SYDNEY GRAMMAR SCHOOL

CANDIDATE NUMBER

2026 Trial Examination

Form VI Mathematics Standard 2

Wednesday 12th August, 2026

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 answer sheet.

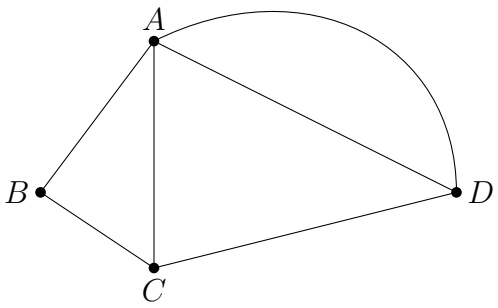
Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 20 pupils

Writer: FMW

Section I

1. **1**



How many of the vertices in the above network diagram have an ODD degree?

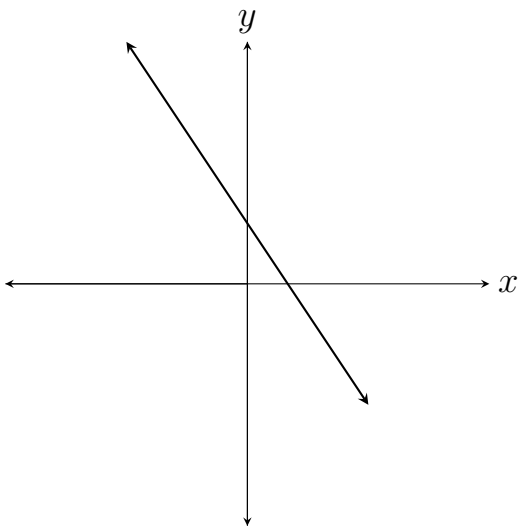
(A) 1

(B) 2

(C) 3

(D) 4

2. **1**



Which of the following could be the equation of the function drawn in the diagram above?

(A) $y = 3x + 1$

(B) $y = 3x - 1$

(C) $y = -3x + 1$

(D) $y = -3x - 1$

3. Which of the following is the simple interest earned when \$3024 is invested at 4% p.a. for 7 months? **1**

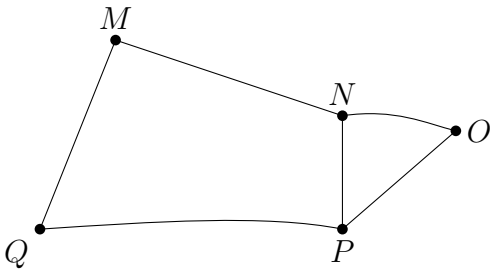
   (A) \$70.56

   (B) \$71.27

   (C) \$705.60

   (D) \$846.72

4. **1**



   Which word best describes $MNOPQ$ in the network diagram above?

   (A) Walk

   (B) Trail

   (C) Path

   (D) Cycle

5. Two years ago, Charlie bought an annual gym membership for \$2170. Due to inflation, the price increased annually by 1.25%. What is the price of the annual gym membership now? **1**

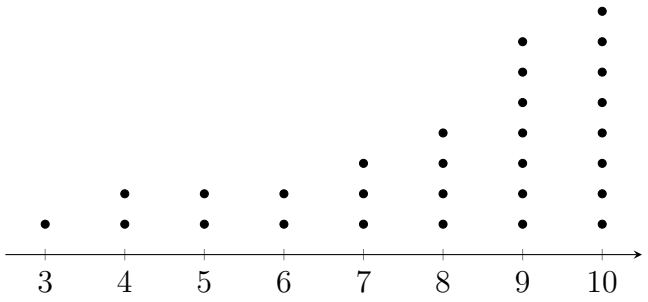
   (A) \$2197.13

   (B) \$2224.25

   (C) \$2224.59

   (D) \$2746.41

6. A set of data is displayed in this dot plot. **1**



Which of the following best describes this set of data?

(A) Normally distributed

(B) Symmetrical

(C) Positively skewed

(D) Negatively skewed

7. An electrician charges a call-out fee of \$150 as well as \$4 per minute while working. Which equation below expresses the amount the electrician charges (\$$E$) as a function of time (t hours)? **1**

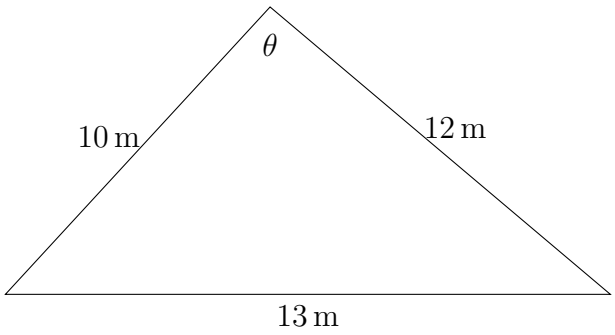
(A) $E = 4 + 150t$

(B) $E = 150 + 4t$

(C) $E = 150 + \dfrac{1}{15}t$

(D) $E = 150 + 240t$

8. The diagram shows a triangle with side lengths 10 m, 12 m, and 13 m. **1**



NOT TO SCALE

What is the value of θ, correct to the nearest degree?

(A) 47°

(B) 61°

(C) 72°

(D) 95°

9. Which expression can be used to convert a speed of 5 metres per minute to a speed in centimetres per second? **1**

   (A) $5 \times 100 \div 60$

   (B) $5 \times 100 \times 60$

   (C) $5 \div 1000 \div 60$

   (D) $5 \div 100 \times 60$

10. How many square centimetres are in 4 square metres? **1**

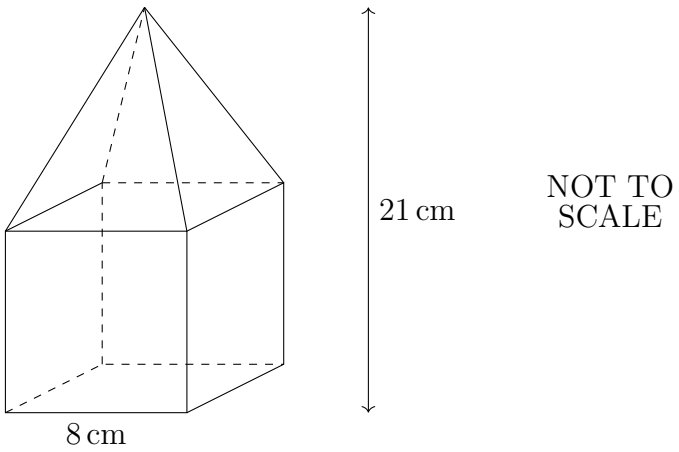
    (A) 4

    (B) 400

    (C) 40 000

    (D) 4 000 000

11. **1**



A solid is made up of a square pyramid stacked on a cube as in the diagram above.

What is its volume, correct to the nearest cubic centimetre?

(A) $684\,\text{cm}^3$

(B) $789\,\text{cm}^3$

(C) $1024\,\text{cm}^3$

(D) $1344\,\text{cm}^3$

12. The marks in a test were normally distributed. The mean mark was 65 and the standard deviation was 12. **1**

    What was the percentage of marks between 53 and 89?

    (A) 5%

    (B) 68%

    (C) 81.5%

    (D) 95%

13. The table below outlines the costs, including GST, of catching a fast train between Sydney and Melbourne. **1**

Ticket Type	**Fare**
Economy	\$133
First Class	\$188
Sleeper	\$220

    Frankie is traveling to Melbourne for a friend's wedding on the long weekend in October. She plans to take a Sleeper on the downwards journey and an Economy seat on the return. There is no discount for return tickets. What is the price of the entire trip before GST?

    (A) \$291.82

    (B) \$320.91

    (C) \$353

    (D) \$388.30

14. A loaded six-sided die is biased so that it lands on 3 twice as often as it lands on any other number. What is the probability that, when it is rolled, it lands on a number other than 3? **1**

    (A) $\frac{1}{6}$

    (B) $\frac{1}{3}$

    (C) $\frac{2}{3}$

    (D) $\frac{5}{7}$

15. The maximum speed of a train going up a hill varies inversely with the square of its weight. What is the effect on the maximum speed of the train if the weight of the train is halved? **1**

(A) Divided by 2

(B) Multiplied by 2

(C) Divided by 4

(D) Multiplied by 4

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)

Five years ago a refrigerator was valued at \$2568. Its value has depreciated by 18% each year, based on the declining-balance method. Find its salvage value today, correct to the nearest dollar. **2**

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QUESTION SEVENTEEN (3 marks)

Seth is a registered nurse and works a 40 hour week at an ordinary rate of \$37.12 per hour.

(a) Last week he worked his normal 40 hours and an extra 9 hours of overtime at time-and-a-half. Calculate his total pay for the week. **1**

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(b) He has a holiday planned in August and will receive four weeks wages plus 17.5% holiday loading. Calculate his total holiday pay. **2**

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QUESTION EIGHTEEN (2 marks)

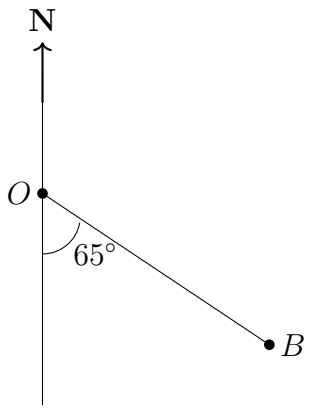
The recent World Cup football game between Australia and Paraguay was broadcast live at 12pm on Friday 26 June in Sydney (UTC+10). Paolo watched the game live in Paraguay (UTC-3). What time did the game start in Paraguay and what day was it? **2**

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QUESTION NINETEEN (1 mark)



What is the bearing of O from B? **1**

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QUESTION TWENTY (1 mark)

A map has a scale of 1:200 000. Two lighthouses are 3 cm apart on the map. What is the actual distance between the two lighthouses? Give your answer in kilometres. **1**

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QUESTION TWENTY ONE (2 marks)

Carlo drove 480 km in 6 hours and 10 minutes. If he averaged 75 km/h for the first 200 km, how long did it take him to travel the remainder of his trip? **2**

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QUESTION TWENTY TWO (2 marks)

Sami measures the length of a piece of paper to be 29.5 cm. Find the percentage error in this measurement. Give your answer correct to two decimal places. **2**

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QUESTION TWENTY THREE (3 marks)

Electricity is charged at 32.56 cents per kWh. A household uses the following appliances: **3**

- A 880 W oven for 2 hours, five times a week
- A 3.25 kW washing machine, for 3 hours, once per day
- A 300 W lamp running 12 hours a day,

Calculate the total electricity cost to run all three appliances for a full 7-day week, if the lamp uses 0.2 W per hour when on standby. Both the oven and the washing machine use no power when on standby.

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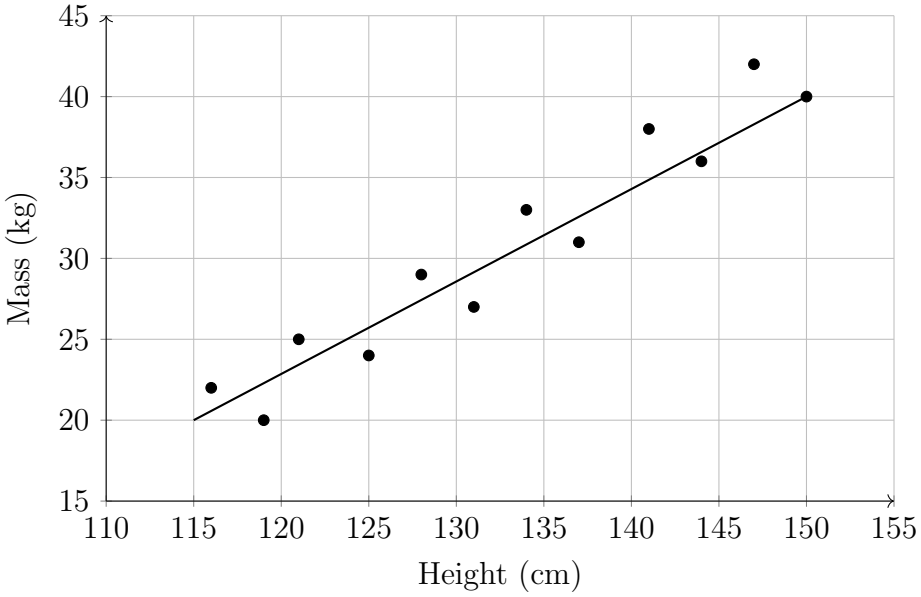
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QUESTION TWENTY FOUR (6 marks)

A doctor's surgery recorded the heights and mass of the children attending appointments over a 3 day period.

(a) The graph below shows the scatter plot of the data collected. A line of best fit has been drawn by eye on the diagram. Find its equation. **3**



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(b) The results collected are displayed in the table below. **3**

Height (cm)	116	119	121	125	128	131	134	137	141	144	147	150
Mass (kg)	22	20	25	24	29	27	33	31	38	36	42	40

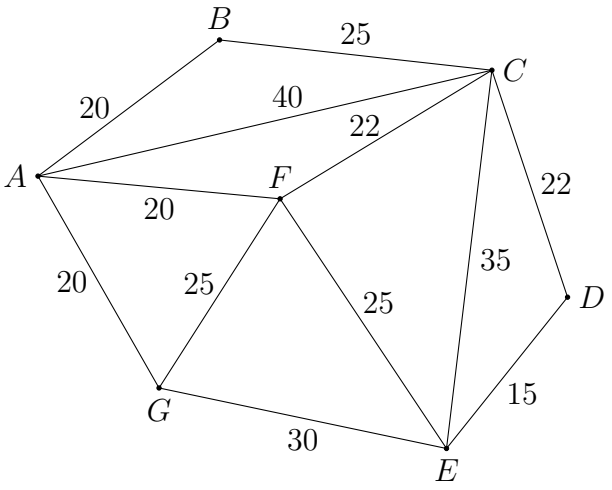
Find the equation of the least-squares regression line and the value of the correlation coefficient. Round your answers to two decimal places.

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QUESTION TWENTY FIVE (4 marks)



NOT TO SCALE

A network of power poles and the distance between them in metres is shown above.

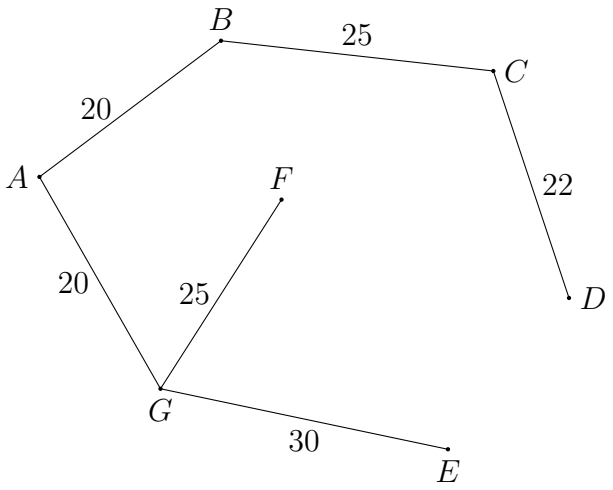
(a) Find the length of the shortest path from pole B to pole E. **1**

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(b) A spanning tree of the network is shown below. Is this a minimum spanning tree? Justify your answer. **3**



NOT TO SCALE

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QUESTION TWENTY SIX (2 marks)

A rowing coach claimed that as time spent training on the water decreases, the time to complete a 1000 m time trial on the rowing machine in the gym increases. When she completed some research, she found the correlation coefficient, r, to be approximately -0.84. What does this value of r indicate and does this value of r support her claim? **2**

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QUESTION TWENTY SEVEN (3 marks)

The table below is used to calculate monthly loan repayments.

Monthly loan repayments (in dollars) per $1000 borrowed

Interest rate % pa	**5 years**	**10 years**	**15 years**	**20 years**
5%	18.87	10.61	7.91	6.60
6%	19.33	11.10	8.44	7.16
7%	19.80	11.61	8.99	7.75
8%	20.28	12.13	9.56	8.36
9%	20.76	12.67	10.14	9.00

Claude borrows $220 000 at 5% per annum for 20 years.

(a) Find his monthly loan repayment. **1**

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(b) Assuming the terms of the loan remain the same over the 20 years, how much interest will Claude have paid over the life of the loan? **2**

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QUESTION TWENTY EIGHT (2 marks)

Mario sits an English test and the marks are normally distributed. The mean mark is 70 and the standard deviation is 8. If Mario's z-score is 1.5, what did he score in the test? **2**

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QUESTION TWENTY NINE (4 marks)

The following formula can be used to calculate an estimate for blood alcohol content (BAC) for males. **4**

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

N is the number of standard drinks consumed.
M is the person's weight in kilograms.
H is the number of hours drinking.

Gregor weighs 80 kg. His BAC was zero when he began drinking alcohol. At 10 pm, after consuming 6 standard drinks, his BAC was 0.075. Using the formula above, estimate the time at which Gregor began drinking alcohol. Give your answer correct to the nearest minute.

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QUESTION THIRTY (3 marks)

Max and Thomas are playing a game. Thomas is the stronger player and the probability of him winning the game is $\frac{7}{9}$. The boys play two games in a row. What is the probability that both boys win a game? **3**

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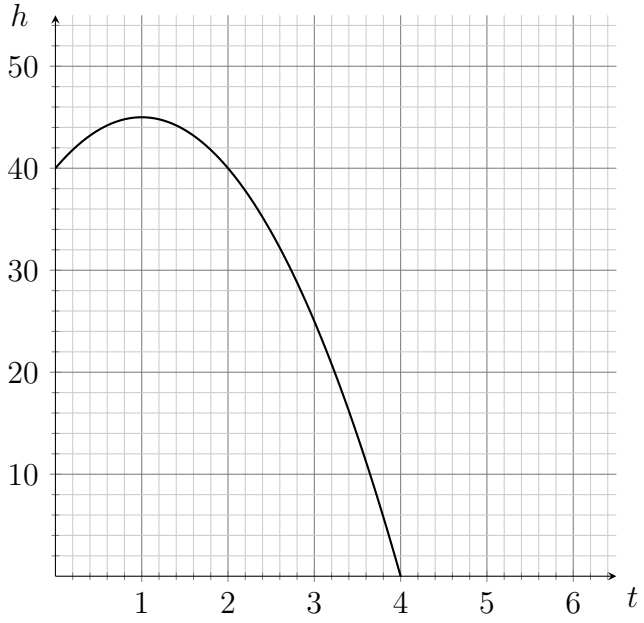
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QUESTION THIRTY ONE (5 marks)

A ball is thrown vertically upwards from a balcony and its height h metres above the ground over time t seconds is modelled using the equation $h = -5t^2 + 10t + 40$. The graph of h against t is shown below.



(a) Find the maximum height reached by the ball. **1**

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(b) How long does it take for the ball to return to the height of the balcony and how far has it travelled vertically then? **2**

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(c) The equation $h = -5t^2 + 10t + 40$ only models the flight of the ball for some values of t. Explain which values are invalid and why. **2**

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QUESTION THIRTY TWO (6 marks)

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

(a) Using the tax table above, find the tax payable on \$35 670. **1**

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(b) Find the value of \$**A** in the table above. **1**

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(c) Sangeeta has a gross salary of \$122 000 and tax deductions which amount to \$2135. She must pay a Medicare Levy which is calculated at 1.5% of her taxable income. She has already paid \$32 000 as Pay As You Go (PAYG) tax. Will Sangeeta receive a tax refund or will she owe more tax? Justify your answer with calculations. **4**

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QUESTION THIRTY THREE (7 marks)

A population P, is to be modelled using the function $P = 500(1.3)^t$, where t is the time in minutes since the start of the population growth.

(a) What is the initial population? **1**

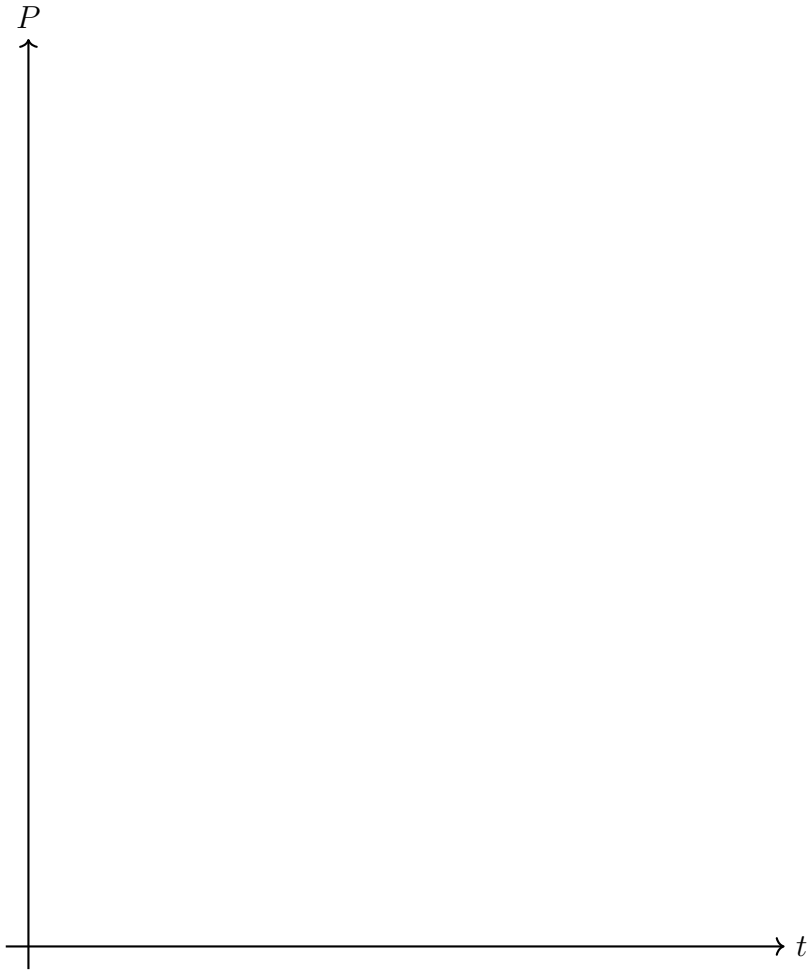
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(b) Find the value of the population after 5 minutes. **1**

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(c) On the axes below, draw the graph of the population against time, showing the points found above and at least two other points. **2**



(d) Use your graph to estimate how long it will take for the initial population to double. **1**

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(e) Predict when the population will be fifty times its initial value. Give your answer correct to the nearest minute. **2**

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QUESTION THIRTY FOUR (3 marks)

A small business operator pays her staff the following wages per week, depending on their experience:

$210, $350, $410, $510, $580, $610, $985

(a) Is the highest wage an outlier? Justify your answer. **2**

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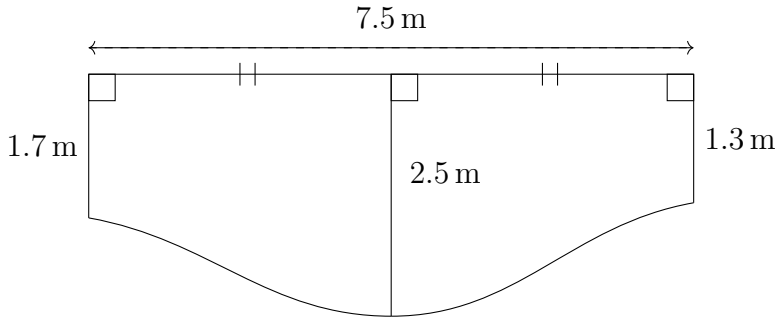
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(b) If each employee receives a pay increase of $45, which of the following summary statistics will change? The range, mean, median, and/or standard deviation. **1**

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QUESTION THIRTY FIVE (4 marks)



NOT TO SCALE

The diagram above shows the aerial view of a domestic swimming pool.

(a) Use two applications of the Trapezoidal Rule to calculate the surface area of the pool. **2**

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(b) The average depth of the pool is 0.8 m. Calculate the approximate volume of the pool. Give your answer in litres. **2**

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QUESTION THIRTY SIX (5 marks)

The table below shows the future value of a \$1 annuity at different interest rates over different numbers of time periods.

Future values of a \$1 annuity

Time Period	Interest rate				
	1%	**2%**	**3%**	**4%**	**5%**
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019
7	7.2135	7.4343	7.6625	7.8983	8.1420
8	8.2857	8.5830	8.8923	9.2142	9.5491

(a) What would be the future value of a \$6500 per year annuity at 4% per annum for 7 years, with interest compounding yearly? **1**

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(b) What is the value of an annuity that would provide a future value of \$34 500 after 4 years at 5% compound interest, compounded yearly? **1**

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(c) An annuity of \$2000 per month is invested at 4% per annum, compounded quarterly, for 2 years. Find the amount of interest earned. **3**

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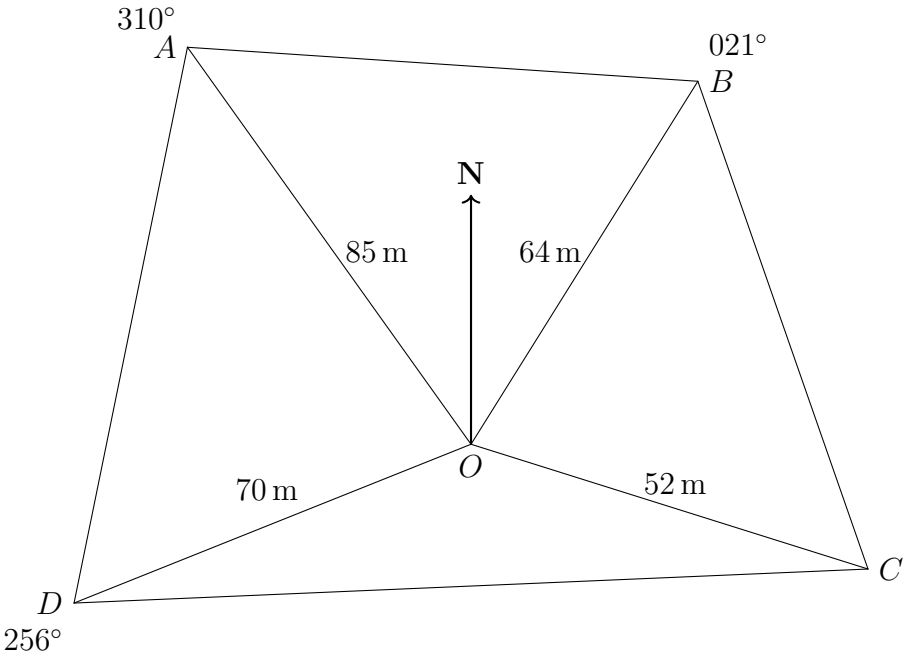
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QUESTION THIRTY SEVEN (7 marks)

A compass radial survey of the field $ABCD$ has been conducted from a central point O.



NOT TO SCALE

(a) Farmer Tran wants to fence around the area $ABOD$. Find the cost of this project if each metre of fencing costs \$22. **4**

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(b) The surveyor finds that the area of triangle BOC is $1664\,\text{m}^2$. Find the bearing of C from O. **3**

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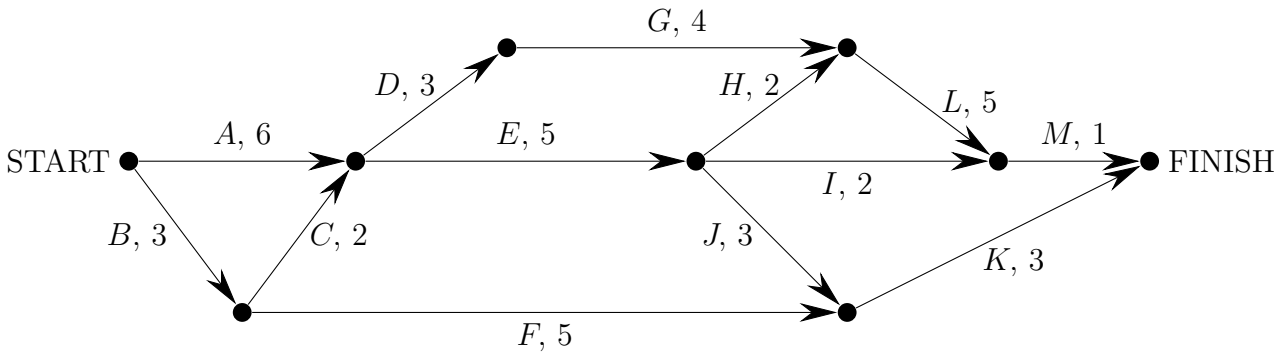
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QUESTION THIRTY EIGHT (8 marks)

Track works are required across the Sydney rail network and 13 activities are needed to be completed. The network diagram below shows these activities, including their completion times in weeks.



(a) By forward scanning, find the earliest start time of activity K? **2**

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(b) Identify any critical paths and find how many of the 13 activities have zero float time. **3**

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(c) The contractor proposes a reduction in completion time for activites A, E, F, and L, at an additional cost. The table below summarises these costs. Each activity can only be reduced by a maximum of three weeks. **3**

If the overall completion time for the project can be reduced to 15 weeks, find the minimum cost of this change. Your answer should explain clearly why the minimum cost is achieved.

Activity	**Weekly cost ($)**
A	130 000
E	110 000
F	120 000
L	100 000

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Extra writing space

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

SYDNEY GRAMMAR SCHOOL

Solutions

CANDIDATE NUMBER

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Form VI Mathematics Standard 2

Wednesday 12th August, 2026

8:40am

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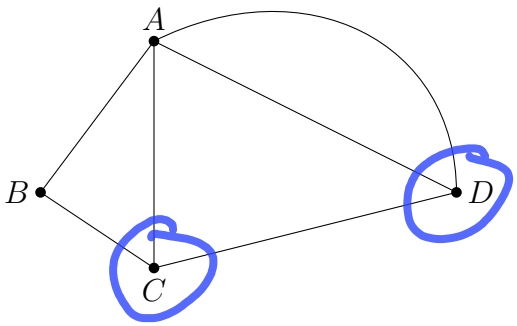
Checklist

- Reference sheet
- Multiple-choice answer sheet
- Candidature: 20 pupils

Writer: FMW

Section I

1. **1**



How many of the vertices in the above network diagram have an ODD degree?

(A) 1

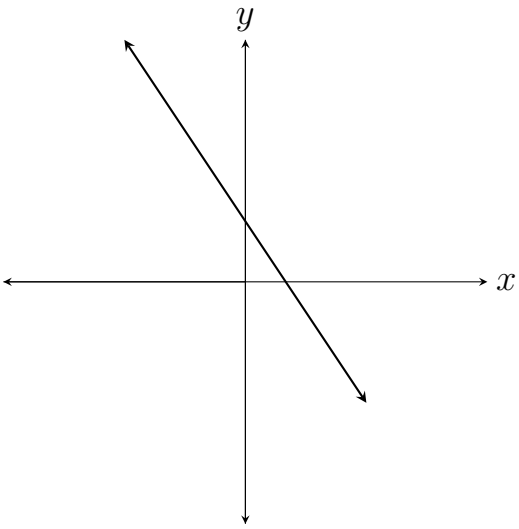
(B) 2

(C) 3

(D) 4

2. **1**

negative gradient, positive y-intercept



Which of the following could be the equation of the function drawn in the diagram above?

(A) $y = 3x + 1$

(B) $y = 3x - 1$

(C) $y = -3x + 1$

(D) $y = -3x - 1$

3. Which of the following is the simple interest earned when \$3024 is invested at 4% p.a. for 7 months? **1**

(A) \$70.56

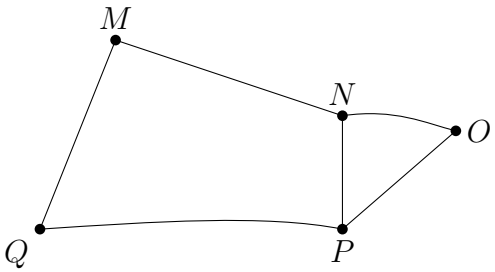
(B) \$71.27

(C) \$705.60

(D) \$846.72

$3024 \times \frac{4}{100} \times \frac{7}{12}$

4. **1**



Which word best describes $MNOPQ$ in the network diagram above?

(A) Walk

(B) Trail

(C) Path

(D) Cycle

all vertices used once

5. Two years ago, Charlie bought an annual gym membership for \$2170. Due to inflation, the price increased annually by 1.25%. What is the price of the annual gym membership now? **1**

(A) \$2197.13

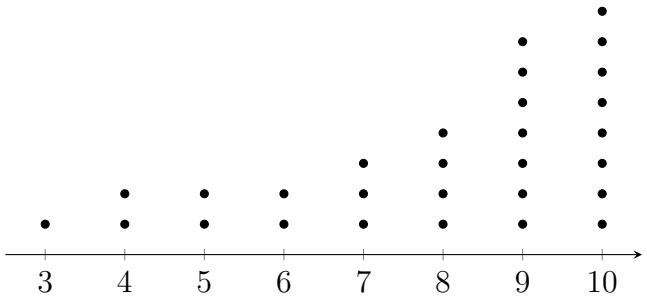
(B) \$2224.25

(C) \$2224.59

(D) \$2746.41

$2170 \times 1.0125^2 =$

6. A set of data is displayed in this dot plot. **1**



Which of the following best describes this set of data?

(A) Normally distributed

(B) Symmetrical

(C) Positively skewed

(D) Negatively skewed

skew ↔ tail

7. An electrician charges a call-out fee of \$150 as well as \$4 per minute while working. Which equation below expresses the amount the electrician charges (\$$E$) as a function of time (t hours)? **1**

(A) $E = 4 + 150t$

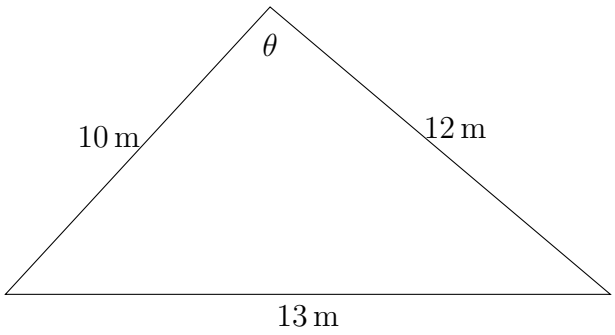
(B) $E = 150 + 4t$

(C) $E = 150 + \frac{1}{15}t$

(D) $E = 150 + 240t$

$E = 150 + 4 \times 60 \times t$

8. The diagram shows a triangle with side lengths 10 m, 12 m, and 13 m. **1**



NOT TO SCALE

What is the value of θ, correct to the nearest degree?

(A) 47°

(B) 61°

(C) 72°

(D) 95°

$\cos\theta = \frac{10^2 + 12^2 - 13^2}{2 \times 10 \times 12}$

9. Which expression can be used to convert a speed of 5 metres per minute to a speed in centimetres per second? **1**

(A) $5 \times 100 \div 60$

(B) $5 \times 100 \times 60$

(C) $5 \div 1000 \div 60$

(D) $5 \div 100 \times 60$

10. How many square centimetres are in 4 square metres? **1**

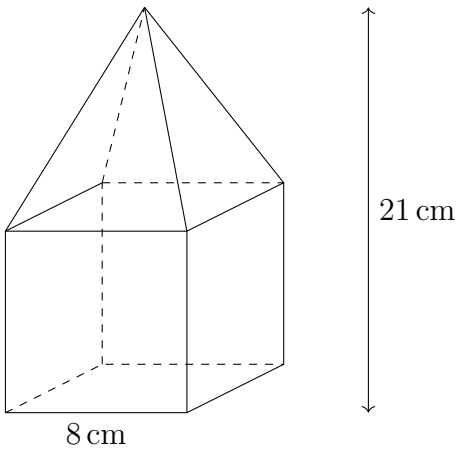
(A) 4

(B) 400

(C) 40 000

(D) 4 000 000

11. **1**



NOT TO SCALE

A solid is made up of a square pyramid stacked on a cube as in the diagram above.

What is its volume, correct to the nearest cubic centimetre?

(A) $684\,\text{cm}^3$

(B) $790\,\text{cm}^3$

(C) $1024\,\text{cm}^3$

(D) $1344\,\text{cm}^3$

12. The marks in a test were normally distributed. The mean mark was 65 and the standard deviation was 12. **1**

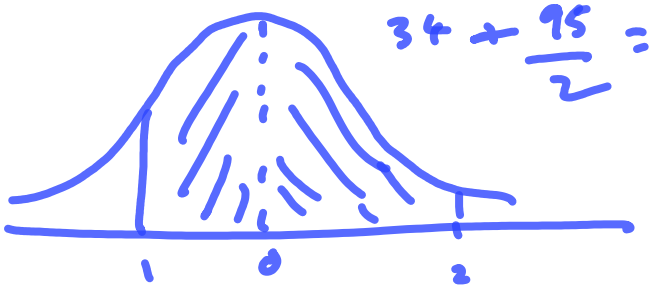
What was the percentage of marks between 53 and 89?

(A) 5%

(B) 68%

(C) 81.5%

(D) 95%



13. The table below outlines the costs, including GST, of catching a fast train between Sydney and Melbourne. **1**

Ticket Type	Fare
Economy	$133
First Class	$188
Sleeper	$220

Frankie is traveling to Melbourne for a friend's wedding on the long weekend in October. She plans to take a Sleeper on the downwards journey and an Economy seat on the return. There is no discount for return tickets. What is the price of the entire trip before GST?

(A) $291.82

(B) $320.91

(C) $353

(D) $388.30

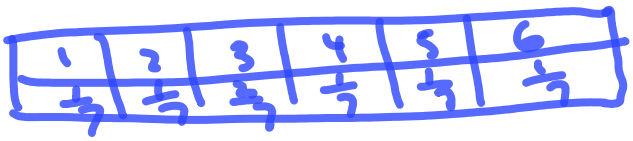
14. A loaded six-sided die is biased so that it lands on 3 twice as often as it lands on any other number. What is the probability that, when it is rolled, it lands on a number other than 3? **1**

(A) $\frac{1}{6}$

(B) $\frac{1}{3}$

(C) $\frac{2}{3}$

(D) $\frac{5}{7}$



15. The maximum speed of a train going up a hill varies inversely with the square of its weight. What is the effect on the maximum speed of the train if the weight of the train is halved? **1**

(A) Divided by 2

(B) Multiplied by 2

(C) Divided by 4

(D) Multiplied by 4

$$S = \frac{k}{\omega^2}$$
$$= \frac{k}{(\frac{1}{2}\omega)^2}$$
$$= \frac{k}{\frac{1}{4}\omega^2}$$
$$= \frac{4k}{\omega^2}$$

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)

Five years ago a refrigerator was valued at \$2568. Its value has depreciated by 18% each year, based on the declining-balance method. Find its salvage value today, correct to the nearest dollar. **2**

$S = 2568(1-0.18)^5$ ✓✓

$= \$952$

QUESTION SEVENTEEN (3 marks)

Seth is a registered nurse and works a 40 hour week at an ordinary rate of \$37.12 per hour.

(a) Last week he worked his normal 40 hours and an extra 9 hours of overtime at time-and-a-half. Calculate his total pay for the week. **1**

$40 \times 37.12 + 9 \times 1.5 \times 37.12$ ✓

$= \$1985.92$

(b) He has a holiday planned in August and will receive four weeks wages plus 17.5% holiday loading. Calculate his total holiday pay. **2**

$(40 \times 37.12 \times 4) \times 1.175$ ✓

$= \$6978.56$ ✓

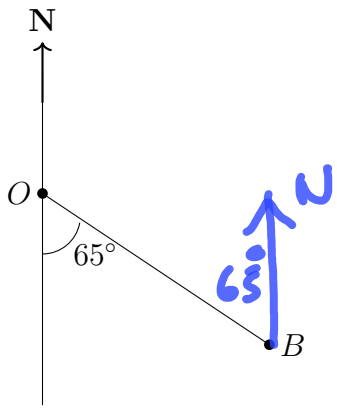
QUESTION EIGHTEEN (2 marks)

The recent World Cup football game between Australia and Paraguay was broadcast live at 12pm on Friday 26 June in Sydney (UTC+10). Paolo watched the game live in Paraguay (UTC-3). What time did the game start in Paraguay and what day was it? **2**

12pm − 10 − 3 = 11pm

Thursday 25 June

QUESTION NINETEEN (1 mark)



What is the bearing of O from B? **1**

N65°W or 295°T

QUESTION TWENTY (1 mark)

A map has a scale of 1:200 000. Two lighthouses are 3 cm apart on the map. What is the actual distance between the two lighthouses? Give your answer in kilometres. **1**

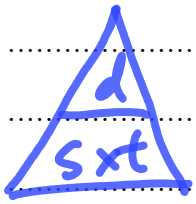
3 × 200000 = 600000 cm

= 6000 m

= 6 km

QUESTION TWENTY ONE (2 marks)

Carlo drove 480 km in 6 hours and 10 minutes. If he averaged 75 km/h for the first 200 km, how long did it take him to travel the remainder of his trip? **2**



$\frac{200}{75} = \frac{8}{3}$ ✓

$= 2\text{h } 40\text{min}$

$6\text{h } 10\text{min} - 2\text{h } 40\text{min} = 3\text{h } 30\text{min}$ ✓

QUESTION TWENTY TWO (2 marks)

Sami measures the length of a piece of paper to be 29.5 cm. Find the percentage error in this measurement. Give your answer correct to two decimal places. **2**

actual error $= 0.05$ ✓

$\frac{0.05}{29.5} \times 100 = 0.1694\ldots$

$\doteq 0.17\%$ ✓

QUESTION TWENTY THREE (3 marks)

Electricity is charged at 32.56 cents per kWh. A household uses the following appliances: **3**

- A 880 W oven for 2 hours, five times a week
- A 3.25 kW washing machine, for 3 hours, once per day
- A 300 W lamp running 12 hours a day,

Calculate the total electricity cost to run all three appliances for a full 7-day week, if the lamp uses 0.2 W per hour when on standby. Both the oven and the washing machine use no power when on standby.

$\frac{880}{1000} \times 2 \times 5 = 8.8$ ✓

$3.25 \times 3 \times 7 = 68.25$

$\frac{300}{1000} \times 12 \times 7 + \frac{0.2}{1000} \times 12 \times 7 = 25.2168$ ✓

total electricity $= 102.2668$ kWh

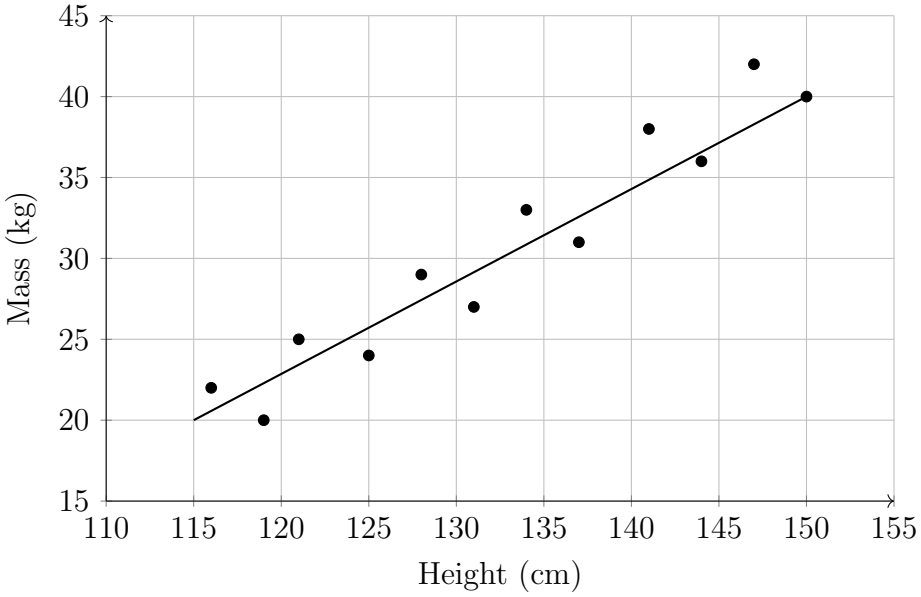
cost $= 102.2668 \times 32.56 - 100$

$\doteq \$33.30$ ✓

QUESTION TWENTY FOUR (6 marks)

A doctor's surgery recorded the heights and mass of the children attending appointments over a 3 day period.

(a) The graph below shows the scatter plot of the data collected. A line of best fit has been drawn by eye on the diagram. Find its equation. **3**



use points (115, 20) and (150, 40)

$m = \frac{40-20}{150-115}$

$= \frac{20}{35}$

$= \frac{4}{7}$ ✓

$40 = \frac{4}{7} \times 150 + b$ ✓

$b = 40 - \frac{4}{7}(150)$

$= -\frac{320}{7}$

line $m = \frac{4}{7}$ $4 - \frac{320}{7}$ ✓

(b) The results collected are displayed in the table below. **3**

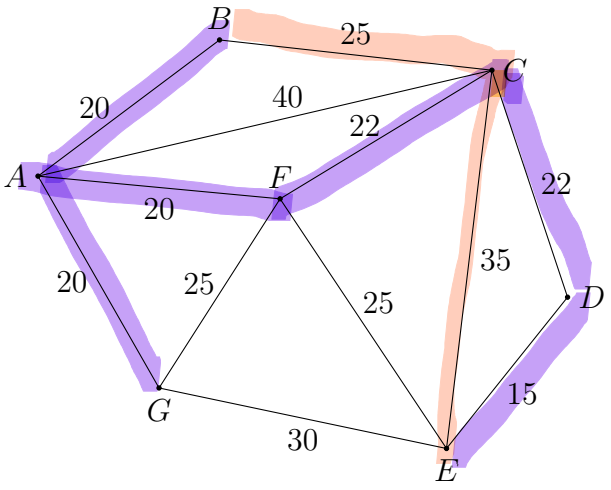
Height (cm)	116	119	121	125	128	131	134	137	141	144	147	150
Mass (kg)	22	20	25	24	29	27	33	31	38	36	42	40

Find the equation of the least-squares regression line and the value of the correlation coefficient. Round your answers to two decimal places.

$m = -51594 + 0.624$ ✓✓

and $r = 0.96$ ✓

QUESTION TWENTY FIVE (4 marks)



NOT TO SCALE

A network of power poles and the distance between them in metres is shown above.

(a) Find the length of the shortest path from pole B to pole E. **1**

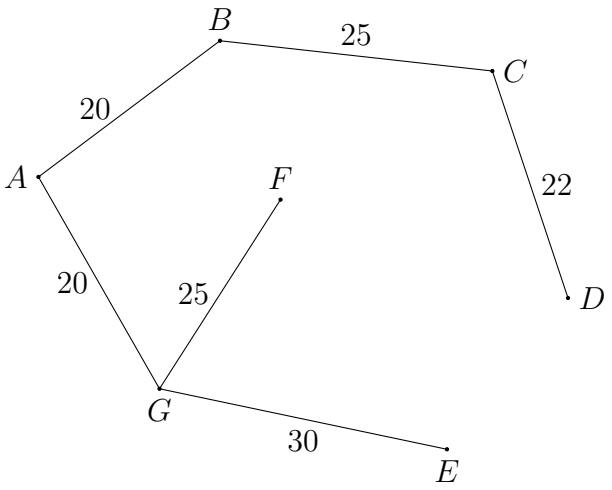
25 + 35 = 60 m ✓

.....

.....

.....

(b) A spanning tree of the network is shown below. Is this a minimum spanning tree? Justify your answer. **3**



NOT TO SCALE

The length of the tree is
22 + 25 + 20 + 20 + 25 + 30
= 142 m ✓

A minimum spanning tree is shown above
Its length is
15 + 22 + 22 + 20 + 20 + 20 ✓
= 119 m
The given tree is therefore NOT a minimum spanning tree ✓

QUESTION TWENTY SIX (2 marks)

A rowing coach claimed that as time spent training on the water decreases, the time to complete a 1000 m time trial on the rowing machine in the gym increases. When she completed some research, she found the correlation coefficient, r, to be approximately -0.84. What does this value of r indicate and does this value of r support her claim? **2**

✓ This value of r indicates a strong negative correlation.
✓ It supports her claim that as time on the water decreases, time on the rowing machine increases.

QUESTION TWENTY SEVEN (3 marks)

The table below is used to calculate monthly loan repayments.

Monthly loan repayments (in dollars) per $1000 borrowed

Interest rate % pa	5 years	10 years	15 years	20 years
5%	18.87	10.61	7.91	6.60
6%	19.33	11.10	8.44	7.16
7%	19.80	11.61	8.99	7.75
8%	20.28	12.13	9.56	8.36
9%	20.76	12.67	10.14	9.00

Claude borrows $220 000 at 5% per annum for 20 years.

(a) Find his monthly loan repayment. **1**

220 × 6.60 = $1452

(b) Assuming the terms of the loan remain the same over the 20 years, how much interest will Claude have paid over the life of the loan? **2**

1452 × 12 × 20 = 348 480

348 480 − 220 000 = $128 480

QUESTION TWENTY EIGHT (2 marks)

Mario sits an English test and the marks are normally distributed. The mean mark is 70 and the standard deviation is 8. If Mario's z-score is 1.5, what did he score in the test? **2**

$$1.5 = \frac{x - 70}{8}$$

$x - 70 = 8 \times 1.5$

$x = 8 \times 1.5 + 70$

$= 82$

QUESTION TWENTY NINE (4 marks)

The following formula can be used to calculate an estimate for blood alcohol content (BAC) for males. **4**

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

N is the number of standard drinks consumed.
M is the person's weight in kilograms.
H is the number of hours drinking.

Gregor weighs 80 kg. His BAC was zero when he began drinking alcohol. At 10 pm, after consuming 6 standard drinks, his BAC was 0.075. Using the formula above, estimate the time at which Gregor began drinking alcohol. Give your answer correct to the nearest minute.

$0.075 = \frac{10 \times 6 - 7.5H}{6.8 \times 80}$ ✓

$40.8 = 60 - 7.5H$

$7.5H = 19.2$ ✓

$H = 2.56$

$2.56\text{hrs} \quad 2\text{h } 34\text{ min}$ ✓

$10\text{pm} - 2\text{h } 34\text{ min} = 7.26\text{pm}$ ✓

QUESTION THIRTY (3 marks)

Max and Thomas are playing a game. Thomas is the stronger player and the probability of him winning the game is $\frac{7}{9}$. The boys play two games in a row. What is the probability that both boys win a game? **3**

Win

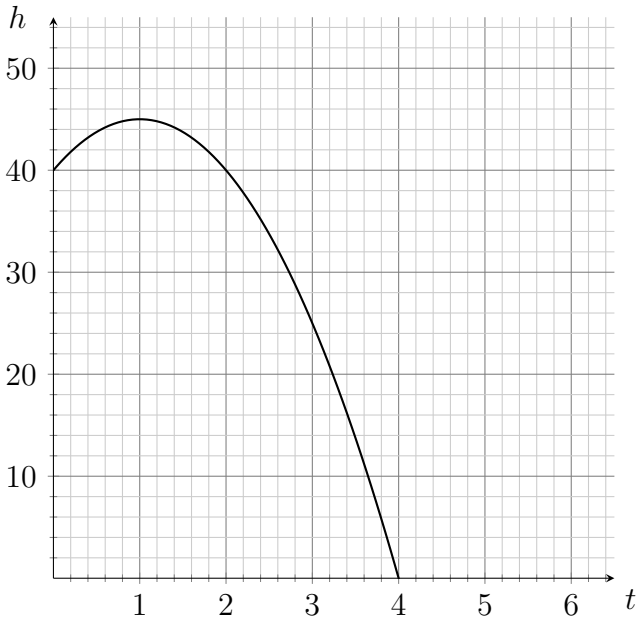
M $\frac{7}{9}$ M ✓ $P(E) = \frac{2}{9} \times \frac{7}{9} \times 2$ ✓

$\frac{2}{9}$ T $\frac{2}{9}$ M $= \frac{28}{81}$ ✓

T ✓ ✓

QUESTION THIRTY ONE (5 marks)

A ball is thrown vertically upwards from a balcony and its height h metres above the ground over time t seconds is modelled using the equation $h = -5t^2 + 10t + 40$. The graph of h against t is shown below.



(a) Find the maximum height reached by the ball. **1**

read off graph ✓

If $t = 1$, $h = -5(1)^2 + 10(1) + 40$

$= 45$ m

(b) How long does it take for the ball to return to the height of the balcony and how far has it travelled vertically then? **2**

It takes 2 seconds and has travelled $5 + 5 = 10$ m

↑ ↓

(c) The equation $h = -5t^2 + 10t + 40$ only models the flight of the ball for some values of t. Explain which values are invalid and why. **2**

$t < 0$, time can't be negative ✓

$t > 4$, the ball hits the ground at $t = 4$ (and will bounce), the model has it travelling below the ground ✓

QUESTION THIRTY TWO (6 marks)

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

(a) Using the tax table above, find the tax payable on \$35 670. **1**

0 19 x (35670 - 18200)
= $3319 30

(b) Find the value of \$**A** in the table above. **1**

5092 + 0 325 x (120000 - 45000)
= $29467

(c) Sangeeta has a gross salary of \$122 000 and tax deductions which amount to \$2135. She must pay a Medicare Levy which is calculated at 1.5% of her taxable income. She has already paid \$32 000 as Pay As You Go (PAYG) tax. Will Sangeeta receive a tax refund or will she owe more tax? Justify your answer with calculations. **4**

122 000 - 2135 = $119 865
Medicare Levy = 119865 x 0 015
tax = 5092 + 0 325 x (119865 - 45000)
tax + medicare levy = $31221 10
32000 - 31221.10 = 778 90
She will receive a refund
of $778 90

QUESTION THIRTY THREE (7 marks)

A population P, is to be modelled using the function $P = 500(1.3)^t$, where t is the time in minutes since the start of the population growth.

(a) What is the initial population? **1**

If $t = 0$, $P = 500$ ✓

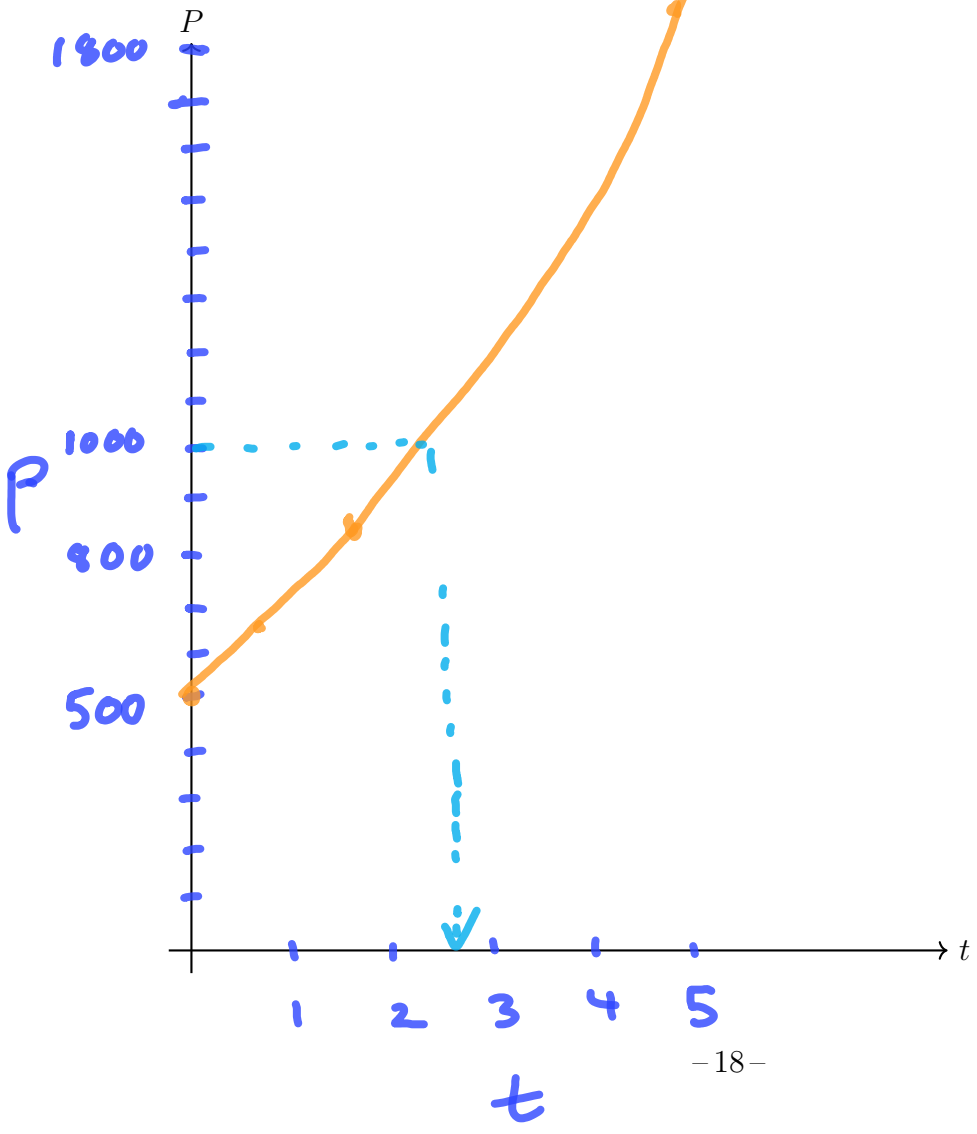
(b) Find the value of the population after 5 minutes. **1**

If $t = 5$, $P = 500(1.3)^5$

$= 1856.465$ ✓

(c) On the axes below, draw the graph of the population against time, showing the points found above and at least two other points. **2**

t	0	1	2
P	500	650	845



✓✓

(d) Use your graph to estimate how long it will take for the initial population to double. **1**

We want P = 1000, from my graph t = 2.75 min

(e) Predict when the population will be fifty times its initial value. Give your answer correct to the nearest minute. **2**

let P = 50 × 500 = 25000

if t = 14, $P = 500(1.3)^{14}$

$= 19687$

if t = 15, $P = 500(1.3)^{15}$

$= 25593$

It will take 15 minutes

QUESTION THIRTY FOUR (3 marks)

A small business operator pays her staff the following wages per week, depending on their experience:

$210, $350, $410, $510, $580, $610, $985

(a) Is the highest wage an outlier? Justify your answer. **2**

IQR = 610 − 350

= 260

610 + 1.5 × 260 = 1000

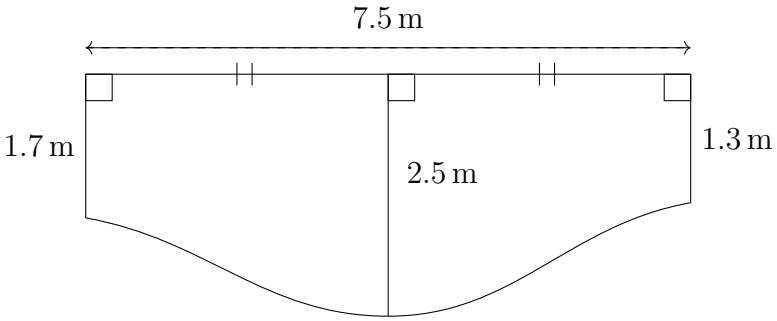
> 985

$985 is not an outlier.

(b) If each employee receives a pay increase of $45, which of the following summary statistics will change? The range, mean, median, and/or standard deviation. **1**

The mean and the median will change.

QUESTION THIRTY FIVE (4 marks)



NOT TO SCALE

The diagram above shows the aerial view of a domestic swimming pool.

(a) Use two applications of the Trapezoidal Rule to calculate the surface area of the pool. **2**

$SA = \frac{1}{2} \times \frac{7.5}{2} \times (1.7 + 2.5) + \frac{1}{2} \times \frac{7.5}{2} (2.5 + 1.3)$

$= 18\ m^2$

(b) The average depth of the pool is 0.8 m. Calculate the approximate volume of the pool. Give your answer in litres. **2**

$V = 15 \times 0.8$

$= 12\ m^3$

$= 12\ kL$

$= 12\,000\ L$

QUESTION THIRTY SIX (5 marks)

The table below shows the future value of a \$1 annuity at different interest rates over different numbers of time periods.

Future values of a \$1 annuity

Time Period	Interest rate				
	1%	2%	3%	4%	5%
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101
5	5.1010	5.2040	5.3091	5.4163	5.5256
6	6.1520	6.3081	6.4684	6.6330	6.8019
7	7.2135	7.4343	7.6625	7.8983	8.1420
8	8.2857	8.5830	8.8923	9.2142	9.5491

(a) What would be the future value of a \$6500 per year annuity at 4% per annum for 7 years, with interest compounding yearly? **1**

FV = 6500 × 7.8983
= \$51338.95

(b) What is the value of an annuity that would provide a future value of \$34 500 after 4 years at 5% compound interest, compounded yearly? **1**

$34500 \div 4.3101 = \$8004.45$

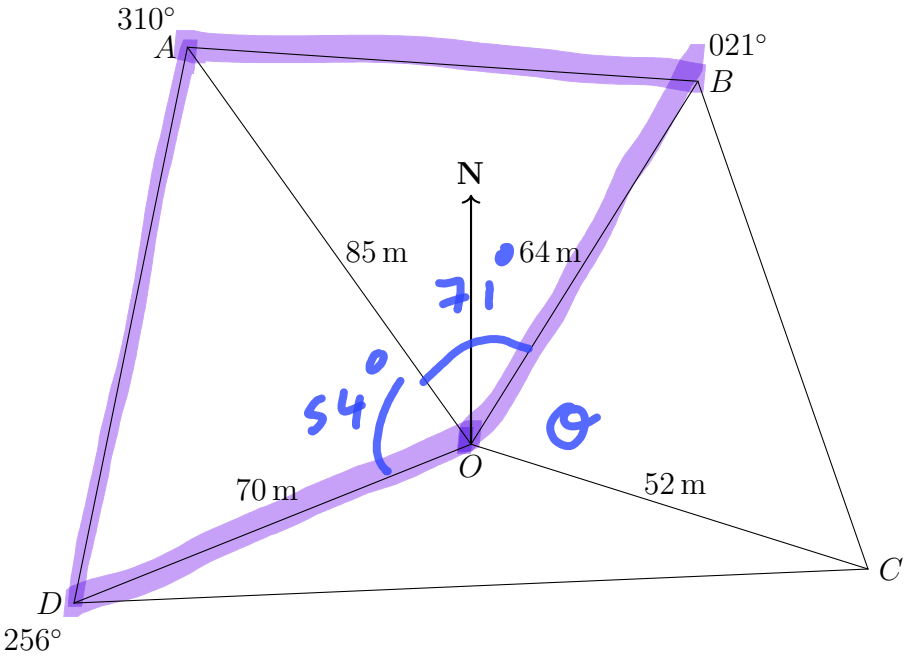
(c) An annuity of \$2000 per month is invested at 4% per annum, compounded quarterly, for 2 years. Find the amount of interest earned. **3**

2000 × 3 = \$6000 per quarter
4% p.a. = 1% per month
2 × 4 = 8 quarters

FV = 6000 × 8.2857
= \$49714.20
Interest = 49714.20 − 6000 × 8
= \$1714.20

QUESTION THIRTY SEVEN (7 marks)

A compass radial survey of the field $ABCD$ has been conducted from a central point O.



NOT TO SCALE

(a) Farmer Tran wants to fence around the area $ABOD$. Find the cost of this project if each metre of fencing costs \$22. **4**

$P = AB + 64 + 70 + AD$

$AB^2 = 85^2 + 64^2 - 2 \times 85 \times 64 \times \cos 71°$

$AB = 88.1976104$

$OD^2 = 85^2 + 70^2 - 2 \times 85 \times 70 \times \cos 54°$

$OD = 71.62649997$

$P = 293.824$

$\text{Cost} = P \times 22$

$= \$6464.13$

(b) The surveyor finds that the area of triangle BOC is $1664\,\text{m}^2$. Find the bearing of C from O. **3**

Let $\angle BOC = \theta$

$\frac{1}{2} \times 64 \times 52 \times \sin\theta = 1664$ ✓

$\sin\theta = 1$

$\theta = 90°$ ✓

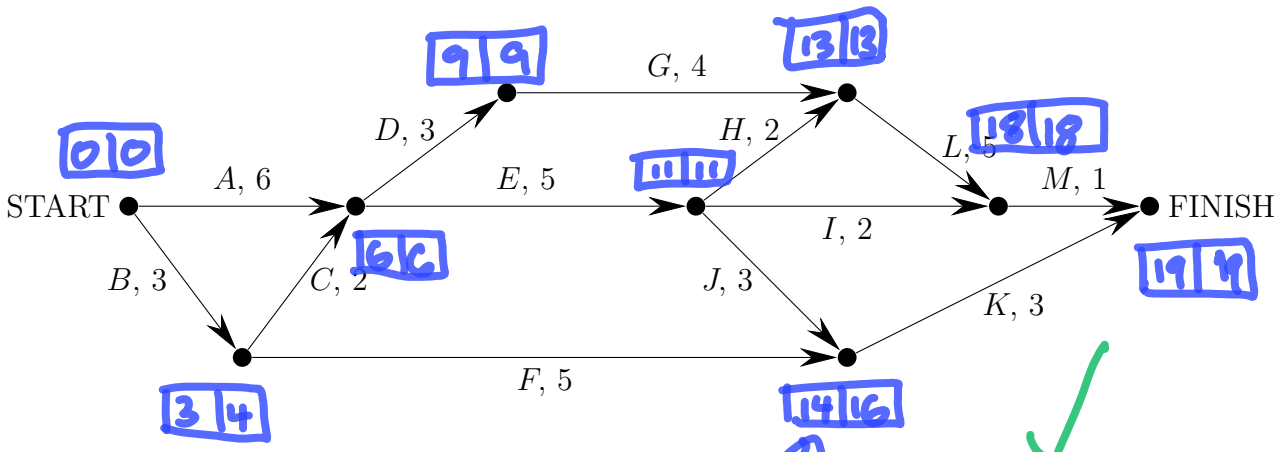
bearing of C from O

$= 21 + 90$

$= 111°\,T$ ✓

QUESTION THIRTY EIGHT (8 marks)

Track works are required across the Sydney rail network and 13 activities are needed to be completed. The network diagram below shows these activities, including their completion times in weeks.



(a) By forward scanning, find the earliest start time of activity K? **2**

14 weeks ✓

(b) Identify any critical paths and find how many of the 13 activities have zero float time. **3**

Critical paths - see diagram ✓

A D G L M

A E H L M 3 ✓

The activities with no float time are A, D, G, L, M, E, H 3 ✓

There are 7

(c) The contractor proposes a reduction in completion time for activites A, E, F, and L, at an additional cost. The table below summarises these costs. Each activity can only be reduced by a maximum of three weeks. **3**

If the overall completion time for the project can be reduced to 15 weeks, find the minimum cost of this change. Your answer should explain clearly why the minimum cost is achieved.

Activity	Weekly cost ($)
A	130 000
E	110 000
F	120 000
L	100 000

Current completion time is 19 weeks so it can be reduced by 4 weeks. Any reduction needs to be from a critical path - eliminate F

Consider ADGLM

options reduce A-3, L-1

A-2, L-2

A-1, L-3 *

cheapest is * at a cost of

130 000 + 3 x 100000 = $430 000

Consider AEHLM.

if we reduce E, then is no longer a critical path and will not allow time for D and G, so the minimum cost is as above

END OF PAPER