Ascham School

Student Number: _____

Teacher: KS LD LK

Friday 2 August 2024

2024 Year 12 Trial Examination

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours 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

Total marks: 100

Section I – 15 marks (pages 3–12)

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

Section II – 85 marks (pages 13–37)

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

Section I	Section II			
Q1 - 15	Q16 - 26	Q27 – 33	Q34 – 39	TOTAL
15	34	29	22	100

Section I

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

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

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ⬭ B ⬬ C ⬭ D ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ⬬ B ⬬ C ⬭ D ⬭

If you have changed your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

correct

A ⬬ B ⬬ C ⬭ D ⬭

1 An amount of $4000 is invested at a simple interest rate of 2% per annum. How much interest is earned in the first 10 years?

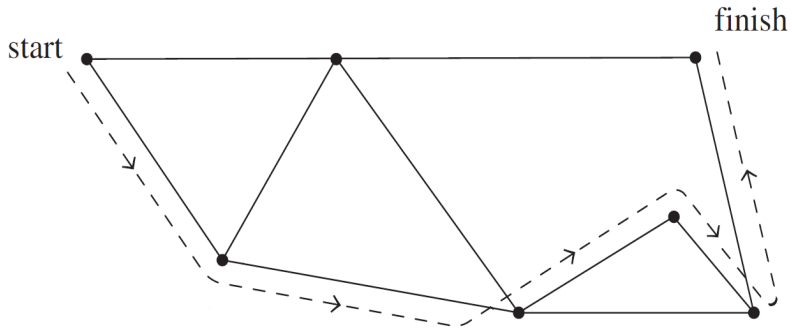
(A) $80

(B) $480

(C) $800

(D) $4800

2 A network diagram is shown:



Which of the following most accurately describe the route presented above?

(A) A closed walk

(B) A path

(C) A cycle

(D) A tree

3 In a normal distribution, approximately what percentage of z-scores are less than 2?

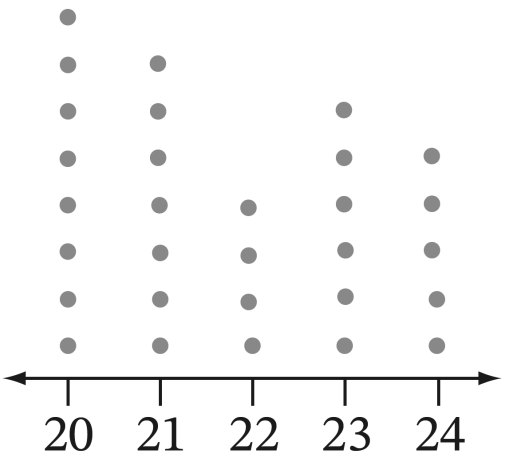
(A) 50%

(B) 47.5%

(C) 95%

(D) 97.5%

4 A set of 30 scores is displayed in the dot-plot below:



What is the median score?

(A) 20

(B) 21

(C) 21.5

(D) 22

5 An item was purchased for $550, including 10% GST.

What is the amount of GST included in the price?

(A) $5

(B) $5.50

(C) $50

(D) $55

6 12 builders can build a house in 6 weeks.

How many builders are needed to finish the same house in 4 weeks?

(A) 18 builders

(B) 16 builders

(C) 8 builders

(D) 6 builders

7 A car uses fuel at a rate of 12L/100km.

How much fuel would the car use to travel 425 km?

(A) 8 L

(B) 28 L

(C) 35 L

(D) 51 L

8 The pyramid of Cestius, in Rome, Italy, has a square base of side length 29.6 m. Its height is 37 m.

The volume of the pyramid of Cestius is closest to:

(A) 365 m^3

(B) 1095 m^3

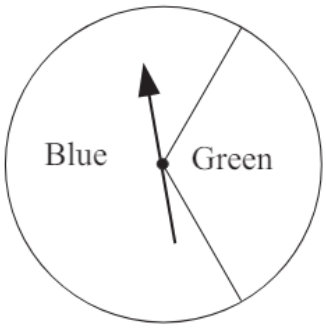
(C) 10806 m^3

(D) 32418 m^3

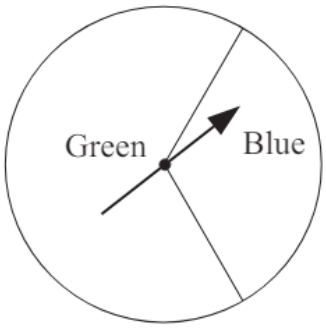
9 A spinner is to be designed so that the probability of the arrow landing in the blue region is twice that of landing in the green region.

Which spinner below meets the desired specification?

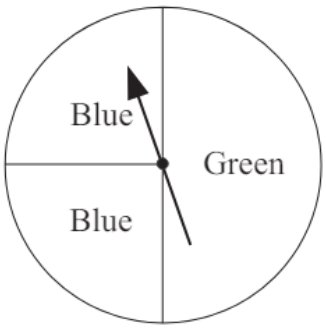
(A)



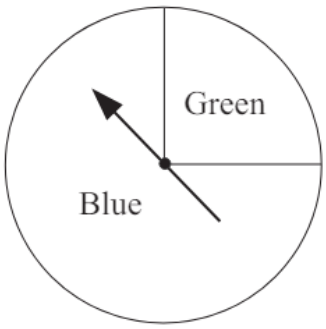
(B)



(C)



(D)



10 Cate has 2000 shares with a current market value of $3.50 each.

During the past twelve months, Cate received a total dividend of $87.50.

What is the current dividend yield on these shares?

(A) 1.25%

(B) 2%

(C) 4%

(D) 12.5%

11 The map below shows all 7 countries in Central America:

A network diagram is drawn with 7 vertices, where each vertex represents each of the countries. Edges are drawn to represent a border shared between two countries.

The number of edges that this network has is:

(A) 6

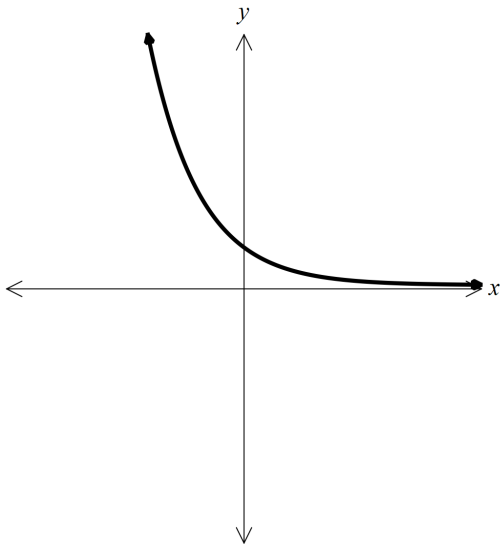
(B) 7

(C) 8

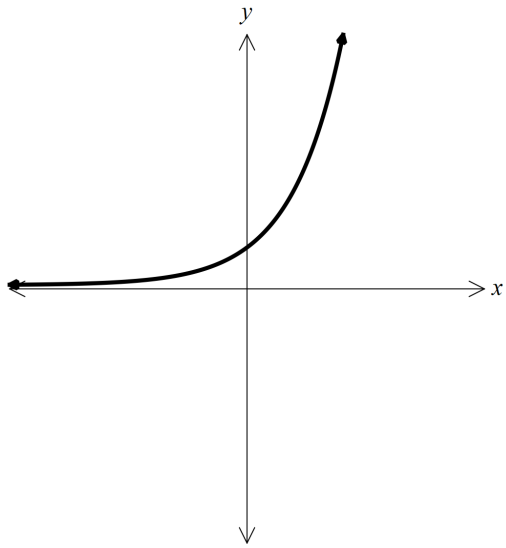
(D) 9

12 Which of the following graphs best represents the equation $y = 2^{-x}$?

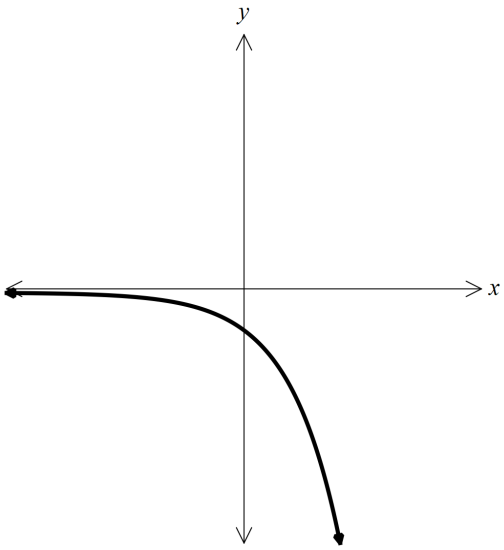
(A)



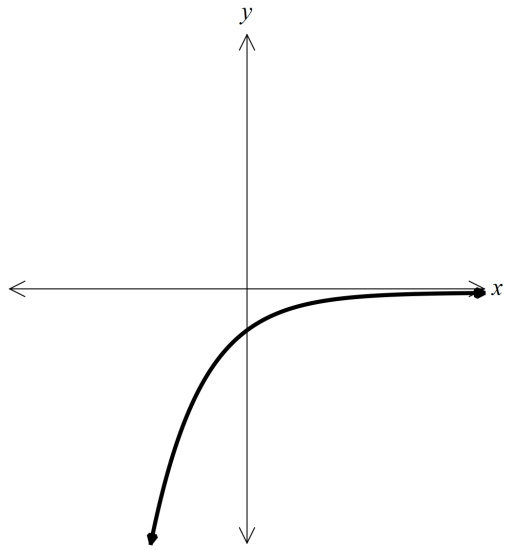
(B)



(C)



(D)



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

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

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

Tristan weighs 80 kg. His BAC was zero when he began drinking alcohol. At 10:00 pm, after consuming 3.5 standard drinks, his BAC was 0.03. Using the formula, estimate at what time Tristan began drinking alcohol, to the nearest minute.

(A) 3:09 pm

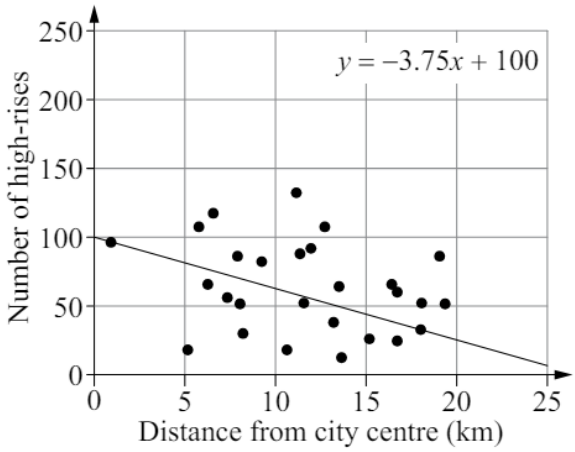
(B) 7:31 pm

(C) 8:04 pm

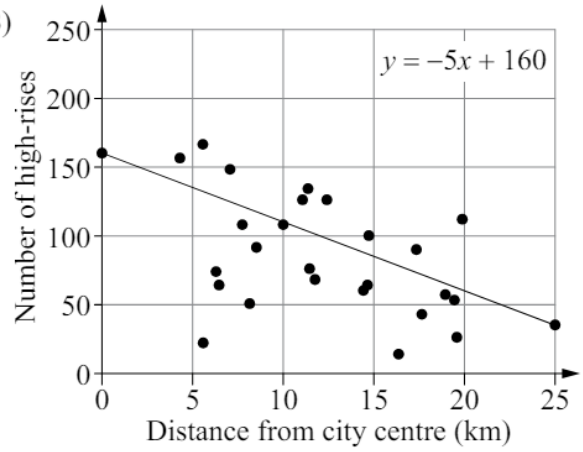
(D) 9:26 pm

14 These scatterplots show the number of high-rises in a city and their distance from the city centre.
Which scatterplot was used to extrapolate that 25 km from the city centre there were 20 high-rises?

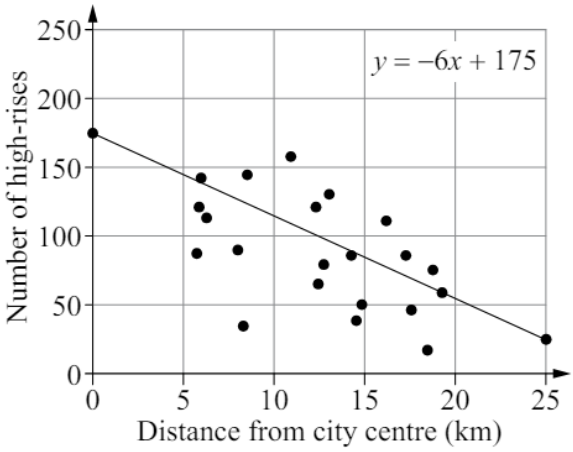
(A)



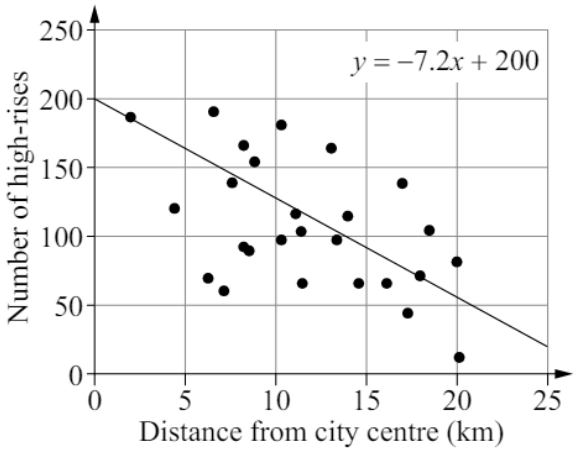
B)



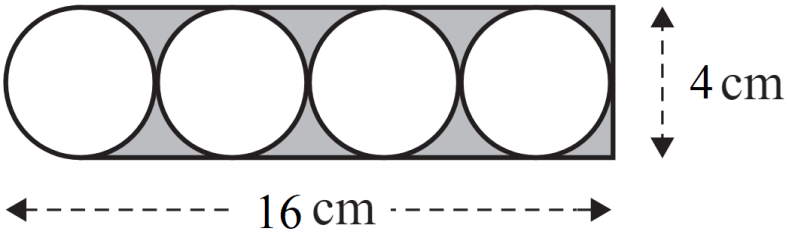
(C)



(D)



15 A child's toy is designed as follows:



The area of the shaded region, in square centimetres, is closest to:

(A) 6

(B) 12

(C) 14

(D) 20

End of Section I

Section II

85 marks

Attempt all questions.

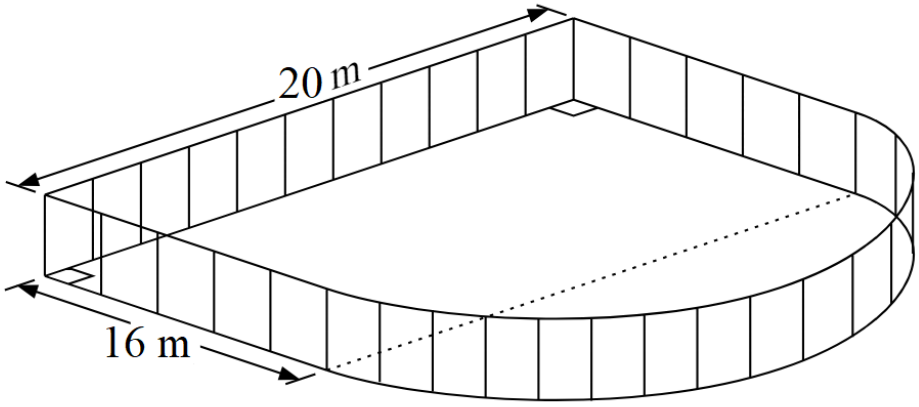
Allow about 2 hours and 5 minutes for this section.

Answer each question in the space provided.

Show all relevant working in questions involving calculations.

Marks

16 The paddock enclosed by the fence shown in the diagram consists of a rectangle and a semicircle.



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Calculate the area of the paddock, to the nearest square metre.

17 A refrigerator has a power rating of 150 W. This refrigerator runs continuously.

(a) How much energy does the refrigerator consume in a week? Answer in kWh. **1**

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(b) What is the cost of using the refrigerator for a week if the cost of electricity is 35.71 cents/kWh. **1**

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18 A farmer used the 'capture-recapture' technique to estimate the number of chickens on his farm. He captured, tagged and released 36 of the chickens. **2**

Later, he caught a second sample of chickens, and found that 40 did not have a tag, while 6 did have a tag.

What is the estimate for the total number of chickens on this farm?

19 The population of Barbieland in the 2021 census was 5 760 000. The annual growth rate of Barbieland is estimated at 1.81% per annum. **2**

Therefore the population, P, of Barbieland, n years after the 2021 census is given by the equation:

$$P = 5760000(1.0181^n)$$

Using the formula, or otherwise, find an estimate for the size of Barbieland's population three years after the 2021 census. Express your answer to the nearest thousand.

20 Peta is driving through a carpark at 20 km/h when she has to brake suddenly to avoid a collision with another car. Her reaction time is 1.5 seconds. The braking distance (D metres) is given by $D = 0.01v^2$, where v is speed in km/h. **3**

Stopping distance can be calculated using the following formula:

$$\text{stopping distance} = \{\text{reaction time distance}\} + \{\text{braking distance}\}$$

Calculate Peta's stopping distance, correct to the nearest metre.

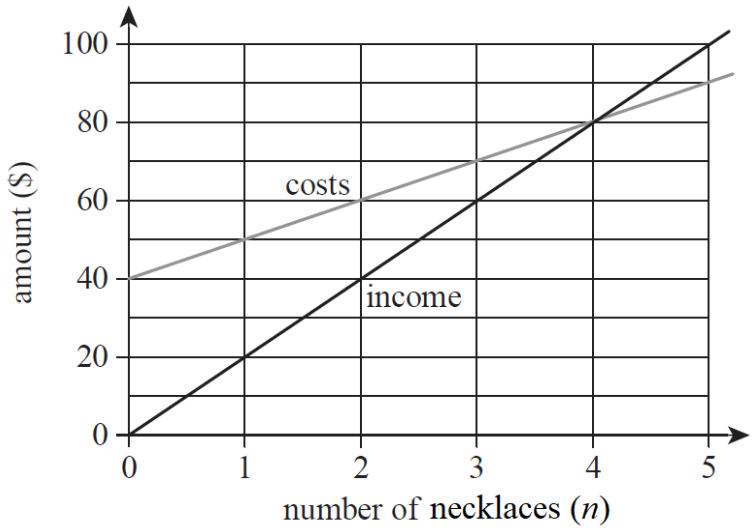
21 The table shows income tax rates for the 2023-2024 financial year. **3**

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

Chris has a gross annual salary of $115 800. He has allowable tax deductions of $3700 for work-related expenses and $1200 in charitable donations.
Chris must also pay a Medicare levy of 2% of his taxable income.

Calculate the total tax payable by Chris including the Medicare levy.

22 Simon makes necklaces and sells them. The graph below shows the cost of making necklaces and the income received from their sale.



(a) What is the y-intercept of the cost line, and what does it represent? **2**

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(b) How many necklaces need to be sold to break even? **1**

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(c) What is the profit when five necklaces are sold? **1**

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(d) Write an equation for the cost, C, in terms of n. **1**

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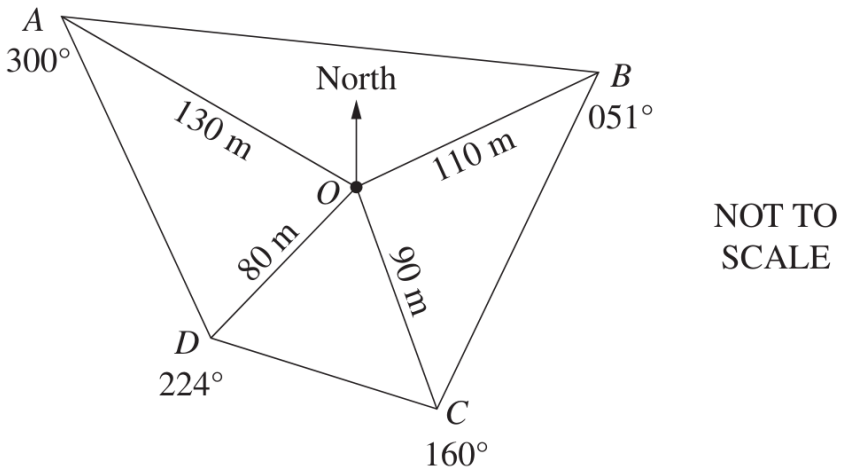
23 The diagram below shows a compass radial survey of a field *ABCD*.



(a) Determine the size of $\angle BOA$. **1**

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(b) Calculate the area of ΔAOD , in square metres, correct to three significant figures. **3**

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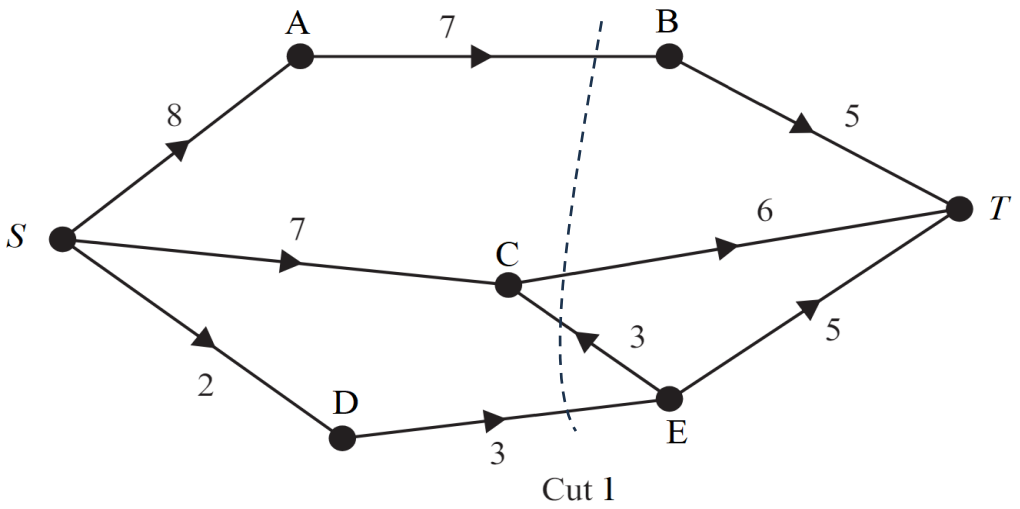
24 A network of water pipes with source S and sink T is shown below.
The numbers on the edges show the maximum capacity of each pipe in litres per minute.



(a) Determine the capacity of Cut 1, in litres per minute. **1**

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(b) Determine the maximum flow of this network, in litres per minute. **1**

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(c) Draw the minimum cut on the diagram above. **1**

(d) You wish to increase the maximum flow through the network, but you only have the budget to replace **one** pipe. **2**
Determine which pipe should be replaced and the new maximum flow through this network, in litres per minute.

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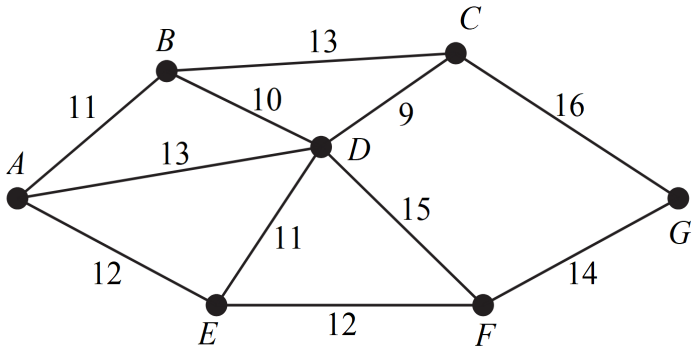
25 Sam scored 76 in her first school assessment task for which the mean was 66 and the standard deviation was 10. **2**

In her second assessment task, she scored 85. for which the mean was 71 and the standard deviation was 14.

Did Sam's performance improve from her first assessment task to the second?
Justify your answer with reference to Sam's z-scores.

26 The network below represents the walking course for a scavenger hunt. The weight on each edge represents the time (in minutes) it takes to walk between each checkpoint.



(a) Name the vertex with even degree. **1**

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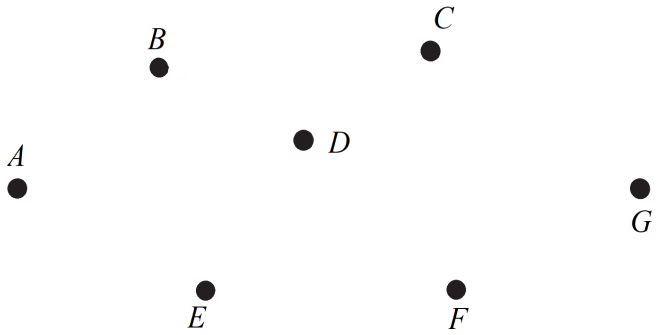
(b) Draw the minimum spanning tree and determine its weight. **2**



Weight of minimum spanning tree: _____

27 Sophie deposits \$600 into an account at the end of every six months for 4 years. The account pays 4% per annum interest, compounding every six months.

Future value of an annuity of \$1 per period at the end of *n* periods

	Interest rate per period				
n	**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

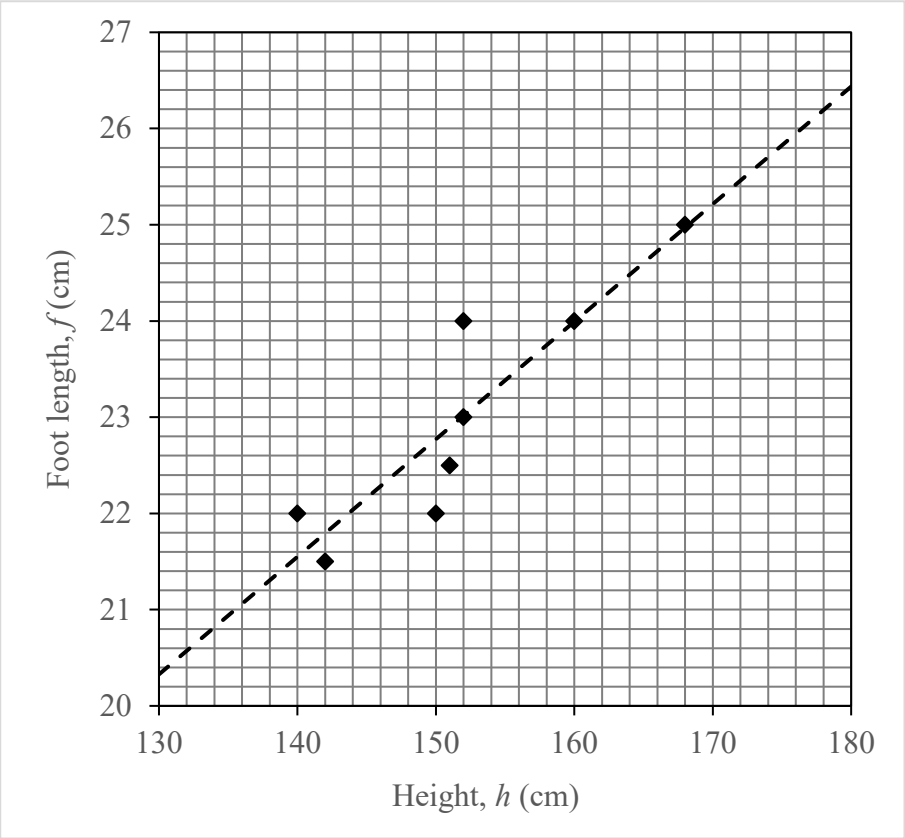
(a) Use the table above to find the future value of Sophie's investment after 4 years, correct to the nearest cent. **2**

(b) Calculate the amount of interest that Sophie will earn on this investment. **1**

(c) Find the single amount Sophie can invest now for 4 years at 4% per annum, compounding every six months, to achieve the same result. **2**

28 Zendaya surveys her extended family on each person's foot length and height, measured in centimetres. The data is displayed in the table and scatterplot below. The least squares regression line for this data is also shown.

Height (cm)	140	142	150	151	152	152	160	168
Foot length (cm)	22	21.5	22	22.5	24	23	24	25



(a) Calculate Pearson's correlation coefficient, correct to 3 decimal places. **1**

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(b) Explain what your result tells you about height and foot length. **1**

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Question 28 continues on page 25

(c) Zendaya's younger sister is 150 cm tall. According to the least squares regression line, what should be her foot length? **1**

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(d) Zendaya decides to include herself in the data. Her foot length is 24.4 cm and her height is 178 cm. **1**

When this point is added to the plot, what happens to the gradient of the regression line?

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End of question 28

29 A farmer wants to build a rectangular garden bed so that the length is 4 metres longer than the width.

(a) Write an equation for the area of the garden bed, A, in terms of the length, l. **1**

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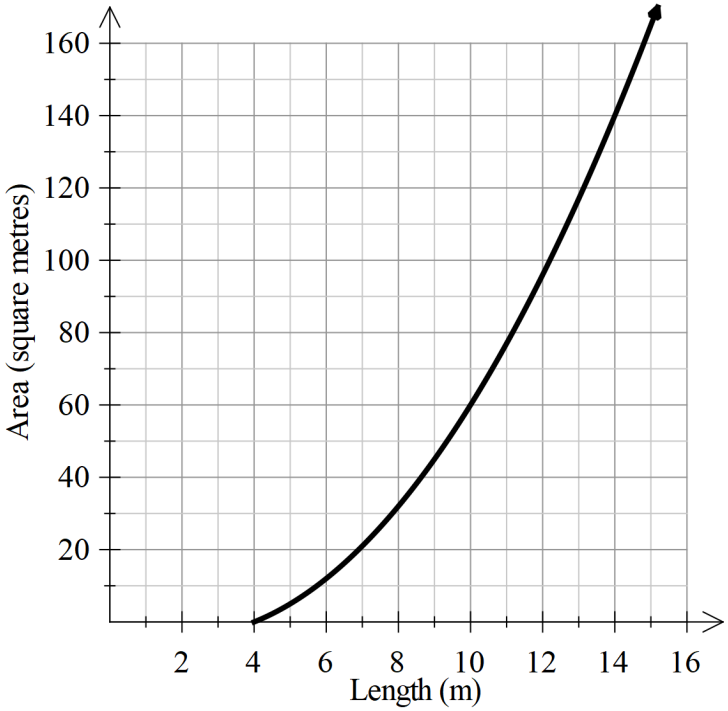
(b) A graph comparing the area of the garden bed to its length is shown.



Why are lengths between 0 and 4 metres not possible? **1**

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(c) Use the graph to determine the dimensions of the garden bed when the area is 45 m^2. **2**

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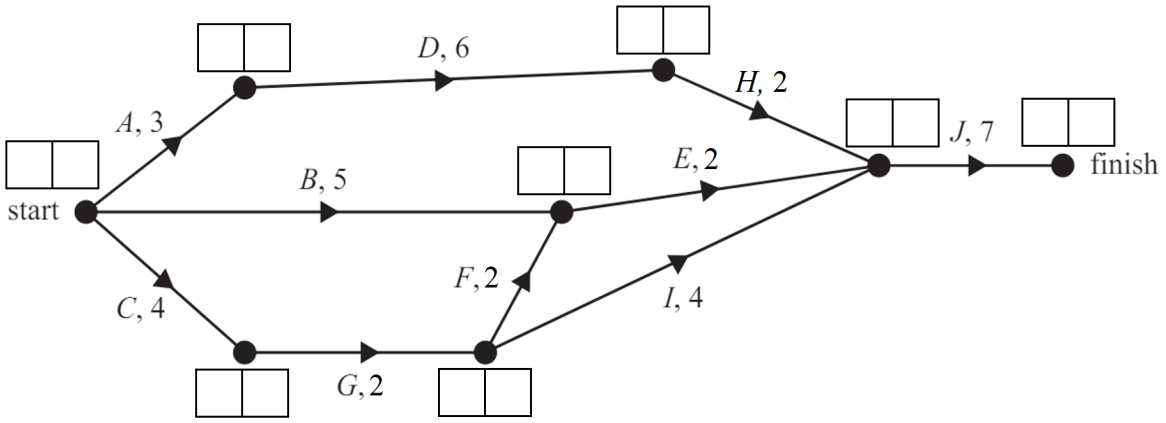
30 The directed graph below shows the sequence of activities required to complete a kitchen renovation project. The time taken to complete each activity, in weeks, is also shown.



(a) List the activities on the critical path. **1**

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(b) Complete a forward and backward scan of the project. **2**

(c) Determine the float time for activity *B*. **1**

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(d) The project manager hires more builders such that Activity *D*'s duration is reduced to 3 weeks. What is the new critical time for the project? **1**

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31 The table below is used to find the **present value** of a \$1 annuity at different interest rates over different numbers of time periods.

Present value of an annuity of \$1 per period at the end of *n* periods

	Interest rate per period					
Period	**0.2%**	**0.25%**	**0.5%**	**0.75%**	**1%**	**2%**
12	11.8454	11.8073	11.6189	11.4349	11.2551	10.5753
24	23.4103	23.2660	22.5629	21.8891	21.2434	18.9139
36	34.7011	34.3865	32.8710	31.4468	30.1075	25.4888
48	45.7244	45.1787	42.5803	40.1848	37.9740	30.6731
60	56.4866	55.6524	51.7256	48.1734	44.9550	34.7609

Anthony borrowed \$25 000 to buy a car.
Interest is charged at 2% interest per annum, compounded quarterly.
Anthony will repay the loan in full, with quarterly repayments over six years.

(a) Find Anthony's quarterly repayment, correct to the nearest cent. **2**

(b) The balance of the loan, A_n, in dollars, after n quarters, can be modelled by the recurrence relation: **2**

$$A_n = 1.005A_{n-1} - R$$

where R is Anthony's quarterly repayment and $A_0 = 25000$.
Use this recurrence relation to find the balance of the loan after two quarters.
Answer to the nearest cent.

32 Elsa lives in Sydney (UTC+10). Her sister Anna is an exchange student in Denver, Colorado USA (UTC–7).

(a) What is the time difference between Sydney and Denver? **1**

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(b) Anna boards a flight from Denver to Sydney via Los Angeles. **3**

Her plane left Denver on Friday at 4:00 pm (Denver time), stopped for 4 hours in Los Angeles, and arrived in Sydney at 6:30 am on Sunday.

What was the plane's total flying time?

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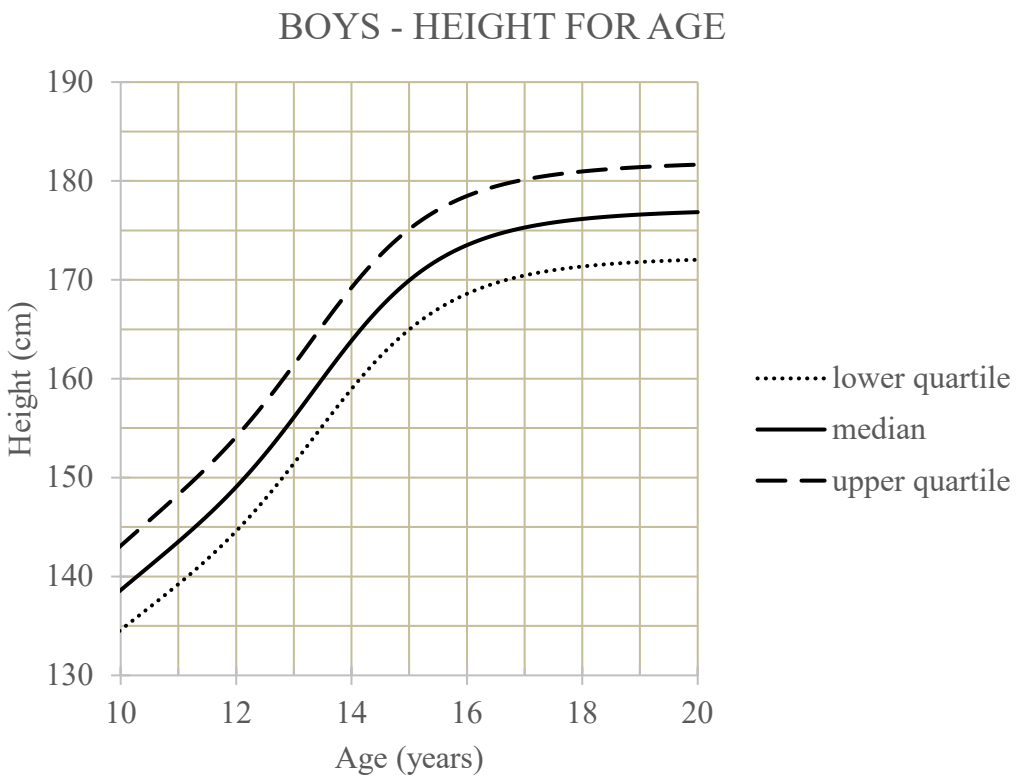
33 The graph below gives information about the weights of boys aged between 10 and 20.



(a) Find the IQR of 15-year-old boys in this group. **1**

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(b) What is the maximum possible range for 15-year-olds if there are no outliers? **2**

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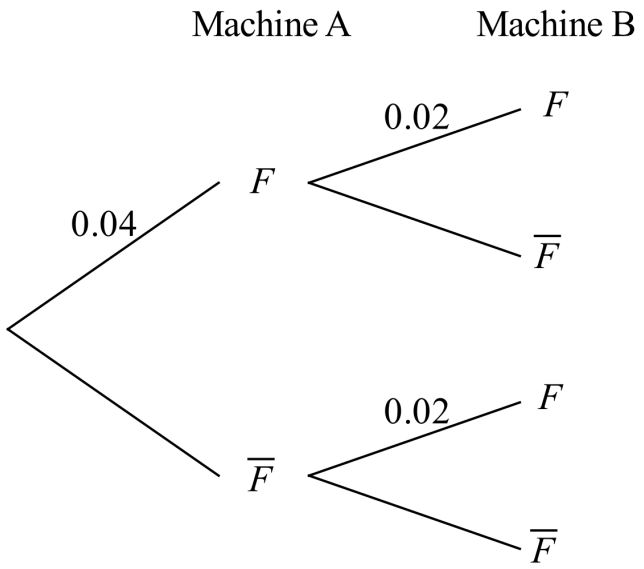
34 Two machines, A and B, produce light globes. It is known that 4% of the light globes produced by machine A are faulty and that 2% of the light globes produced by machine B are faulty.

Timothee selects two light globes at random, one from each machine.

(a) Complete the probability tree diagram by writing the correct probability on each branch. **2**



(b) Find the probability of choosing two faulty light globes. Answer as a percentage. **1**

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(c) What is the probability that at least one light globe is faulty? Answer as a percentage. **2**

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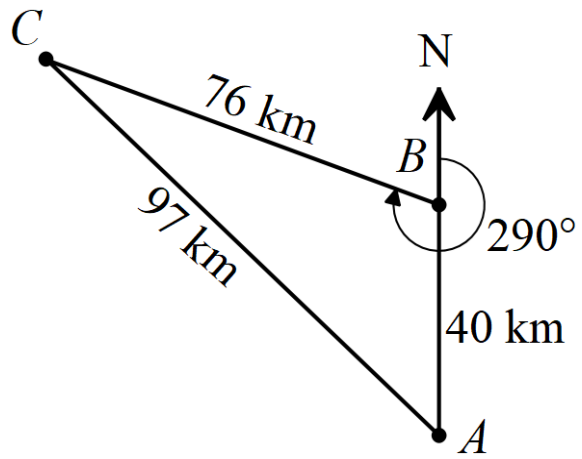
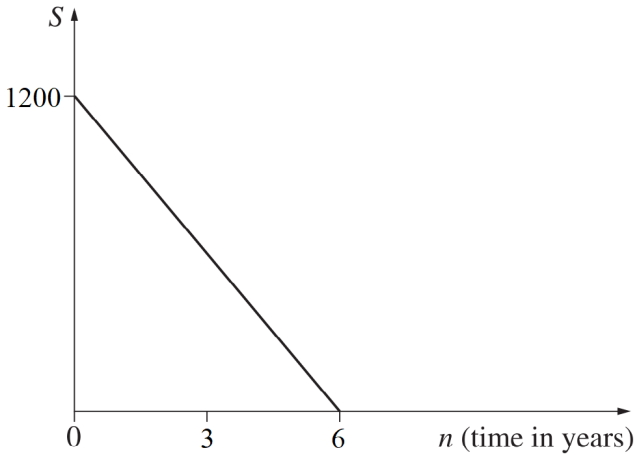
35 An aeroplane completed a flight consisting of three stages. **3**

Starting at Amberley (A), it flew 40 km directly due north to Beachwood (B).
From Beachwood, it flew 76 km on a bearing of 290° to Chalton (C).
From Chalton, it flew 97 km to return to Amberley.

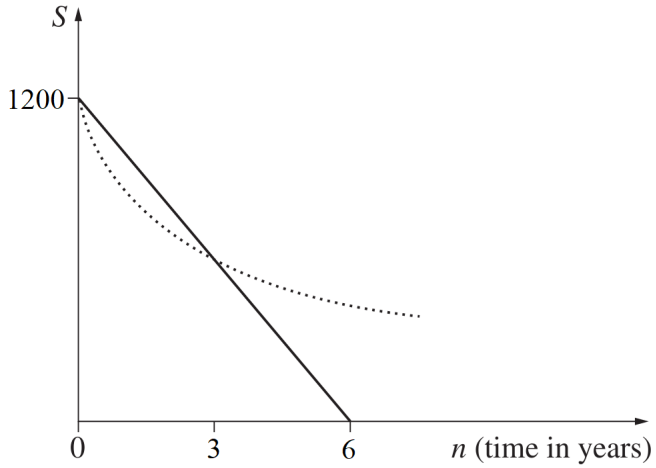


Find the bearing of the trip from Chalton to Amberley. Round your answer to the nearest degree.

36 While Barbie is on holidays she buys a new laptop computer for \$1200. Using the straight-line method of depreciation, the salvage value, S, of the laptop computer will be zero in six years time, as shown on the graph below. **3**



Using the declining balance method of depreciation, at a rate of R% per annum, the salvage value is represented by the dotted curve on the graph below.

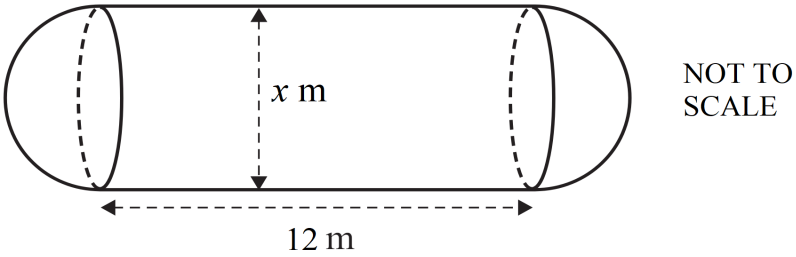


NOT TO SCALE

Both methods give the same salvage value after three years. Find the value of R, correct to the nearest whole.

37 A large storage tank consists of a cylinder with a hemisphere at each end.

The cylinder has a length of 12 m and a diameter of x m, as shown in the diagram below.



(a) A scale model of this storage tank is constructed. The length of the cylinder of the scale model is 480 mm. **1**

Show that scale used to construct the model is 1:25.

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(b) The diameter of the scale model of the tank is 160 mm. **3**

The real tank is filled with fuel at a rate of 1000 L/min.

How long does it take to fill the tank completely? Answer in hours and minutes, correct to the nearest minute.

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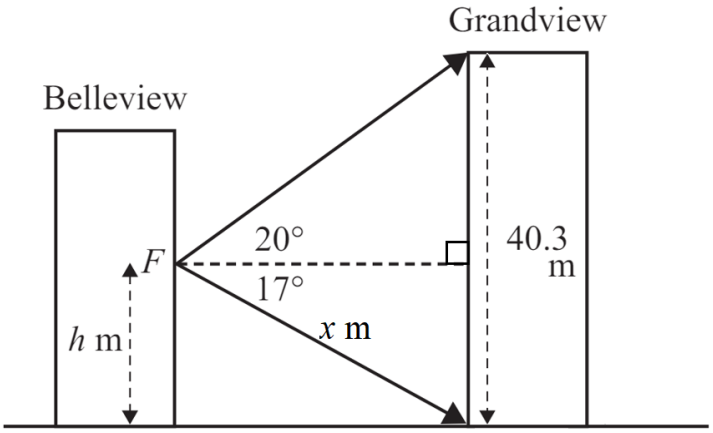
38 Two hotels, the Belleview and the Grandview, built on flat, level ground, face each other. The Grandview has a height of 40.3 m.

From Fred's window ledge in the Belleview, F, he measured an angle of elevation of 20° to the top of the Grandview and an angle of depression of 17° to the ground at the Grandview. This information is shown in the diagram below. **3**



By first finding the distance labelled x, find the height, h, from the ground to Fred's window ledge. Answer in metres, to one decimal place.

39 There is a "Giant Pumpkins" competition at the Royal Easter Show. The weights of pumpkins were normally distributed, with a mean of 8 kg and a standard deviation of 1.5 kg. **4**

The largest pumpkins were given awards. Three award categories were used:

- **Honours** for the heaviest 15% of pumpkins;
- **Distinction** for the next 15% and
- **Commendation** for the next 20%.

Emma's pumpkin only just missed out on a commendation. Lachlan's pumpkin only just qualified for honours. Determine the weight difference, to the nearest gram, between Emma and Lachlan's pumpkins.

You may use the standardised z-scores table on page 37 to assist you.

Ascham School

NESA Number: Solutions

Name: _____

Teacher: KS LD LK

Mathematics Standard 2 | HSC Trial 2024

Section I – Multiple Choice Answer Sheet

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

Ascham School

Student Number: SOLUTIONS

Teacher: KS LD LK

Friday 2 August 2024

2024 Year 12 Trial Examination

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours 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

Total marks: 100

Section I – 15 marks (pages 3–12)

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

Section II – 85 marks (pages 13–37)

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

Section I	Section II			
Q1 - 15	Q16 - 26	Q27 – 33	Q34 – 39	TOTAL
15	34	29	22	100

Section I

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

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

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ⬭ B ⬬ C ⬭ D ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ⬬ B ⬬ C ⬭ D ⬭

If you have changed your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

correct

A ⬬ B ⬬ C ⬭ D ⬭

1 An amount of \$4000 is invested at a simple interest rate of 2% per annum. How much interest is earned in the first 10 years?

(A) \$80

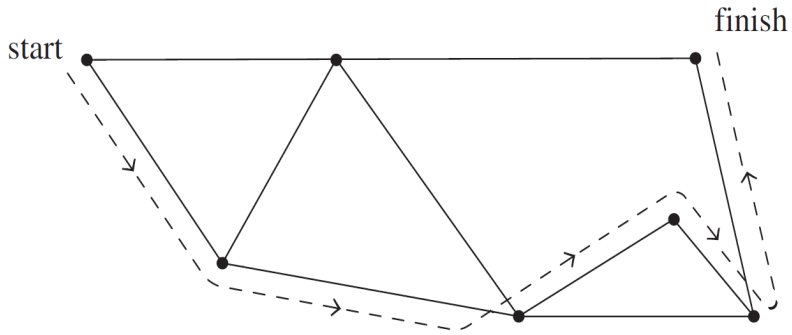
(B) \$480

(C) \$800

(D) \$4800

$I = 4000 \times 0.02 \times 10$

2 A network diagram is shown:



Which of the following most accurately describe the route presented above?

(A) A closed walk

(B) A path

(C) A cycle

(D) A tree

3 In a normal distribution, approximately what percentage of z-scores are less than 2?

(A) 50%

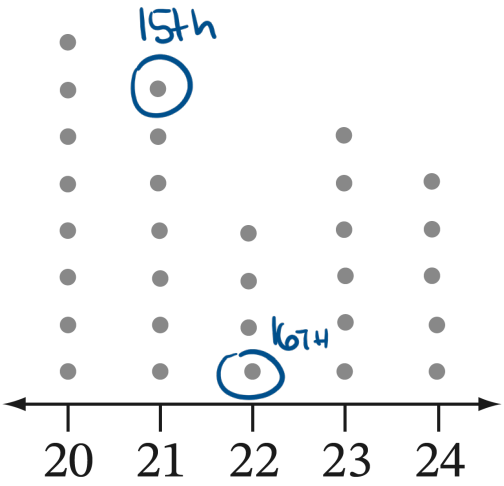
(B) 47.5%

(C) 95%

(D) 97.5%

$$50\% + \frac{95\%}{2}$$

4 A set of 30 scores is displayed in the dot-plot below:



What is the median score?

(A) 20

(B) 21

(C) 21.5

(D) 22

5 An item was purchased for $550, including 10% GST.

What is the amount of GST included in the price?

(A) $5

(B) $5.50

(C) $50

(D) $55

$12 = \frac{K}{6}$

$K = 72$

$\therefore B = \frac{72}{t}$

$B = \frac{72}{4}$

6 12 builders can build a house in 6 weeks.

How many builders are needed to finish the same house in 4 weeks?

(A) 18 builders

(B) 16 builders

(C) 8 builders

(D) 6 builders

12L/100km ÷100

/1km

/425 km ×425

7 A car uses fuel at a rate of 12L/100km.

How much fuel would the car use to travel 425 km?

(A) 8 L

(B) 28 L

(C) 35 L

(D) 51 L

8 The pyramid of Cestius, in Rome, Italy, has a square base of side length 29.6 m. Its height is 37 m.

The volume of the pyramid of Cestius is closest to:

(A) 365 m^3

(B) 1095 m^3

(C) 10806 m^3

(D) 32418 m^3

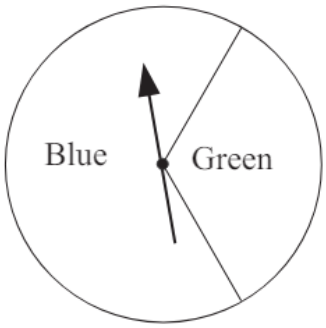
$V = \frac{1}{3}Ah$

$= \frac{1}{3} \times 29.6^2 \times 37$

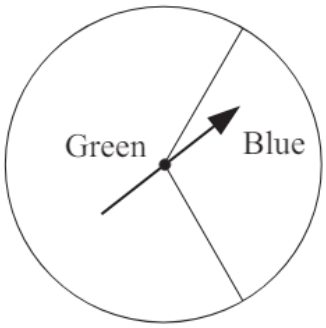
9 A spinner is to be designed so that the probability of the arrow landing in the blue region is twice that of landing in the green region.

Which spinner below meets the desired specification?

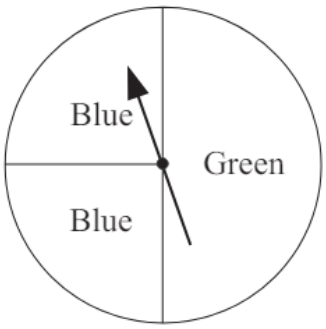
(A)



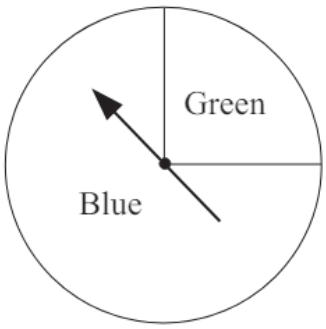
(B)



(C)



(D)



10 Cate has 2000 shares with a current market value of \$3.50 each.

During the past twelve months, Cate received a total dividend of \$87.50.

What is the current dividend yield on these shares?

(A) 1.25%

(B) 2%

(C) 4%

(D) 12.5%

$$\frac{87.50}{2000 \times 3.50} \times 100\%$$

11 The map below shows all 7 countries in Central America:

A network diagram is drawn with 7 vertices, where each vertex represents each of the countries. Edges are drawn to represent a border shared between two countries.

The number of edges that this network has is:

(A) 6

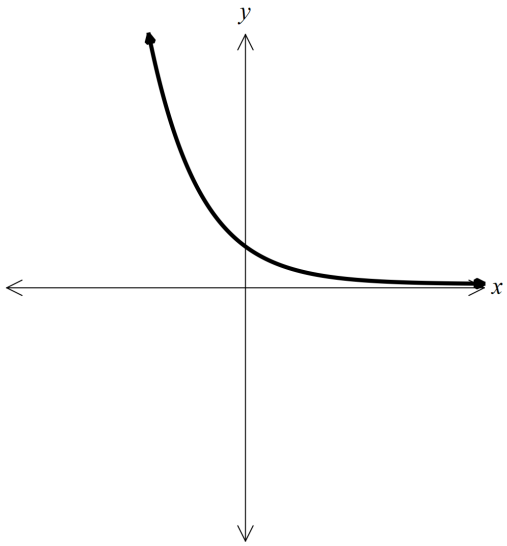
(B) 7

(C) 8

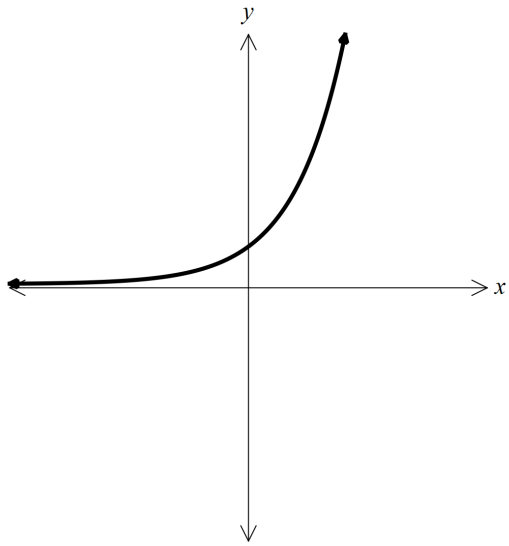
(D) 9

12 Which of the following graphs best represents the equation $y = 2^{-x}$?

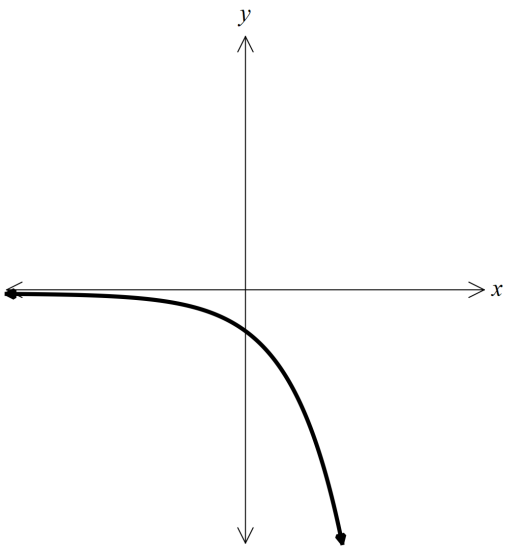
(A)



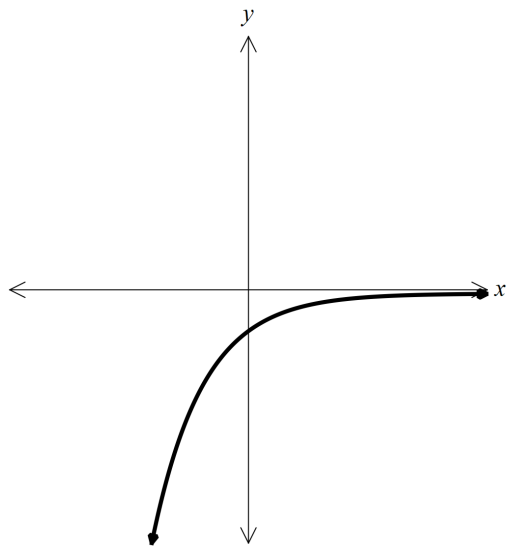
(B)



(C)



(D)



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

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

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

Tristan weighs 80 kg. His BAC was zero when he began drinking alcohol. At 10:00 pm, after consuming 3.5 standard drinks, his BAC was 0.03. Using the formula, estimate at what time Tristan began drinking alcohol, to the nearest minute.

(A) 3:09 pm

(B) 7:31 pm

(C) 8:04 pm

(D) 9:26 pm

$$0.03 = \frac{10 \times 3.5 - 7.5H}{6.8 \times 80}$$

$$0.03 = \frac{35 - 7.5H}{544}$$

$$16.32 = 35 - 7.5H$$

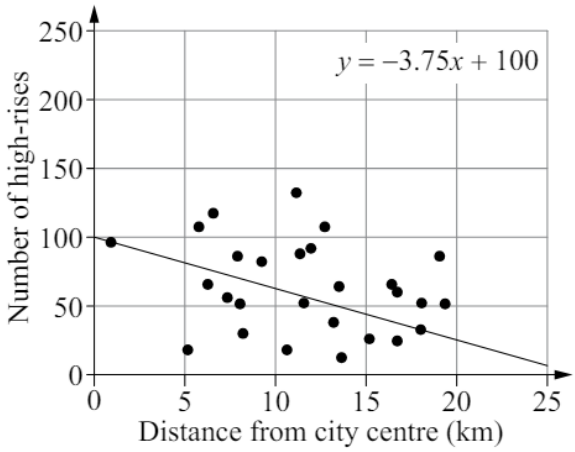
$$7.5H = 35 - 16.32$$

$$7.5H = 18.68$$

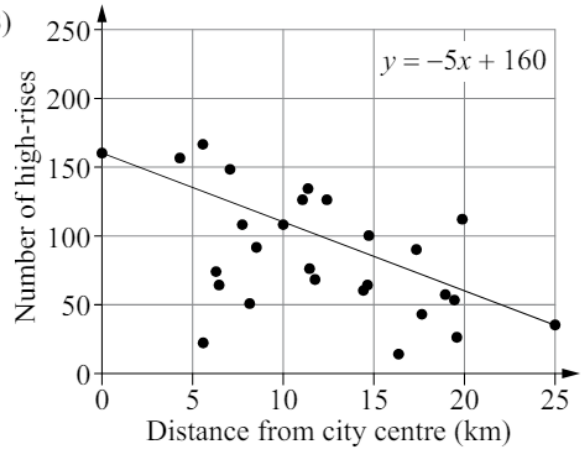
$$H \doteqdot 2.5 \text{ HOURS}$$

14 These scatterplots show the number of high-rises in a city and their distance from the city centre.
Which scatterplot was used to extrapolate that 25 km from the city centre there were 20 high-rises?

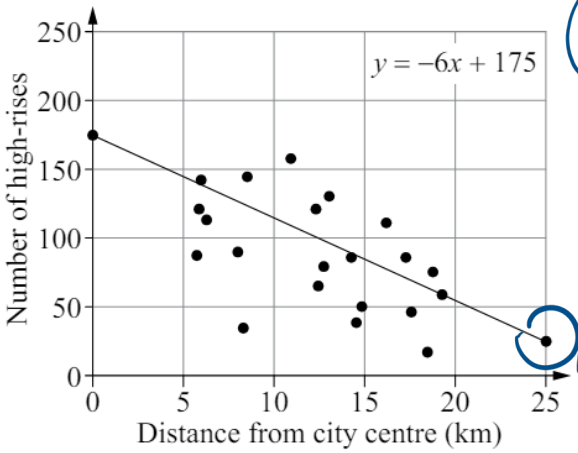
(A)



B)

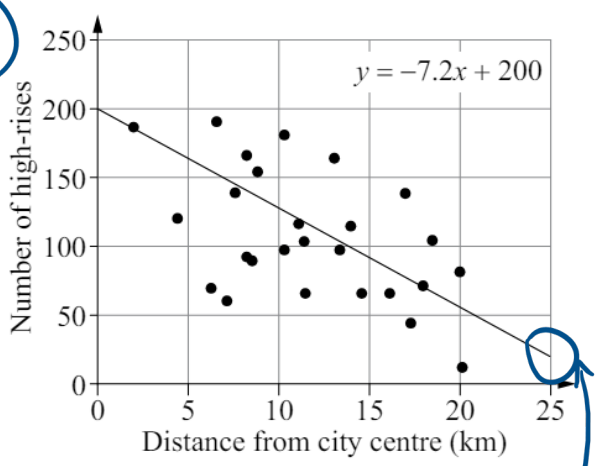


(C)



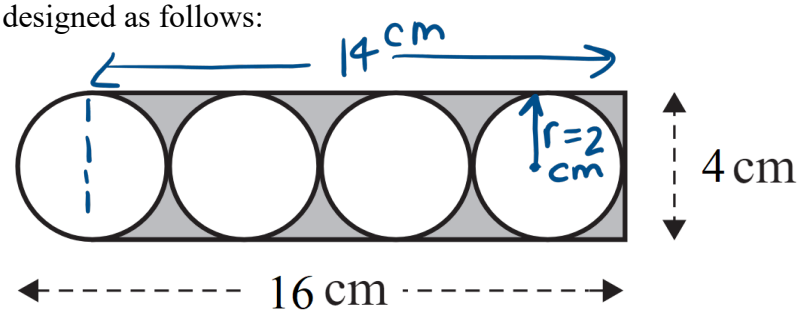
INTERPOLATION

(D)



EXTRAPOLATION

15 A child's toy is designed as follows:



The area of the shaded region, in square centimetres, is closest to:

(A) 6

(B) 12

(C) 14

(D) 20

$A_{RECTANGLE} - 3.5 \times A_{CIRCLE}$

$= 14 \times 4 - 3.5 \times \pi \times 2^2$

End of Section I

Section II

85 marks

Attempt all questions.

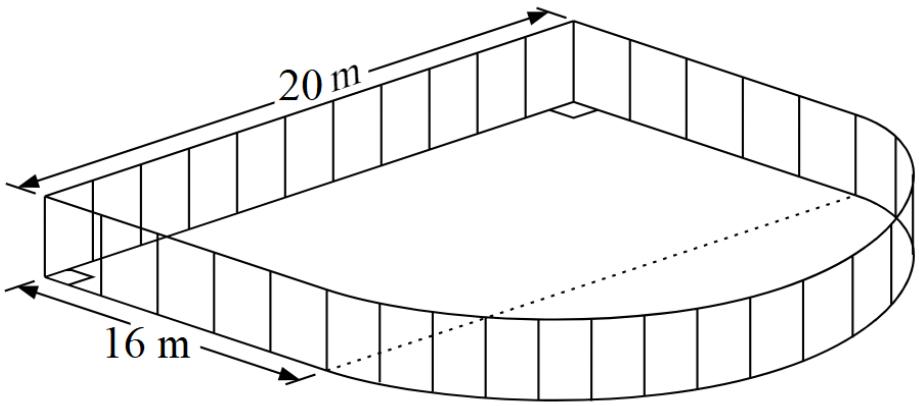
Allow about 2 hours and 5 minutes for this section.

Answer each question in the space provided.

Show all relevant working in questions involving calculations.

Marks

16 The paddock enclosed by the fence shown in the diagram consists of a rectangle and a semicircle.



3

Calculate the area of the paddock, to the nearest square metre.

$A_{RECTANGLE} = 20 \times 16$

$= 320 \text{ m}^2$ ✓

$A_{SEMICIRCLE} = \frac{\pi \times 10^2}{2}$ $r = 10$ ✓½

$= 50\pi$ or $\doteqdot 157 \text{ m}^2$ ✓½

$A_{PADDOCK} = 320 + 50\pi$

$= 477 \text{ m}^2$ (NEAREST m^2)

✓½ ✓½ ROUNDING AND UNITS.

17 A refrigerator has a power rating of 150 W. This refrigerator runs continuously.

(a) How much energy does the refrigerator consume in a week? Answer in kWh. **1**

ENERGY = POWER [kW] x TIME [h]

= 0.15 x 24 x 7

= 25.2 kWh ✓

(b) What is the cost of using the refrigerator for a week if the cost of electricity is 35.71 cents/kWh. **1**

COST = 25.2 x 0.3571

= $9 ✓

18 A farmer used the 'capture-recapture' technique to estimate the number of chickens on his farm. He captured, tagged and released 36 of the chickens. **2**

Later, he caught a second sample of chickens, and found that 40 did not have a tag, while 6 did have a tag.

What is the estimate for the total number of chickens on this farm?

TOTAL : TAGGED

= 46 : 6) x6 ✓ SETS UP A RATIO

= x : 36

∴ APPROXIMATELY 276 CHICKENS ✓

OR UNTAGGED : TAGGED

40 : 6) x6

y : 36

∴ APPROXIMATELY 240+36 = 276 CHICKENS

19 The population of Barbieland in the 2021 census was 5 760 000. The annual growth rate of Barbieland is estimated at 1.81% per annum. **2**

Therefore the population, P, of Barbieland, n years after the 2021 census is given by the equation:

$$P = 5760000(1.0181^n)$$

Using the formula, or otherwise, find an estimate for the size of Barbieland's population three years after the 2021 census. Express your answer to the nearest thousand.

$P = 5760000(1.0181)^3$ ✓

$= 6078463.256$

$= 6078000$ (NEAREST 1000) ✓

20 Peta is driving through a carpark at 20 km/h when she has to brake suddenly to avoid a collision with another car. Her reaction time is 1.5 seconds. The braking distance (D metres) is given by $D = 0.01v^2$, where v is speed in km/h. **3**

Stopping distance can be calculated using the following formula:

$$\text{stopping distance} = \{\text{reaction time distance}\} + \{\text{braking distance}\}$$

Calculate Peta's stopping distance, correct to the nearest metre.

SPEED $= \frac{20\,000 \text{ m}}{3600 \text{ s}}$

$= 5.\dot{5}$ m/s ✓

REACTION TIME $d = s \times t$

$= 5.\dot{5} \times 1.5$

$= 8.\dot{3}$ m ½

BRAKING $d = 0.01 \times 20^2$

$= 4$ m ½

STOPPING $d = 8.\dot{3} + 4$

$= 12$ m (NEAREST m)

½ ½ UNITS AND ROUNDING

21 The table shows income tax rates for the 2023-2024 financial year. **3**

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

Chris has a gross annual salary of $115 800. He has allowable tax deductions of $3700 for work-related expenses and $1200 in charitable donations.
Chris must also pay a Medicare levy of 2% of his taxable income.

Calculate the total tax payable by Chris including the Medicare levy.

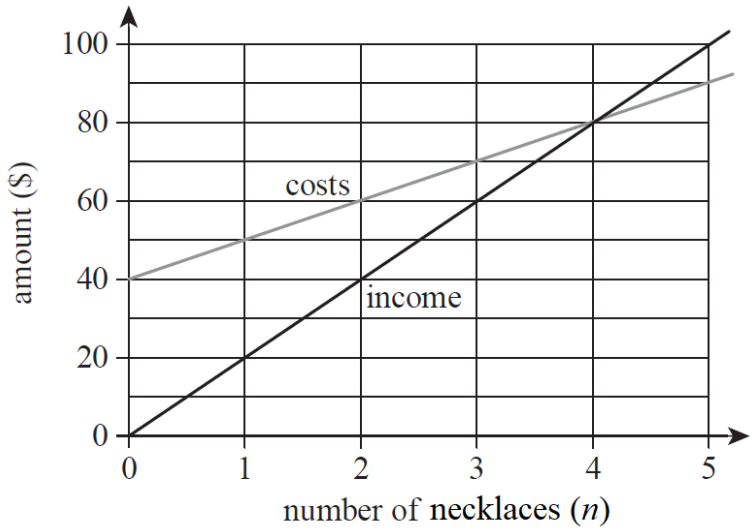
TAXABLE INCOME = 115 800 − 3700 − 1200
= $110900 ½

INCOME TAX = 5092 + 0.325 (110900 − 45000)
= $ 26509.50 ✓

MEDICARE LEVY = 110900 × 0.02
= $ 2218 ½

TOTAL TAX = 26509.50 + 2218
= $ 28 727.50 ✓

22 Simon makes necklaces and sells them. The graph below shows the cost of making necklaces and the income received from their sale.



(a) What is the y-intercept of the cost line, and what does it represent? **2**

40. ✓

THESE ARE THE FIXED COSTS OF THE NECKLACE BUSINESS. ✓

(b) How many necklaces need to be sold to break even? **1**

4 ✓

(c) What is the profit when five necklaces are sold? **1**

$P = I - C$

$= 100 - 90$

$= \$10$ ✓

(d) Write an equation for the cost, C, in terms of n. **1**

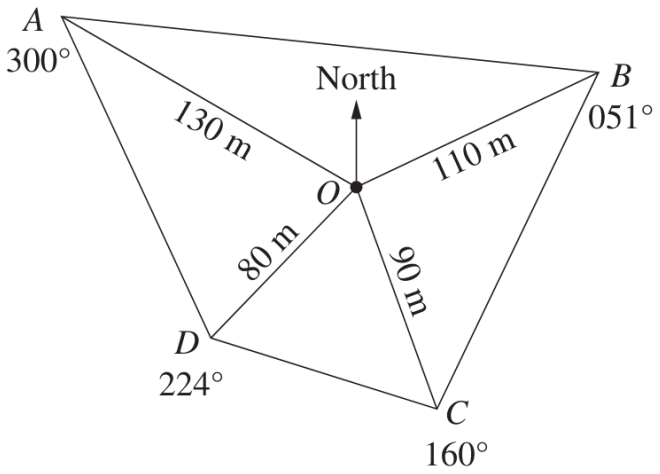
GRADIENT $= \frac{40}{4}$

$= 10$ $\therefore C = 10n + 40$ ✓

y-INT $= 40$

NO HALF MARKS.

23 The diagram below shows a compass radial survey of a field *ABCD*.



NOT TO SCALE

(a) Determine the size of $\angle BOA$. **1**

$\angle BOA = (360 - 300) + 51$

$= 111°$ ✓

(b) Calculate the area of ΔAOD , in square metres, correct to three significant figures. **3**

$\angle AOD = 300 - 224$

$= 76°$ ✓

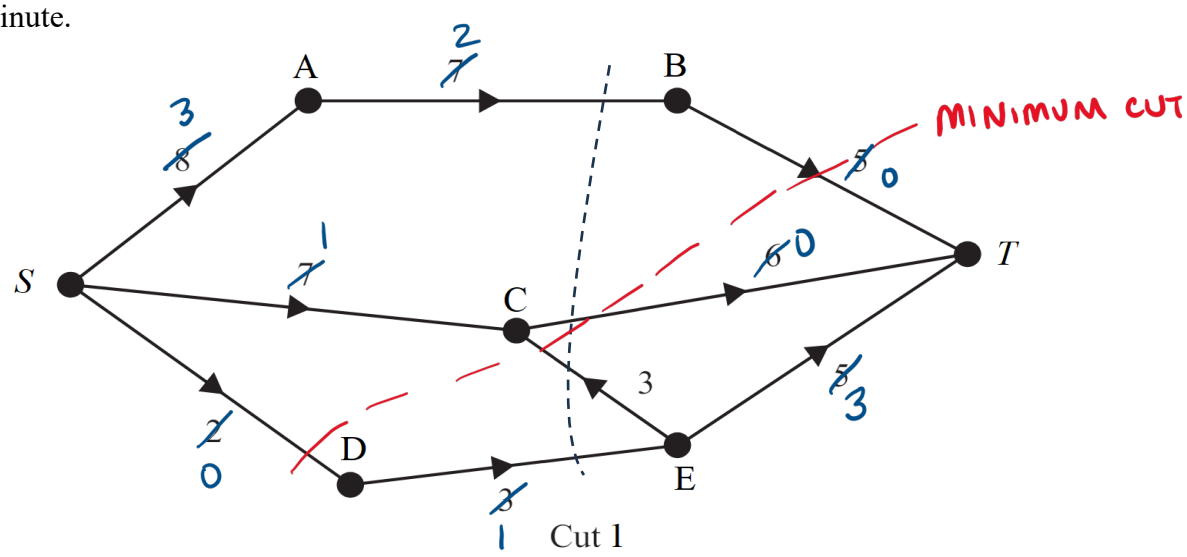
$A = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \times 130 \times 80 \times \sin 76$

$= 5046.53\ldots$ ✓

$= 5050\ m^2$ (3 sig. figs) ✓

24 A network of water pipes with source S and sink T is shown below.
The numbers on the edges show the maximum capacity of each pipe in litres per minute.



(a) Determine the capacity of Cut 1, in litres per minute. **1**

7+6+3 = 16 L/min

(b) Determine the maximum flow of this network, in litres per minute. **1**

5+6+2 = 13L/min

(c) Draw the minimum cut on the diagram above. SEE DIAGRAM **1**

(d) You wish to increase the maximum flow through the network, but you only have the budget to replace **one** pipe. **2**
Determine which pipe should be replaced and the new maximum flow through this network, in litres per minute.

INCREASING THE CAPACITY OF BT CAN INCREASE MAX. FLOW TO 15 L/min.

25 Sam scored 76 in her first school assessment task for which the mean was 66 and the standard deviation was 10. **2**

In her second assessment task, she scored 85. for which the mean was 71 and the standard deviation was 14.

Did Sam's performance improve from her first assessment task to the second? Justify your answer with reference to Sam's *z*-scores.

$$Z_1 = \frac{76-66}{10}$$

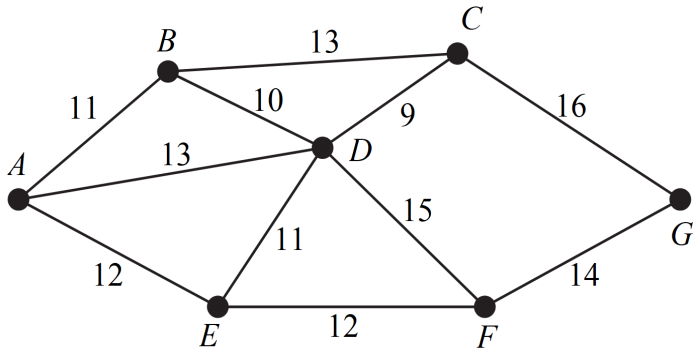
$$= 1$$ ✓

$$Z_2 = \frac{85-71}{14}$$

$$= 1$$ ½

NO. SAM PERFORMED THE SAME IN BOTH TASKS. ½

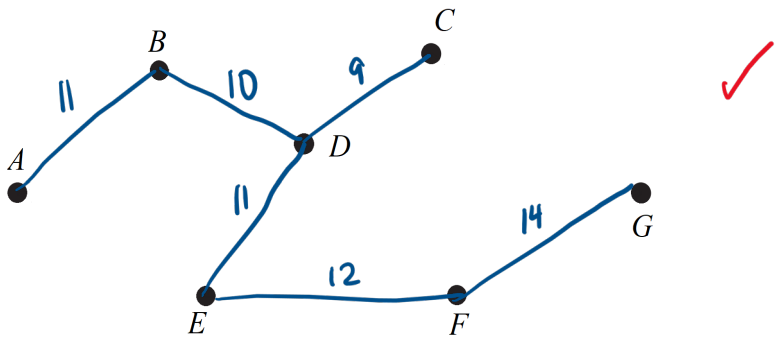
26 The network below represents the walking course for a scavenger hunt. The weight on each edge represents the time (in minutes) it takes to walk between each checkpoint.



(a) Name the vertex with even degree. **1**

G ✓

(b) Draw the minimum spanning tree and determine its weight. **2**



✓

Weight of minimum spanning tree: 11+10+9+11+12+14 = 67 mins ✓

27 Sophie deposits \$600 into an account at the end of every six months for 4 years. The account pays 4% per annum interest, compounding every six months.

Future value of an annuity of \$1 per period at the end of *n* periods

	Interest rate per period				
n	**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) Use the table above to find the future value of Sophie's investment after 4 years, correct to the nearest cent. **2**

$FV = a \times X$

$= 600 \times 8.5830$

$= \$\ 5149.80$

(b) Calculate the amount of interest that Sophie will earn on this investment. **1**

$I = 5149.80 - 600 \times 8$

$= \$\ 349.80$

(c) Find the single amount Sophie can invest now for 4 years at 4% per annum, compounding every six months, to achieve the same result. **2**

$FV = PV(1+r)^n$

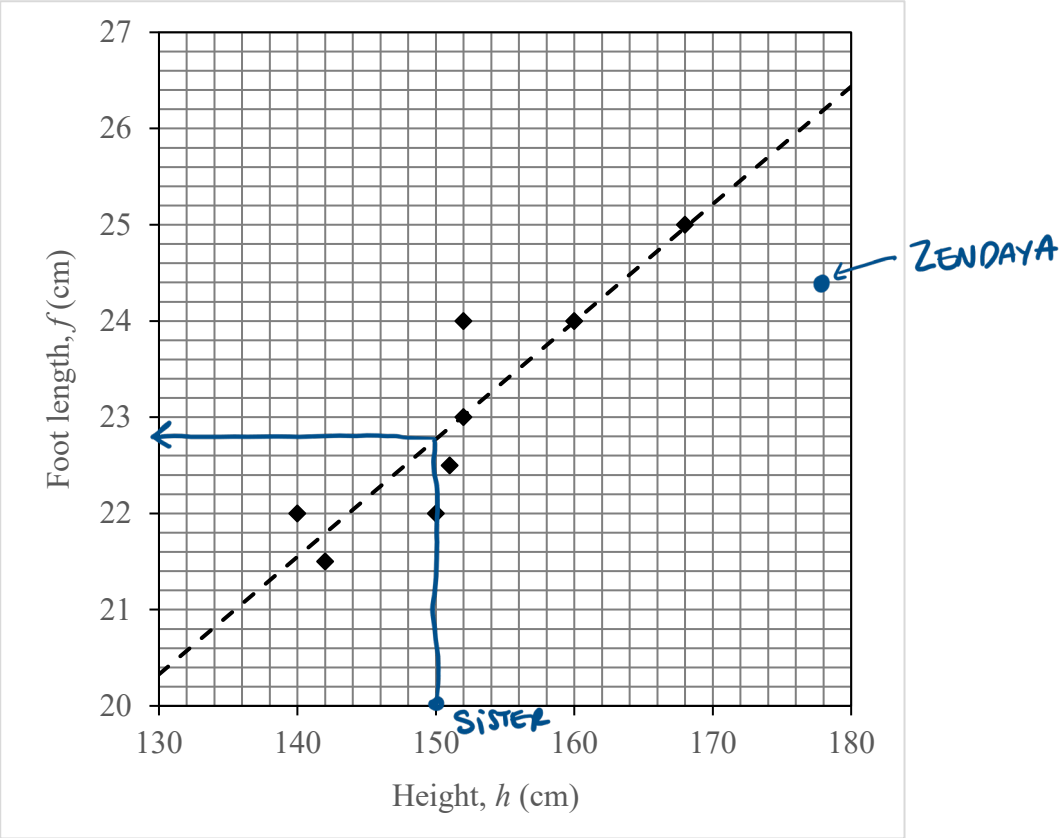
$5149.80 = PV(1.02)^8$

$PV = \dfrac{5149.80}{(1.02)^8}$

$= \$4395.30$

28 Zendaya surveys her extended family on each person's foot length and height, measured in centimetres. The data is displayed in the table and scatterplot below. The least squares regression line for this data is also shown.

Height (cm)	140	142	150	151	152	152	160	168
Foot length (cm)	22	21.5	22	22.5	24	23	24	25



(a) Calculate Pearson's correlation coefficient, correct to 3 decimal places. **1**

r = 0.899 (3 d.p.) ✓

(b) Explain what your result tells you about height and foot length. **1**

THERE IS A STRONG POSITIVE ✓ CORRELATION BETWEEN HEIGHT AND FOOT LENGTH.

Question 28 continues on page 25

(c) Zendaya's younger sister is 150 cm tall. According to the least squares regression line, what should be her foot length? **1**

22.8 cm

(d) Zendaya decides to include herself in the data. Her foot length is 24.4 cm and her height is 178 cm. **1**

When this point is added to the plot, what happens to the gradient of the regression line?

THE GRADIENT DECREASES

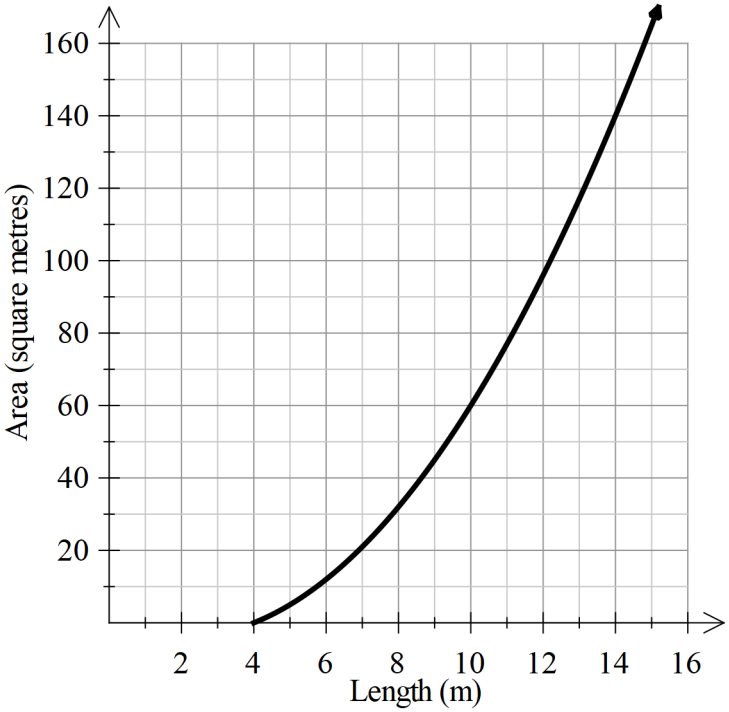
End of question 28

29 A farmer wants to build a rectangular garden bed so that the length is 4 metres longer than the width.

(a) Write an equation for the area of the garden bed, A, in terms of the length, l. **1**

$A = l(l-4)$ ✓

(b) A graph comparing the area of the garden bed to its length is shown.



Why are lengths between 0 and 4 metres not possible? **1**

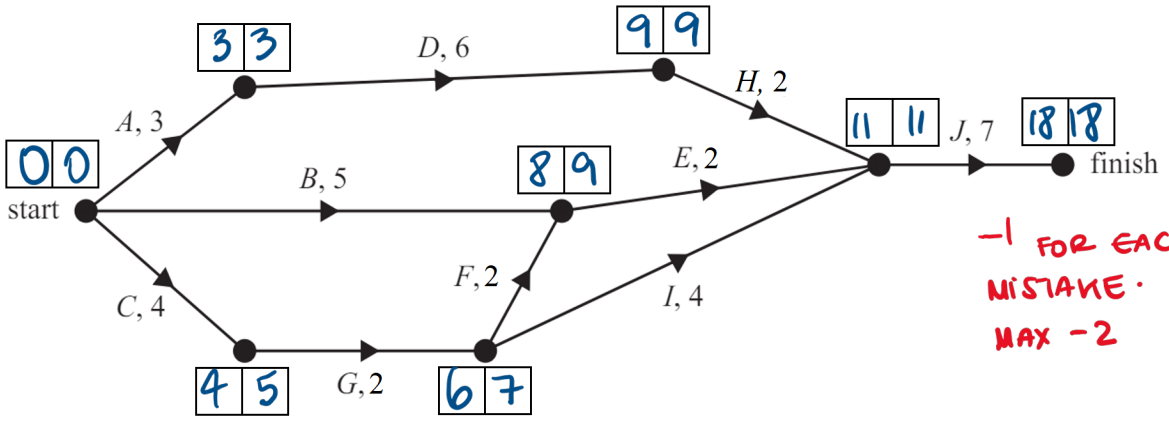
BECAUSE WIDTH CAN'T BE NEGATIVE. ✓

(c) Use the graph to determine the dimensions of the garden bed when the area is 45 m^2. **2**

$l = 9$ m ✓

$w = 5$ m ✓

30 The directed graph below shows the sequence of activities required to complete a kitchen renovation project. The time taken to complete each activity, in weeks, is also shown.



−1 FOR EACH MISTAKE. MAX −2

(a) List the activities on the critical path. **1**

A D H J ✓

(b) Complete a forward and backward scan of the project. **2**

(c) Determine the float time for activity *B*. **1**

FLOAT TIME = LFT − EST − duration
= 9 − 0 − 5
= 4 WEEKS ✓

(d) The project manager hires more builders such that Activity *D*'s duration is reduced to 3 weeks. What is the new critical time for the project? **1**

NEW CRITICAL PATH IS C G F E J OR C G I J.
CRITICAL TIME IS NOW 17 WEEKS. ✓

−½ IF TIME UNITS MISSING IN EITHER (c), (d) OR BOTH.

31 The table below is used to find the **present value** of a \$1 annuity at different interest rates over different numbers of time periods.

Present value of an annuity of \$1 per period at the end of *n* periods

	Interest rate per period					
Period	**0.2%**	**0.25%**	**0.5%**	**0.75%**	**1%**	**2%**
12	11.8454	11.8073	11.6189	11.4349	11.2551	10.5753
24	23.4103	23.2660	22.5629	21.8891	21.2434	18.9139
36	34.7011	34.3865	32.8710	31.4468	30.1075	25.4888
48	45.7244	45.1787	42.5803	40.1848	37.9740	30.6731
60	56.4866	55.6524	51.7256	48.1734	44.9550	34.7609

Anthony borrowed \$25 000 to buy a car.
Interest is charged at 2% interest per annum, compounded quarterly. r = 0.5% PER QUARTER
Anthony will repay the loan in full, with quarterly repayments over six years. n = 24 QUARTERS

(a) Find Anthony's quarterly repayment, correct to the nearest cent. **2**

PV = a × X

25000 = a × 22.5629 ✓

a = 25000 / 22.5629

= \$1108.01 ✓

(b) The balance of the loan, A_n, in dollars, after n quarters, can be modelled by the recurrence relation: **2**

$$A_n = 1.005A_{n-1} - R$$

where R is Anthony's quarterly repayment and $A_0 = 25000$.
Use this recurrence relation to find the balance of the loan after two quarters.
Answer to the nearest cent.

A_1 = 1.005 × 25000 − 1108.01

= \$24016.99 ✓

A_2 = 1.005 × 24016.99 − 1108.01

= \$23029.06 ✓

32 Elsa lives in Sydney (UTC+10). Her sister Anna is an exchange student in Denver, Colorado USA (UTC–7).

(a) What is the time difference between Sydney and Denver? **1**

17 hours ✓

(b) Anna boards a flight from Denver to Sydney via Los Angeles. **3**

Her plane left Denver on Friday at 4:00 pm (Denver time), stopped for 4 hours in Los Angeles, and arrived in Sydney at 6:30 am on Sunday.

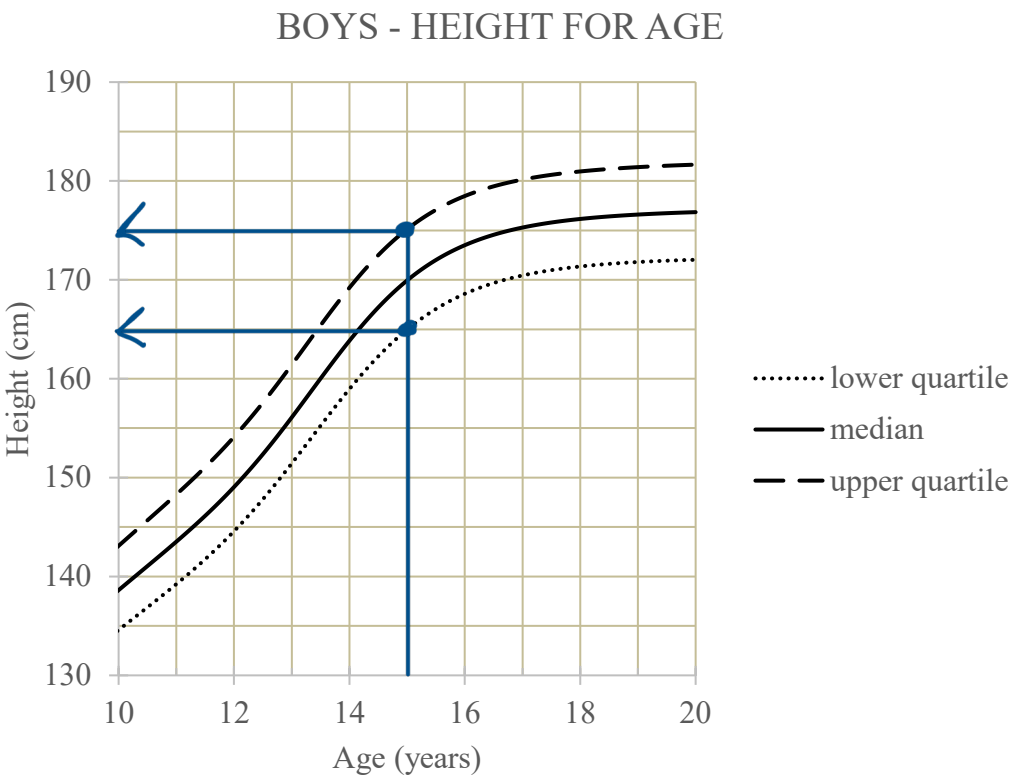
What was the plane's total flying time?

DEPARTURE TIME IN SYDNEY = 4:00pm + 12h + 5h
= 4:00 AM + 5h
= 9:00 AM SATURDAY ✓ *

TOTAL TRAVEL TIME = 21 h 30 min ✓
TOTAL FLYING TIME = 17 h 30 min ✓

* Alternatively arrival time in Denver = 6:30 AM − 12h − 5h
= 6:30 pm − 5h
= 1:30 pm SATURDAY

33 The graph below gives information about the weights of boys aged between 10 and 20.



(a) Find the IQR of 15-year-old boys in this group. **1**

IQR = 175 − 165
= 10cm

(b) What is the maximum possible range for this set of data if there are no outliers? **2**

MAX HEIGHT = $Q_3 + 1.5\,IQR$
= 175 + 1.5×10
= 190cm

MIN HEIGHT = $Q_1 - 1.5\,IQR$
= 165 − 1.5×10
= 150 cm

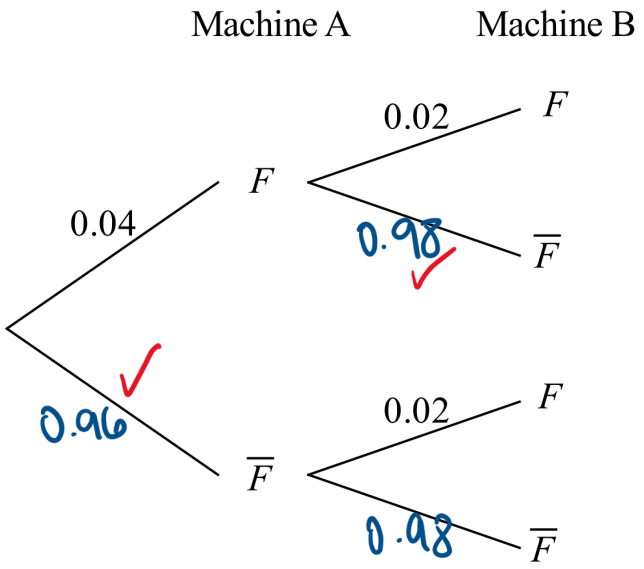
EITHER ONE CORRECT ✓

MAX RANGE = 190 − 150
= 40 cm ✓ CORRECT RANGE

34 Two machines, A and B, produce light globes. It is known that 4% of the light globes produced by machine A are faulty and that 2% of the light globes produced by machine B are faulty.

Timothee selects two light globes at random, one from each machine.

(a) Complete the probability tree diagram by writing the correct probability on each branch. **2**



(b) Find the probability of choosing two faulty light globes. Answer as a percentage. **1**

$0.04 \times 0.02 = 0.0008$

$= 0.08\%$

(c) What is the probability that at least one light globe is faulty? Answer as a percentage. **2**

$P(\text{AT LEAST } 1) = 1 - P(\text{NONE})$

$= 1 - P(\bar{F}\bar{F})$

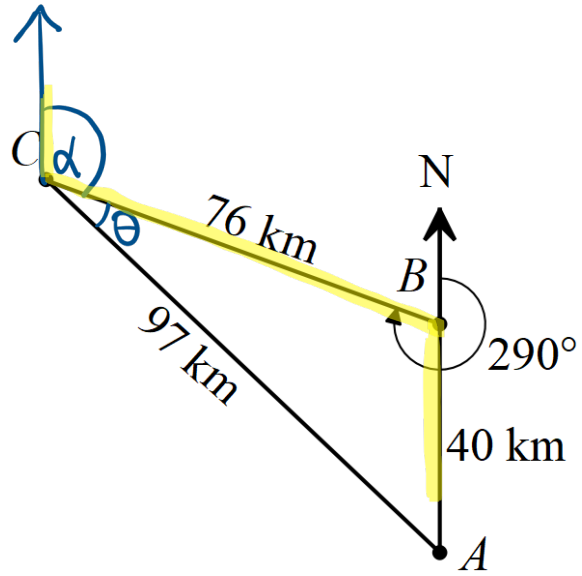
$= 1 - 0.96 \times 0.98$

$= 0.0592$

$= 5.92\%$

35 An aeroplane completed a flight consisting of three stages. **3**

S Starting at Amberley (A), it flew 40 km directly due north to Beachwood (B).
From Beachwood, it flew 76 km on a bearing of 290° to Chalton (C).
From Chalton, it flew 97 km to return to Amberley.



Find the bearing of the trip from Chalton to Amberley. Round your answer to the nearest degree.

$\alpha = 290 - 180$ ALTERNATE ∠s ON PARALLEL
$= 110°$ ✓ LINES ARE EQUAL.

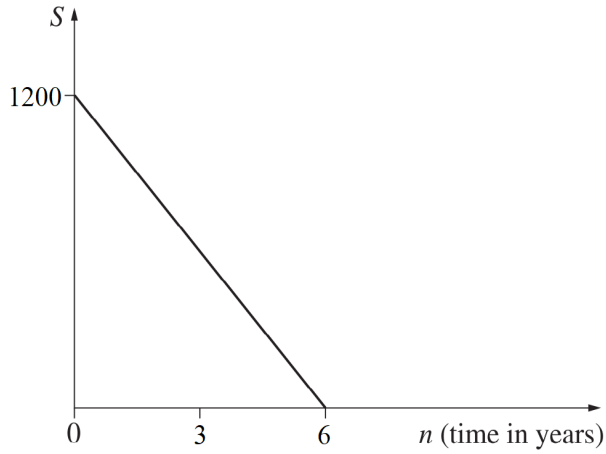
* $\cos\theta = \dfrac{76^2 + 97^2 - 40^2}{2 \times 76 \times 97}$

$\theta = 22°\,52'\,11''$ ✓

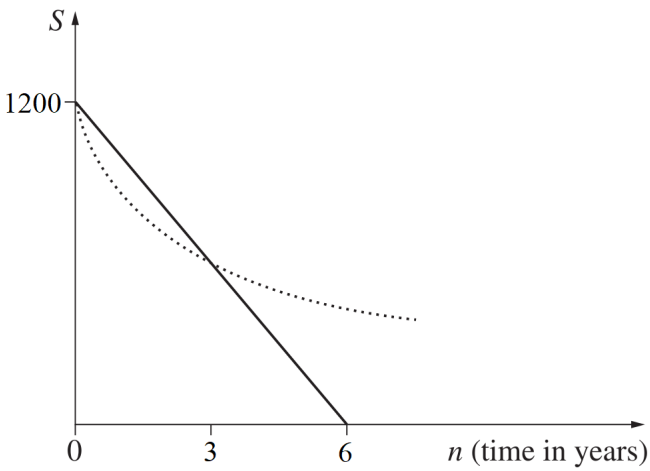
BEARING OF A FROM C $= 110 + 22°\,52'\,11''$
$= 133°$ ✓ (NEAREST DEG.)

* CAN ALSO BE SOLVED USING THE SINE RULE.

36 While Barbie is on holidays she buys a new laptop computer for \$1200. Using the straight-line method of depreciation, the salvage value, S, of the laptop computer will be zero in six years time, as shown on the graph below. **3**



Using the declining balance method of depreciation, at a rate of R% per annum, the salvage value is represented by the dotted curve on the graph below.



NOT TO SCALE

Both methods give the same salvage value after three years. Find the value of R, correct to the nearest whole.

FROM STRAIGHT LINE DEPRECIATION, AFTER 3 YEARS:

$S = 600.$ ✓

FROM DECLINING BALANCE:

$600 = 1200(1-R)^3$ ✓

$\frac{1}{2} = (1-R)^3$

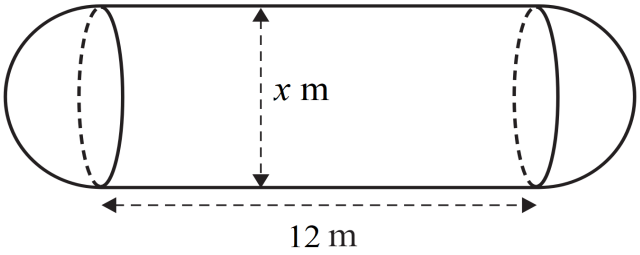
$1-R = \sqrt[3]{\frac{1}{2}}$

$R = 1 - 0.7937\ldots$

$\therefore R = 21\%$ ✓ (NEAREST WHOLE)

37 A large storage tank consists of a cylinder with a hemisphere at each end.

The cylinder has a length of 12 m and a diameter of x m, as shown in the diagram below.



NOT TO SCALE

(a) A scale model of this storage tank is constructed. The length of the cylinder of the scale model is 480 mm. **1**

Show that scale used to construct the model is 1:25.

SCALED : REAL = 480 mm : 12 m

= 480 : 12000 ✓ MUST SHOW THIS STEP

= 1 : 25

(b) The diameter of the scale model of the tank is 160 mm. **3**

The real tank is filled with fuel at a rate of 1000 L/min.

How long does it take to fill the tank completely? Answer in hours and minutes, correct to the nearest minute.

REAL DIAMETER = 160 × 25

= 4000 mm

= 4 m ✓

V = V CYLINDER + V SPHERE

$= \pi \times 2^2 \times 12 + \frac{4}{3}\pi \times 2^3$ ½

= 184.306... m^3

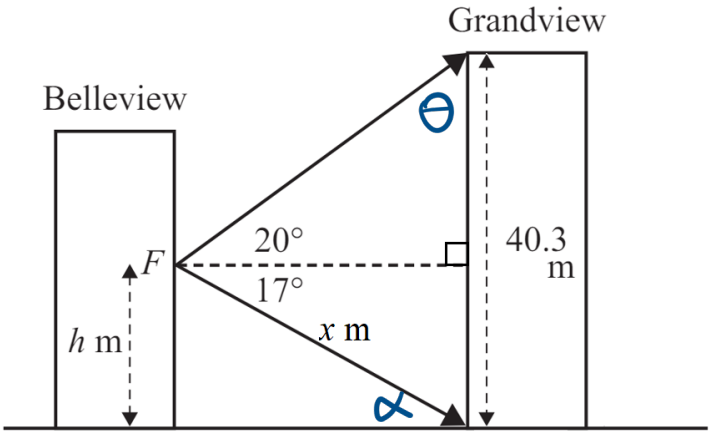
= 184.306... KL ½

TIME TO FILL = 184.306... MINUTES ½

= 3h 4 min (NEAREST MIN) ½

38 Two hotels, the Belleview and the Grandview, built on flat, level ground, face each other. The Grandview has a height of 40.3 m.

From Fred's window ledge in the Belleview, F, he measured an angle of elevation of 20° to the top of the Grandview and an angle of depression of 17° to the ground at the Grandview. This information is shown in the diagram below. **3**



By first finding the distance labelled x, find the height, h, from the ground to Fred's window ledge. Answer in metres, to one decimal place.

$\theta = 180 - 90 - 20$ ✓ OR ANY OTHER USEFUL ANGLE

$= 70°$

$\frac{x}{\sin 70°} = \frac{40.3}{\sin 37°}$

$x = \frac{40.3}{\sin 37°} \times \sin 70°$

$= 62.9256\ldots$ m ✓ OR ANY OTHER USEFUL DISTANCE

$\alpha = 17°$ ALTERNATE ∠s ON PARALLEL LINES

$\sin 17° = \frac{h}{x}$

$h = \sin 17° \times 62.9256\ldots$

$= 18.3976\ldots$

$= 18.4$ m (1 d.p.) ✓

Question 37 continues on page 36

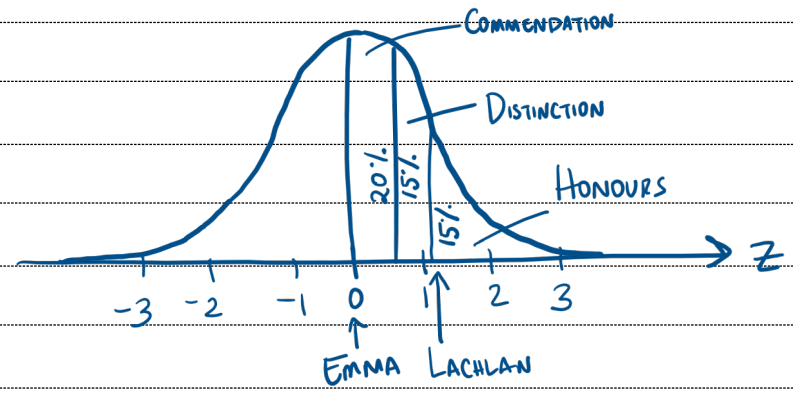
39 There is a "Giant Pumpkins" competition at the Royal Easter Show. The weights of pumpkins were normally distributed, with a mean of 8 kg and a standard deviation of 1.5 kg. **4**

The largest pumpkins were given awards. Three award categories were used:

- **Honours** for the heaviest 15% of pumpkins;
- **Distinction** for the next 15% and
- **Commendation** for the next 20%.

Emma's pumpkin only just missed out on a commendation. Lachlan's pumpkin only just qualified for honours. Determine the weight difference, to the nearest gram, between Emma and Lachlan's pumpkins.

You may use the standardised z-scores table on page 37 to assist you.



LET LACHLAN'S Z-SCORE BE Z_L.

$P(Z < Z_L) = 0.85$ ✓ $\therefore Z_L = 1.04$ ✓

LACHLAN'S PUMPKIN: $1.04 = \dfrac{x_L - 8}{1.5}$

$x_L = 8 + 1.5 \times 1.04$

$= 9.56$ kg ✓

EMMA'S PUMPKIN: $x_E = 8$ kg

DIFFERENCE $= 9.56 - 8$

$= 1.560$ kg or 1560 g ✓

$-\frac{1}{2}$ FOR ROUNDING