SYDNEY GRAMMAR SCHOOL

CANDIDATE NUMBER

2025 Trial HSC Examination

Form VI Mathematics Standard 2

Thursday 14th August, 2025

8:40am

General Instructions

- Reading time — 10 minutes
- Working time — 2 hours 30 minutes
- Attempt all questions.
- Write using black pen.
- Calculators approved by NESA may be used.
- A loose reference sheet is provided separate to this paper.

Thirty Eight Questions — 100 Marks

Section I (15 marks) Questions 1 – 15

- This section is multiple-choice. Each question is worth 1 mark.
- Record your answers on the provided answer sheet.

Section II (85 marks) Questions 16 – 38

- Relevant mathematical reasoning and calculations are required.
- Answer the questions in this paper in the spaces provided.

Collection

- Write your candidate number on this page and on the multiple choice sheet.

Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 10 pupils

Writer: OMD

Section I

1. Thomas went for a run. He stopped to check his pulse and counted 39 beats in 15 seconds. How can Thomas calculate his pulse rate in beats per minute? **1**

   (A) $39 \div 15 \div 60$

   (B) $39 \times 15 \div 60$

   (C) $39 \div 15 \times 60$

   (D) $39 \times 15 \times 60$

2. A survey asked students to indicate their favourite pet from the list: *dog*, *cat*, *fish*, *bird*, *rabbit*, or *other*. **1**

   What type of data is this?

   (A) Categorical nominal

   (B) Categorical ordinal

   (C) Quantitative continuous

   (D) Quantitative discrete

3. Which of the following is **NOT** a linear function? **1**

   (A) $y = 7 - 2x$

   (B) $y = \dfrac{x}{2} + 5$

   (C) $y = -\dfrac{3}{x}$

   (D) $y = 1.8x - 4$

4. As of 2025, the current official land speed record is held by ThrustSSC at a speed of almost 1228 km/h. **1**

   What is this speed in metres per second?

   (A) 289.94 m/s

   (B) 341.11 m/s

   (C) 4420.8 m/s

   (D) 20 466.67 m/s

5. A laptop costs \$899, including 10% GST. What is the price of the laptop before GST? **1**

   (A) \$89.90

   (B) \$809.10

   (C) \$817.27

   (D) \$988.90

6. Jake wants to catch a train on the Metro from Cherrybrook to Gadigal. This is the timetable he would use. **1**

Castle Hill	07:40	07:50	08:00	08:10	08:20	08:30
Cherrybrook	07:44	07:54	08:04	08:14	08:24	08:34
Epping	07:50	08:00	08:10	08:20	08:30	08:40
Macquarie University	07:55	08:05	08:15	08:25	08:35	08:45
Chatswood	08:02	08:12	08:22	08:32	08:42	08:52
Barangaroo	08:10	08:20	08:30	08:40	08:50	09:00
Martin Place	08:13	08:23	08:33	08:43	08:53	09:03
Gadigal	08:15	08:25	08:35	08:45	08:55	09:05
Central	08:18	08:28	08:38	08:48	08:58	09:08

   What is the latest train Jake can catch from Cherrybrook to arrive at Gadigal station before 8:30 am?

   (A) 7:40 am

   (B) 7:44 am

   (C) 7:50 am

   (D) 7:54 am

7. Will follows a strict diet. He consumes 180 g of protein each day, correct to the nearest gram. **1**

   What is the percentage error in this measurement, correct to one significant figure?

   (A) 0.2%

   (B) 0.3%

   (C) 0.5%

   (D) 0.6%

8. Charlie invested \$22 000 that will be compounded monthly at 6% per annum. **1**

   Which calculation will give the value of his investment after four years?

   (A) $22\,000 \times \left(1 + \dfrac{0.5}{100}\right)^{4}$

   (B) $22\,000 \times \left(1 + \dfrac{0.5}{100}\right)^{48}$

   (C) $22\,000 \times \left(1 + \dfrac{6}{100}\right)^{4}$

   (D) $22\,000 \times \left(1 + \dfrac{6}{100}\right)^{48}$

9. Daniel has 1000 shares in Alphabet Corp. A dividend of 18 cents per share is paid on his shares with a market value per share of \$4.50. What is the dividend yield? **1**

   (A) \$0.18

   (B) \$180

   (C) 0.04%

   (D) 4%

10. Siem Reap has a latitude of 13°N and a longitude of 104°E. Bangkok is due west of Siem Reap. The coordinates of Bangkok could be: **1**

    (A) (3°N, 104°E)

    (B) (13°N, 100°E)

    (C) (13°N, 108°E)

    (D) (23°N, 104°E)

11. Tom's normal rate of pay is \$26.40 per hour. In one week, he worked 16 hours at the normal rate, 5.5 hours at time-and-a-half, and 3 hours at double time. He also received a danger allowance of \$72 for the week. **1**

    What were his total earnings for the week?

    (A) \$718.80

    (B) \$798.80

    (C) \$854.10

    (D) \$870.60

12. The Coordinated Universal Time (UTC) of Sydney, Australia is +10 hours and the UTC of Toronto, Canada is −4 hours. What is the local time in Toronto if it is 8 am on Monday in Sydney? **1**

    (A) 2 pm Sunday

    (B) 6 pm Sunday

    (C) 2 am Monday

    (D) 2 pm Monday

13. Jonah is asked to solve $\frac{x-1}{2} = \frac{4x}{3} + 3$. Which of the following could be Jonah's next step? **1**

    (A) $2(x-1) = 3(4x) + 18$

    (B) $3(x-1) = 2(4x) + 3$

    (C) $3(x-1) = 2(4x) + 18$

    (D) $6(x-1) = 6(4x) + 18$

14. Ten students sat a practice trial examination and received the following marks: **1**

    67 92 68 88 87 79 91 76 82 90

    After further revision, the examination was repeated and each student's mark increased by 7. When comparing the second set of results with the first:

    (A) the mean had decreased by 7 and the standard deviation had remained the same.

    (B) the mean had increased by 7 and the standard deviation had remained the same.

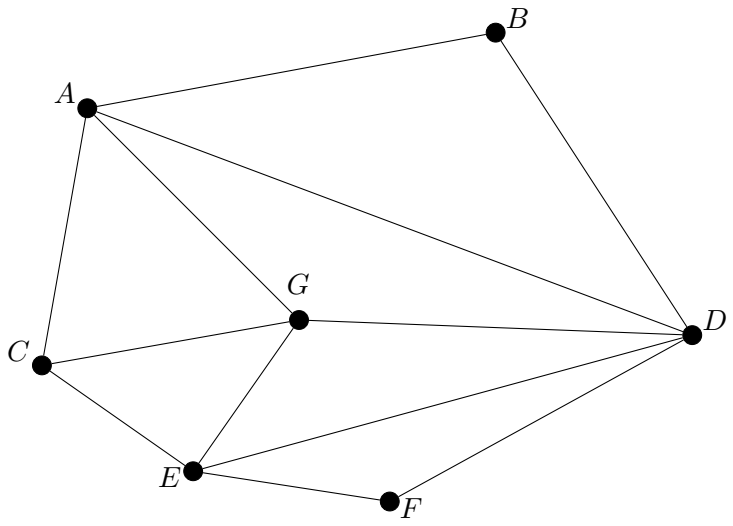
    (C) the mean had decreased by 7 and the standard deviation had increased by 7.

    (D) the mean had increased by 7 and the standard deviation had increased by 7.

15. A mountain bike course is represented by a network of tracks, where each track is modelled as an edge connecting two vertices. The network is shown below. **1**

Due to bad weather, two tracks have been closed. After these closures, Thomas is able to cycle a route that uses each remaining track exactly once without repetition. He may start and finish at different locations.

Which one of the following options does **not** allow such a route to be completed?



(A) With AG and CG closed.

(B) With AG and DG closed.

(C) With AG and GE closed.

(D) With CE and DG closed.

End of Section I

The paper continues in the next section

Section II

This section consists of long-answer questions.
Marks may be awarded for reasoning and calculations.
Marks may be lost for poor setting out or poor logic.
Record your answers in the space provided in this paper.

QUESTION SIXTEEN (2 marks)

The area of a trapezium has the formula $A = \frac{h}{2}(a+b)$. Make b the subject of the formula. **2**

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QUESTION SEVENTEEN (2 marks)

A school purchases a photocopier for \$12 000. It depreciates at a rate of 15% per annum, using the declining balance method. **2**

Calculate the value of the photocopier after 4 years.

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QUESTION EIGHTEEN (5 marks)

Cohen is taking out a loan of \$60 000 at an interest rate of 8.41% per annum. The interest is calculated monthly on a reducible basis. The following table shows the progress of the first three months of the loan.

Month	**Principal**	**Interest**	**Balance**
1	\$60 000.00	\$420.50	\$59 473.02
2	\$59 473.02	\$416.81	\$58 942.35
3	\$58 942.35	\$413.09	\$58 407.96
4	\$58 407.96	A	B

(a) What is the regular monthly repayment? **1**

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(b) Calculate the values of A and B. **2**

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(c) This loan will be paid off after 84 months. How much interest will Cohen pay in this time? **2**

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QUESTION NINETEEN (4 marks)

A fruit punch is made by mixing orange juice, apple juice, and pineapple juice in the ratio 3 : 4 : 5.

Angus wants to make 96 litres of this fruit punch for his party.

(a) How many litres of each type of juice should he use? **3**

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(b) If the cost per litre is \$2.50 for orange juice, \$3.00 for apple juice, and \$3.50 for pineapple juice, what is the total cost of making the fruit punch? **1**

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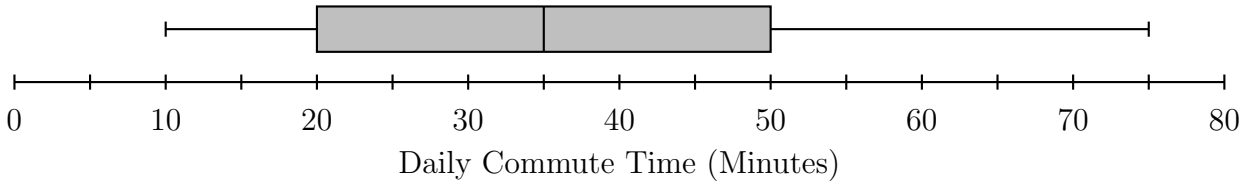
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QUESTION TWENTY (2 marks)

Jake surveyed 300 pupils to find out their daily commute time. That is, how long it takes them to travel to school each day. The results of the survey were recorded and used to construct the box plot below.



How many pupils have a commute time between 20 and 35 minutes? **2**

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QUESTION TWENTY ONE (5 marks)

Ollie has bought a Toyota RAV4 Hybrid because of its impressive fuel efficiency. The fuel consumption is 4.8 litres per 100 kilometres.

(a) Calculate the distance that the car can travel on a full tank of 50 litres. Give your answer correct to the nearest kilometre. **2**

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(b) (i) Calculate the number of litres required for the car to make the journey from Sydney to Jindabyne, 458 kilometres away. Give your answer correct to the nearest litre. **2**

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(ii) Calculate the fuel cost for the journey from Sydney to Jindabyne, based on a price of \$1.91 per litre. **1**

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QUESTION TWENTY TWO (2 marks)

Tom purchases a gaming console for \$850, using a credit card with no annual fee. The interest rate of 18% per annum is compounded daily on the amount owing. The full amount owing was repaid 15 days later. **2**

Calculate the amount of interest charged on the purchase, assuming that interest is charged for the 15 days. Give your answer correct to the nearest cent.

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QUESTION TWENTY THREE (6 marks)

Young's rule is a formula used to calculate a child's medication dosage based on age:

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

D is the child's dosage

y is the age of the child in years

A is the adult dosage

(a) Cohen is 6 years old and needs some amoxicillin, where the adult dosage is 500 mg. What should Cohen's dosage be? Give your answer correct to the nearest mg. **2**

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(b) The correct dosage of loratadine for an 8 year old is 4 mg. What is the adult dosage? Give your answer correct to the nearest mg. **2**

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(c) According to this formula, if a child's dosage was $\frac{1}{2}$ of an adult dosage, what age would the child be? **2**

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QUESTION TWENTY FOUR (4 marks)

The table below shows the income tax rates for Australian residents for the 2024–25 financial year.

Taxable Income	**Tax Payable**
\$0 – \$18 200	Nil
\$18 201 – \$45 000	16c for each \$1 over \$18 200
\$45 001 – \$135 000	\$4 288 plus 30c for each \$1 over \$45 000
\$135 001 – \$190 000	\$31 288 plus 37c for each \$1 over \$135 000
\$190 001 and over	\$51 638 plus 45c for each \$1 over \$190 000

(a) The Medicare levy is calculated as 2% of taxable income. William paid a Medicare levy of \$2037.80 in the 2024–25 financial year. Calculate the amount of tax payable on William's taxable income, excluding the Medicare levy. **3**

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(b) William had allowable deductions of \$3213. What was his gross income? **1**

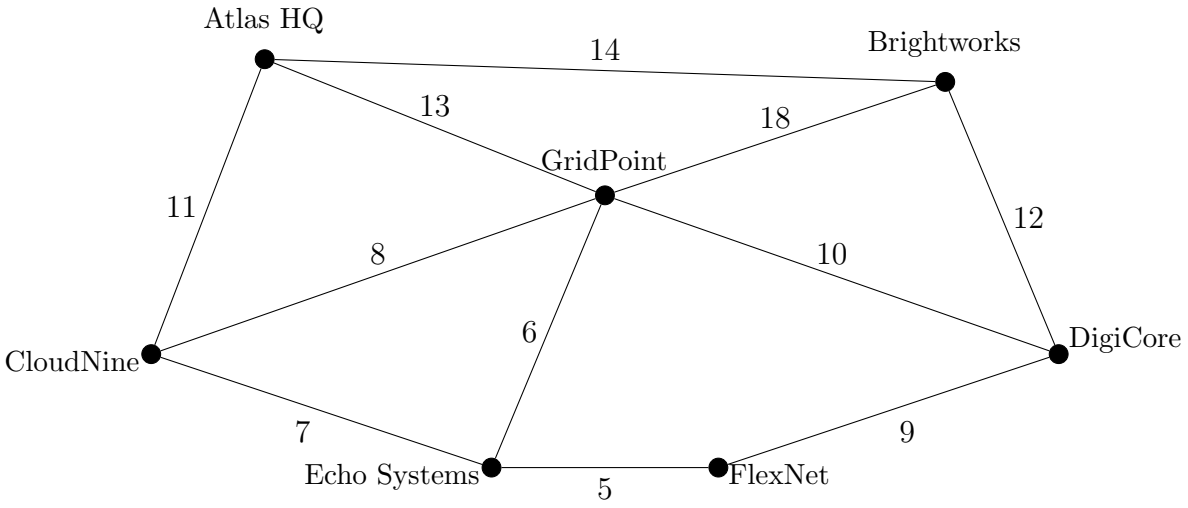
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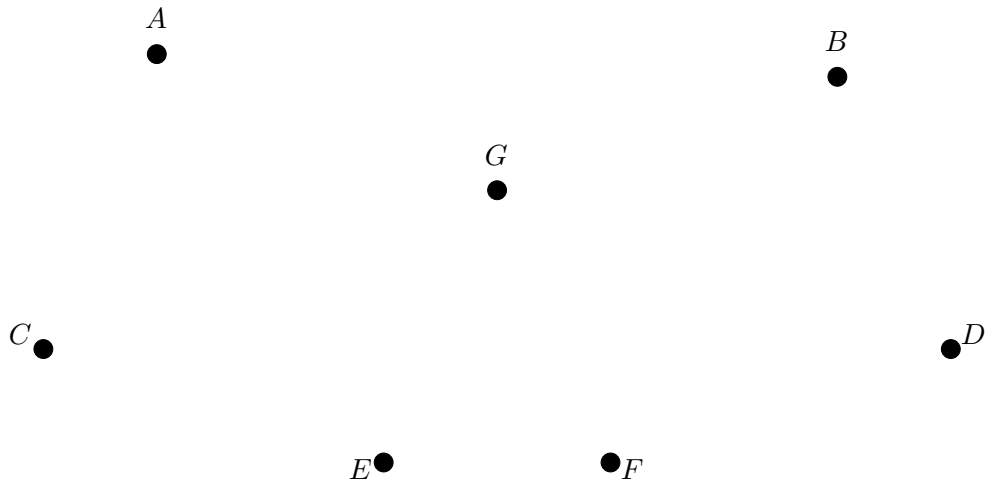
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QUESTION TWENTY FIVE (3 marks)

Charlie is a courier for a logistics company which manages deliveries between several tech hubs. The diagram below shows the network of offices and the travel times between them in minutes.



(a) Draw a minimum spanning tree for this network. **2**



(b) Determine the total weight of the minimum spanning tree. **1**

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QUESTION TWENTY SIX (4 marks)

Achilles starts drinking at 2 pm. He has 5 schooners of beer over three and a half hours. Each schooner is 1.6 standard drinks, and Achilles weighs 65 kg. The formula to calculate his Blood Alcohol Content (BAC) is:

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

where N is the number of standard drinks consumed,

H is the number of hours drinking, and

M is the person's mass in kilograms.

(a) Calculate Achilles's Blood Alcohol Content at 5:30 pm. Give your answer correct to 3 decimal places. **2**

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(b) The following formula calculates the number of hours until his BAC returns to zero: **2**

$$\text{Time to zero} = \frac{BAC}{0.015}$$

If Achilles consumes no more alcohol, determine at what time his Blood Alcohol Content returns to zero. Give your answer correct to the nearest minute.

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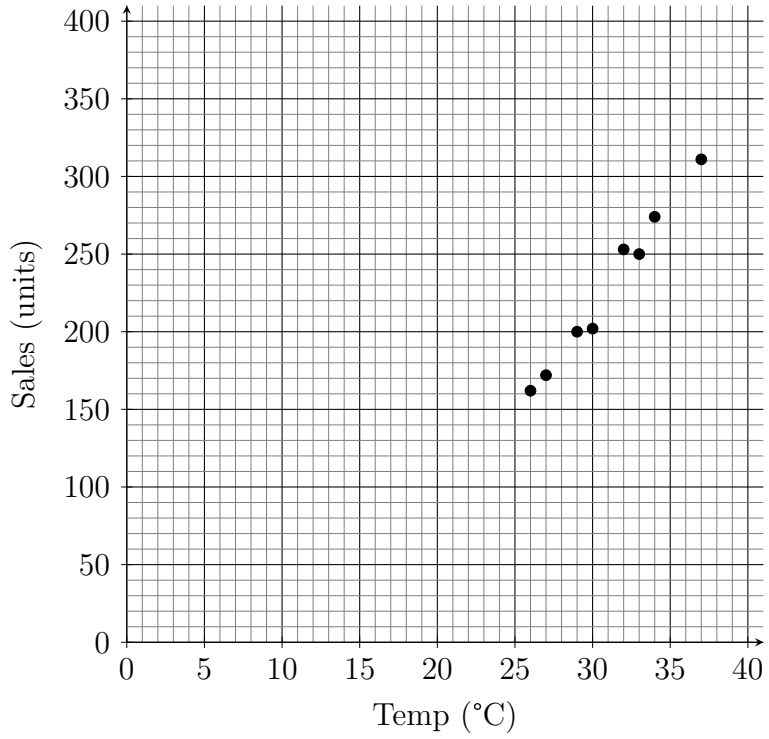
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QUESTION TWENTY SEVEN (6 marks)

One summer, Jonah gets a job selling ice creams. Each day, he records the number of ice creams sold and the temperature. This information is shown in the table below.

Temp (°C)	26	27	29	30	32	33	34	37	39	40
Sales (units)	162	172	200	202	253	250	274	311	291	353

(a) Draw the last two points on the scatterplot and add a line of best fit, by eye, on the graph below. **2**



(b) Write the equation of the least-squares regression line, giving your values correct to two decimal places. **2**

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(c) Calculate the value of Pearson's correlation coefficient, r. Give your answer correct to two decimal places. **1**

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(d) Comment on the strength of the correlation within the context of this question. **1**

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QUESTION TWENTY EIGHT (3 marks)

Daniel is a conservationist. As part of his job he estimates the number of wombats in a reserve using the capture-recapture method.

In the first capture, 80 wombats are caught, tagged, and released. A week later, a second capture of 100 wombats is made, and 20 of them are found to be tagged.

(a) Estimate the total number of wombats in the reserve. **2**

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(b) Explain one assumption that must be made for this estimate to be valid. **1**

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QUESTION TWENTY NINE (5 marks)

Angus records the number of minutes he spends exercising each day for two weeks. The stem-and-leaf plot below shows the results.

Stem	**Leaf**
2	3 5 8
3	0 2 2 4 7
4	1 5 9
5	0
6	
7	5

Key: $2\,|\,3 = 23$ minutes

(a) Is 75 minutes an outlier? Justify your answer with calculations. **3**

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(b) Calculate the standard deviation. Give your answer correct to 2 decimal places. **1**

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(c) Which is the better measure of spread for this data set? The interquartile range (IQR) or the standard deviation. Justify your answer. **1**

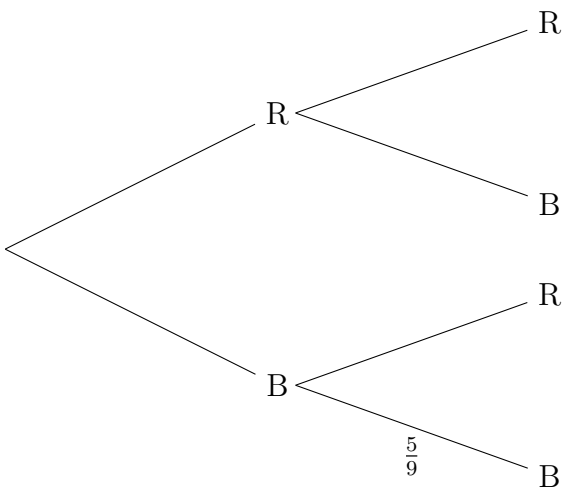
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QUESTION THIRTY (3 marks)

Cohen has a bag containing 4 red and 6 black marbles. Two marbles are selected at random without replacement. A partially completed tree diagram is shown below. **3**



Complete the tree diagram by including the missing probabilities. Calculate the probability of choosing at least 1 black marble.

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QUESTION THIRTY ONE (3 marks)

Ollie installs an electric water heater to reduce his household's carbon footprint. The heater uses 4.5 kWh of electricity per day. Electricity costs 30 cents per kWh.

(a) How much does it cost to run the water heater for one year? Give your answer correct to the nearest cent. **2**

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(b) Ollie considers switching to a solar water heater that costs $1800 upfront and uses no electricity from the grid. How many years will it take to recover the cost of switching to solar? **1**

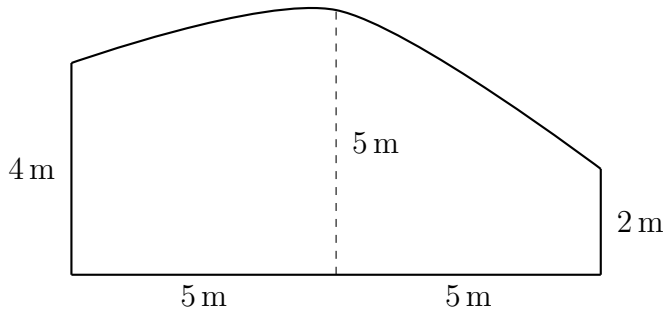
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QUESTION THIRTY TWO (2 marks)

The diagram below shows one side of an irregularly shaped dam. The width of the dam is measured at 5-metre intervals. **2**



Use two applications of the trapezoidal rule to estimate the area of the dam.

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QUESTION THIRTY THREE (3 marks)

The time T (in hours) it takes to paint a big fence varies inversely with the number of workers W painting.

(a) If it takes 4 workers 3 hours to paint the fence, how long would it take 6 workers? **2**

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(b) If the fence was painted in 30 minutes, how many workers were painting the fence? **1**

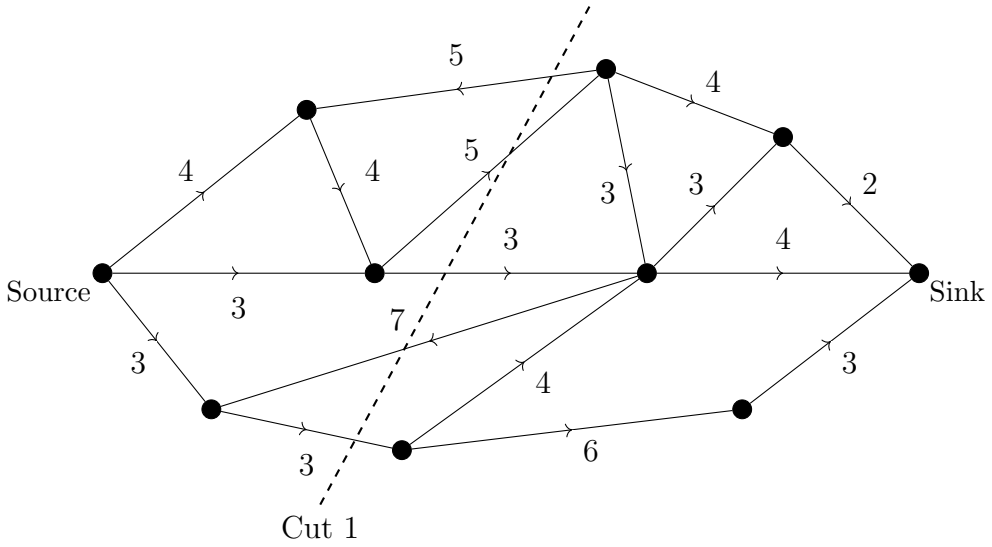
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QUESTION THIRTY FOUR (1 mark)

Find the capacity of Cut 1 shown in the network flow diagram below. **1**



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QUESTION THIRTY FIVE (4 marks)

The table shows the future value for an annuity of \$1 for varying interest rates and time periods.

	Interest rate (r) per period					
Periods (n)	0.25%	0.5%	0.75%	1%	1.5%	2%
12	12.16	12.30	12.49	12.68	13.05	13.43
24	24.47	24.87	25.35	25.84	26.88	27.92
36	36.91	37.57	38.48	39.39	41.01	42.63
48	49.47	50.39	51.56	52.94	55.34	57.74
60	62.15	63.33	64.66	66.51	69.67	73.36
72	74.95	76.39	77.88	80.10	83.99	89.51

(a) William invests \$200 at the start of each month for 5 years at 6% per annum, compounded monthly. Calculate the future value of William's investment using the table above. **2**

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(b) Charlie is planning to buy a motorbike and wants to save \$5000. How much should he invest each month, in order to save \$5000 after 4 years at 9% per annum, compounded monthly? **2**

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QUESTION THIRTY SIX (3 marks)

Jake is passionate about running. He always records the time he takes to run 10 km. He finds that his times follow a normal distribution, with a mean of 52 minutes and a standard deviation of 4 minutes.

(a) What is the probability that Jake completes the run between 48 and 60 minutes? **2**

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(b) On his birthday, Jake runs so well that his time is among the best 2.5% of all his recorded 10 km runs. **1**

What time separates the best 2.5% of Jake's runs from the rest?

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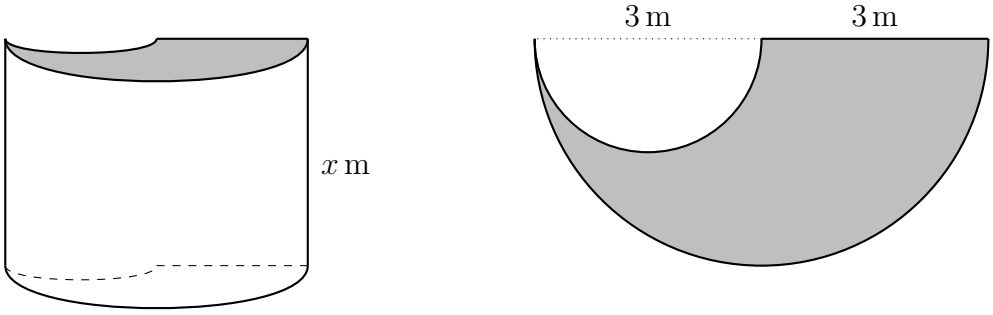
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QUESTION THIRTY SEVEN (7 marks)

The diagram shows a water storage tank and its cross-section. The cross-section is a semi-circle with another, smaller, semicircle cut out.



(a) What is the shaded area? Give your answer correct to 1 decimal place. **3**

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(b) The water storage tank has a capacity of 100 000 litres. Calculate the height, x, of the tank in metres. Give your answer correct to 1 decimal place. **2**

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(c) The tank is connected to an irrigation system. The irrigation system uses water at a rate of 750 litres per hour. **2**

For how many hours and minutes can the irrigation system be used before a full tank is emptied?

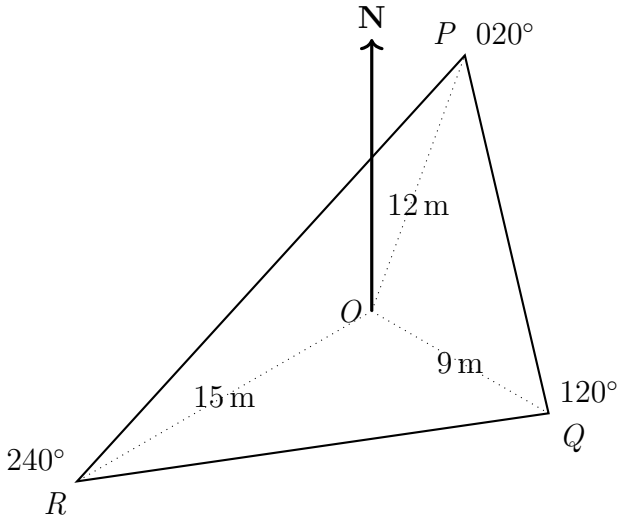
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QUESTION THIRTY EIGHT (6 marks)

Tom is a surveyor. He stands at a fixed point O and records the position of three boundary markers using bearings and distances. The results are shown in the diagram below.



(a) Find the area of $\triangle POQ$. Give your answer correct to 1 decimal place. **2**

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(b) Find the bearing of Q from R. **4**

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Section I

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   What type of data is this?

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   What is this speed in metres per second?

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   (B) 341.11 m/s

   (C) 4420.8 m/s

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\$899 ÷ 110% = \$817.27

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Macquarie University	07:55	08:05	08:15	08:25	08:35	08:45
Chatswood	08:02	08:12	08:22	08:32	08:42	08:52
Barangaroo	08:10	08:20	08:30	08:40	08:50	09:00
Martin Place	08:13	08:23	08:33	08:43	08:53	09:03
Gadigal	08:15	08:25	08:35	08:45	08:55	09:05
Central	08:18	08:28	08:38	08:48	08:58	09:08

What is the latest train Jake can catch from Cherrybrook to arrive at Gadigal station before 8:30 am?

(A) 7:40 am

(B) 7:44 am

(C) 7:50 am

(D) 7:54 am

7. Will follows a strict diet. He consumes 180 g of protein each day, correct to the nearest gram. **1**

What is the percentage error in this measurement, correct to one significant figure?

(A) 0.2%

(B) 0.3%

(C) 0.5%

(D) 0.6%

$\frac{0.5\text{g}}{180\text{g}} \times 100\% = 0.2\dot{7}\%$

8. Charlie invested \$22 000 that will be compounded monthly at 6% per annum. **1**

   Which calculation will give the value of his investment after four years?

   (A) $22\,000 \times \left(1 + \frac{0.5}{100}\right)^{4}$

   (B) $22\,000 \times \left(1 + \frac{0.5}{100}\right)^{48}$

   (C) $22\,000 \times \left(1 + \frac{6}{100}\right)^{4}$

   (D) $22\,000 \times \left(1 + \frac{6}{100}\right)^{48}$

   $\frac{6\% \text{ p.a.}}{12} = 0.5\%$ per month

   4 yrs $\times 12 = 48$ months

9. Daniel has 1000 shares in Alphabet Corp. A dividend of 18 cents per share is paid on his shares with a market value per share of \$4.50. What is the dividend yield? **1**

   (A) \$0.18

   (B) \$180

   (C) 0.04%

   (D) 4%

   $\frac{0.18}{4.50} \times 100\% = 4\%$

10. Siem Reap has a latitude of 13°N and a longitude of 104°E. Bangkok is due west of Siem Reap. The coordinates of Bangkok could be: **1**

    (A) (3°N, 104°E)

    (B) (13°N, 100°E)

    (C) (13°N, 108°E)

    (D) (23°N, 104°E)

11. Tom's normal rate of pay is \$26.40 per hour. In one week, he worked 16 hours at the normal rate, 5.5 hours at time-and-a-half, and 3 hours at double time. He also received a danger allowance of \$72 for the week. **1**

    What were his total earnings for the week?

    (A) \$718.80

    (B) \$798.80

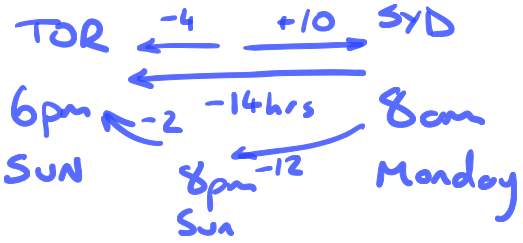
    (C) \$854.10

    (D) \$870.60

    $26.40 \times (16 + 5.5 \times 1.5 + 3 \times 2) + 72$

    $= \$870.60$

12. The Coordinated Universal Time (UTC) of Sydney, Australia is +10 hours and the UTC of Toronto, Canada is −4 hours. What is the local time in Toronto if it is 8 am on Monday in Sydney? **1**



(A) 2 pm Sunday

(B) 6 pm Sunday

(C) 2 am Monday

(D) 2 pm Monday

13. Jonah is asked to solve $\frac{x-1}{2} = \frac{4x}{3} + 3$. Which of the following could be Jonah's next step? **1**

$\frac{(x-1)}{2} \times 6 = \frac{4x}{3} \times 6 + 3 \times 6$

$3(x-1) = 2(4x) + 18$

(A) $2(x-1) = 3(4x) + 18$

(B) $3(x-1) = 2(4x) + 3$

(C) $3(x-1) = 2(4x) + 18$

(D) $6(x-1) = 6(4x) + 18$

14. Ten students sat a practice trial examination and received the following marks: **1**

67 92 68 88 87 79 91 76 82 90

After further revision, the examination was repeated and each student's mark increased by 7. When comparing the second set of results with the first:

(A) the mean had decreased by 7 and the standard deviation had remained the same.

(B) the mean had increased by 7 and the standard deviation had remained the same.

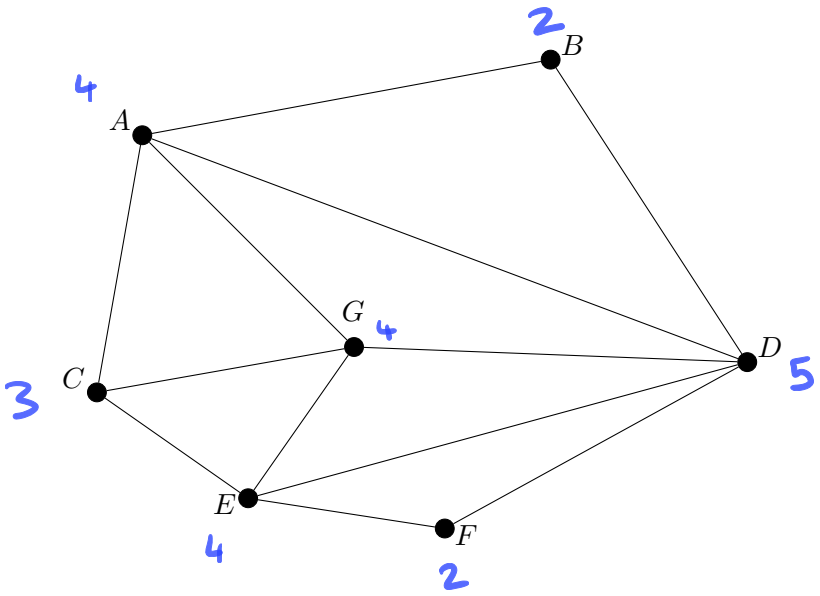
(C) the mean had decreased by 7 and the standard deviation had increased by 7.

(D) the mean had increased by 7 and the standard deviation had increased by 7.

15. A mountain bike course is represented by a network of tracks, where each track is modelled as an edge connecting two vertices. The network is shown below. **1**

Due to bad weather, two tracks have been closed. After these closures, Thomas is able to cycle a route that uses each remaining track exactly once without repetition. He may start and finish at different locations.

Which one of the following options does **not** allow such a route to be completed?



requires 2 odd.

(A) With AG and CG closed.

(B) With AG and DG closed.

(C) With AG and GE closed.

(D) With CE and DG closed.

A) A→3, G→2, C→2 — 2 odd A+D

B) A→3, G→2, D→4 — 2 odd A+C

C) A→3, G→2, E→3 — 4 odd A,C,D,E

D) C→2, E→3, D→4, G→3 — 2 odd E+G

End of Section I

The paper continues in the next section

Section II

This section consists of long-answer questions.
Marks may be awarded for reasoning and calculations.
Marks may be lost for poor setting out or poor logic.
Record your answers in the space provided in this paper.

QUESTION SIXTEEN (2 marks)

The area of a trapezium has the formula $A = \frac{h}{2}(a+b)$. Make b the subject of the formula. **2**

$2A = h(a+b)$ } one step correct ✓

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

$b = \frac{2A}{h} - a$ ✓ allow ECF

OR $b = \frac{2A - ah}{h}$

QUESTION SEVENTEEN (2 marks)

A school purchases a photocopier for \$12 000. It depreciates at a rate of 15% per annum, using the declining balance method. **2**

Calculate the value of the photocopier after 4 years.

$12000 \times \left(1 - \frac{15}{100}\right)^4$ ✓ $= 6264.075$

$\doteqdot \$6264.08$ ✓

QUESTION EIGHTEEN (5 marks)

Cohen is taking out a loan of \$60 000 at an interest rate of 8.41% per annum. The interest is calculated monthly on a reducible basis. The following table shows the progress of the first three months of the loan.

Month	Principal	Interest	Balance
1	\$60 000.00	\$420.50	\$59 473.02
2	\$59 473.02	\$416.81	\$58 942.35
3	\$58 942.35	\$413.09	\$58 407.96
4	\$58 407.96	A	B

(a) What is the regular monthly repayment? **1**

$60000 + 420.50 - 59473.02 = \$947.48$ ✓

OR $59473.02 + 416.81 - 58942.35 = \$947.48$

OR $58942.35 + 413.09 - 58407.96 = \$947.48$

(b) Calculate the values of A and B. **2**

$A = 58407.96 \times \left(1 + \frac{0.0841}{12}\right) - 58407.96$

$\doteqdot \$409.34$ ✓

$B = 58407.96 + A - 947.48$

$\doteqdot \$57\,869.82$ ✓

(c) This loan will be paid off after 84 months. How much interest will Cohen pay in this time? **2**

Total Repayments $= 84 \times 947.48 = \$79588.32$ ✓

$\therefore$ Interest $= 79588.32 - 60000$

$= \$19\,588.32$ ✓

QUESTION NINETEEN (4 marks)

A fruit punch is made by mixing orange juice, apple juice, and pineapple juice in the ratio 3 : 4 : 5.

Angus wants to make 96 litres of this fruit punch for his party.

(a) How many litres of each type of juice should he use? **3**

Total Parts = 3+4+5 = 12 ✓

Each Part = 96÷12 = 8 ✓

3×8 : 4×8 : 5×8

24L OJ : 32L AJ : 40L PJ ✓

allow 24:32:40

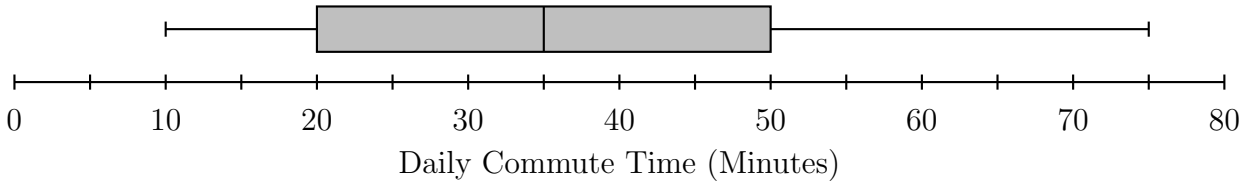
(b) If the cost per litre is \$2.50 for orange juice, \$3.00 for apple juice, and \$3.50 for pineapple juice, what is the total cost of making the fruit punch? **1**

Total Cost = 24×2·5 + 32×3 + 40×3·5

= \$296 ✓

QUESTION TWENTY (2 marks)

Jake surveyed 300 pupils to find out their daily commute time. That is, how long it takes them to travel to school each day. The results of the survey were recorded and used to construct the box plot below.



How many pupils have a commute time between 20 and 35 minutes? **2**

$Q_1 \rightarrow Med$ = 25% ✓

25% of 300 = 75 pupils ✓

QUESTION TWENTY ONE (5 marks)

Ollie has bought a Toyota RAV4 Hybrid because of its impressive fuel efficiency. The fuel consumption is 4.8 litres per 100 kilometres.

(a) Calculate the distance that the car can travel on a full tank of 50 litres. Give your answer correct to the nearest kilometre. **2**

Distance $= \frac{50}{4.8} \times 100$ ✓

$= 1041.6$ ✓

$\doteq 1042$ km

(b) (i) Calculate the number of litres required for the car to make the journey from Sydney to Jindabyne, 458 kilometres away. Give your answer correct to the nearest litre. **2**

Litres $= 458 \div 100 \times 4.8$ ✓

$= 21.984$ ✓

$\doteq 22$ litres

(ii) Calculate the fuel cost for the journey from Sydney to Jindabyne, based on a price of \$1.91 per litre. **1**

Cost $= 22 \times 1.91$ ✓ OR 21.984×1.91

$= \$42.02$ ✓ $= 41.98944$

$\doteq \$41.99$ ✓

QUESTION TWENTY TWO (2 marks)

Tom purchases a gaming console for \$850, using a credit card with no annual fee. The interest rate of 18% per annum is compounded daily on the amount owing. The full amount owing was repaid 15 days later. **2**

Calculate the amount of interest charged on the purchase, assuming that interest is charged for the 15 days. Give your answer correct to the nearest cent.

Total $= 850 \times \left(1 + \frac{0.18}{365}\right)^{15}$

$\doteq \$856.31$ ✓

Interest $= \$6.31$ ✓

QUESTION TWENTY THREE (6 marks)

Young's rule is a formula used to calculate a child's medication dosage based on age:

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

D is the child's dosage

y is the age of the child in years

A is the adult dosage

(a) Cohen is 6 years old and needs some amoxicillin, where the adult dosage is 500 mg. What should Cohen's dosage be? Give your answer correct to the nearest mg. **2**

$D = \frac{6 \times 500}{6+12}$ ✓

$= 166.6$

$\doteq 167$ mg ✓

(b) The correct dosage of loratadine for an 8 year old is 4 mg. What is the adult dosage? Give your answer correct to the nearest mg. **2**

$4 = \frac{8 \times A}{8+12}$ ✓ $\rightarrow$ $\frac{4 \times 20}{8} = A$

$A = 10$ mg ✓

(c) According to this formula, if a child's dosage was $\frac{1}{2}$ of an adult dosage, what age would the child be? **2**

let $A = 2, D = 1$ $1 = \frac{2y}{y+12}$ ✓ $(\times (y+12))$

$y + 12 = 2y$ $(-y)$

$y = 12$ ✓

QUESTION TWENTY FOUR (4 marks)

The table below shows the income tax rates for Australian residents for the 2024–25 financial year.

Taxable Income	Tax Payable
\$0 – \$18 200	Nil
\$18 201 – \$45 000	16c for each \$1 over \$18 200
\$45 001 – \$135 000	\$4 288 plus 30c for each \$1 over \$45 000
\$135 001 – \$190 000	\$31 288 plus 37c for each \$1 over \$135 000
\$190 001 and over	\$51 638 plus 45c for each \$1 over \$190 000

101890

(a) The Medicare levy is calculated as 2% of taxable income. William paid a Medicare levy of \$2037.80 in the 2024–25 financial year. Calculate the amount of tax payable on William's taxable income, excluding the Medicare levy. **3**

2% = \$2037.80

100% = \$101890 ✓

TAX = 4288 + 0·3(101890 − 45000) ✓

= \$21355 ✓

(b) William had allowable deductions of \$3213. What was his gross income? **1**

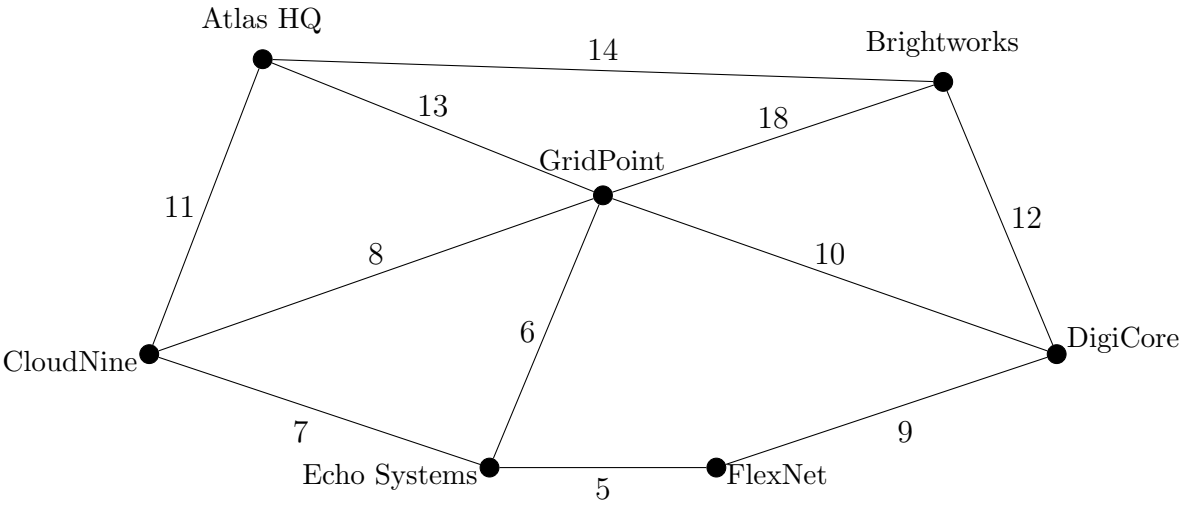
Gross income = taxable income + deductions

= 101890 + 3213

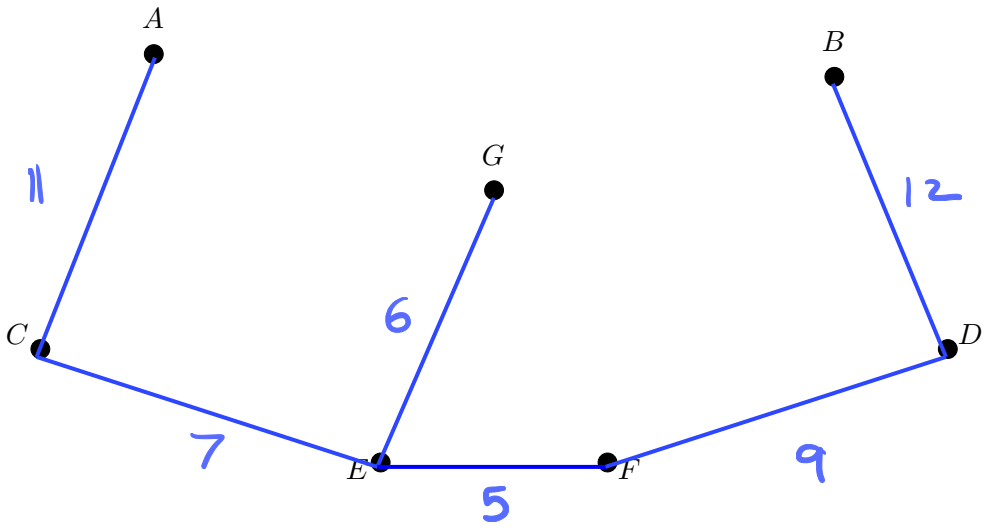
= \$105 103 ✓

QUESTION TWENTY FIVE (3 marks)

Charlie is a courier for a logistics company which manages deliveries between several tech hubs. The diagram below shows the network of offices and the travel times between them in minutes.



(a) Draw a minimum spanning tree for this network. **2**



tree ✓
minimum ✓

(b) Determine the total weight of the minimum spanning tree. **1**

11+7+6+5+9+12 = 50 minutes ✓

QUESTION TWENTY SIX (4 marks)

Achilles starts drinking at 2 pm. He has 5 schooners of beer over three and a half hours. Each schooner is 1.6 standard drinks, and Achilles weighs 65 kg. The formula to calculate his Blood Alcohol Content (BAC) is:

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

where N is the number of standard drinks consumed,

H is the number of hours drinking, and

M is the person's mass in kilograms.

(a) Calculate Achilles's Blood Alcohol Content at 5:30 pm. Give your answer correct to 3 decimal places. **2**

2pm → 5:30pm = 3·5hrs ✓ $N = 5 \times 1.6 = 8$

$$BAC = \frac{10 \times 8 - 7.5 \times 3.5}{6.8 \times 65}$$

$= 0.121606334 8$ ✓

$\doteq 0.122$

(b) The following formula calculates the number of hours until his BAC returns to zero: **2**

$$\text{Time to zero} = \frac{BAC}{0.015}$$

If Achilles consumes no more alcohol, determine at what time his Blood Alcohol Content returns to zero. Give your answer correct to the nearest minute.

$$\text{Time} = \frac{0.122}{0.015}$$

$= 8.1\dot{3}$ ✓

$= 8\text{hrs } 8\text{mins}$

8hrs 8mins after 5:30 pm

$= 1:38\text{am}$ ✓

or $= \frac{0.121606334 8}{0.015}$

$= 8.107088989$ ✓

$\doteq 8\text{hrs } 6\text{mins}$

after 5:30 pm

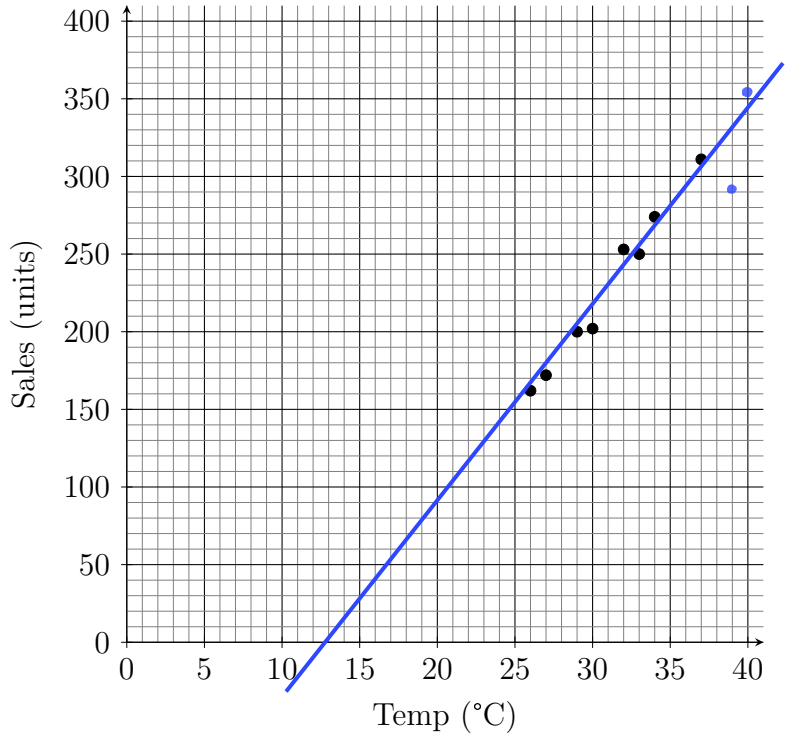
1:36am ✓

QUESTION TWENTY SEVEN (6 marks)

One summer, Jonah gets a job selling ice creams. Each day, he records the number of ice creams sold and the temperature. This information is shown in the table below.

Temp (°C)	26	27	29	30	32	33	34	37	39	40
Sales (units)	162	172	200	202	253	250	274	311	291	353

(a) Draw the last two points on the scatterplot and add a line of best fit, by eye, on the graph below. **2**



points ✓
line ✓

(b) Write the equation of the least-squares regression line, giving your values correct to two decimal places. **2**

$A \doteqdot -161{\cdot}82$

$B \doteqdot 12{\cdot}50$

$y = 12{\cdot}50x - 161{\cdot}82$ ✓ ✓

(sales $= 12{\cdot}50T - 161{\cdot}82$)

(c) Calculate the value of Pearson's correlation coefficient, r. Give your answer correct to two decimal places. **1**

$r = 0{\cdot}9710223204$

$\doteqdot 0{\cdot}97$ ✓

(d) Comment on the strength of the correlation within the context of this question. **1**

There is a strong positive correlation between sales and Temperature. i.e. the higher the temp the more sales. ✓

QUESTION TWENTY EIGHT (3 marks)

Daniel is a conservationist. As part of his job he estimates the number of wombats in a reserve using the capture-recapture method.

In the first capture, 80 wombats are caught, tagged, and released. A week later, a second capture of 100 wombats is made, and 20 of them are found to be tagged.

(a) Estimate the total number of wombats in the reserve. **2**

Let x be the total number of wombats.

$\frac{80}{x} = \frac{20}{100}$ ✓

$x = 80 \times \frac{100}{20}$

$= 400$ ✓

(b) Explain one assumption that must be made for this estimate to be valid. **1**

That the capture is random and has an equal chance of selecting any of the wombats. ✓

OR

That the reserve is closed and that the wombats are not able to come and go at will.

QUESTION TWENTY NINE (5 marks)

Angus records the number of minutes he spends exercising each day for two weeks. The stem-and-leaf plot below shows the results.

Stem	Leaf
2	3 5 8
3	0 2 2 4 7
4	1 5 9
5	0
6	
7	5

med

Key: 2 | 3 = 23 minutes

(a) Is 75 minutes an outlier? Justify your answer with calculations. **3**

median = 34 $Q_1 = \frac{28+30}{2} = 29$ $Q_3 = \frac{45+49}{2} = 47$

$IQR = Q_3 - Q_1$

$= 47 - 29 = 18$ ✓

$Q_3 + 1{\cdot}5 \times IQR = 47 + 18 \times 1{\cdot}5 = 74$ ✓

∴ Yes ✓ 75 is an outlier as it is more than $Q_3 + 1{\cdot}5 \times IQR$

(b) Calculate the standard deviation. Give your answer correct to 2 decimal places. **1**

s.d. = 13·402728 68 ✓

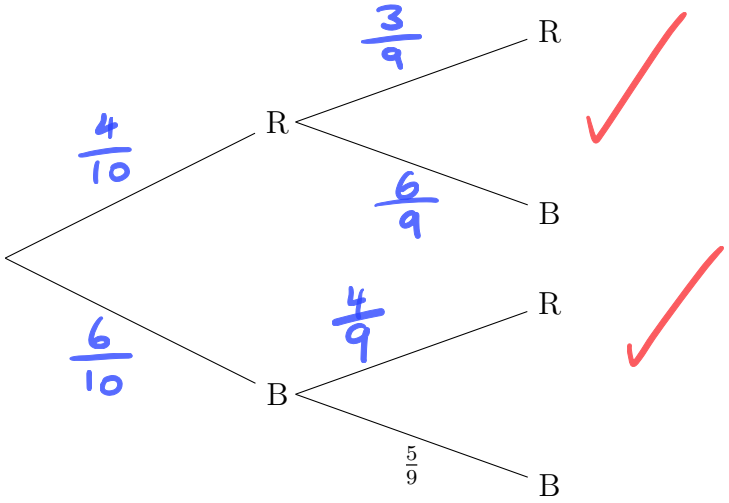
≐ 13·40

(c) Which is the better measure of spread for this data set? The interquartile range (IQR) or the standard deviation. Justify your answer. **1**

The IQR is a better measure of spread as it is not overly affected by outliers. ✓

QUESTION THIRTY (3 marks)

Cohen has a bag containing 4 red and 6 black marbles. Two marbles are selected at random without replacement. A partially completed tree diagram is shown below. **3**



Complete the tree diagram by including the missing probabilities. Calculate the probability of choosing at least 1 black marble.

$P(\text{at least 1 B}) = 1 - P(0\text{B})$

$= 1 - \frac{4}{10} \times \frac{3}{9}$

$= \frac{13}{15}$

QUESTION THIRTY ONE (3 marks)

Ollie installs an electric water heater to reduce his household's carbon footprint. The heater uses 4.5 kWh of electricity per day. Electricity costs 30 cents per kWh.

(a) How much does it cost to run the water heater for one year? Give your answer correct to the nearest cent. **2**

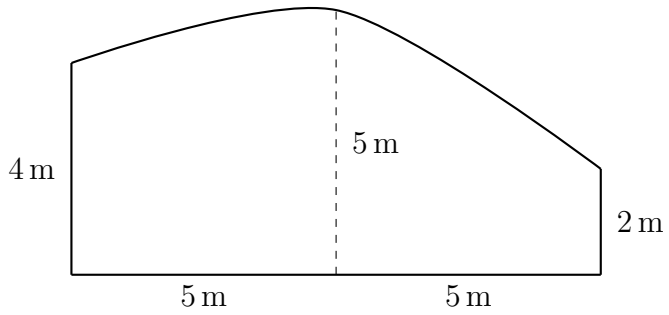
Cost = $4.5 \times 0.3 \times 365$ ✓
$= \$492.75$ ✓

(b) Ollie considers switching to a solar water heater that costs \$1800 upfront and uses no electricity from the grid. How many years will it take to recover the cost of switching to solar? **1**

Years = $1800 \div 492.75$
$= 3.652968037$ ✓
It will take 4 years to recover the cost.

QUESTION THIRTY TWO (2 marks)

The diagram below shows one side of an irregularly shaped dam. The width of the dam is measured at 5-metre intervals. **2**



Use two applications of the trapezoidal rule to estimate the area of the dam.

Area $\doteq \frac{5}{2}(4 + 5 \times 2 + 2)$ ✓
$\doteq 40 m^2$ ✓

QUESTION THIRTY THREE (3 marks)

The time T (in hours) it takes to paint a big fence varies inversely with the number of workers W painting.

(a) If it takes 4 workers 3 hours to paint the fence, how long would it take 6 workers? **2**

$T = \frac{k}{W}$ $\therefore T = \frac{12}{W}$

$k = WT$ $T = 12 \div 6$

$k = 4 \times 3$ $= 2$ hours ✓

$= 12$ ✓

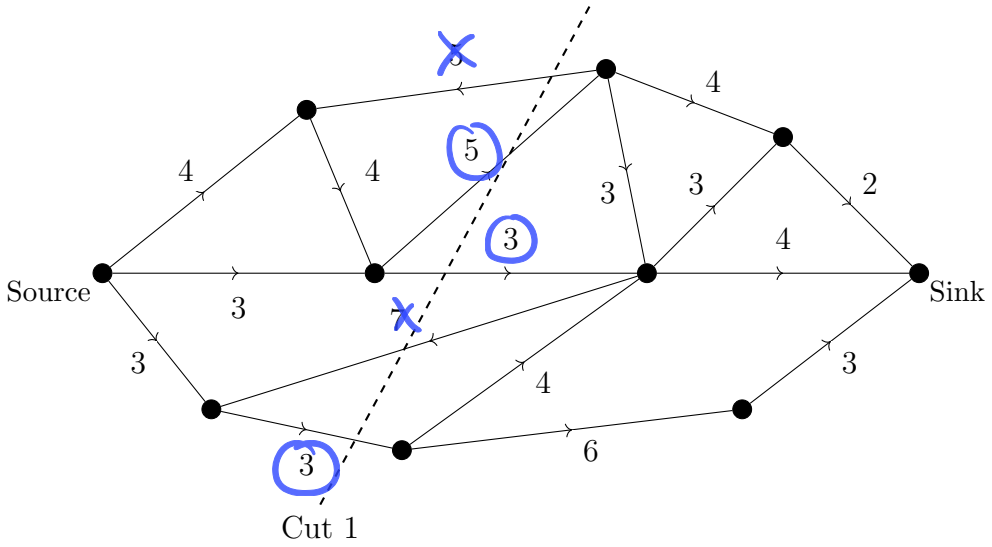
(b) If the fence was painted in 30 minutes, how many workers were painting the fence? **1**

$0.5 = \frac{12}{W}$

$W = 24$ ✓ Allow ECF

QUESTION THIRTY FOUR (1 mark)

Find the capacity of Cut 1 shown in the network flow diagram below. **1**



Capacity $= 3 + 3 + 5$

$= 11$ ✓

QUESTION THIRTY FIVE (4 marks)

The table shows the future value for an annuity of \$1 for varying interest rates and time periods.

Periods (n)	**Interest rate (r) per period**					
	0.25%	0.5%	0.75%	1%	1.5%	2%
12	12.16	12.30	12.49	12.68	13.05	13.43
24	24.47	24.87	25.35	25.84	26.88	27.92
36	36.91	37.57	38.48	39.39	41.01	42.63
48	49.47	50.39	51.56	52.94	55.34	57.74
60	62.15	63.33	64.66	66.51	69.67	73.36
72	74.95	76.39	77.88	80.10	83.99	89.51

(a) William invests \$200 at the start of each month for 5 years at 6% per annum, compounded monthly. Calculate the future value of William's investment using the table above. **2**

6% p.a. ÷ 12 = 0·5% per month 5 years = 60 months

FV = 200 × 63·33 ✓

= \$12 666 ✓

(b) Charlie is planning to buy a motorbike and wants to save \$5000. How much should he invest each month, in order to save \$5000 after 4 years at 9% per annum, compounded monthly? **2**

9% p.a. ÷ 12 = 0·75% per month 4 years = 48 mths

5000 = x × 51·56 ✓

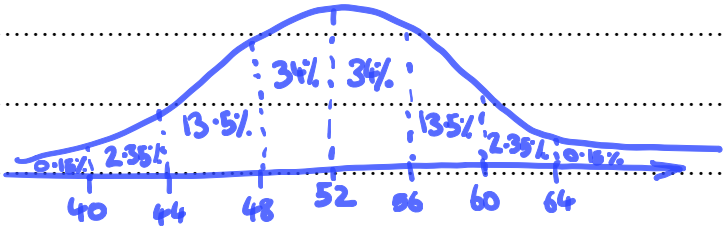
x = 96·97439876

≈ \$96·97 ✓

QUESTION THIRTY SIX (3 marks)

Jake is passionate about running. He always records the time he takes to run 10 km. He finds that his times follow a normal distribution, with a mean of 52 minutes and a standard deviation of 4 minutes.

(a) What is the probability that Jake completes the run between 48 and 60 minutes? **2**



$48 - 60 = 34 + 34 + 13.5$ ✓

$= 81.5\%$ ✓

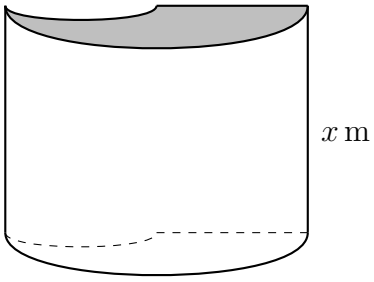
(b) On his birthday, Jake runs so well that his time is among the best 2.5% of all his recorded 10 km runs. **1**

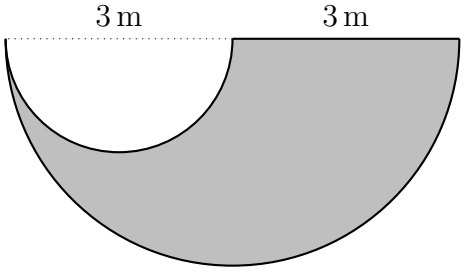
What time separates the best 2.5% of Jake's runs from the rest?

$0.15 + 2.35 = 2.5\%$ $\therefore$ 44 mins ✓

QUESTION THIRTY SEVEN (7 marks)

The diagram shows a water storage tank and its cross-section. The cross-section is a semi-circle with another, smaller, semicircle cut out.





(a) What is the shaded area? Give your answer correct to 1 decimal place. **3**

$A = \frac{1}{2}\pi \times 3^2 - \frac{1}{2}\pi \times 1.5^2$

$= 10.602875\ldots$

$\doteqdot 10.6 \text{ m}^2$

(b) The water storage tank has a capacity of 100 000 litres. Calculate the height, x, of the tank in metres. Give your answer correct to 1 decimal place. **2**

$100\,000 \text{ L} = 100 \text{ m}^3$

$x = 100 \div 10.6 \text{ m}^2$

$\doteqdot 9.43 \text{ m}$

(c) The tank is connected to an irrigation system. The irrigation system uses water at a rate of 750 litres per hour. **2**

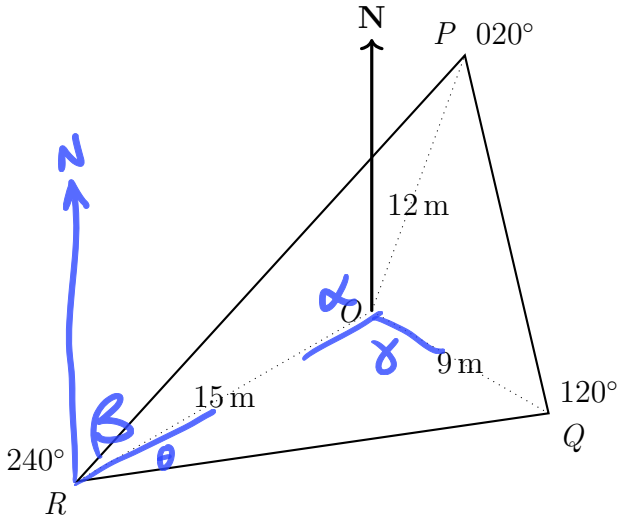
For how many hours and minutes can the irrigation system be used before a full tank is emptied?

$100000 \div 750 = 133.\dot{3} \text{ hrs}$

$= 133 \text{ hrs } 20 \text{ mins}$

QUESTION THIRTY EIGHT (6 marks)

Tom is a surveyor. He stands at a fixed point O and records the position of three boundary markers using bearings and distances. The results are shown in the diagram below.



(a) Find the area of $\triangle POQ$. Give your answer correct to 1 decimal place. **2**

$\angle POQ = 120° - 20°$

$= 100°$ ✓

$A = \frac{1}{2} \times 12 \times 9 \times \sin 100°$

$= 53.17961866...$

$\doteq 53.2 \text{ m}^2$ ✓

(b) Find the bearing of Q from R. **4**

$\angle NOR = \alpha$

$\alpha = 360° - 240°$

$= 120°$

$\angle QOR = \gamma$

$\gamma = 240° - 120°$

$= 120°$

$\frac{\sin\theta}{9} = \frac{\sin 120°}{21}$

$\angle NRO = \beta$

$\beta = 180° - 120°$

$= 60°$ ✓

$QR = \sqrt{9^2 + 15^2 - 2 \times 9 \times 15 \cos 120}$

$= 21 \text{ m}$ ✓

$\theta = \sin^{-1}\left(\frac{9 \sin 120°}{21}\right)$

$= 21.78678493$ ✓

$\therefore$ BEARING $= 60 + \theta$

$= 082°T$ ✓