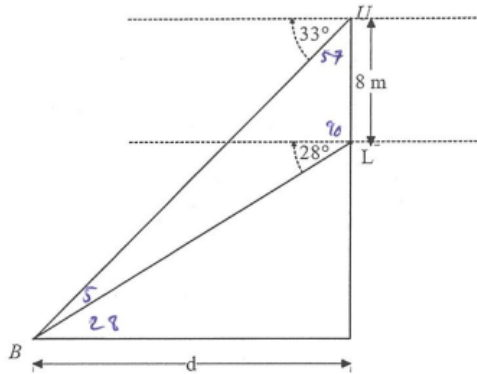
Calculate the distance d between the boat and the bottom of the lighthouse. Leave your answer to the nearest metre.

$$\frac{BL}{\sin 57} = \frac{8}{\sin 5}$$

$$BL = 76.98\ldots$$

$$\cancel{} \cos 28 = \frac{d}{76.98\ldots}$$

$$d = 76.98\ldots \times \cos 28$$

$$\doteq 68 \text{ M}$$

Criteria	Marks
Finding the length d (rounding not important)	2
▪ Finding the angle ∠UBL OR ▪ Setting up a tan equation using the two triangles OR ▪ Finding BL	1

Feedback:
- Many students found the length of the horizontal line segment from L to where in intersects UB. This alone was not enough to earn a mark.
- To earn one mark, students needed to find length BU or BL, and then use sine or cosine to get d.
- One student set up two equations with tan and solved simultaneously, this approach also earned full marks.
- Quite a few students used sine rule with right-angle triangles instead of using SOHCAHTOA. This is not wrong, but unnecessarily complicates the algebra.

Question 40

A park in the shape of a trapezium is shown below, with corners at A, B, C and D. It has been drawn to scale on a 1-cm grid.
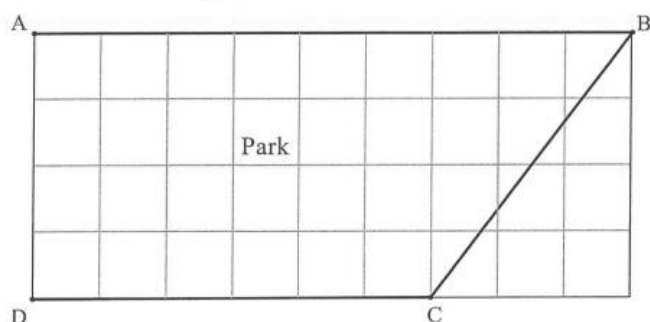
(a) Elise is running along three edges of a park. She starts at A, runs to B, then C, and finishes at D.

She runs at an average speed of 8 km/h and runs the three edges in 6 minutes

Show that the scale used above is 1: 4000.

$CB = \sqrt{3^2 + 4^2} = 5\,cm$

run is $6 + 5 + 9 = 20\,cm$

$d = s \times t = 8 \times \frac{6}{60} = 0.8\,km$

$20\,cm : 0.8\,km$

$= 20 : 80000$

$= 1 : 4000$

(b) In one day, 0.5 cm of rain falls on the trapezium park.

How many kilolitres of water falls on the park on this day?

$Area = \frac{4 \times 4000}{2}(6 \times 4000 + 9 \times 4000)$

$= 4800000000\,cm^2 \quad \times 0.5$

$= 2400000000\,cm^3$

$= 2400000000\,mL$

$= 240\,kL$

Part (a)

Criteria	Marks
Correctly showing the scale provides consistent results for distance calculated from scale diagram and distance calculated from speed.	3
▪ Find the actual length of the three edges based on some working, and makes significant attempt to find the distance from speed	2
▪ Find the scaled length of the three edges based on some working OR ▪ Calculates the distance run in 6 min	1

Part (b)

Criteria	Marks
Calculates the correct volume of the water	2
▪ Finds the actual volume of the trapezium OR ▪ Finds and incorrect volume for the trapezium, but has converted to Kl correctly	1

Feedback:
Part (a) - Generally well done
Very few students wrote that the scaled distance was 20 cm with no working or justification at all – this did not earn a mark.
Some students incorrectly calculated scaled distance, and so were unable to demonstrate that the scale is 1:4000

In part (b), quite a few students calculated scaled area correctly, but then tried to convert it to real area by multiplying by scale factor 4000 and therefore did not secure the mark. Remember, when working with areas, you need to multiply by the scale factor *squared*.
Some students mixed scale and real measurements in their volume calculation, which led to an incorrect answer and didn't earn the mark.

Question 41

Some friends are planning to go on a popular trail from point A to point C. Starting at point A, they plan to walk 6.5 km directly west to point B, and then walk 5.3 km on a bearing of 195°T.

Criteria	Marks
Provides correct solution	4
▪ Finds the angle $\angle BDC$ OR ▪ Finds the angle $\angle ADC$	3
▪ Finds the length CD	2
▪ Uses the bearing to state $\angle ABC$	1
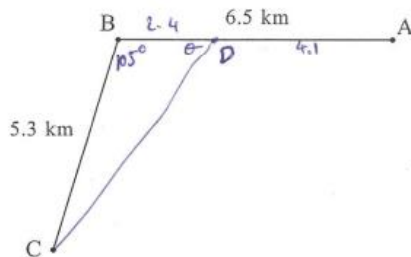
After walking 4.1 km from A to B, there is a blockage on the path. They choose to walk directly from the blockage to the destination at C.

Find the true bearing they must walk on to reach point C, correct to the nearest degree.

$$CD^2 = 2.4^2 + 5.3^2 - 2(2.4)(5.3)\cos 105°$$
$$= 40.434\cdots$$
$$CD = 6.3588\cdots$$

$$\frac{\sin \theta}{5.3} = \frac{\sin 105}{6.3588\cdots}$$

$$\sin \theta = 0.805\cdots$$
$$\theta = 53.6\cdots$$

$$\text{Bearing} = 270 - 53.6\cdots$$
$$= 216°T$$

Feedback:
This question was very mixed. A number of students approached it comfortably and used the most efficient method to find the bearing. A number also achieved 3 out of 4 but need to remember how to find the bearing after finding the correct angle in the new triangle.

Some students need to thoroughly review Non-Right-Angled Trigonometry. This is an important topic and has been the most heavily assessed in the HSC over the last 5 years.

Question 42

A group of 10 people were given tests to determine their reaction time. Their results are plotted against the number of hours of sleep they had the night before in the scatter plot below.
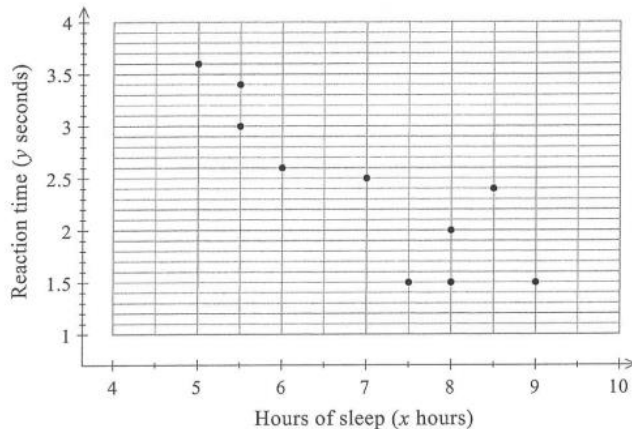
The least-squares regression line for this data is $y = 5.725 - 0.475x$.

(a) Interpret the value of the gradient for this line in the context of the data.

Reaction time decreases by 0.475sec for each hour of sleep

(b) A new person is tested, and gets a reaction time of 2.4 seconds, after having 7 hours of sleep. This point lies exactly on the least-squares regression line.

How would the correlation coefficient change after the new person is added?

r gets closer to −1

Part (a)

Criteria	Marks
Interprets correctly using the variables and noting the decrease, referring to the number itself	2
▪ Notes the gradient and attempts to explain with a variable OR ▪ Explains that an increase in sleep hours leads to a decrease in reaction time	1

Part (b)

Criteria	Marks
▪ Stating it gets closer to −1 (or smaller, or the *magnitude* gets bigger) OR ▪ Stating it would stay the same	1

Feedback:

Part (a) caused a bit of confusion, with a lot of students confusing the gradient with the correlation. You answer here needed to **interpret the <u>value</u> of the gradient**, which means they needed to refer to the number, and explain what it meant in terms of the variables.

Part (b) had two answer that were accepted: either the correlation coefficient gets closer to –1 or stays the same. Ordinarily the correlation will strengthen when a point on the least-squares regression is added (in this case, decrease), however, for this particular point it doesn't change.

Question 43

Chris takes out a loan of $400 000 in 2025, to be paid back over 30 years. He pays back $2796 at the end of each month, after interest has been added.

At the end of the first month, Chris owes $399 704. (You may use this to calculate the interest rate).

The table shows the monthly repayment needed per $1000 borrowed.

Interest Rate (per annum)	Term of Loan (years)				
	10	15	20	25	30
7%	11.61	8.99	7.75	7.07	6.65
7.5%	11.87	9.27	8.06	7.39	6.99
8%	12.13	9.56	8.36	7.72	7.34
8.5%	12.40	9.85	8.69	8.05	7.69

After 5 years of paying off the loan, Chris still owes $378 532. (Do not show this)

He then decides to increase his monthly payment so that he can pay back the loan in 2050.

Calculate the total amount of interest Chris has paid on the loan in total after making this change, correct to the nearest whole number.

$$399704 + 2796 = 402500$$

$$\frac{402500}{400000} = 1.00625$$

Monthly interest rate is 0.625%
annual rate is $0.625 \times 12 = 7.5\%$

new monthly payment $= 378.532 \times 8.06$
$$= \$3050.97$$

Interest $= 3050.97 \times 20 \times 12 + 2796 \times 5 \times 12 - 400000$
$$= \$499992.80$$

4

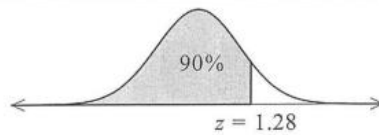| Criteria	Marks
Provides correct solution	4
▪ Finds the annual interest rate and the correct interest factor to find the new monthly payments **OR** ▪ Finds the correct interest rate and factor, but uses it wrong to find the new monthly payment, along with the correct total paid in the first 5 years	3
▪ Finds the annual interest rate and the correct interest factor (8.06) **OR** ▪ Finds the annual interest rate and uses the wrong interest factor correctly (7.39)	2
▪ Finds the monthly interest rate (0.625%) **OR** ▪ Multiplies 2796 by 5 and 12	1

Feedback:
This proved to be the most difficult question in the paper. Well done to the several students who achieved 3 or 4 marks here.

The most common cause of concern here is using the table once an interest rate is found. Many students were dividing 378,532 by the factor. Reviewing loan tables and interest from them is important for many students.

Question 44

For a normal distribution with a mean of 0 and standard deviation of 1, it is known that approximately 90% of the data lies below the z-score of 1.28.

A company sells chocolate bars. Currently, the mass of the chocolate bars is normally distributed with a mean of 150.6 g and a standard deviation σ. It is known that 10% of these bars weigh less than 149 g.

The bars cannot fit in their packaging if their mass exceeds 153 g.

The company is changing the mean mass of their chocolate bars so that only 2.5% of them weigh less than 149 g. The standard deviation of the masses is staying the same.

By making this change, determine whether at least 90% of the chocolate bars produced will still fit in their packaging. Justify your answer with appropriate calculations.

Criteria	Marks
Correctly justifies the answer with correct working	3
▪ Calcualtes the new mean	2
▪ Finds the standard deviation	1

$$-1.28 = \frac{149 - 150.6}{\sigma}$$

$$\sigma = \frac{-1.6}{-1.28} = 1.25$$

new mean μ.

$$-2 = \frac{149 - \mu}{1.25}$$

$$149 - \mu = -2.5$$

$$\mu = 151.5$$

$$z = \frac{153 - 151.5}{1.25} = 1.2$$

So no, less than 90% will weigh less than 153g

Feedback:
This question proved challenging, but a number of students were successful or got close. This one relied on a strong conceptual understanding of the normal distribution, z-scores and probabilities. This is a good aim for students as this topic often has some harder questions in the HSC.