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Merewether High School

2024

Year 12 Mathematics Standard 2

Trial HSC : Assessment Task 4

General Instructions

- Reading Time – 10 minutes.
- Working Time – 2 hours and 30 minutes.
- Write using black pen.
- Calculators approved by NESA may be used.
- A reference sheet is provided.
- For questions in Section II, show relevant mathematical reasoning and/or calculations.
- Submit ALL work at the end of the examination.
- Diagrams are NOT drawn to scale.

Total Marks: 100

Section I - 15 marks (pages 2 – 10)

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

Section II - 85 marks (pages 11 – 34)

- Attempt Questions 16 – 38.
- Allow 2 hours and 5 minutes for this section.

Section I

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

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

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1 A household appliance is given an efficiency star rating shown on the label.

When star ratings of other brands are compared, what classification of data is being used?

A. Continuous

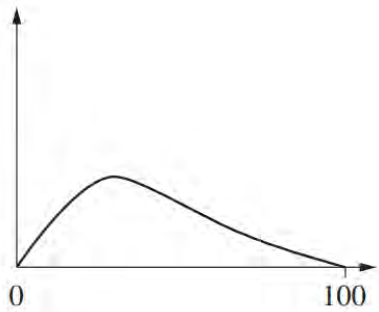
B. Discrete

C. Ordinal

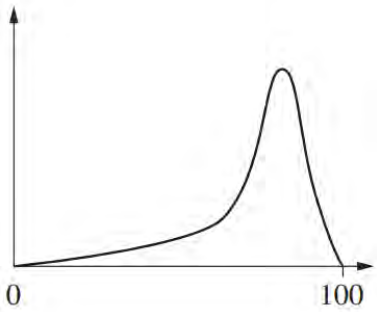
D. Nominal

2 Which of these graphs best represents positively skewed data with the smaller standard deviation?

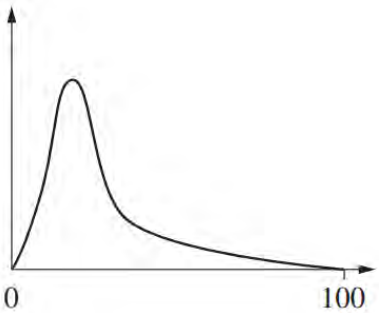
A.



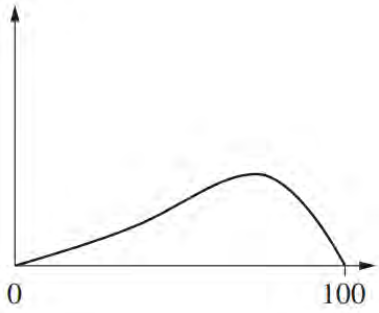
B.



C.



D.



3 Taylah is flying from Sydney (UTC+10) to Dubai (UTC+4), at a time when Sydney is on daylight saving time and Dubai is not.

She flies out at 4:30 pm on the 31st December, and the flight time is 14 hours.

What is the local time in Dubai when she arrives?

A. 10:30 pm on 31st December

B. 11:30 pm on 31st December

C. 12:30 am on 1st January

D. 1:30 am on 1st January

4 Which equation correctly gives Q as the subject of the formula: $p = \sqrt[3]{\frac{5Q}{2}}$

A. $Q = \frac{2p^3}{5}$

B. $Q = \frac{4p^3}{5}$

C. $Q = \frac{5p^3}{4}$

D. $Q = \frac{8p^3}{125}$

5 In a normally distributed set of scores, the mean is 72 and the standard deviation is 6. Approximately what percentage of the scores will lie between 60 and 84?

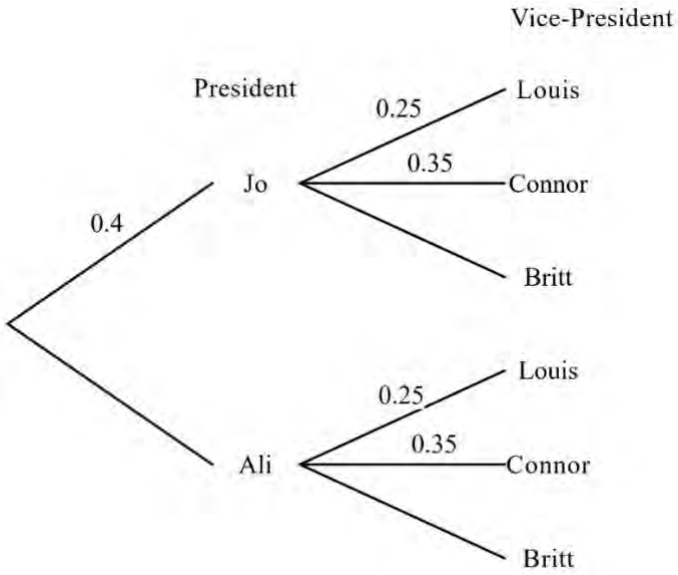
A. 34%

B. 68%

C. 95%

D. 99.7%

6 The partially completed probability tree shows the voting intentions of shareholders in an election for President and Vice-President of a large corporation.



Based on this survey, what is the probability that Ali is elected President, with either Britt or Connor as Vice-President?

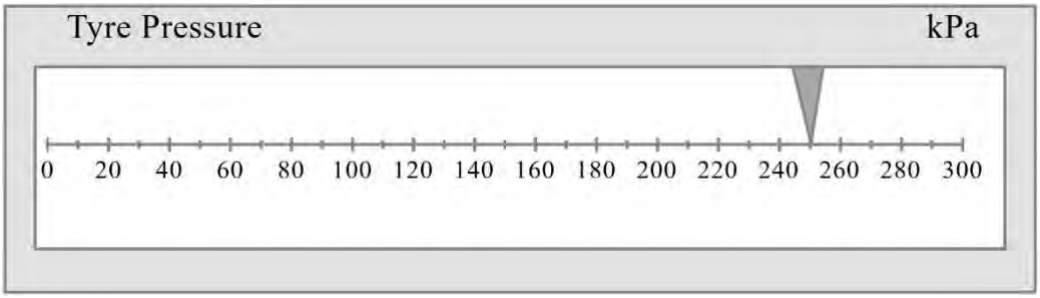
A. 0.21

B. 0.24

C. 0.45

D. 0.55

7 The tyre gauge below shows a pressure of 250 kilopascals.



What is the percentage error in this measurement?

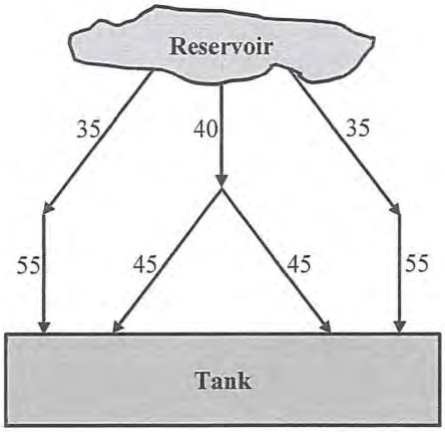
A. 2%

B. 2.5%

C. 4%

D. 5%

8 Water is being emptied from a reservoir and pumped through a series of 7 pipes to an empty tank shown in the network below.
The capacities (L/min) are shown for each pipe.



Based on the flow rates through the pipes, what volume of water (litres) would be in the tank 2 minutes after the water began flowing?

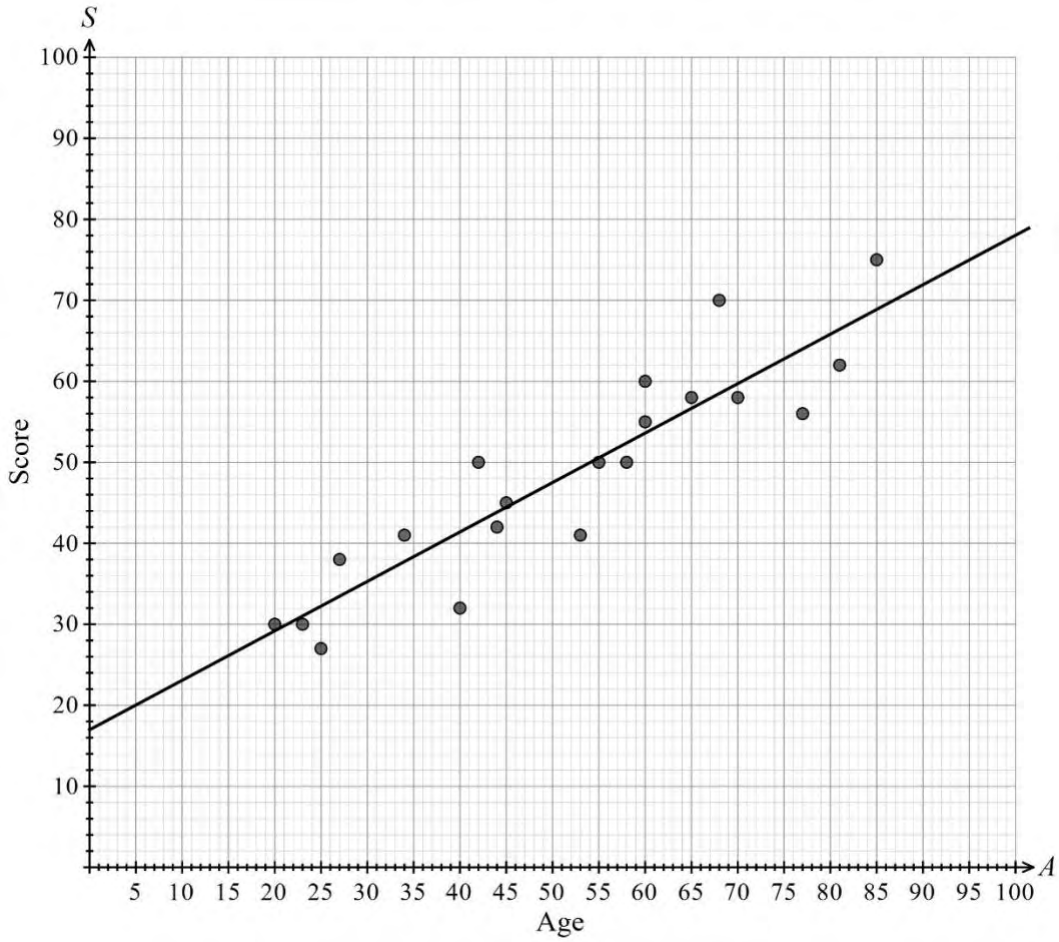
A. 200 litres

B. 220 litres

C. 300 litres

D. 700 litres

9 Jackson collected data on the ages of participants at a trivia night and their scores. The results are shown in the scatterplot below, along with a line-of-best-fit.



Which could be the value of the Pearson's correlation coefficient for this data?

A. -0.9

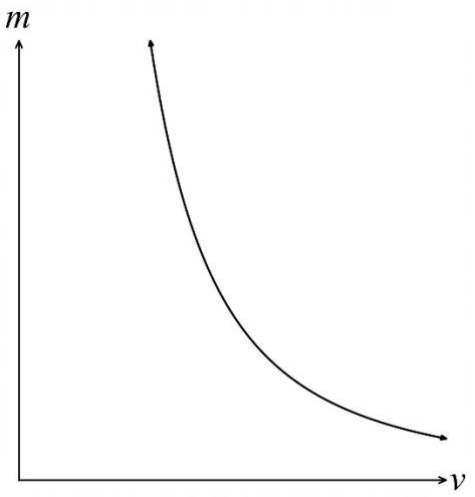
B. -0.1

C. 0.1

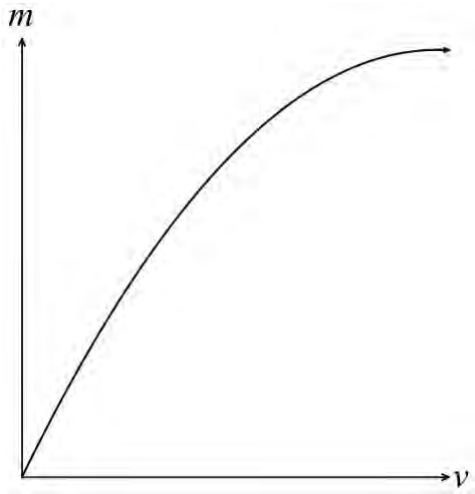
D. 0.9

10 It is known that a quantity m varies inversely with the square of a second quantity v. Which of these graphs could represent the relation between m and v ?

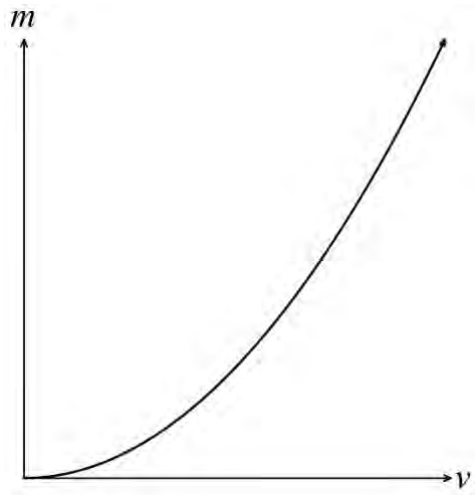
A.



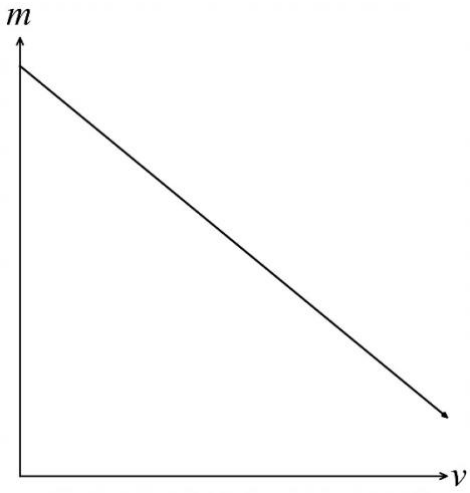
B.



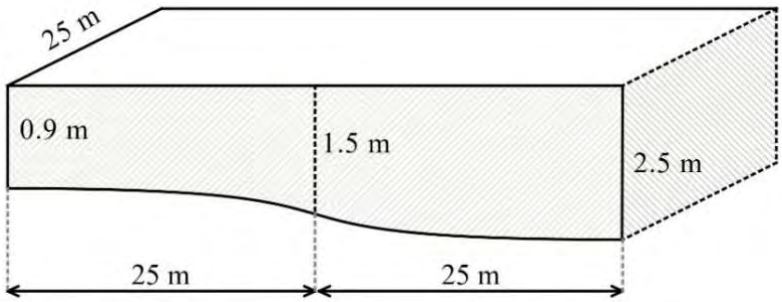
C.



D.



11 An Olympic swimming pool is 50 m long and 25 m wide and gradually increases in depth as shown in the cross section below.



By first using two applications of the trapezoidal rule to find the area of the cross-section, find the volume of the pool in cubic metres.

A. 2000 m^3

B. 2125 m^3

C. 4000 m^3

D. 4250 m^3

12 A test had the following five number summary: {20, 55, 61, 65, 73}.

Declan, Ross, and Mia scored the results below on the test

	Mark
Declan	69
Mia	73
Ross	30

Which of these results would be considered as outliers on the test?

A. Only Mia's result is an outlier.

B. Only Ross's result is an outlier.

C. Mia's and Ross's results are both outliers.

D. All three results are outliers.

13 The number of beads in two jars *A* and *B* are in the ratio 5 : 8.
When 5 beads are added to jar *A*, the new ratio of beads in the jars is now 5 : 6.
How many beads were initially in jar *A*?

A. 14

B. 15

C. 20

D. 30

14 Lachlan is concerned about the lizard population in the local community. He collects 170 lizards and tags them. A couple of months later he collects 32 lizards and found 10 of them were tagged. What is his estimate of the lizard population using the capture recapture method?

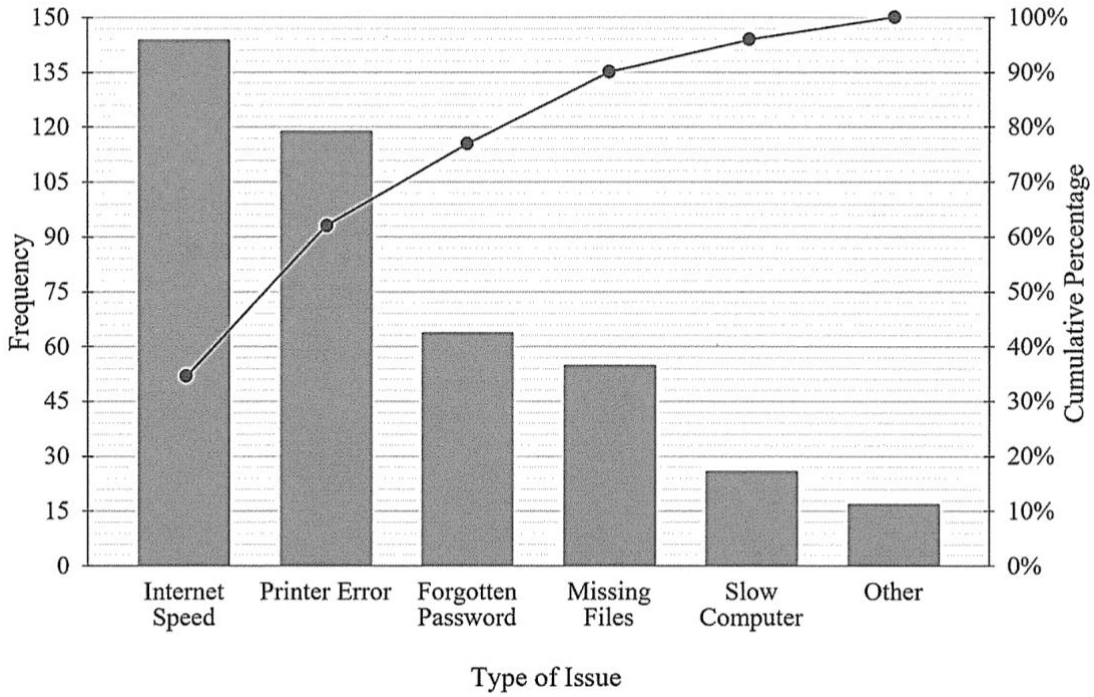
A. 53

B. 524

C. 536

D. 544

15 A company records the types of issues for IT support over a period of time. The results are shown in the Pareto chart below.



What percentage of issues were due to "Printer Error" or Forgotten Password"?

A. 15%

B. 28%

C. 43%

D. 60%

End of Section I

Mathematics Standard 2

Section II Answer Booklet

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85 marks

Attempt Question 16 – 38

Allow about 2 hours and 5 minutes for this section

Instructions

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

Please turn over

Question 16 (3 marks)

Solve the following equations:

(a) $\sqrt{x-7}=9$ **1**

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(b) $2y - 5 = \frac{y}{2}$ **2**

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Question 17 (1 mark)

The share price of a company is $16.25. The predicted yield is 2.2%. What would be the dividend? **1**

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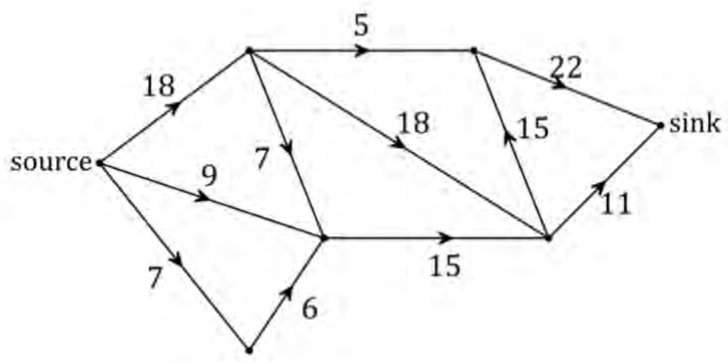
Question 18 (2 marks)

For the following network diagram:

(a) Draw the minimum cut on the diagram **1**



(b) Calculate the minimum cut. **1**

Minimum cut = ……

Question 19 (2 marks)

Isla's phone has a camera which takes photographs with an aspect ratio of 9 : 16.
(The aspect ratio is the ratio of the width to the length.)
She prints one such photograph, keeping the same aspect ratio, so that the width is 7.2 cm.
What is the area of the printed photograph? **2**

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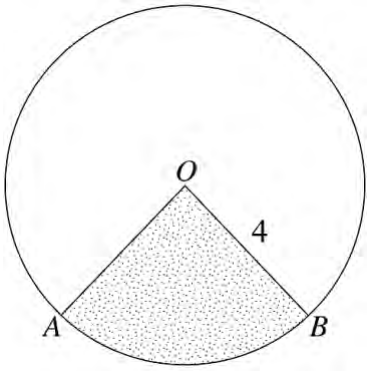
Question 20 (3 marks)

The circle centred at O has radius 4 cm. The area of the sector AOB is 10 cm^2. **3**



Find the length of the arc AB correct to 1 decimal place.

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Question 21 (2 marks)

The energy consumption of a computer in standby mode is 19 watts. The cost of electricity 28 cents per kWh. How much will the school save by switching off 80 computers during 2 weeks of school holiday? **2**

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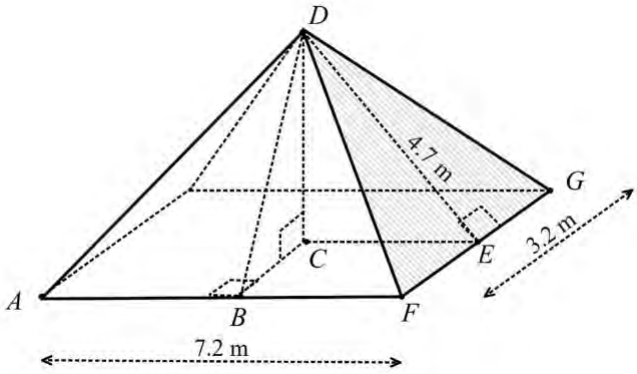
Question 22 (3 marks)

A cabin has a roof in the shape of a rectangular pyramid, as shown below.



AF = 7.2 m, FG = 3.2 m, DE = 4.7 m, and the vertical height DC = 3.0 m.
Find the length of DB and calculate the total surface area of the roof. **3**

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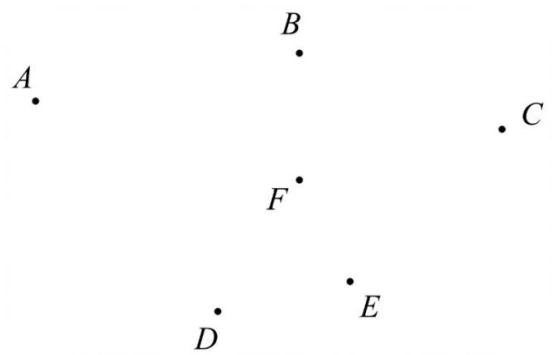
Question 23 (5 marks)

There are six accommodation buildings on a university campus, which are connected by paths.

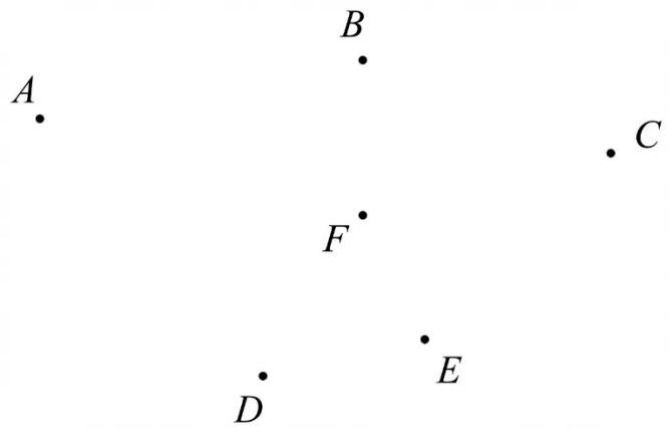
The table below shows the length of each path in metres.

Building	Archer	Bowen	Clarke	Dyson	Everly	Field
Archer		350	-	400	-	380
Bowen	350		300	-	-	120
Clarke	-	300		-	200	220
Dyson	400	-	-		110	-
Everly	-	-	200	110		180
Field	380	120	220	-	180	

(a) Use the vertices below to draw a weighted network diagram to represent the information in the table. **2**



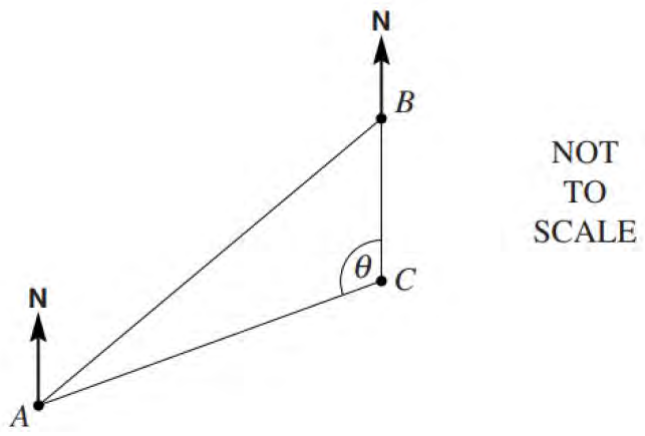
(b) The university wants to pave some of the paths so that it is possible to move between all the buildings on paved paths, but at a minimum cost.
Draw the minimum spanning tree that accomplishes this and give the length of paving required. **2**



(c) Length of paving required …… **1**

Question 24 (4 marks)

A hiking group walks from point A on a bearing of 058° for 21 km to point B. They then walk south until they reach a campsite, C, that is 18.5 km from A.
$\angle BCA$ is an obtuse angle with size θ.



(a) Calculate the size of angle θ. **2**

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(b) The hiking group continues to walk due south in search of a waterfall, W.
The waterfall is due east of point A. What is the distance, to the nearest metre, from the campsite, C, to the waterfall, W? **2**

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Question 25 (3 marks)

Lara owns a credit card that has no annual fees and charges 18.4% p.a. interest on all purchases. The interest is charged from the day of purchase, including the day of purchase.

(a) Show that the daily interest rate is 0.0504%. **1**

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(b) On the 29th June, Lara bought a TV for \$899 using her credit card. Lara paid her credit card account on the 10th July. What was the total amount she paid for the TV, including interest? Answer correct to the nearest cent. **2**

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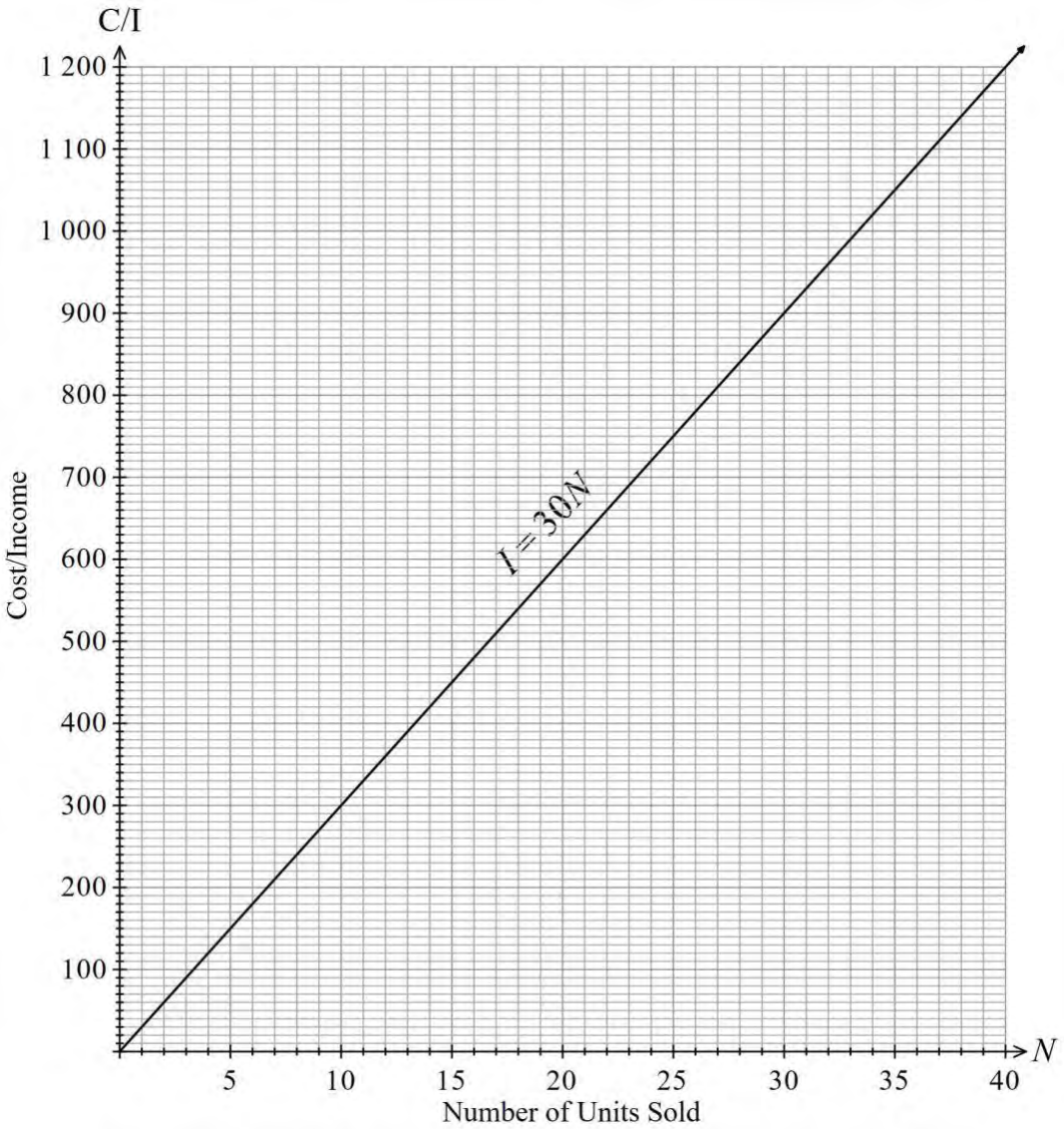
Question 26 (5 marks)

A wholesaler sells a device for \$30 each.



Each day their fixed costs (wages, rent etc) are \$300 and each device costs them \$10.

(a) The formula for the cost involved in selling N devices in a day is $C = 10N + 300$.

What is the cost when 20 devices are sold in a day? **1**

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(b) Draw the line representing the equation $C = 10N + 300$ on the graph above. **2**

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Question 26 continues on page 21

Question 26 (continued)

(c) How many devices would they need to sell in a day to break even? **1**

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(d) If the wholesaler sells 30 devices, determine if a profit or loss will occur. Justify your answer with calculations. **1**

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Questions 16 – 28 are worth 41 marks in total

Question 27 (5 marks)

James is paid a yearly salary of $80 500 and has allowable deductions of $3025.

The table below shows the current rates of income tax payable to the Australian Taxation Office.

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

Source: Australian Government: Australian Taxation Office

(a) Calculate James' total tax payable for the financial year, including the 2% Medicare Levy. **3**

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(b) James received a tax refund of $780 at the end of the financial year.

Calculate the amount of Pay As You Go (PAYG) tax that James paid each week. **2**

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Question 28 (3 marks)

Mary arrives at a party at 8:00 p.m. and wants to ensure her Blood Alcohol Content (*BAC*) is lower than 0.05 by 11:00 p.m. when it concludes.

If Mary weighs 52 kg, what is the maximum number of full standard alcoholic drinks (*N*) she can consume over the time *H* (hours) she is at the party?

[Use the formula: $BAC = \dfrac{10N - 7.5H}{5.5M}$ where *M* is mass (kg).] **3**

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Question 29 (3 marks)

Tom and Mike both purchase vehicles on the same day. Tom buys an SUV for $30 500, and Mike buys a motorbike for $27 450.
Both vehicles are depreciated using the declining balance method. The SUV depreciates at 12.5% per annum and the motor bike depreciates at 0.8% per month.

What is the difference in the value of the vehicles, exactly three years after their purchase?

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Question 30 (3 marks)

(a) An antique book was worth \$2450 on January 31st 2016 and it appreciated in value at an annual rate of 6% per annum compounding annually.
What is its value on January 31st 2024? **1**

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(b) A second book was bought for \$5650.00, and some years later had increased in value by \$2140.46.

Given that it appreciated at 5.5% per annum compounding annually, determine how many years it took to do this. **2**

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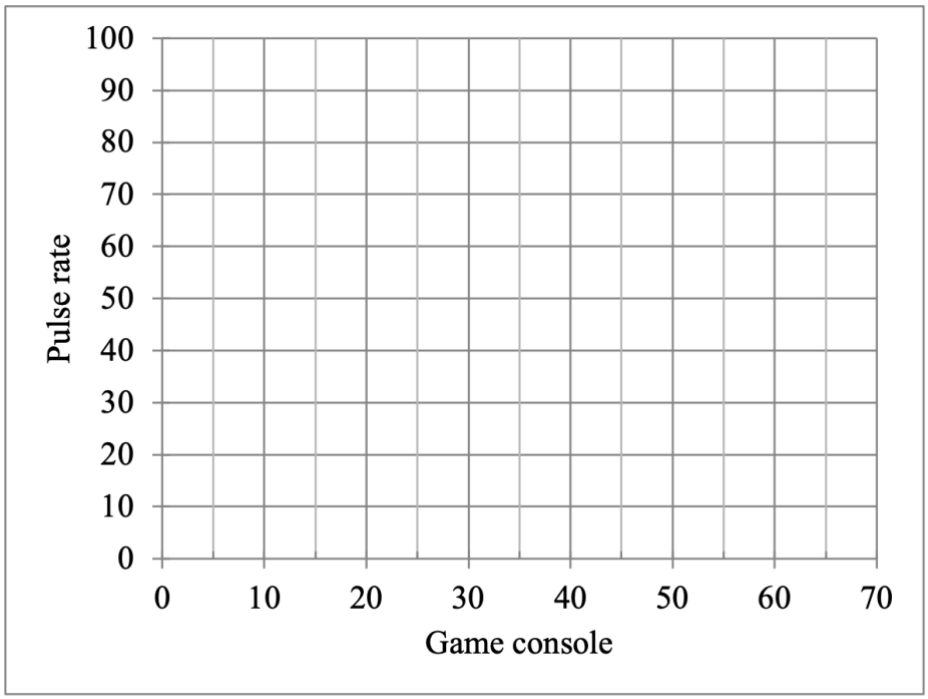
Question 31 (7 marks)

The table shows a student's score (x) on a game console and their pulse rate (y).

Score (x) Game Console	5	10	18	20	30	43	50	58	60	65
Pulse Rate (y)	97	90	85	77	75	64	70	64	60	55

(a) Draw a scatterplot and a line of best fit. **2**



(b) Write an equation for your line of best fit. **2**

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(c) Calculate Pearson's correlation coefficient. Answer correct to 2 decimal places. **1**

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(d) Write an equation for the least squares regression line. **2**

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Question 32 (4 marks)

Tables of future value and present value interest factors for an annuity of $1 are shown below.

Future Value Interest Factors for an Annuity of $1								
	Rate per Period							
Number of Periods	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%
5	5.101	5.204	5.309	5.416	5.526	5.637	5.751	5.867
10	10.462	10.950	11.464	12.006	12.578	13.181	13.816	14.487
20	22.019	24.297	26.870	29.778	33.066	36.786	40.995	45.762
30	34.785	40.568	47.575	56.085	66.439	79.058	94.461	113.283
40	48.886	60.402	75.401	95.026	120.800	154.762	199.635	259.057
50	64.463	84.579	112.797	152.667	209.348	290.336	406.529	573.770

Present Value Interest Factors for an Annuity of $1								
	Rate per Period							
Number of Periods	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818
30	25.808	22.396	19.600	17.292	15.372	13.765	12.409	11.258
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925
50	39.196	31.424	25.730	21.482	18.256	15.762	13.801	12.233

(a) Kara plans to deposit $5000 at the end of each year into an annuity paying 8.0% p.a. compounding annually. What is the value of her investment after 10 years? **2**

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(b) What amount could Kara invest now at 8.0% p.a. compounding annually, to achieve an amount of $72435 after 10 years? **2**

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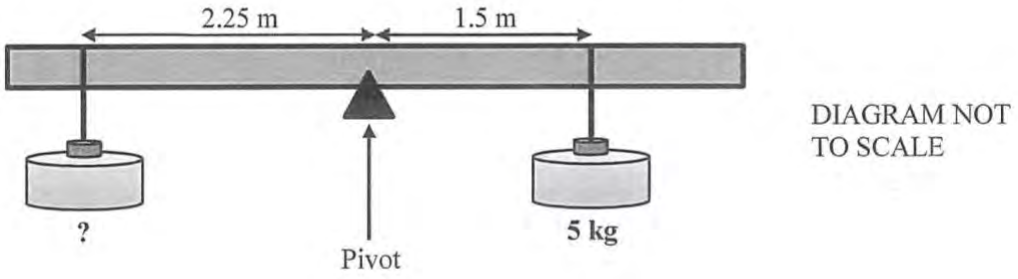
Question 33 (5 marks)

The weights (W), in kilograms, needed to keep a beam horizontal are related to their distances (d) in metres from the centre pivot of the beam.

The diagram below shows a typical beam with weights attached at respective distances of 2.25 m and 1.5 m from the centre pivot. One of the weights of 5 kg is shown.



(a) By writing an equation relating W and d, find the size of the weight at 2.25 m from the pivot to balance the beam. **3**

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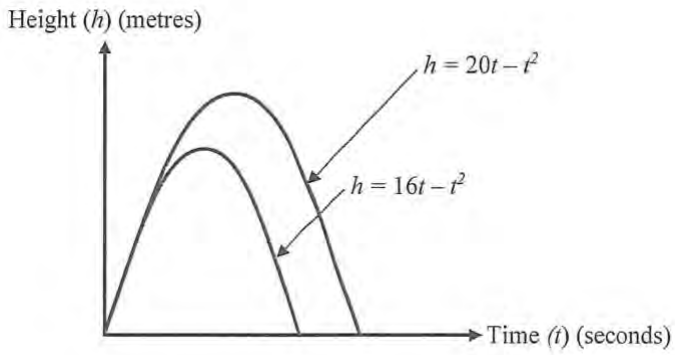
(b) On the axes below, draw a graph demonstrating the relationships between W and d showing the coordinates of two points on the graph. **2**

Question 34 (4 marks)

The diagram below shows the paths of two skyrockets, R_1 and R_2, after being fired into the air.
The paths of the rockets can be modelled by the equations:

$$R_1 : h = 16t - t^2 \quad \text{and} \quad R_2 : h = 20t - t^2$$



(a) Show the heights reached and the times of travel on the axes of the graph to determine how many seconds longer R_2 will take to reach its maximum height than R_1. **3**

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(b) How much further does R_2 travel than R_1? **1**

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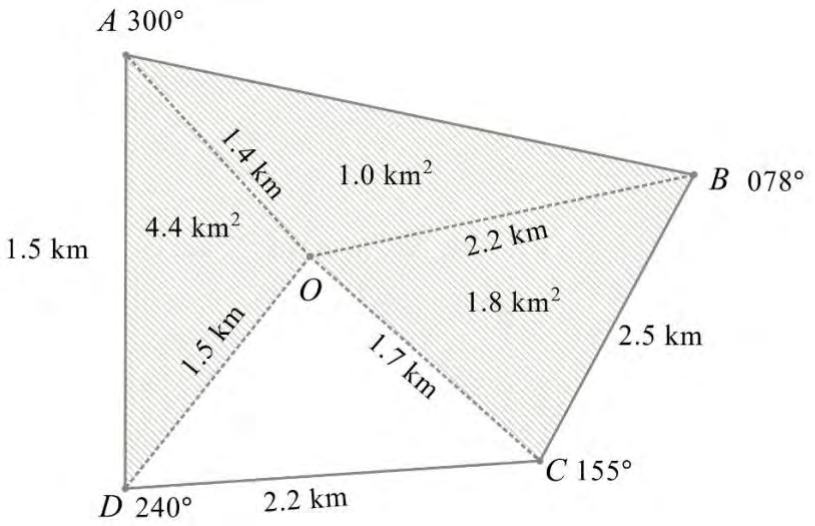
Question 35 (5 marks)

Chris completed a radial survey of one of his paddocks, which he has labelled *ABCD*, from a point *O* inside the paddock.

Using his measurements, he has calculated the length of three of the boundaries and the area of three of the triangular sections of the paddock.

His measurements and the results of his calculations are shown on the diagram below.



NOT TO SCALE

(a) Show that $\angle AOB = 138°$. **1**

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(b) Calculate the length of the boundary *AB* and find the perimeter of the paddock. **2**

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Question 35 continues on page 31

Question 35 continued

(c) Calculate the area of the entire paddock. **2**

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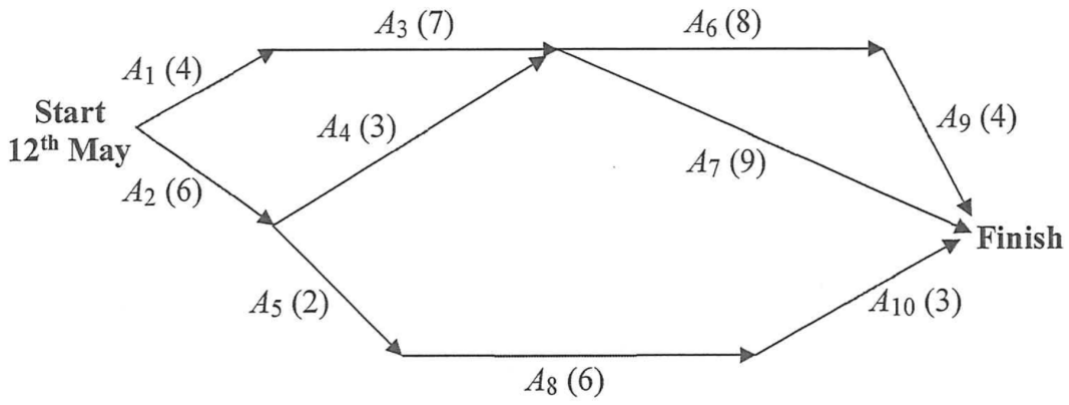
Question 36 (5 marks)

A project has 10 activities (A_1 - A_{10}) to be completed. The commencement date is Monday 12th May.

The network diagram below shows the duration of each activity (days).



(a) By listing the activities on the critical path of the project, determine on which day and month the project is expected to finished. **3**

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(b) If activity A_8 is delayed by 3 days, would the expected finishing date for the project be delayed? Justify your answer with calculations. **2**

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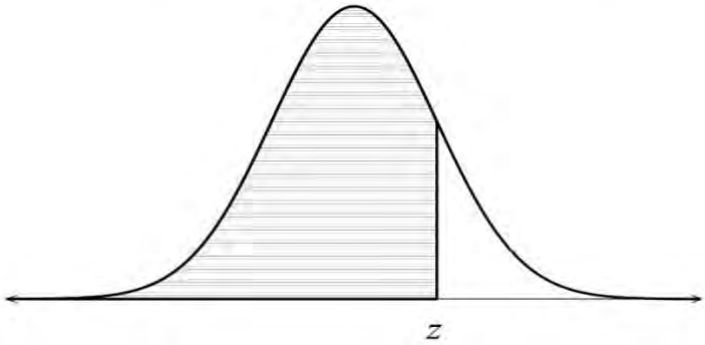
Question 37 (4 marks)

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

z	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Probability	0.6915	0.7258	0.7580	0.7881	0.8159	0.8413	0.8643	0.8849	0.9032	0.9192	0.9332

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



The marks on the entrance test for a scholarship are normally distributed with mean $\mu = 125$ and standard deviation $\sigma = 15$.

All students who scored above 143 marks on the entrance test received a full scholarship and those who score between 137 and 143 received a partial scholarship.

There were 1250 students who sat the examination. How many students received a partial scholarship? **4**

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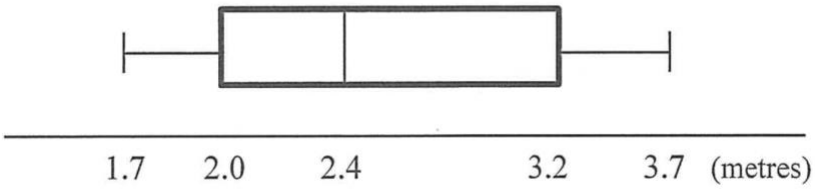
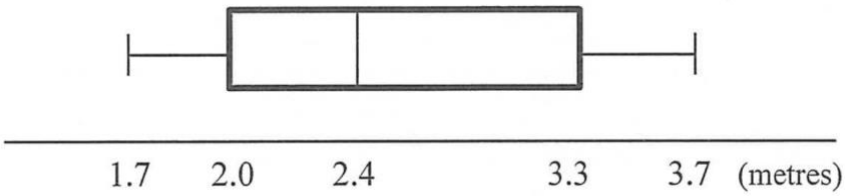
Question 38 (4 marks)

For research purposes, scientists capture and tag 7 crocodiles which are inhabiting a swamp.

The lengths (in metres) of these crocodiles have been recorded in the following box plot.



After an eighth crocodile was captured and tagged from the same swamp, a new box plot for the lengths of the eight captured crocodiles was drawn and is shown below.



Find the mean length of the eighth captured crocodile and the average length of all eight captured crocodiles? (Justify your answer with calculations.) **4**

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End of Paper

Section II extra writing space

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

Section II extra writing space

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

Attach sticker here

Merewether High School

2024

Year 12 Mathematics Standard 2

Trial HSC : Assessment Task 4

General Instructions

- Reading Time – 10 minutes.
- Working Time – 2 hours and 30 minutes.
- Write using black pen.
- Calculators approved by NESA may be used.
- A reference sheet is provided.
- For questions in Section II, show relevant mathematical reasoning and/or calculations.
- Submit ALL work at the end of the examination.
- Diagrams are NOT drawn to scale.

Total Marks: 100

Section I - 15 marks (pages 2 – 10)

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

Section II - 85 marks (pages 11 – 34)

- Attempt Questions 16 – 38.
- Allow 2 hours and 5 minutes for this section.

Section I

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

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

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1 A household appliance is given an efficiency star rating shown on the label.

When star ratings of other brands are compared, what classification of data is being used?

A. Continuous

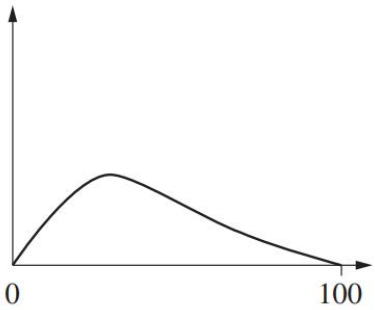
B. Discrete

C. Ordinal

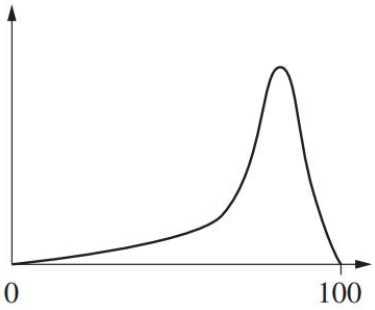
D. Nominal

2 Which of these graphs best represents positively skewed data with the smaller standard deviation?

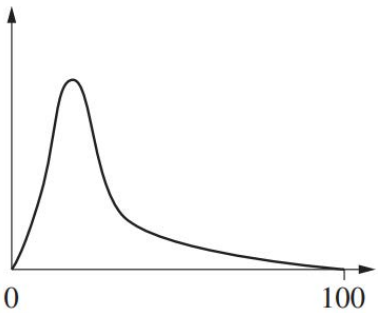
A.



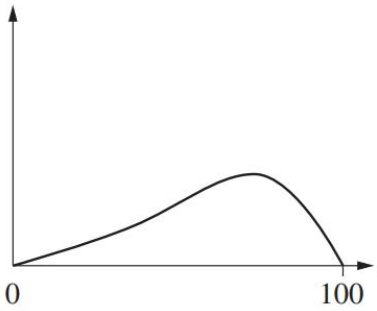
B.



C.



D.



+1 DST

3 Taylah is flying from Sydney (UTC+10) to Dubai (UTC+4), at a time when Sydney is on daylight saving time and Dubai is not.

She flies out at 4:30 pm on the 31st December, and the flight time is 14 hours.

What is the local time in Dubai when she arrives?

A. 10:30 pm on 31st December

B. 11:30 pm on 31st December

C. 12:30 am on 1st January

D. 1:30 am on 1st January

Dubai $\xrightarrow{+7}$ Sydney

4:30 pm 31/12

−7 hrs time difference

+14 hrs flight time

+7 ⇒ 11:30 pm 31/12

4 Which equation correctly gives Q as the subject of the formula: $p = \sqrt[3]{\frac{5Q}{2}}$

A. $Q = \frac{2p^3}{5}$

B. $Q = \frac{4p^3}{5}$

C. $Q = \frac{5p^3}{4}$

D. $Q = \frac{8p^3}{125}$

$p^3 = \frac{5Q}{2}$

$Q = \frac{2p^3}{5}$

5 In a normally distributed set of scores, the mean is 72 and the standard deviation is 6. Approximately what percentage of the scores will lie between 60 and 84?

A. 34%

B. 68%

C. 95%

D. 99.7%

$\bar{x} = 72$

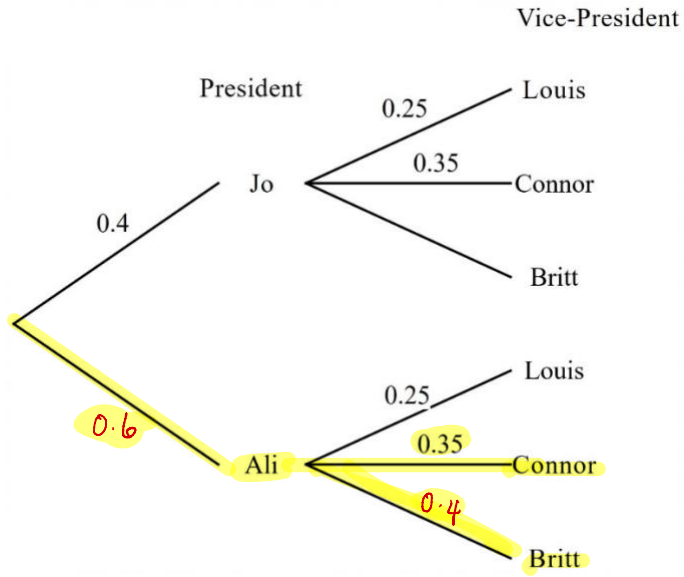
$\sigma = 6$

$12 = 2\sigma$

$-2\sigma \leftarrow \bar{x} \rightarrow 2\sigma$

60 72 84

6 The partially completed probability tree shows the voting intentions of shareholders in an election for President and Vice-President of a large corporation.



Based on this survey, what is the probability that Ali is elected President, with either Britt or Connor as Vice-President?

A. 0.21

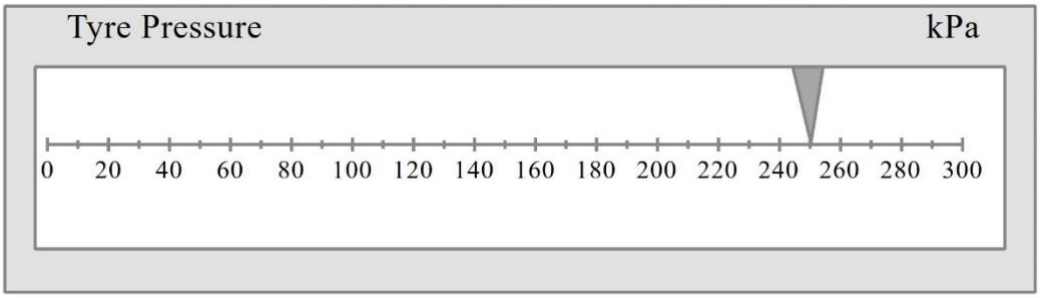
B. 0.24

C. 0.45

D. 0.55

$0.6 \times 0.35 + 0.6 \times 0.4 = 0.45$

7 The tyre gauge below shows a pressure of 250 kilopascals.



What is the percentage error in this measurement?

A. 2%

B. 2.5%

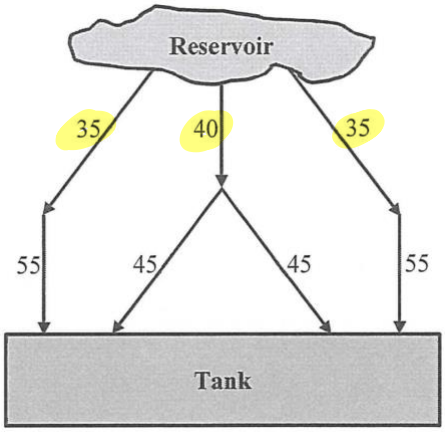
C. 4%

D. 5%

Absolute error $= \frac{1}{2} \times 10$ kPa
$= 5$ kPa

Percentage error $= \frac{5}{250} \times 100\%$
$= 2\%$

8 Water is being emptied from a reservoir and pumped through a series of 7 pipes to an empty tank shown in the network below.
The capacities (L/min) are shown for each pipe.



min flow
$35 + 40 + 35 = 110$ L/min

Based on the flow rates through the pipes, what volume of water (litres) would be in the tank 2 minutes after the water began flowing?

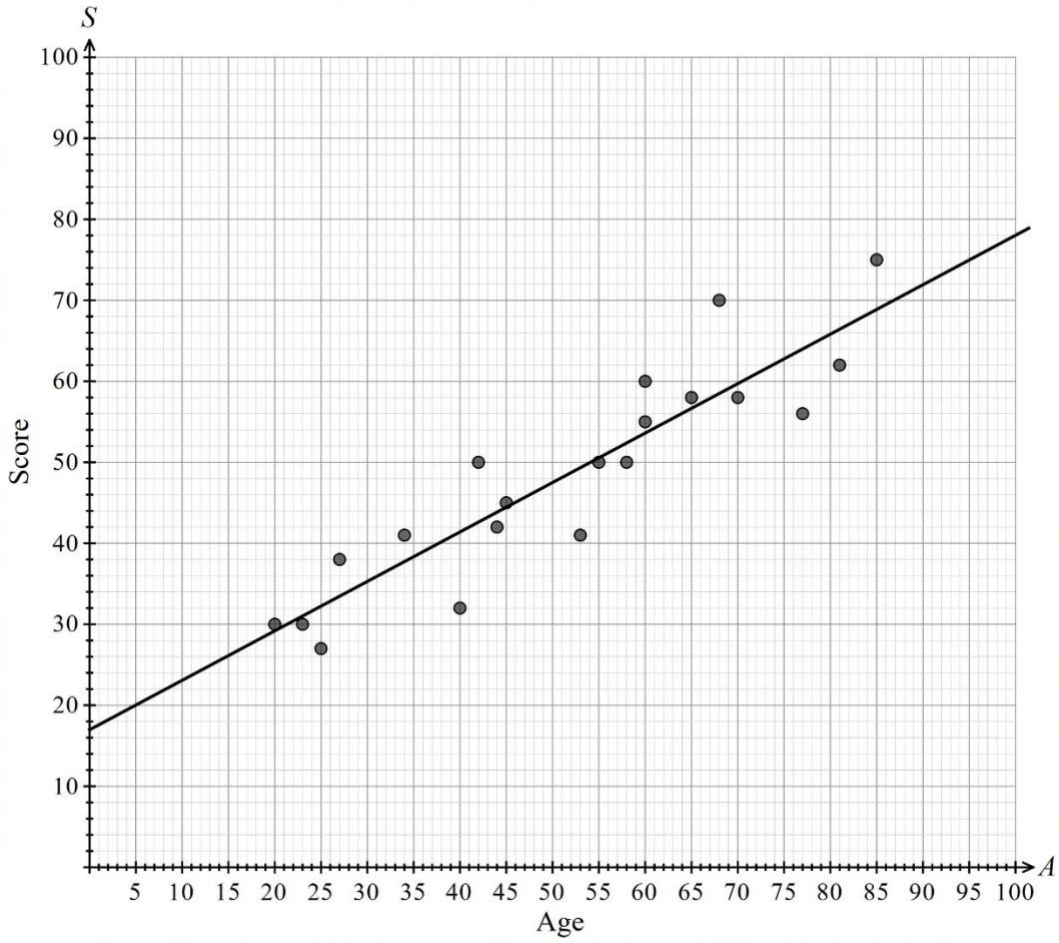
A. 200 litres

B. 220 litres

C. 300 litres

D. 700 litres

9 Jackson collected data on the ages of participants at a trivia night and their scores. The results are shown in the scatterplot below, along with a line-of-best-fit.



Which could be the value of the Pearson's correlation coefficient for this data?

A. -0.9

B. -0.1

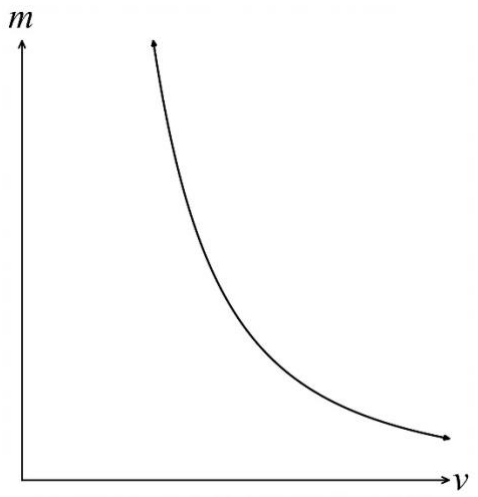
C. 0.1

D. 0.9

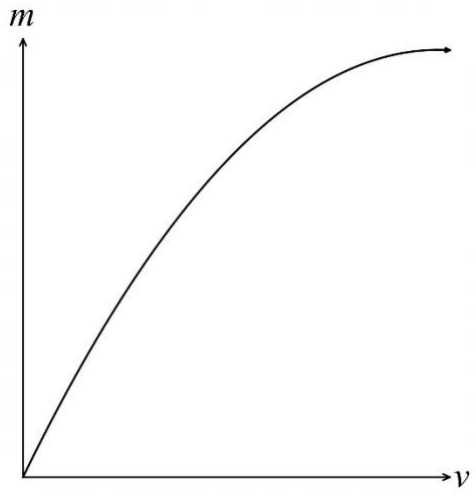
10 It is known that a quantity m varies inversely with the square of a second quantity v. Which of these graphs could represent the relation between m and v ?

$m = \frac{k}{v^2}$

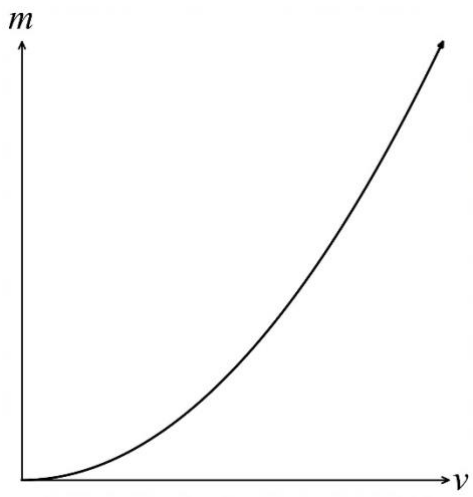
A.



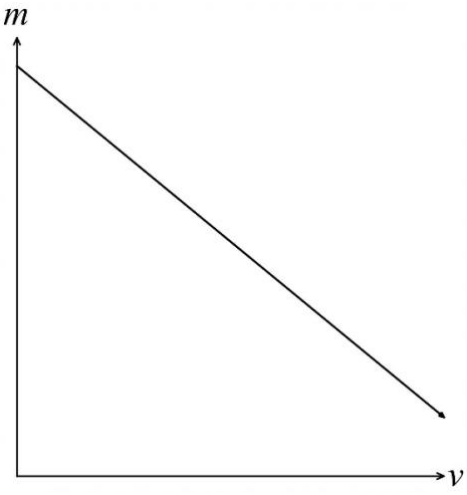
B.



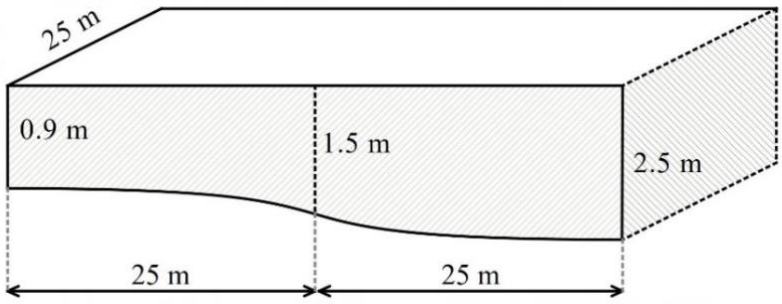
C.



D.



11 An Olympic swimming pool is 50 m long and 25 m wide and gradually increases in depth as shown in the cross section below.



By first using two applications of the trapezoidal rule to find the area of the cross-section, find the volume of the pool in cubic metres.

A. 2000 m^3

B. 2125 m^3

C. 4000 m^3

D. 4250 m^3

$A = \frac{25}{2}(0.9 + 1.5) + \frac{25}{2}(1.5 + 2.5)$

$= 30 + 50$

$= 80$

$V = 80 \times 25$

$= 2000 m^3$

12 A test had the following five number summary: {20, 55, 61, 65, 73}.

min Q_1 Q_2 Q_3 max

Declan, Ross, and Mia scored the results below on the test

	Mark
Declan	69 ✗
Mia	73 ✗
Ross	30 ✓

$IQR = 65 - 55$
$= 10$

$Q_1 - 1.5 \times IQR = 40$

$Q_3 + 1.5 \times IQR = 80$

Which of these results would be considered as outliers on the test?

A. Only Mia's result is an outlier.

B. Only Ross's result is an outlier.

C. Mia's and Ross's results are both outliers.

D. All three results are outliers.

13 The number of beads in two jars *A* and *B* are in the ratio 5 : 8.
When 5 beads are added to jar *A*, the new ratio of beads in the jars is now 5 : 6.
How many beads were initially in jar *A*?

A. 14

B. 15

C. 20

D. 30

A : B

5 : 8 initial

5b : 8b

5b+5 : 8b +5 Jar A

= 5 : 6

$\frac{5b+5}{5} = \frac{8b}{6}$

6(5b+5) = 5(8b)

30b + 30 = 40b

10b = 30

b = 3

5b = 5×3

= 15

14 Lachlan is concerned about the lizard population in the local community. He collects 170 lizards and tags them. A couple of months later he collects 32 lizards and found 10 of them were tagged. What is his estimate of the lizard population using the capture recapture method?

A. 53

B. 524

C. 536

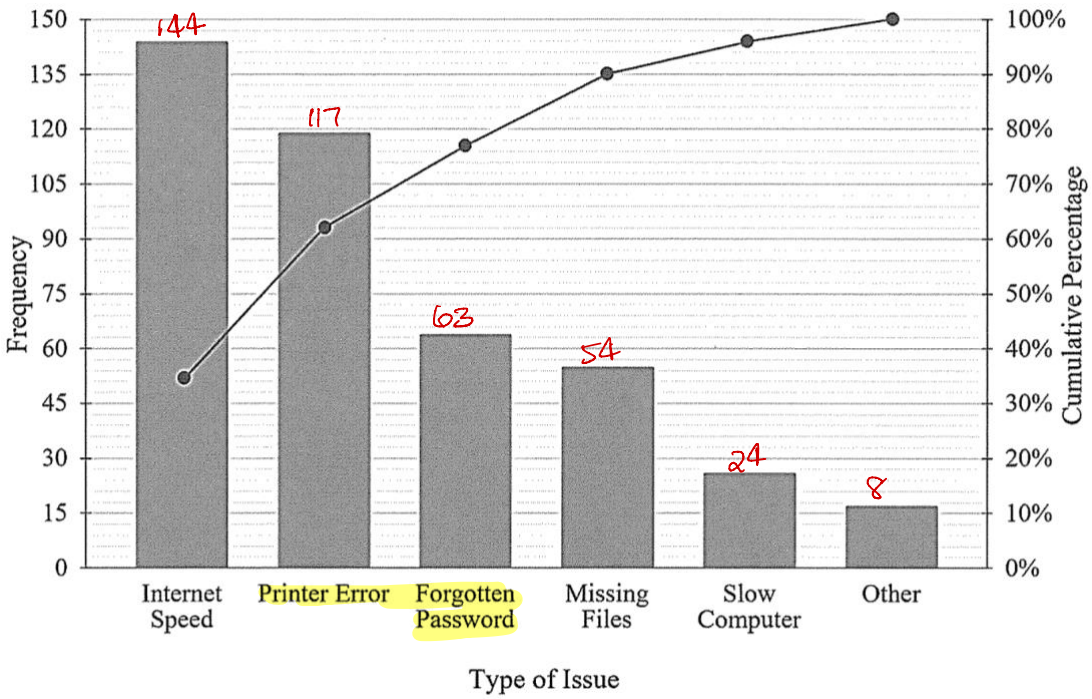
D. 544

$\frac{170}{P} = \frac{10}{32}$

$P = \frac{32 \times 170}{10}$

= 544

15 A company records the types of issues for IT support over a period of time. The results are shown in the Pareto chart below.



What percentage of issues were due to "Printer Error" or Forgotten Password"?

A. 15%

B. 28%

C. 43%

D. 60%

$\frac{117+63}{420} \times 100\%$

End of Section I

Mathematics Standard 2

Section II Answer Booklet

Attach sticker here

85 marks

Attempt Question 16 – 38

Allow about 2 hours and 5 minutes for this section

Instructions

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

Please turn over

Question 16 (3 marks)

Solve the following equations:

(a) $\sqrt{x-7}=9$ **1**

$x-7=81$

$x=88$

(b) $2y - 5 = \frac{y}{2}$ **2**

$2(2y-5)=y$

$4y-10=y$

$3y=10$

$y=\frac{10}{3}$

Question 17 (1 mark)

The share price of a company is \$16.25. The predicted yield is 2.2%. What would be the dividend? **1**

$$D.Y = \frac{\text{dividend per share}}{\text{market price per share}} \times 100\%$$

$$2.2\% = \frac{D}{\$16.25} \times 100\%$$

$$0.022 = \frac{D}{16.25} \times 1$$

$$\text{dividend} = 0.022 \times 16.25$$

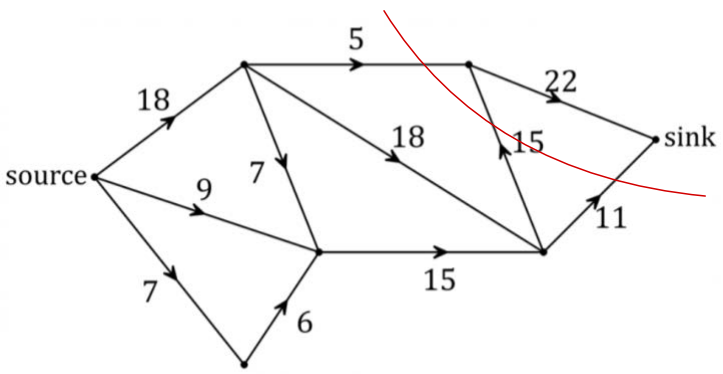
$$= 0.3575$$

$$\doteqdot 0.36$$

Question 18 (2 marks)

For the following network diagram:

(a) Draw the minimum cut on the diagram **1**



(b) Calculate the minimum cut. **1**

Minimum cut = 31

Question 19 (2 marks)

Isla's phone has a camera which takes photographs with an aspect ratio of 9 : 16.

(The aspect ratio is the ratio of the width to the length.)

She prints one such photograph, keeping the same aspect ratio, so that the width is 7.2 cm.

What is the area of the printed photograph? **2**

w : L

9 : 16

9 units = 7.2 cm

1 unit = 0.8 cm

∴ 16 units = 16 × 0.8

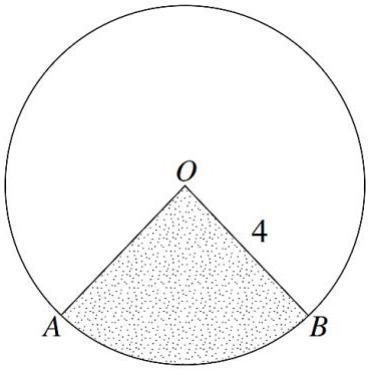
= 12.8

Area = 7.2 × 12.8

= 92.16 cm^2

Question 20 (3 marks)

The circle centred at O has radius 4 cm. The area of the sector AOB is 10 cm^2. **3**



Find the length of the arc AB correct to 1 decimal place.

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

$10 = \frac{\theta}{360} \times \pi \times 4^2$

$\theta = \frac{10 \times 360}{16\pi}$

$= 71.62$

$l = \frac{71.62}{360} \times 2\pi \times 4$

$= 5\text{cm}$

Question 21 (2 marks)

The energy consumption of a computer in standby mode is 19 watts. The cost of electricity 28 cents per kWh. How much will the school save by switching off 80 computers during 2 weeks of school holiday? **2**

Watts used $= 80 \times 19 \times 24 \times 14$

$= 510\,720$ W

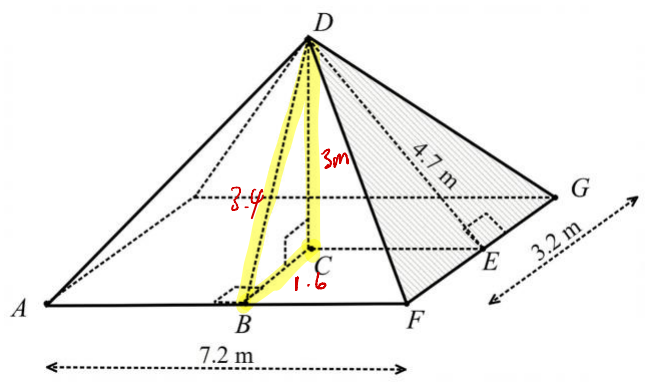
$= 510.720$ kW

Cost $= 510.72 \times 0.28$

$= \$143.00$

Question 22 (3 marks)

A cabin has a roof in the shape of a rectangular pyramid, as shown below.



AF = 7.2 m, FG = 3.2 m, DE = 4.7 m, and the vertical height DC = 3.0 m.
Find the length of DB and calculate the total surface area of the roof. **3**

$DB^2 = 1.6^2 + 3^2$

$= 11.56$

$DB = \sqrt{11.56}$

$= 3.4$ (1)

$SA = 2\left(\frac{3.4 \times 7.2}{2} + \frac{4.7 \times 3.2}{2}\right)$ (1)

$= 2(12.24 + 7.52)$

$= 39.52\ m^2$ (1)

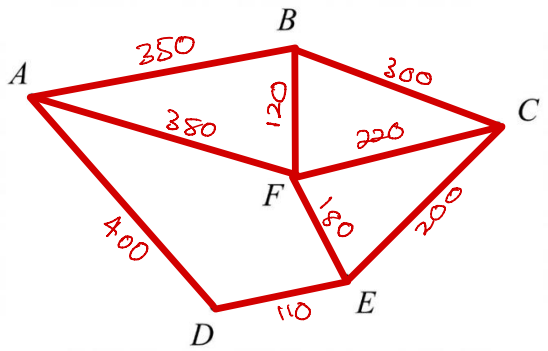
Question 23 (5 marks)

There are six accommodation buildings on a university campus, which are connected by paths.

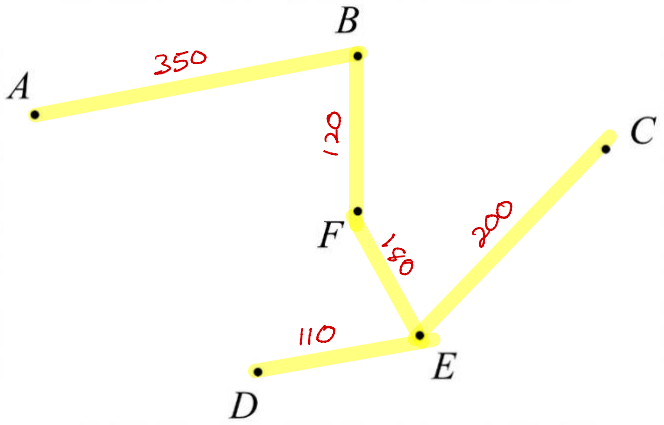
The table below shows the length of each path in metres.

Building	Archer	Bowen	Clarke	Dyson	Everly	Field
Archer		350	-	400	-	380
Bowen	350		300	-	-	120
Clarke	-	300		-	200	220
Dyson	400	-	-		110	-
Everly	-	-	200	110		180
Field	380	120	220	-	180	

(a) Use the vertices below to draw a weighted network diagram to represent the information in the table. **2**



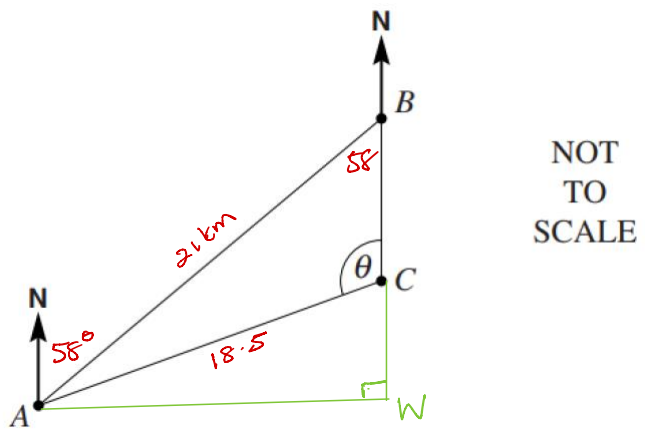
(b) The university wants to pave some of the paths so that it is possible to move between all the buildings on paved paths, but at a minimum cost.
Draw the minimum spanning tree that accomplishes this and give the length of paving required. **2**



(c) Length of paving required ……960 m…… **1**

Question 24 (4 marks)

A hiking group walks from point A on a bearing of 058° for 21 km to point B. They then walk south until they reach a campsite, C, that is 18.5 km from A.
$\angle BCA$ is an obtuse angle with size θ.



(a) Calculate the size of angle θ. **2**

$\frac{\sin\theta}{21} = \frac{\sin 58}{18.5}$

$\sin\theta = \frac{21 \sin 58}{18.5}$

$\theta = \sin^{-1}\left(\frac{21 \sin 58^\circ}{18.5}\right)$

$= 74.29$ (1)

$= 74^\circ 17'$

$\theta = 180^\circ - 74^\circ 17'$

$= 105^\circ 43$

(b) The hiking group continues to walk due south in search of a waterfall, W.
The waterfall is due east of point A. What is the distance, to the nearest metre, from the campsite, C, to the waterfall, W? **2**

$\cos 74^\circ 17' = \frac{CW}{18.5}$

$CW = 5.0092$ km (1)

$= 5\,009$ m (1)

Question 25 (3 marks)

Lara owns a credit card that has no annual fees and charges 18.4% p.a. interest on all purchases. The interest is charged from the day of purchase, including the day of purchase.

(a) Show that the daily interest rate is 0.0504%. **1**

$18.4\% \text{ pa} = \frac{18.4\%}{365} \text{ p.d}$

$= 0.0504\%$

(b) On the 29th June, Lara bought a TV for $899 using her credit card. Lara paid her credit card account on the 10th July. What was the total amount she paid for the TV, including interest? Answer correct to the nearest cent. **2**

(July) 10 days + (June) 2 days = 12 days

Interest $= 12 \times 0.0504\% \times 899$

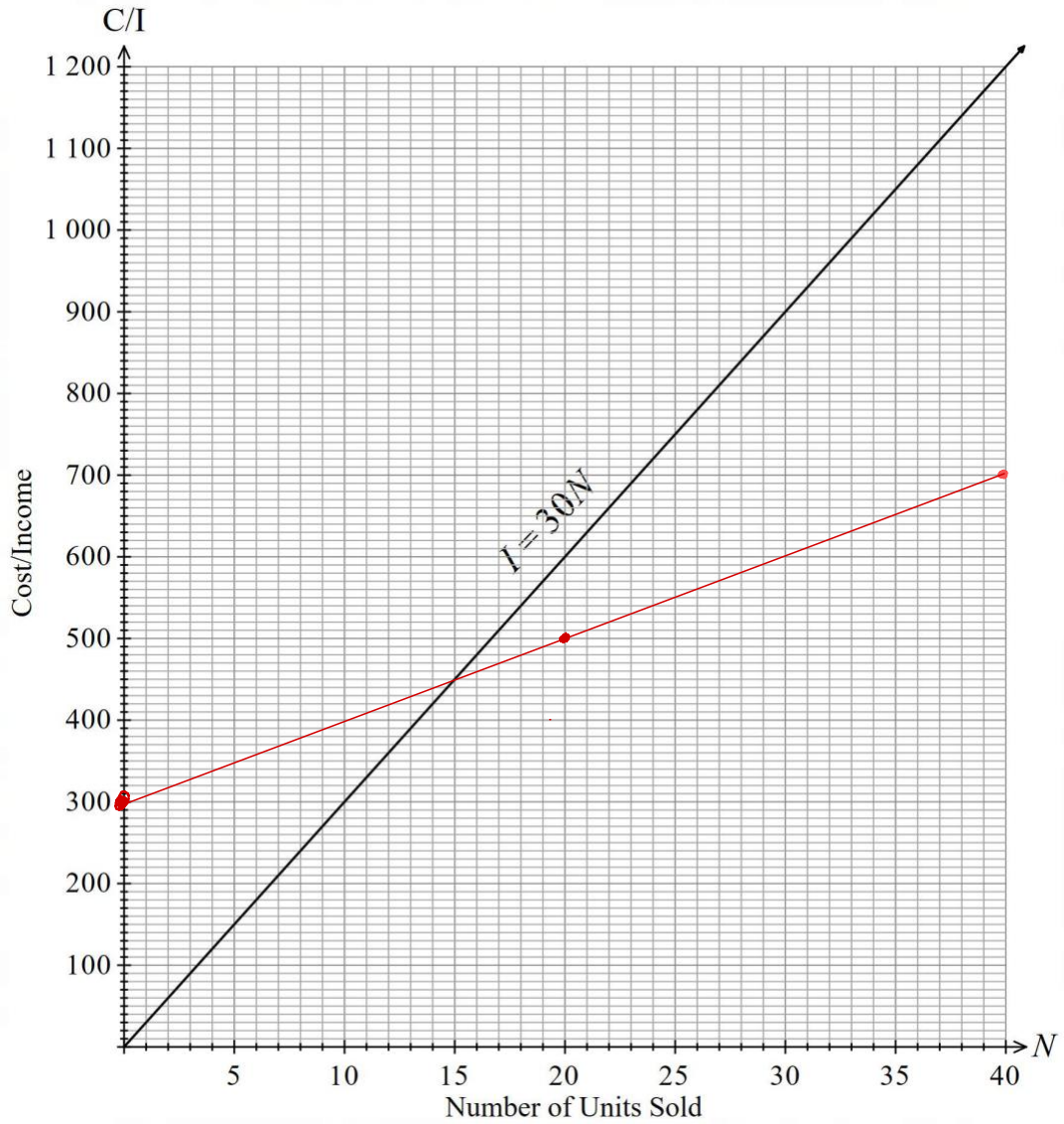
$= \$5.437$

Total Paid $= 899 + 5.44$

$= \$904.44$

Question 26 (5 marks)

A wholesaler sells a device for \$30 each.



Each day their fixed costs (wages, rent etc) are \$300 and each device costs them \$10.

(a) The formula for the cost involved in selling N devices in a day is $C = 10N + 300$.

What is the cost when 20 devices are sold in a day? **1**

$C = 10 \times 20 + 300$

$= 500$

(b) Draw the line representing the equation $C = 10N + 300$ on the graph above. **2**

Question 26 continues on page 21

Question 26 (continued)

(c) How many devices would they need to sell in a day to break even? **1**

15

(d) If the wholesaler sells 30 devices, determine if a profit or loss will occur. Justify your answer with calculations. **1**

30 devices $C = 10 \times 30 + 300$ $I = 30 \times 30$

$= 600$ $= 900$

Profit $= I - C$

$= 900 - 600$

$= 300$

Questions 16 – 28 are worth 41 marks in total

Question 27 (5 marks)

James is paid a yearly salary of $80 500 and has allowable deductions of $3025.

The table below shows the current rates of income tax payable to the Australian Taxation Office.

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

Source: Australian Government: Australian Taxation Office

(a) Calculate James' total tax payable for the financial year, including the 2% Medicare Levy. **3**

Taxable Income = 80500 − 3025 = $77475

Tax Payable = $5092 + (77475 − 45000) × 32.5¢

= $15646.375

Medicare = 2% Tax Payable = 2% × 77475 = $1549.50

∴ Total Tax Payable = $15646.37 + $1549.50

= $17195.87

(b) James received a tax refund of $780 at the end of the financial year.

Calculate the amount of Pay As You Go (PAYG) tax that James paid each week. **2**

PAYG tax paid = (17195.87 + 780) ÷ 52

= $345.69

Question 28 (3 marks)

Mary arrives at a party at 8:00 p.m. and wants to ensure her Blood Alcohol Content (*BAC*) is lower than 0.05 by 11:00 p.m. when it concludes.

If Mary weighs 52 kg, what is the maximum number of full standard alcoholic drinks (*N*) she can consume over the time *H* (hours) she is at the party?

[Use the formula: $BAC = \dfrac{10N - 7.5H}{5.5M}$ where *M* is mass (kg).] **3**

Mary at party 3 hrs

Need BAC < 0.05

$$\frac{10N - 7.5 \times 3}{5.5 \times 52} < 0.05$$

$$10N < (0.05 \times 5.5 \times 52) + 7.5 \times 3$$

$$10N < 36.8$$

$$N < 3.68$$

∴ Mary can consume no more than 3 standard drinks

Question 29 (3 marks)

Tom and Mike both purchase vehicles on the same day. Tom buys an SUV for $30 500, and Mike buys a motorbike for $27 450.
Both vehicles are depreciated using the declining balance method. The SUV depreciates at 12.5% per annum and the motor bike depreciates at 0.8% per month.

What is the difference in the value of the vehicles, exactly three years after their purchase?

3

Tom

$S = 30500(1-12.5\%)^3$

$= 30500 \times 0.875^3$

$= \$20432.617$ (1)

Mike

$S = 27450 \times (1-0.8\%)^{36}$

$= 24450 \times 0.992^{36}$

$= \$20\,557.13$ (1)

Tom's vehicle is valued $124.52 less than Mike's (1)

Question 30 (3 marks)

(a) An antique book was worth \$2450 on January 31st 2016 and it appreciated in value at an annual rate of 6% per annum compounding annually.
What is its value on January 31st 2024? **1**

$V = 2450\ (1+0.06)^8$

$= \$3904.93$

(b) A second book was bought for \$5650.00, and some years later had increased in value by \$2140.46.

Given that it appreciated at 5.5% per annum compounding annually, determine how many years it took to do this. **2**

Present Value

$(5650 + 2140.46) = 5650\ (1+0.055)^n$

$7790.46 = 5650\ (1.055)^n$

$5650\ (1.055)^5 = \$7384.32$

$5650\ (1.055)^6 = \$7790.46$

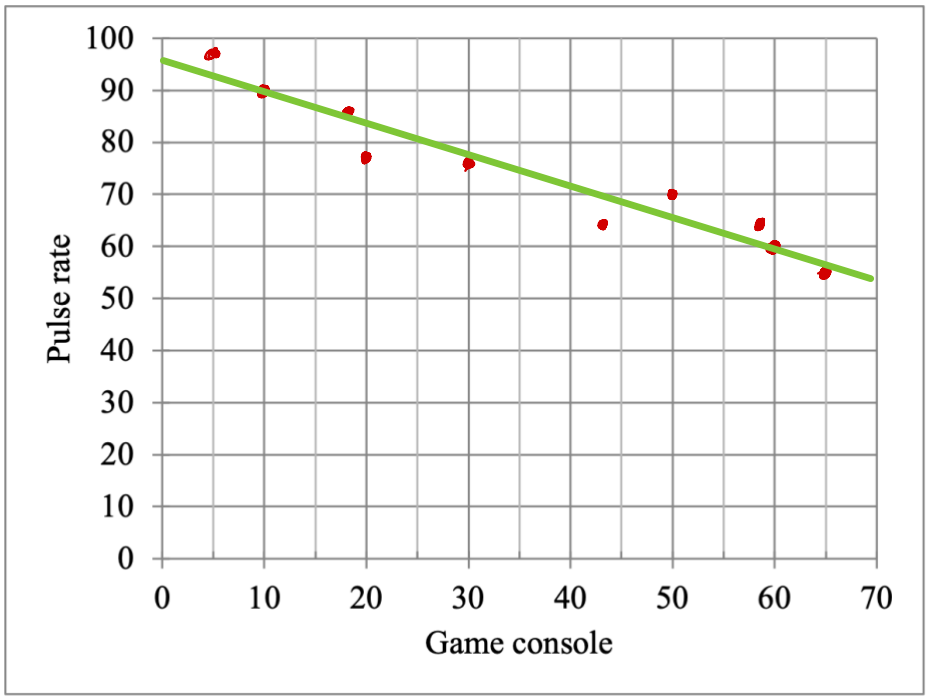
$\therefore$ required term was 6 yrs

Question 31 (7 marks)

The table shows a student's score (x) on a game console and their pulse rate (y).

Score (x) Game Console	5	10	18	20	30	43	50	58	60	65
Pulse Rate (y)	97	90	85	77	75	64	70	64	60	55

(a) Draw a scatterplot and a line of best fit. **2**



(b) Write an equation for your line of best fit. **2**

$m = \frac{90-60}{10-60} = \frac{30}{-50} = -\frac{3}{5}$ $b = 96$

$y = -\frac{3}{5}x + b$ $y = -\frac{3}{5}x + 96$

$90 = -\frac{3}{5} \times 10 + b$

$90 = -6 + b$

(c) Calculate Pearson's correlation coefficient. Answer correct to 2 decimal places. **1**

$r = -0.95936\ldots$ -0.96

(d) Write an equation for the least squares regression line. **2**

$A = 95.0356$ (1) $y = -0.5943x + 95.04$ (1)

$B = -0.5943$

Question 32 (4 marks)

Tables of future value and present value interest factors for an annuity of $1 are shown below.

Future Value Interest Factors for an Annuity of $1								
	Rate per Period							
Number of Periods	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%
5	5.101	5.204	5.309	5.416	5.526	5.637	5.751	5.867
10	10.462	10.950	11.464	12.006	12.578	13.181	13.816	14.487
20	22.019	24.297	26.870	29.778	33.066	36.786	40.995	45.762
30	34.785	40.568	47.575	56.085	66.439	79.058	94.461	113.283
40	48.886	60.402	75.401	95.026	120.800	154.762	199.635	259.057
50	64.463	84.579	112.797	152.667	209.348	290.336	406.529	573.770

Present Value Interest Factors for an Annuity of $1								
	Rate per Period							
Number of Periods	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818
30	25.808	22.396	19.600	17.292	15.372	13.765	12.409	11.258
40	32.835	27.355	23.115	19.793	17.159	15.046	13.332	11.925
50	39.196	31.424	25.730	21.482	18.256	15.762	13.801	12.233

(a) Kara plans to deposit $5000 at the end of each year into an annuity paying 8.0% p.a. compounding annually. What is the value of her investment after 10 years? **2**

FV = 5000 × 14.487

= $72 435

(b) What amount could Kara invest now at 8.0% p.a. compounding annually, to achieve an amount of $72435 after 10 years? **2**

$72435 = P(1 + 0.08)^{10}$

$P = \frac{72435}{1.08^{10}}$

= $33 551

PV = 5000 × 6.710

= $33550

Question 33 (5 marks)

The weights (W), in kilograms, needed to keep a beam horizontal are related to their distances (d) in metres from the centre pivot of the beam.

The diagram below shows a typical beam with weights attached at respective distances of 2.25 m and 1.5 m from the centre pivot. One of the weights of 5 kg is shown.

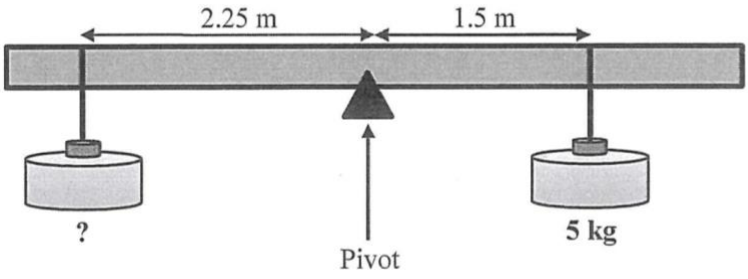


DIAGRAM NOT TO SCALE

(a) By writing an equation relating W and d, find the size of the weight at 2.25 m from the pivot to balance the beam. **3**

$d = \frac{k}{W}$ $\quad d = \frac{7.5}{W}$ (1)

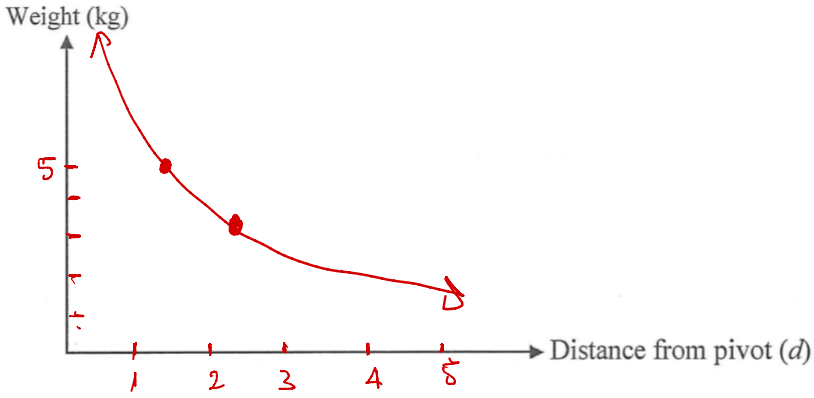
$1.5 = \frac{k}{5}$

$k = 7.5$ (1) $\quad 2.25 = \frac{7.5}{W}$

$W = \frac{7.5}{2.25}$

$= 3.3$ kg

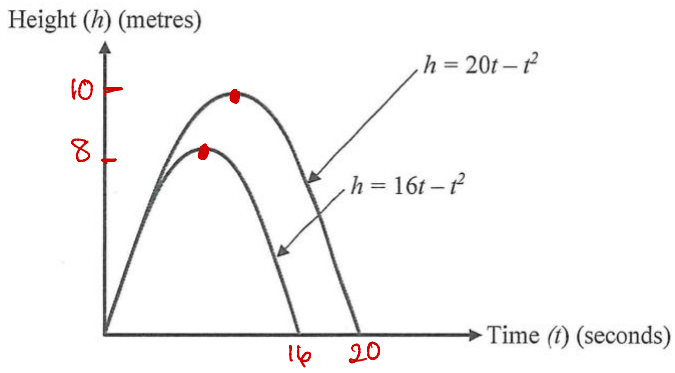
(b) On the axes below, draw a graph demonstrating the relationships between W and d showing the coordinates of two points on the graph. **2**



Question 34 (4 marks)

The diagram below shows the paths of two skyrockets, R_1 and R_2, after being fired into the air.
The paths of the rockets can be modelled by the equations:

$$R_1 : h = 16t - t^2 \quad \text{and} \quad R_2 : h = 20t - t^2$$



(a) Show the heights reached and the times of travel on the axes of the graph to determine how many seconds longer R_2 will take to reach its maximum height than R_1. **3**

R_1 $h = 16t - t^2$ $h = t(16-t)$ $t = 0$ and 16 max at $t = 8$

R_2 $h = 20t - t^2$ $h = t(20-t)$ $t = 0$ and 20 max at $t = 10$

R_2 will take 2 seconds longer than R_1

(b) How much further does R_2 travel than R_1? **1**

R_1 $t = 8$ $h = 16 \times 8 - 8^2$ $= 64$

R_2 $t = 10$ $h = 20 \times 10 - 10^2$ $= 100$

total distance

$R_1 = 128$ $R_2 = 200$

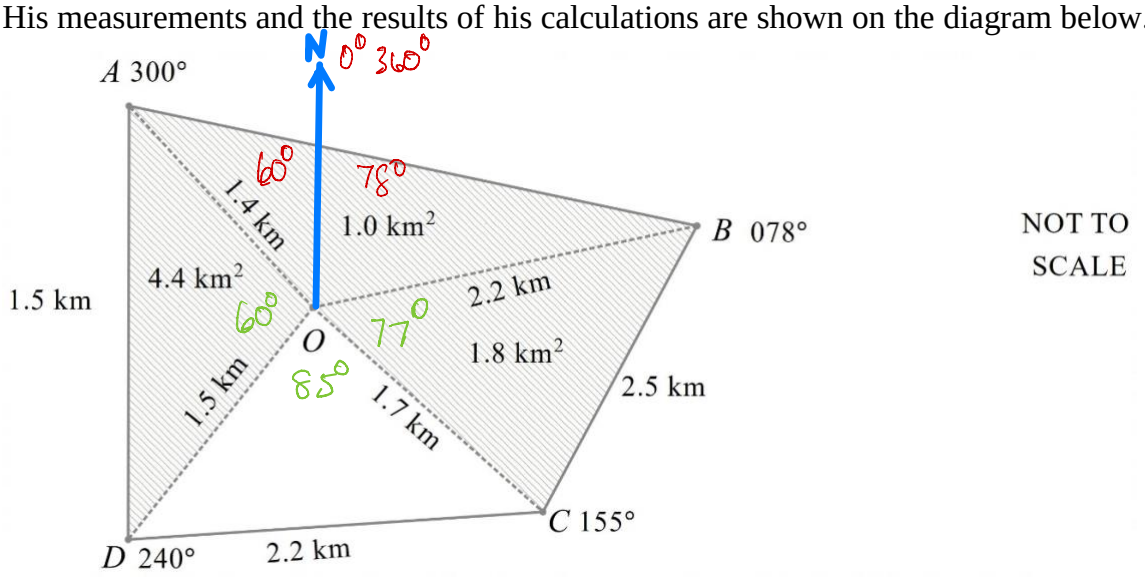
R_2 will travel 72 m more than R_1

Question 35 (5 marks)

Chris completed a radial survey of one of his paddocks, which he has labelled *ABCD*, from a point *O* inside the paddock.

Using his measurements, he has calculated the length of three of the boundaries and the area of three of the triangular sections of the paddock.

His measurements and the results of his calculations are shown on the diagram below.



(a) Show that $\angle AOB = 138°$. **1**

$\angle AOB = \angle AON + \angle NOB$

$= (360° - 300°) + (78° - 0°)$

$= 138°$

OR $= 360° - (77° + 85° + 60°)$

(b) Calculate the length of the boundary *AB* and find the perimeter of the paddock. **2**

$AB^2 = 1.4^2 + 2.2^2 - 2 \times 1.4 \times 2.2 \cos 138°$

$= 11.3777$

$AB = 3.373$

$\doteqdot 3.4$ km

$P = 3.4 + 1.5 + 2.2 + 2.5 = 9.6$ km

Question 35 continues on page 31

Question 35 continued

(c) Calculate the area of the entire paddock. **2**

$A_{COD} = \frac{1}{2} \times 1.5 \times 1.7 \times \sin 85^\circ$

$= 1.27$

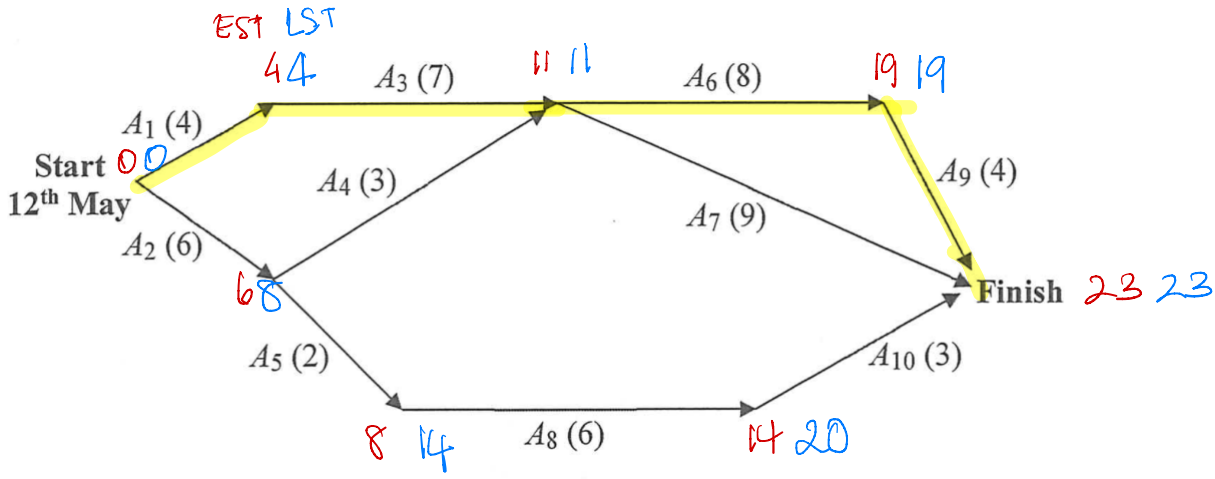
Total Area $= 1.3 + 4.4 + 1.0 + 1.8$

$= 8.5 \text{ km}^2$

Question 36 (5 marks)

A project has 10 activities (A_1 - A_{10}) to be completed. The commencement date is Monday 12th May.

The network diagram below shows the duration of each activity (days).



(a) By listing the activities on the critical path of the project, determine on which day and month the project is expected to finished. **3**

A_1 A_3 A_6 A_9 (1)

time 23 days (1)

Mon 12th May + 23 days ⇒ 4th June

(b) If activity A_8 is delayed by 3 days, would the expected finishing date for the project be delayed? Justify your answer with calculations. **2**

Float time is 6 days (1)

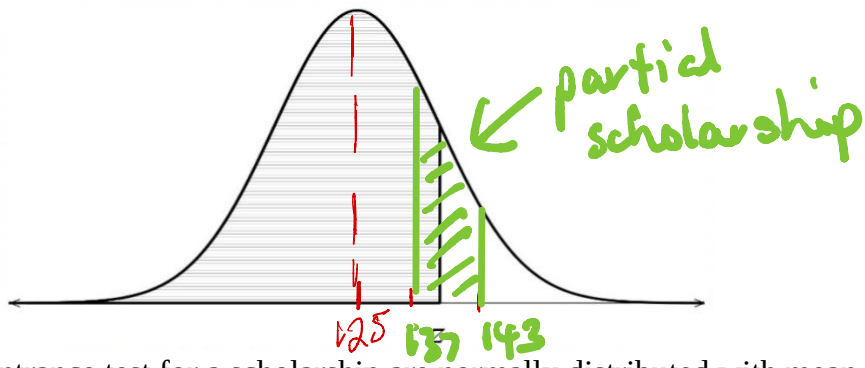
3 day Delay will not impact finish date. (1)

Question 37 (4 marks)

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

z	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Probability	0.6915	0.7258	0.7580	0.7881	0.8159	0.8413	0.8643	0.8849	0.9032	0.9192	0.9332

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



The marks on the entrance test for a scholarship are normally distributed with mean $\mu = 125$ and standard deviation $\sigma = 15$.

All students who scored above 143 marks on the entrance test received a full scholarship and those who score between 137 and 143 received a partial scholarship.

There were 1250 students who sat the examination. How many students received a partial scholarship? **4**

$z = \frac{137-125}{15}$ $\quad$ $z = \frac{143-125}{15}$

$= 0.8$ (1) $\quad$ $= 1.2$ (1)

$P(0.8 < z < 1.2) = 0.8849 - 0.7881$

$= 0.0968$ (1)

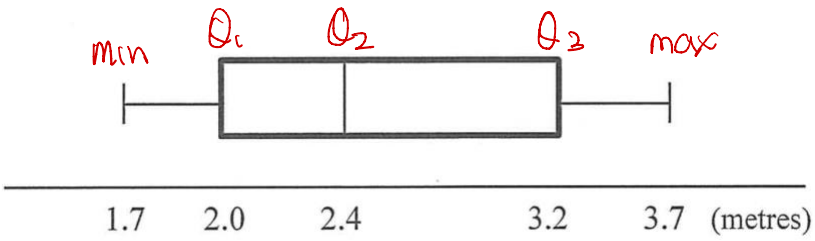
Number of students $= 0.0968 \times 1250$

$= 121$ (1)

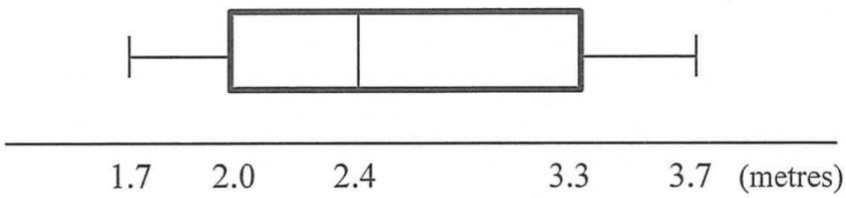
Question 38 (4 marks)

For research purposes, scientists capture and tag 7 crocodiles which are inhabiting a swamp.

The lengths (in metres) of these crocodiles have been recorded in the following box plot.



After an eighth crocodile was captured and tagged from the same swamp, a new box plot for the lengths of the eight captured crocodiles was drawn and is shown below.



What was the mean length of the eight captured crocodiles? **4**

(Give an explanation for your answer.)

1st capture (7 scores) $Q_2 \Rightarrow 4^{th}$ Croc

C_1	C_2	C_3	C_4	C_5	C_6	C_7
1.7	2.0	?	2.4	?	3.2	3.7
min	Q_1		Q_2		Q_3	max

2nd capture (8 scores) Q_2 = middle $\frac{4^{th} \text{ \& } 5^{th}}{2}$ scores

C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
1.7	2.0	2.0	2.4	2.4	3.2	3.4	3.7
min		Q_1		Q_2		Q_3	max

2.0 2.4 3.3

$Q_1 = \frac{2.0 + C_3}{2}$

$2.0 = \frac{2.0 + C_3}{2}$

$\therefore C_3 = 2.0$

average of 6th & 7th croc

$3.3 = \frac{3.2 + C_6}{2}$

$\therefore C_6 = 3.4$

1

$\therefore$ 8th croc was 3.4m