SHORE

Examination Number: | | | |

Set: | |

2023

YEAR 12
HSC TRIAL EXAMINATION

Mathematics Standard 2

General Instruction

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using non-erasable 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 2–8)

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

Section II – 85 marks (pages 9–48)

- Attempt Questions 16–37
- Allow about 2 hours and 5 minutes for this section

Note: Any time you have remaining should be spent reviewing your answers

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

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

Use the multiple-choice answer sheet for questions 1−15

1 Oliver designed a survey in which the following question was asked.

"How many pets do you have?"

What kind of data would the responses be classified as?

A. Categorical, nominal
B. Categorical, ordinal
C. Numerical, discrete
D. Numerical, continuous

2 A truck is travelling at 72 km/h.

How far will it travel in 1 hour 30 minutes?

A. 48 km
B. 55.4 km
C. 93.6 km
D. 108 km

3 Cat food is sold in four different sized bags.

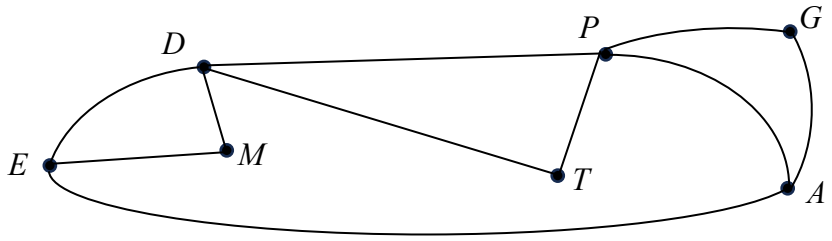
Which is the best buy?

A. \$12.50 for 750 g
B. \$22.50 for 1.5 kg
C. \$30.20 for 2 kg
D. \$45.60 for 3 kg

4 What is 0.020 356 written in standard form, to 3 significant figures?

A. 2.03×10^{-2}
B. 2.035×10^{-2}
C. 2.036×10^{-2}
D. 2.04×10^{-2}

5 Consider the network diagram, and the degrees of each vertex.



What is the ratio of vertices with odd degree, to vertices with even degree?

A. 2 : 5

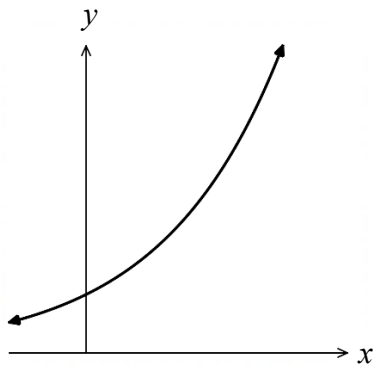
B. 3 : 4

C. 4 : 3

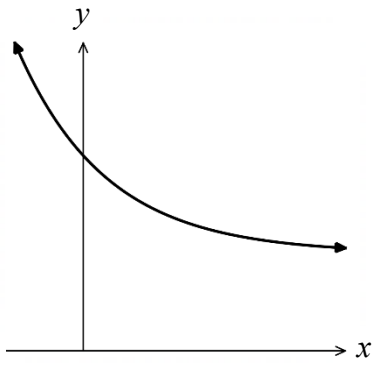
D. 5 : 2

6 Which of the following best represents the graph of $y = 2^x$?

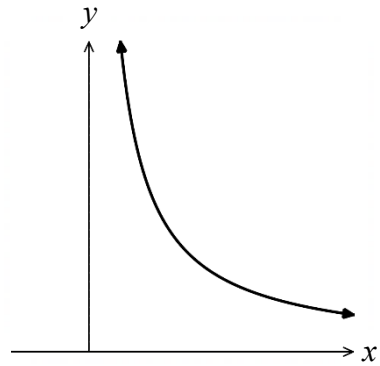
A.



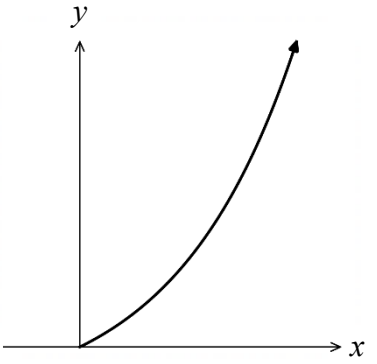
C.



B.



D.



7 Mitch rolled a die 50 times and recorded the results in a table, shown below.

Number on die	1	2	3	4	5	6
Relative Frequency	20%	16%	14%	16%	X	22%

How many times did Mitch roll a 5?

A. 5

B. 6

C. 8

D. 12

8 Which true bearing is the same as a compass bearing of N40°W ?

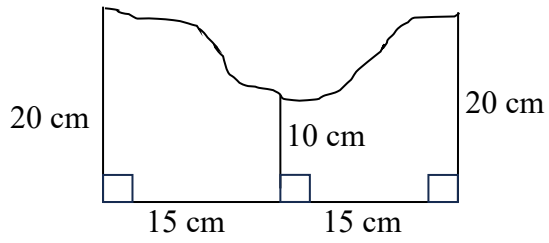
A. 040°

B. 050°

C. 220°

D. 320°

9 Hugo correctly uses two applications of the Trapezoidal Rule to estimate the area of the shape below.



NOT TO SCALE

What does Hugo estimate the area of the shape to be?

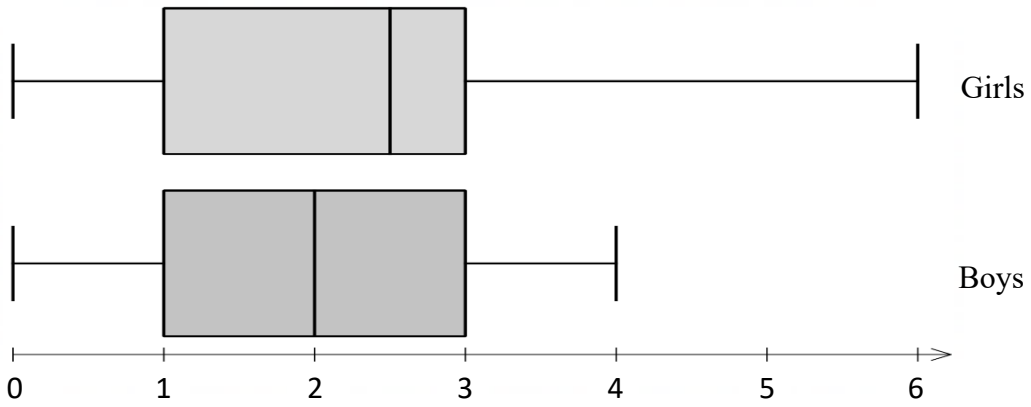
A. 300 cm^2

B. 450 cm^2

C. 600 cm^2

D. 900 cm^2

10 The number of books Year 12 girls and boys checked out of the school library in one week, is shown in the box plots below.



Which one of these statements is true?

A. The range and the interquartile range for the girls, are the same for the boys.

B. The lowest extreme and the median for the girls, are the same for the boys.

C. The interquartile range and the lowest extreme for the girls, are the same for the boys.

D. The 5-number summaries for the girls and the boys are the same.

11 Which of the following correctly expresses x as the subject of $y = \frac{mx-2}{3}$?

A. $x = \frac{3y+2}{m}$

B. $x = \frac{3y}{m} + 2$

C. $x = \frac{y+2}{3m}$

D. $x = \frac{y}{3m} + 2$

12 Billy is driving at 80 km/h when he must stop quickly, so he applies the brakes. If his reaction time is 1.2 seconds and the braking distance is 65 m, what is the stopping distance, to the nearest metre?

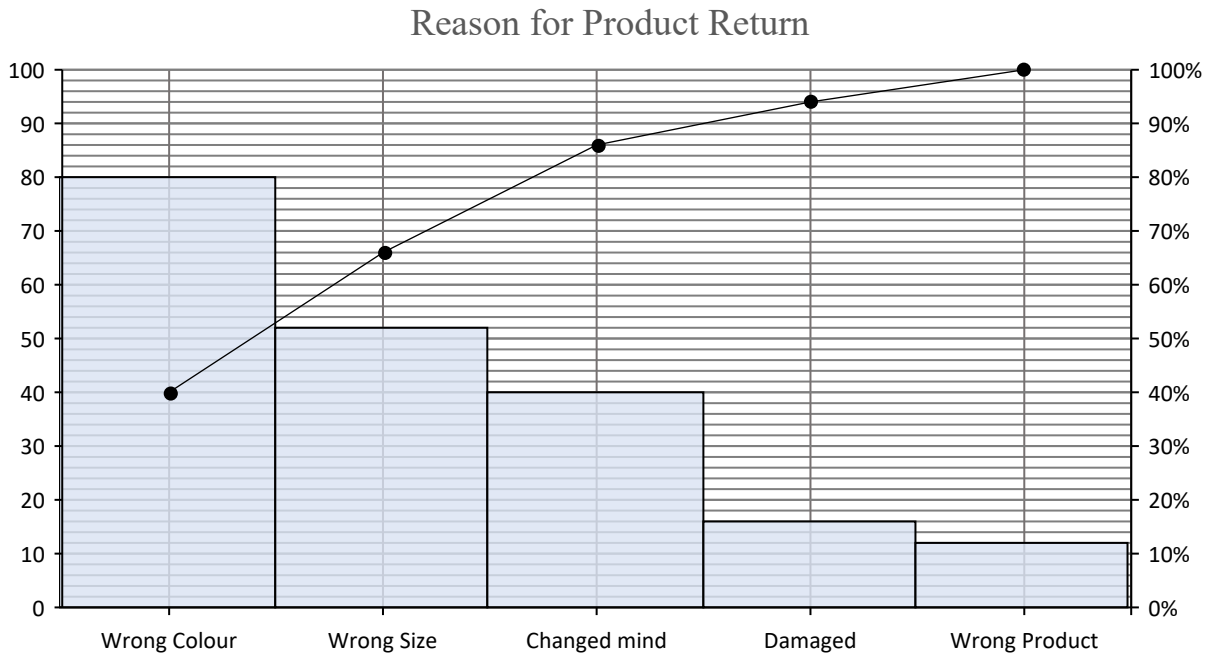
A. 66 m

B. 87 m

C. 92 m

D. 161 m

13 The pareto chart shows data collected from 200 customers who returned the product they had ordered, and the reason for returning it.



What percentage of customers returned a product because they had changed their mind?

A. 8%

B. 20%

C. 40%

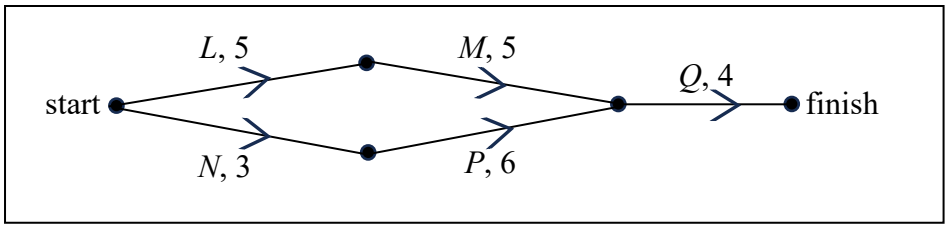
D. 86%

14 The table shows activities *A* to *E*, which must be completed for a project, with any immediate prerequisite(s) and the duration of each activity.

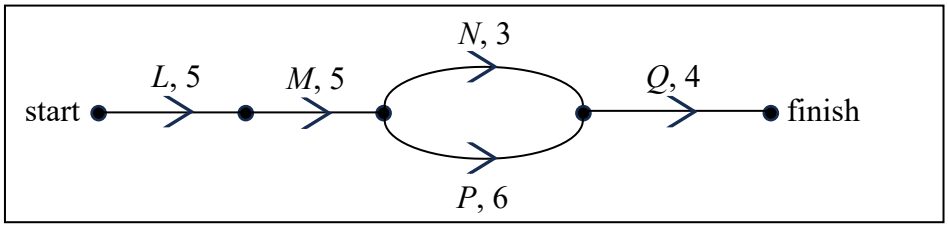
Activity	*Immediate prerequisite(s)*	*Duration in minutes*
L	none	5
M	none	5
N	*L*	3
P	*M*	6
Q	*N*, *P*	4

Which one of the network diagrams below best represents the activity table?

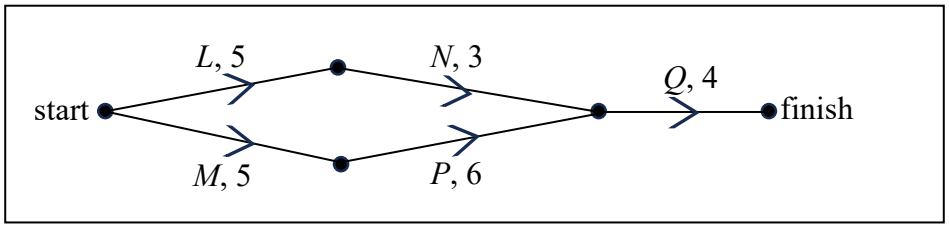
A.



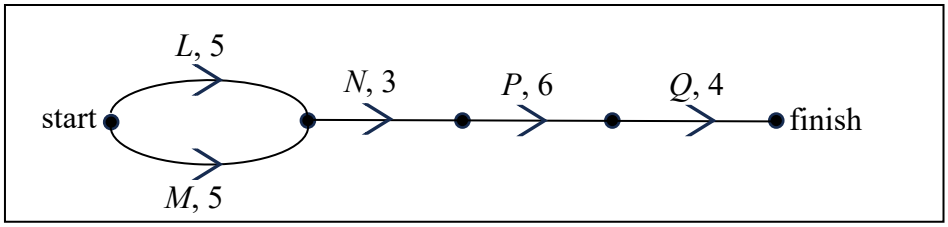
B.



C.

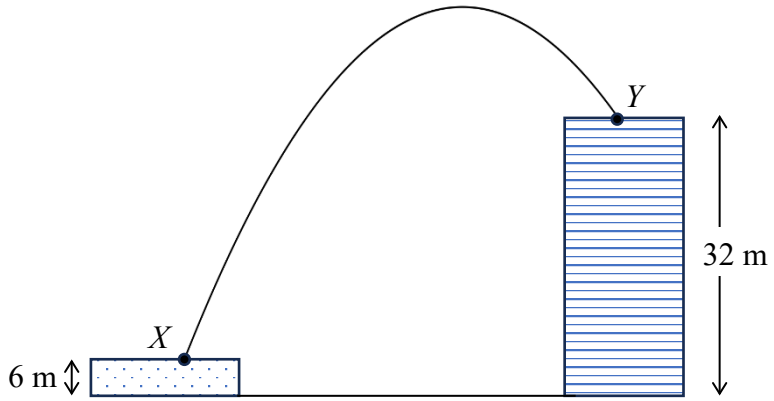


D.

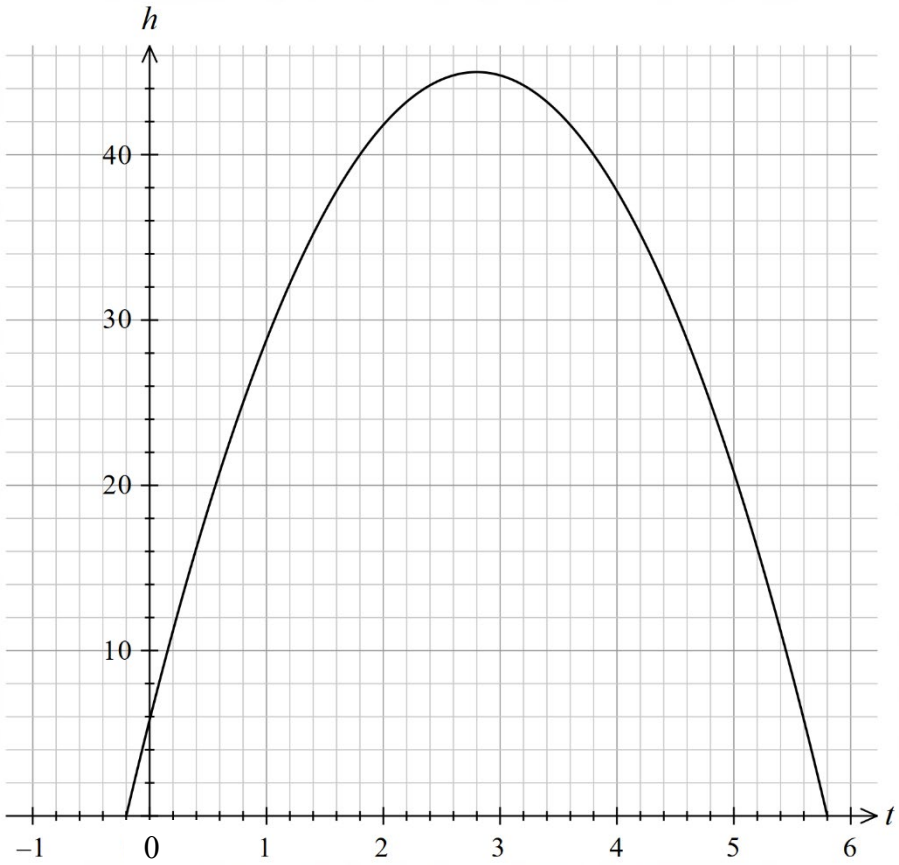


15 A golf ball is hit from a point X, 6 metres above the ground, to a point Y, 32 metres above the ground. The golf ball passes its maximum height, before landing at point Y.

The diagram shows the path of the golf ball from point X to point Y.



The graph shows the relationship between time, t seconds and the height, h metres, of the golf ball above the ground.



For how long is the ball in the air, between points X and point Y?

A. 2.8 seconds

B. 4.4 seconds

C. 5.6 seconds

D. 5.8 seconds

2023 **YEAR 12 HSC TRIAL**

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Mathematics Standard 2

Section II Answer Booklet

A

Section II

85 marks
Attempt Questions 16-37
Allow about 2 hours 5 minutes for this section

Booklet A — Attempt Questions 16-22 (17 marks)
Booklet B — Attempt Questions 23-26 (17 marks)
Booklet C — Attempt Questions 27-31 (17 marks)
Booklet D — Attempt Questions 32-34 (17 marks)
Booklet E — Attempt Questions 35-37 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Section II

85 marks
Attempt Questions 16–37
Allow about 2 hours and 5 minutes for this section

Answer the questions in the spaces provided.

Your responses should include relevant mathematical reasoning and/or calculations.

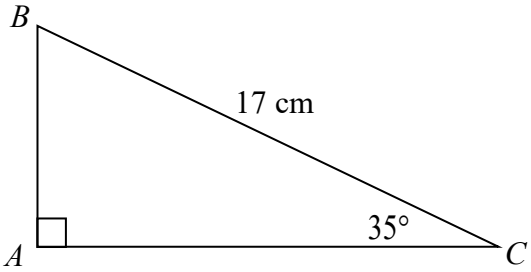
Extra writing space is provided at the end of each question booklet. If you use this space, clearly indicate which question you are answering.

Assume 52 weeks in a year, and 365 days in a year where necessary.

Booklet A: Questions 16 – 22 (17 marks)

Question 16 (2 marks)

Consider the right-angled triangle, ABC, shown below. **2**

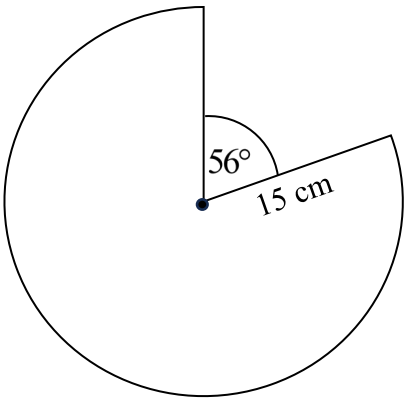


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Find the length of side AB, to 2 decimal places.

Question 17 (2 marks)

Find the area of this sector, to one decimal place. **2**



Question 18 (2 marks)

Toby used his new credit card on May 5th to make a single purchase of $340. **2**

His credit card charges interest at a rate of 0.055% per day, compounding daily. Interest is charged from the day of purchase (included) to the day of payment (included).

Toby made no other purchases and paid the balance on the card on 15th June. What was the balance that Toby paid?

Question 19 (2 marks)

Luke models the population, R, of rabbits on his property using the function $R = 400(1.3)^n$, where n is the number of years that have passed.

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

(b) What will be the population of rabbits after 4 years? **1**

Question 20 (3 marks)

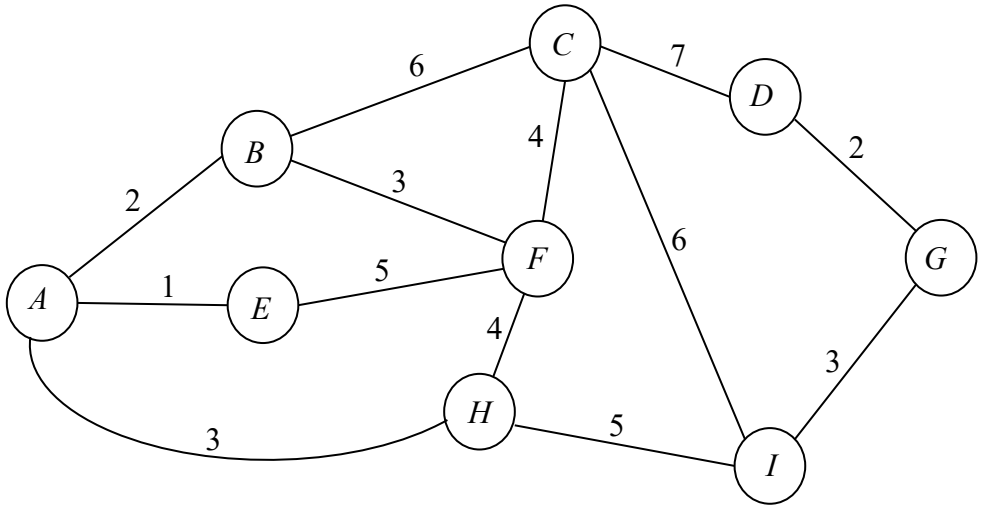
Will discovers that the time it takes to clean all the rooms in the Marada Hotel is inversely proportional to the number of cleaners he uses. When there are 15 cleaners, it takes 3 hours to clean all the rooms.

(a) By first finding the constant of proportionality, k, write an equation for the relationship between time, t, and the number of cleaners, n. **2**

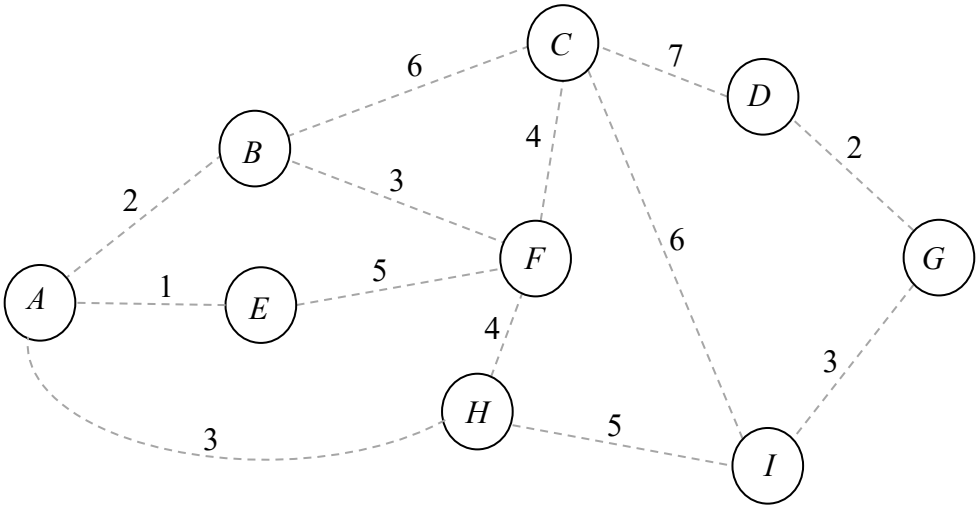
(b) How long will it take 7 cleaners to clean all the hotel rooms? Give your answer in hours and minutes. **1**

Question 21 (4 marks)

Consider the network below with vertices *A* to *I*.



(a) Draw a minimum spanning tree on the outline of the network diagram below. **2**



(b) What is the total edge weight of the minimum spanning tree? **1**

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(c) A new edge with a weight of 3 is added, connecting vertices *A* and *C*. How will this change the total weight of the minimum spanning tree? **1**

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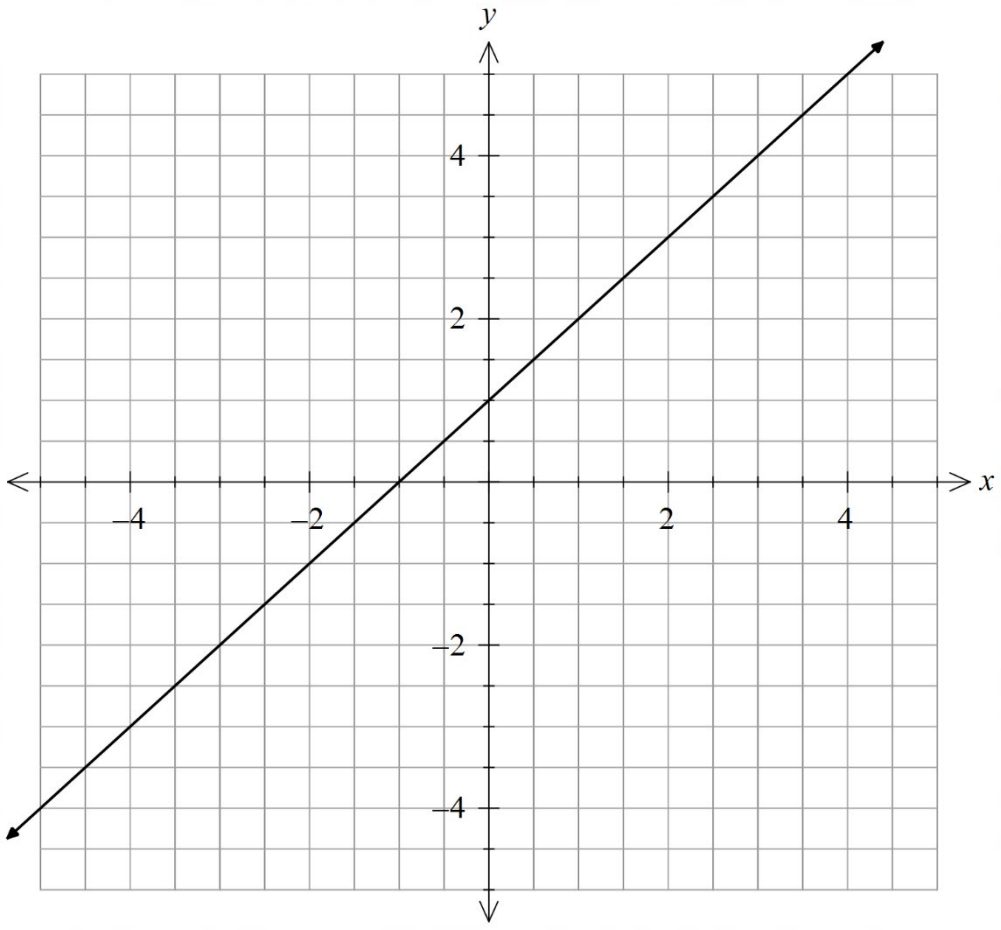
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Question 22 (2 marks)

Sophie is solving two equations simultaneously. She has plotted the first equation on the grid below.



Sophie also created the table of values, below, for the second equation.

x	−1	0	3
y	4	3	0

(a) Use the table of values to plot the second equation on the grid above. **1**

(b) What is the solution to the two equations simultaneously? **1**

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End of Booklet A

Questions 16 – 22 Extra writing space
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2023 YEAR 12 HSC TRIAL

Examination Number:

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Mathematics Standard 2

Section II Answer Booklet B

Booklet B — Attempt Questions 23-26 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Booklet B: Questions 23 – 26 (17 marks)

Question 23 (4 marks)

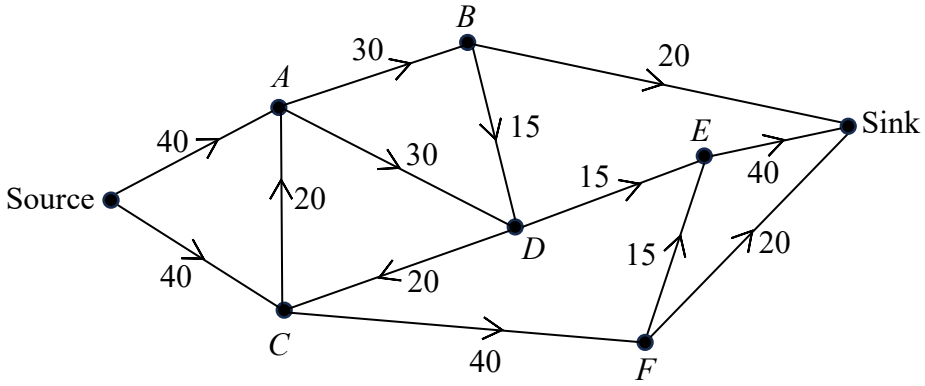
The stem-and-leaf plot shows the number of house plants owned by each of the students in a study group. **4**

0	1	8	9		
1	5	6	6	7	8
2	1	2	2		
3	1	9			

Are there outliers in this dataset and if so, what are they? Show suitable calculations to justify your answer(s).

Question 24 (3 marks)

A zoo has 6 special animal exhibits connected by one-way paths. A network diagram is shown, with vertices *A*, *B*, *C*, *D*, *E* and *F,* representing the exhibits. The maximum number of people who can pass along each path at one time is also shown as the edge weight.



(a) Draw a minimum cut and use it to determine the maximum flow of this network. **2**

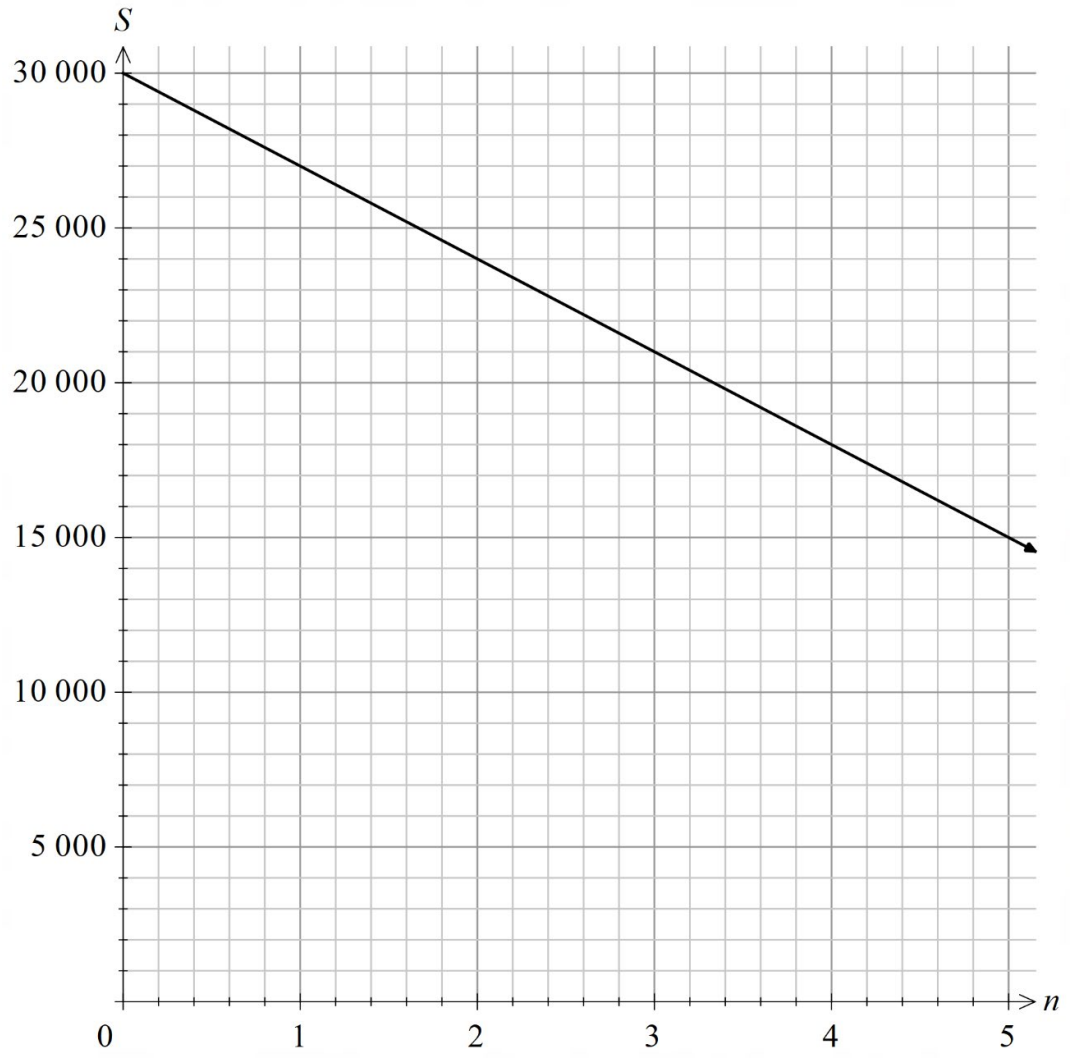
(b) The manager of the zoo wants to increase the flow of people along the paths. She decides she will increase the capacity of the path connecting *C* to *F*. **1**

Give a reason why this will not increase the maximum flow of the network.

Question 25 (6 marks)

Lachlan bought a new car, 10 years ago. For the first 5 years, he used the straight line depreciation method to depreciate the car's value. He then used the declining balance method.

Graph 1: shows the salvage value ($\$S$) of his car after n years (for the first 5 years).



(a) What was the value of Lachlan's car when he bought it 10 years ago? **1**

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(b) In the **first** 5 years, by how much did his car depreciate each year? **1**

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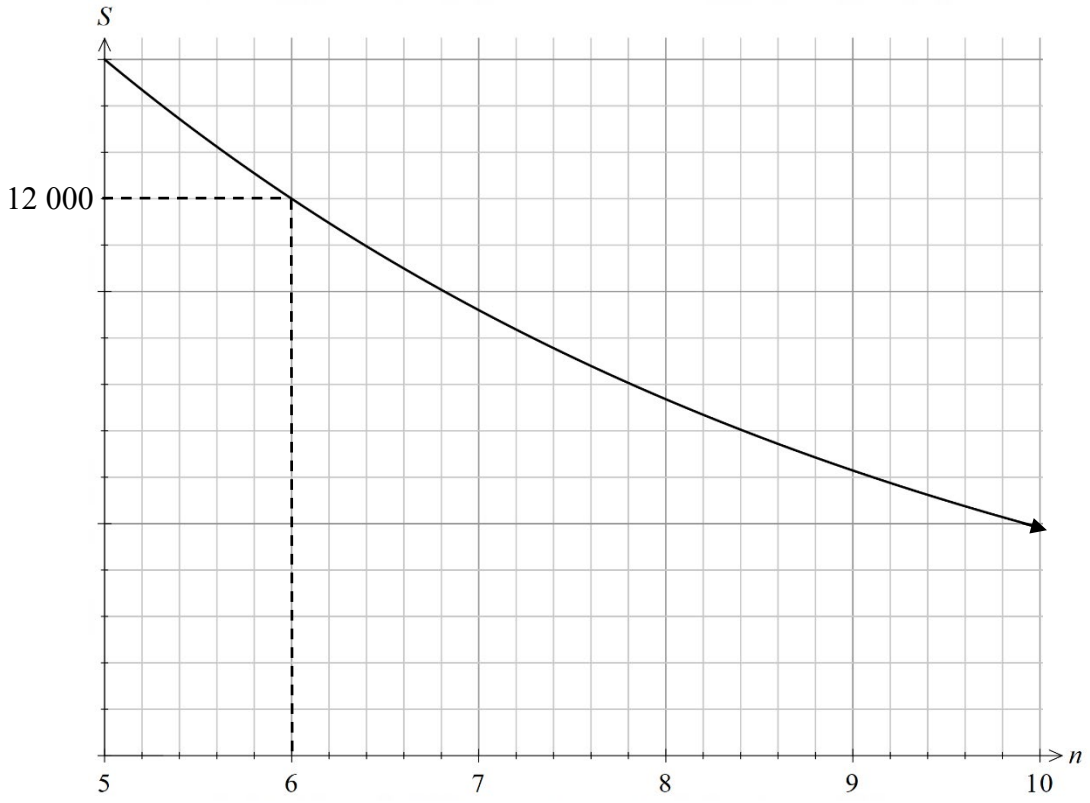
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Question 25 continues on the following page

Question 25 (continued)

Graph 2: shows the salvage value ($\$S$) of the car for the second 5 years. Some of the values on the vertical axis are missing.



(c) What was the rate of depreciation that Lachlan used in the **second** 5 years? **2**

(d) What will be the salvage value of the car 12 years after Lachlan bought it, if he continues to depreciate it using the declining balance method? **2**

Question 26 (4 marks)

The table shows the future values of an annuity of $1.

Periods	Interest rate per period						
	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%
5	5.1010	5.1523	5.2040	5.2563	5.3091	5.3625	5.4163
6	6.1520	6.2296	6.3081	6.3877	6.4684	6.5502	6.6330
7	7.2135	7.3230	7.4343	7.5474	7.6625	7.7794	7.8983
8	8.2857	8.4328	8.5830	8.7361	8.8923	9.0517	9.2142
9	9.3685	9.5593	9.7546	9.9545	10.1591	10.3685	10.5828
10	10.4622	10.7027	10.9497	11.2034	11.4639	11.7314	12.0061

Zac is saving for his dream holiday and needs approximately $18 000. He opens an annuity account which is paying 2.5% interest per annum.

(a) How much must Zac deposit each year if he wants to have saved $18 000 in 6 years time? **2**

(b) If Zac decided instead, to invest in an account earning compound interest at 2.5% per annum, for 6 years, how much would he have to invest in the account, as a lump sum, to have $18 000 in 6 years time? **2**

End of Booklet B

Questions 23 – 26 Extra writing space

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

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2023 YEAR 12 HSC TRIAL

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Mathematics Standard 2

Section II Answer Booklet C

Booklet C — Attempt Questions 27-31 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Booklet C: Questions 27 – 31 (17 marks)

Question 27 (4 marks)

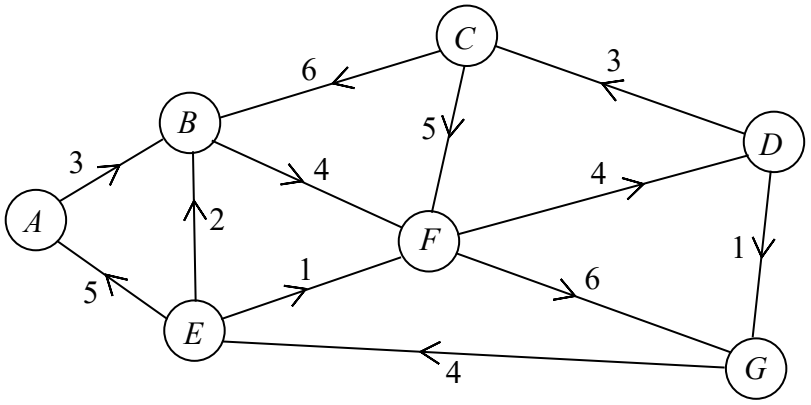
Packets of nuts contain almonds, brazil nuts and cashews in the ratio 7 : 3 : 5. There are different sizes of packet.

(a) In a 450 g packet, how many grams of brazil nuts will there be? **2**

(b) In a differently sized packet, there are 140 g of almonds. How many grams of cashews will be in this packet? **2**

Question 28 (2 marks)

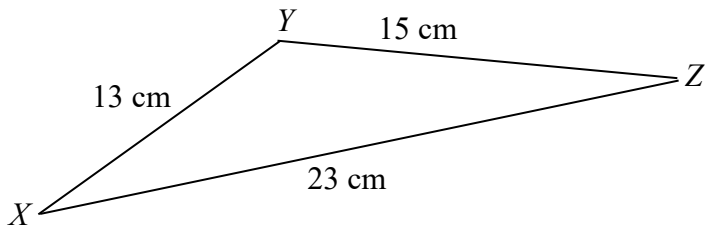
Consider the directed network shown, with vertices A, B, C, D, E, F and G. **2**



What is the shortest path from vertex C to vertex A? State the path and its total weight.

Question 29 (3 marks)

Find the size of $\angle XYZ$. Give your answer to the nearest minute. **3**



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Question 30 (3 marks)

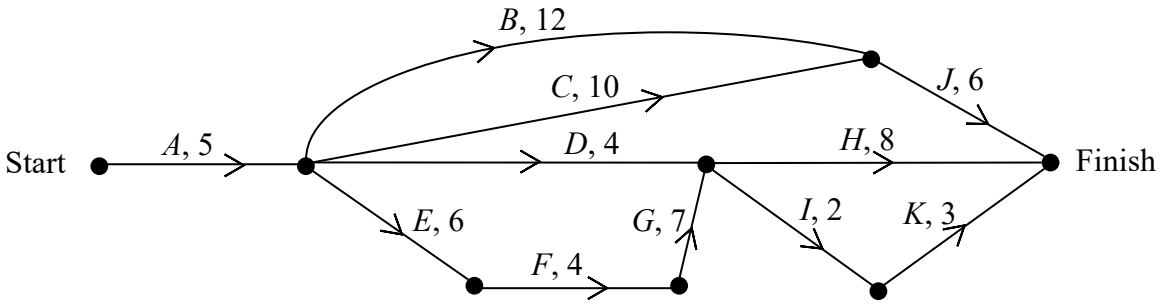
Sydney is 10 hours ahead of Coordinated Universal Time (UTC +10), and Toronto is 4 hours behind Coordinated Universal Time (UTC – 4). **3**

Ronan travels from Sydney to Toronto. His non-stop flight leaves Sydney at 1.50 pm on Friday, local time and arrives in Toronto at 7.41 pm, Toronto time, on the same day.

How long was the flying time?

Question 31 (5 marks)

Jasper is undertaking a project, which requires the completion of activities *A* to *K*. He uses the network diagram below, which shows these activities and their completion times in minutes.



(a) What is the minimum time it will take Jasper to complete his project? **1**

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.....

.....

(b) State the critical path for this project. **1**

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(c) Which activity has the greatest float time? State the activity and its float time. **2**

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(d) Jasper realises that he can complete activity *H* in 2 minutes, instead of 8. What will be the impact of this on the minimum time it takes for him to complete the project? **1**

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End of Booklet C

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Questions 27 – 31 Extra writing space
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2023 YEAR 12 HSC TRIAL

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Mathematics Standard 2

Section II Answer Booklet D

Booklet D — Attempt Questions 32-34 (17 marks)

Instructions

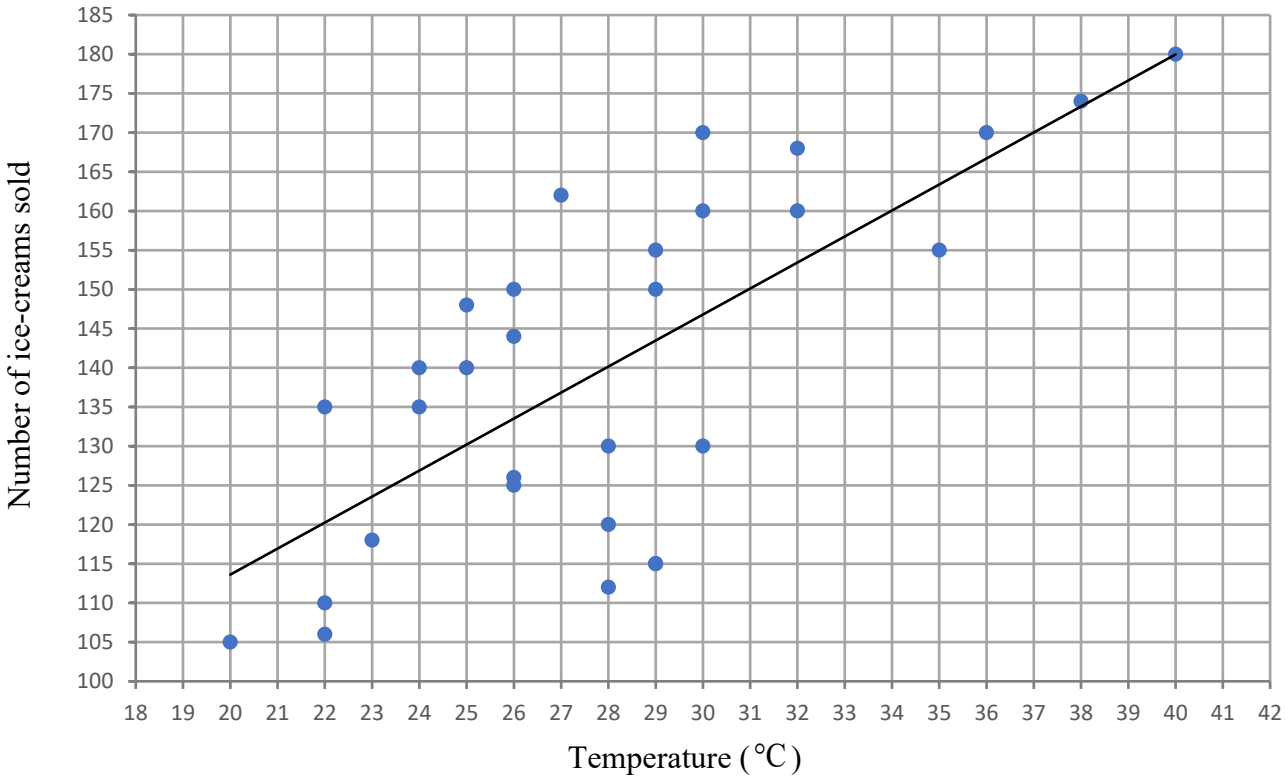
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Please turn over

Question 32 (4 marks)

Orlando collected data over 30 days, between 12 pm and 3 pm, on how many ice-creams are sold, and the average temperature outside.

The graph shows the data along with the regression line.



(a) Show that the gradient of the regression line is approximately 3.33. **1**

Question 32 continues on the following page

(b) Interpret the value of this gradient in the given context. **1**

(c) Use the graph to predict the number of ice-creams that would be sold if the outside temperature is $28\,°C$. **1**

(d) The correlation coefficient of the data is $r = 0.72$ (to 2 decimal places). **1**

Describe the correlation in Orlando's data set.

End of Question 32

Question 33 (8 marks)

A table of **present values** for an annuity of $1 is shown.

	Interest rate per period					
Period	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173

(a) Nathan invests $1500 at the end of every year for 3 years, in an annuity paying interest at 4% per annum, compounding annually. **1**

Use the table to find the present value of Nathan's annuity.

(b) Nathan calculated the future value of his annuity to be $4682.42. How much interest did his annuity earn over three years? **1**

Question 33 continues on the following page

(c) Spencer thinks that his own investment will earn more interest than Nathan's, because he is going to invest \$720 at the end of every 6 months for 3 years, at a rate of 4% per annum, compounding 6 monthly. **3**

Is Spencer correct? Justify your answer with suitable working.

(d) Jackson wishes to invest an amount at the end of every year in an annuity paying 5% per annum, compounding annually. He wants a future value of \$10 000. **3**

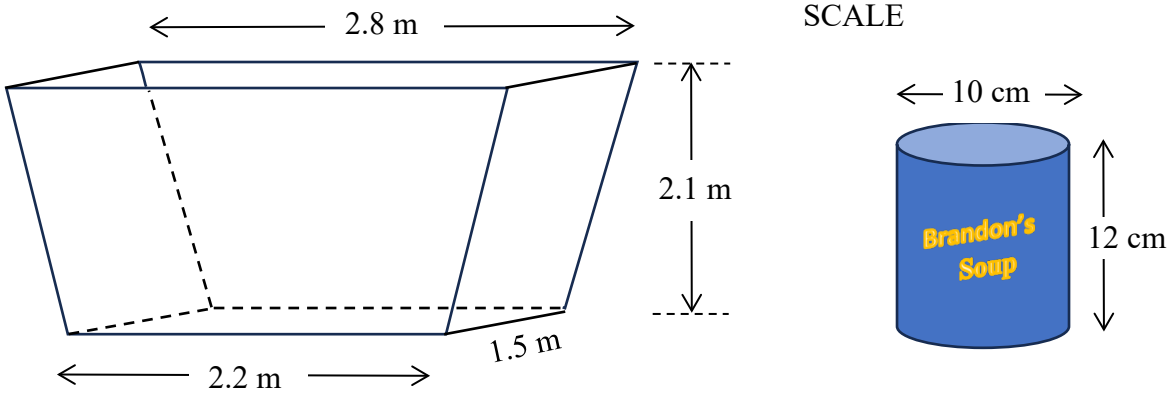
If he invests in the annuity for 6 years, how much must he invest at the end of every year?

End of Question 33

Question 34 (5 marks)

Brandon's factory makes soup, which is sold in cans. **5**

Soup mixture is made in a large vat which is in the shape of a trapezoidal prism. Each soup can is cylindrical. The diagrams show both the vat and one cylindrical can.



How many cans can be filled with soup from one full vat of soup mixture?

End of Booklet D

Questions 32 – 34 Extra writing space
If you use this space, clearly indicate which question you are answering.

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2023 YEAR 12 HSC TASK 3

Examination Number:

Set:

Mathematics Standard 2

Section II Answer Booklet E

Booklet E — Attempt Questions 35-37 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

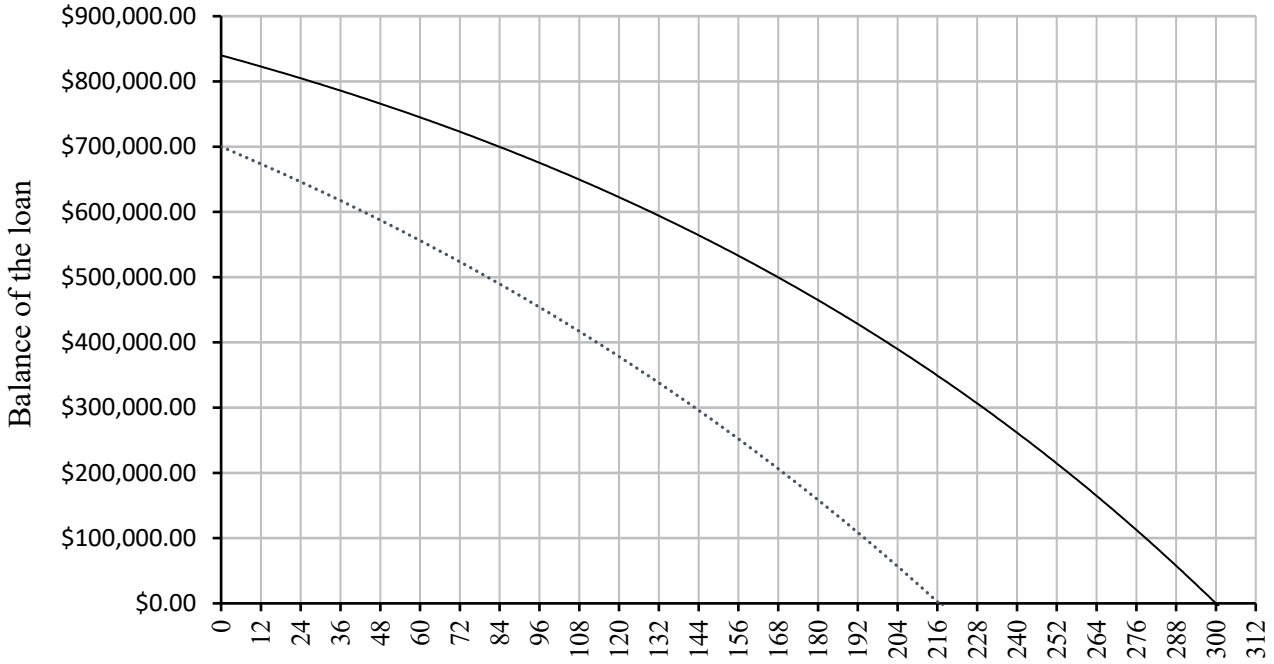
Please turn over

Booklet E: Questions 35 – 37 (17 marks)

Question 35 (6 marks)

Corrie took out a loan for $840 000 and Kian took out a loan at the same time for a different amount. The graph shows the balance of both loans, as they were repaid monthly.

Corrie's repayment was $4950 per month.
Kian repaid his loan at $4635 per month.



(a) How much did **Kian** borrow? **1**

.....

.....

(b) After how many months had **Kian** repaid $400 000 of his loan? **1**

.....

.....

Question 35 continues on the following page

(c) How much did **Kian** pay, in total, for his loan? **1**

(d) After 168 months, **Corrie** paid off the balance of his loan as a lump sum. **3**

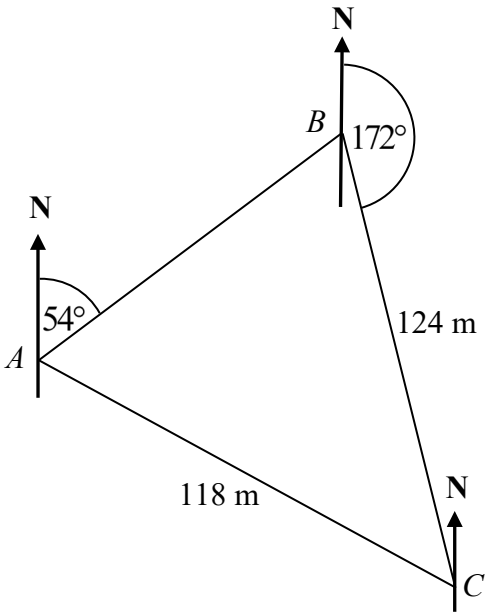
How much did he save on the total cost of his loan by doing this?

End of Question 35

Question 36 (6 marks)

Finn walked around the perimeter of his triangular piece of land. He started at the apple tree (A) and walked to the beech tree (B) on a bearing of $54°$. He then walked 124 metres to the cherry tree (C), on a bearing of $172°$.

He drew a diagram, shown below.



NOT TO SCALE

(a) Show that $\angle ABC$ is $62°$. **1**

Question 36 continues on the following page

Question 36 (continued)

(b) What is the area of Finn's piece of land? Give your answer to the nearest square metre. **4**

(c) What is the bearing of the apple tree, A, from the cherry tree, C? **1**

End of Question 36

Question 37 (5 marks)

The lifespan of ReadyEver batteries is normally distributed with a mean of 940 hours and a standard deviation of 30 hours.

The table gives the probability that a ReadyEver battery chosen at random will have a z-score that lies below z for certain values of z.

z	.00	.01	.02	.03	.04
1.0	.84134	.84375	.84614	.84849	.85083
1.1	.86433	.86650	.86864	.87076	.87286
1.2	.88493	.88686	.88877	.89065	.89251

(a) What is the probability that a ReadyEver battery will have a z-score below 1.1? **1**

(b) What is the z-score for a ReadyEver battery which has a lifespan of 976.9 hours? **2**

(c) What is the probability that a ReadyEver battery chosen at random will have a lifespan greater than 976.9 hours? **2**

End of Paper ☺

Questions 35 – 37 Extra writing space
If you use this space, clearly indicate which question you are answering.

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SHORE

Examination Number: | | | |

Set: | |

2023

YEAR 12
HSC TRIAL EXAMINATION

Mathematics Standard 2

General Instruction

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using non-erasable 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 2–8)

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

Section II – 85 marks (pages 9–48)

- Attempt Questions 16–37
- Allow about 2 hours and 5 minutes for this section

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

A 3
B 5
C 4
D 3

Note: Any time you have remaining should be spent reviewing your answers

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

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

Use the multiple-choice answer sheet for questions 1–15

---

1 Oliver designed a survey in which the following question was asked.

"How many pets do you have?"

What kind of data would the responses be classified as?

A. Categorical, nominal
B. Categorical, ordinal
C. Numerical, discrete
D. Numerical, continuous

2 A truck is travelling at 72 km/h.

How far will it travel in 1 hour 30 minutes?

A. 48 km
B. 55.4 km
C. 93.6 km
D. 108 km

$d = s \times t$
$= 72 \times 1.5$
$= 108 \text{ km}$

3 Cat food is sold in four different sized bags.

Which is the best buy?

A. \$12.50 for 750 g
B. \$22.50 for 1.5 kg
C. \$30.20 for 2 kg
D. \$45.60 for 3 kg

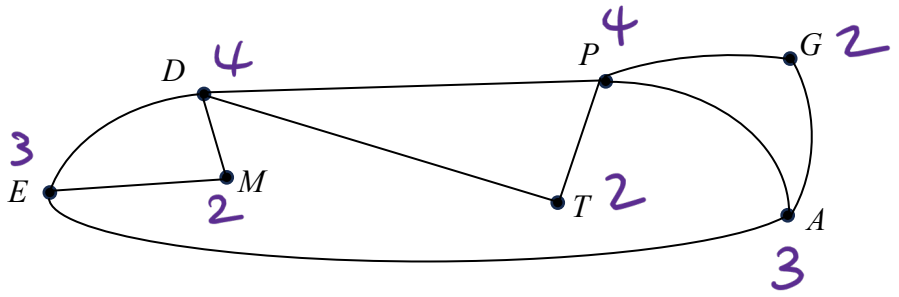
60 g / \$
66.6... g / \$
66.2 g / \$
65.7 g / \$

4 What is 0.020 356 written in standard form, to 3 significant figures?

A. 2.03×10^{-2}
B. 2.035×10^{-2}
C. 2.036×10^{-2}

D. 2.04×10^{-2}

5 Consider the network diagram, and the degrees of each vertex.



What is the ratio of vertices with odd degree, to vertices with even degree?

A. 2 : 5

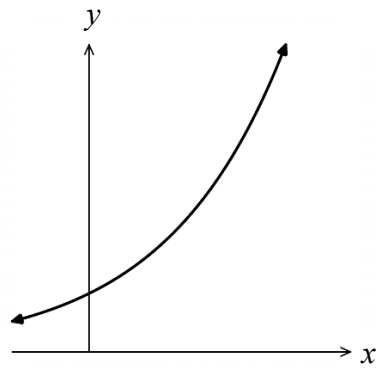
B. 3 : 4

C. 4 : 3

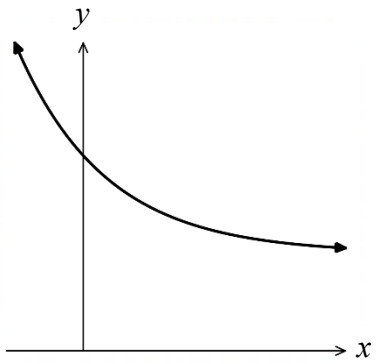
D. 5 : 2

6 Which of the following best represents the graph of $y = 2^x$?

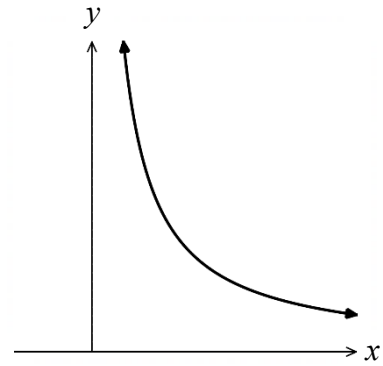
A.



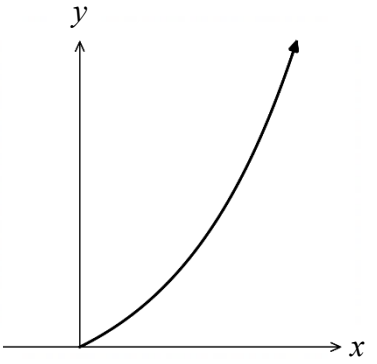
C.



B.



D.



7 Mitch rolled a die 50 times and recorded the results in a table, shown below.

Number on die	1	2	3	4	5	6
Relative Frequency	20%	16%	14%	16%	X	22%

How many times did Mitch roll a 5?

$X = 1 - (0.2 + 1.6 + 1.4 + 1.6 + 2.2)$

$= 0.12$

5 rolled $= 0.12 \times 50$

$= 6$ times

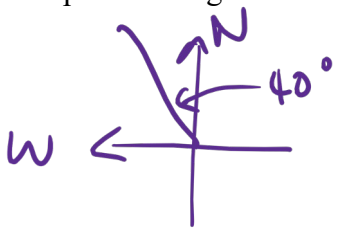
A. 5

B. 6

C. 8

D. 12

8 Which true bearing is the same as a compass bearing of N40°W ?



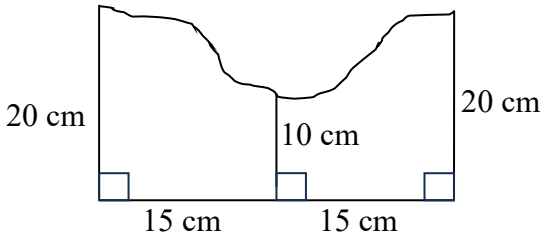
A. 040°

B. 050°

C. 220°

D. 320°

9 Hugo correctly uses two applications of the Trapezoidal Rule to estimate the area of the shape below.



NOT TO SCALE

$A \doteqdot \frac{h}{2}(d_f + d_l)$

What does Hugo estimate the area of the shape to be?

$= \frac{15}{2}(20 + 10 + 10 + 20)$

$= 450 \text{ cm}^2$

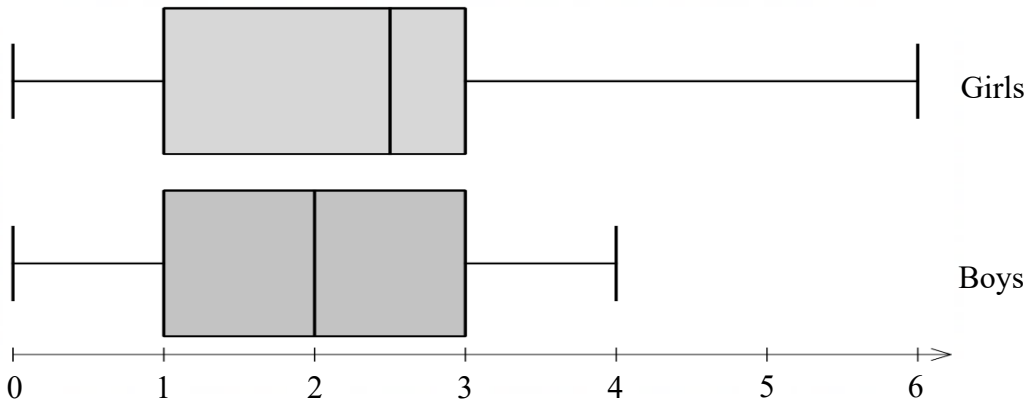
A. 300 cm^2

B. 450 cm^2

C. 600 cm^2

D. 900 cm^2

10 The number of books Year 12 girls and boys checked out of the school library in one week, is shown in the box plots below.



Which one of these statements is true?

A. The range and the interquartile range for the girls, are the same for the boys.

B. The lowest extreme and the median for the girls, are the same for the boys.

C. The interquartile range and the lowest extreme for the girls, are the same for the boys.

D. The 5-number summaries for the girls and the boys are the same.

11 Which of the following correctly expresses x as the subject of $y = \frac{mx-2}{3}$?

A. $x = \frac{3y+2}{m}$

B. $x = \frac{3y}{m} + 2$

C. $x = \frac{y+2}{3m}$

D. $x = \frac{y}{3m} + 2$

$3y = mx - 2$

$3y + 2 = mx$

$x = \frac{3y+2}{m}$

12 Billy is driving at 80 km/h when he must stop quickly, so he applies the brakes. If his reaction time is 1.2 seconds and the braking distance is 65 m, what is the stopping distance, to the nearest metre?

A. 66 m

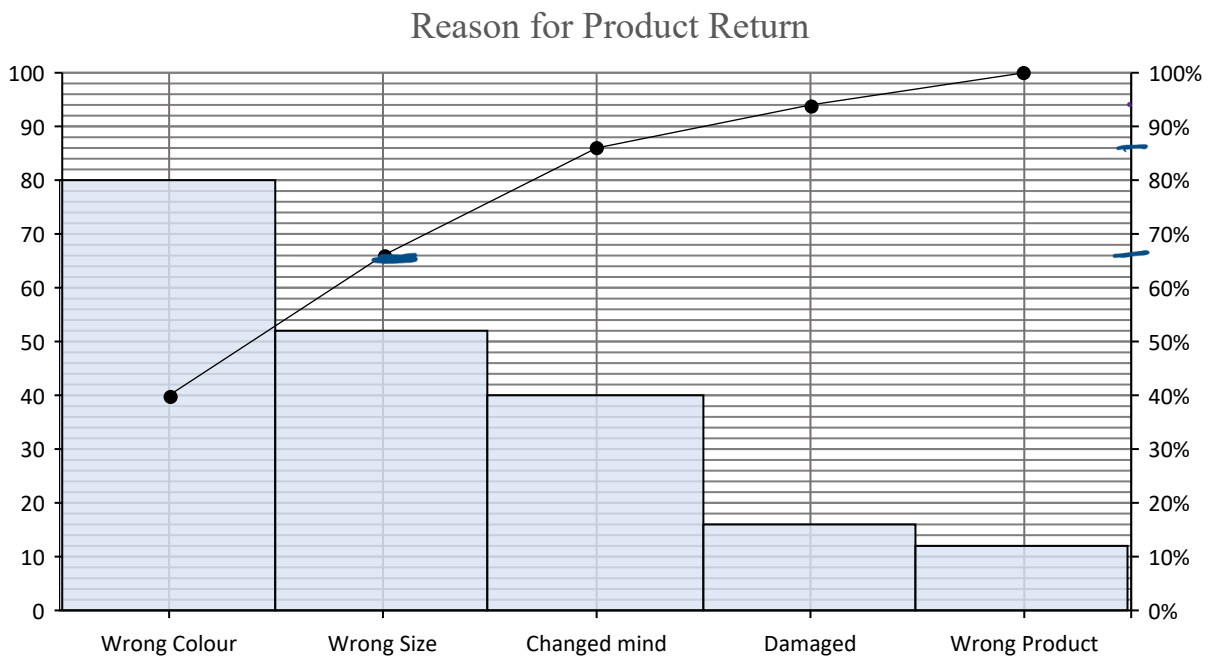
B. 87 m

C. 92 m

D. 161 m

$$sd = \frac{80\,000}{60 \times 60} \times 1.2 + 65$$
$$= 91.66\ldots$$
$$\doteq 92 \text{ m}$$

13 The pareto chart shows data collected from 200 customers who returned the product they had ordered, and the reason for returning it.



What percentage of customers returned a product because they had changed their mind?

A. 8%

B. 20%

C. 40%

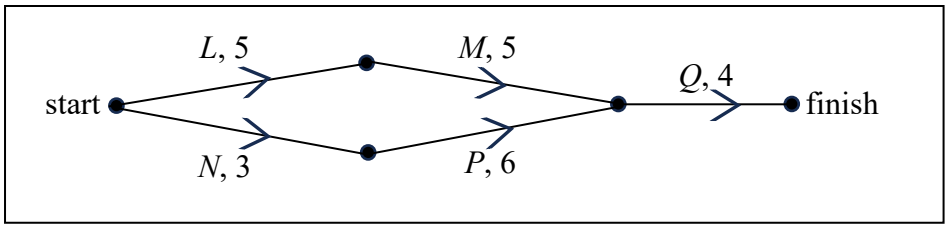
D. 86%

14 The table shows activities *A* to *E*, which must be completed for a project, with any immediate prerequisite(s) and the duration of each activity.

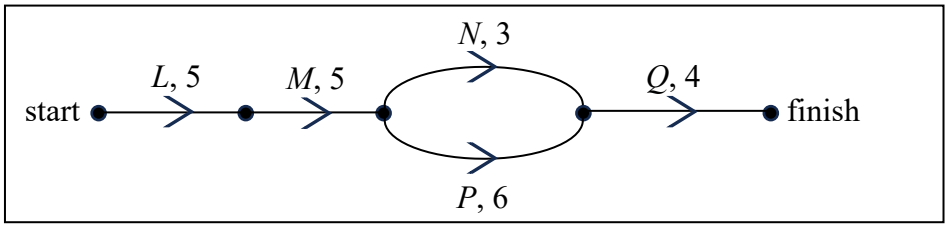
Activity	*Immediate prerequisite(s)*	*Duration in minutes*
L	none	5
M	none	5
N	*L*	3
P	*M*	6
Q	*N*, *P*	4

Which one of the network diagrams below best represents the activity table?

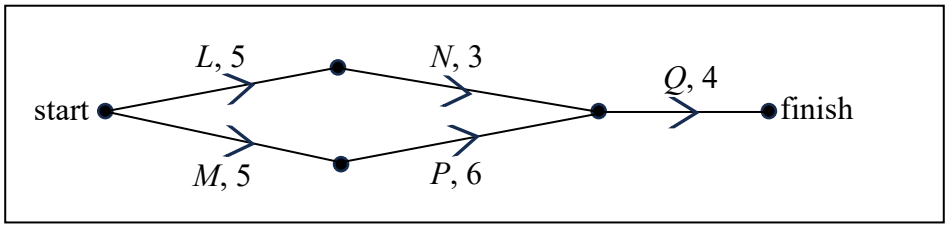
A.



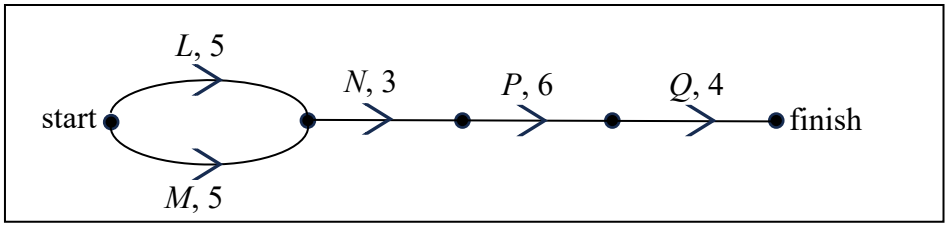
B.



C.

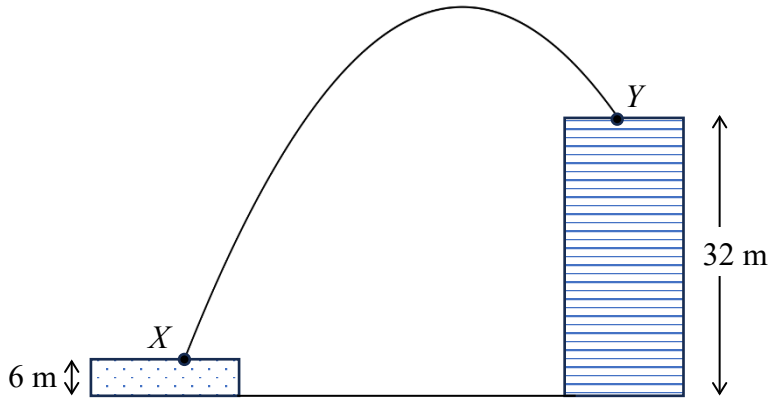


D.

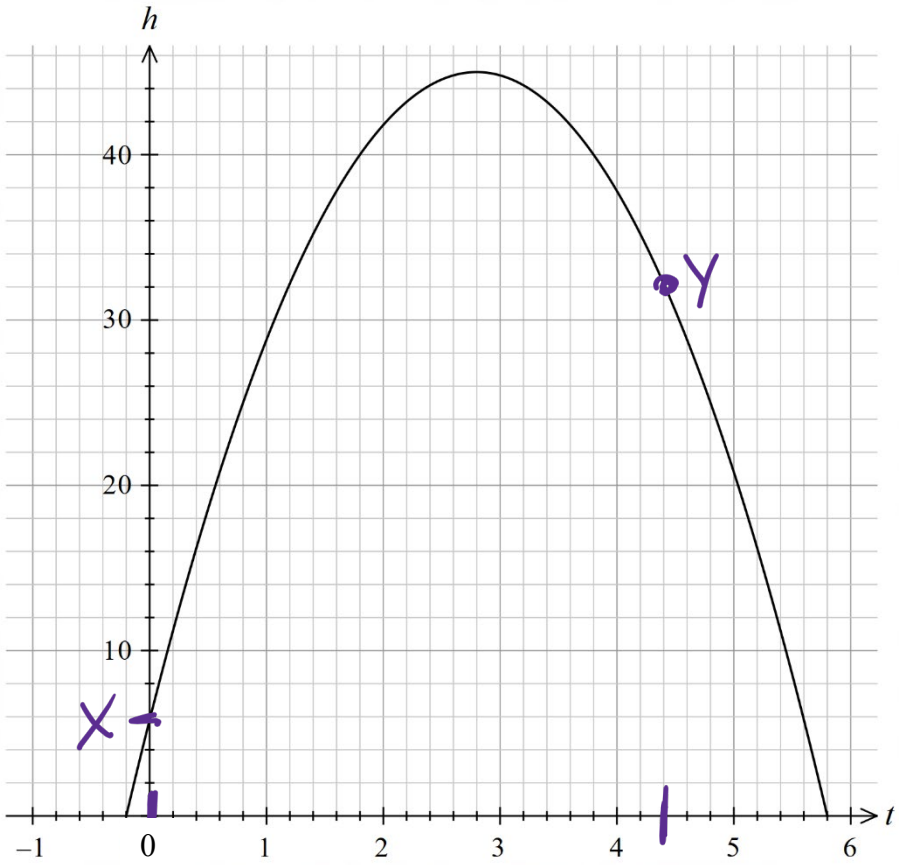


15 A golf ball is hit from a point X, 6 metres above the ground, to a point Y, 32 metres above the ground. The golf ball passes its maximum height, before landing at point Y.

The diagram shows the path of the golf ball from point X to point Y.



The graph shows the relationship between time, t seconds and the height, h metres, of the golf ball above the ground.



For how long is the ball in the air, between points X and point Y?

A. 2.8 seconds

B. 4.4 seconds

C. 5.6 seconds

D. 5.8 seconds

2023 **YEAR 12 HSC TRIAL**

Examination Number: | | | |

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Mathematics Standard 2

Section II Answer Booklet

A

Section II

85 marks
Attempt Questions 16-37
Allow about 2 hours 5 minutes for this section

Booklet A — Attempt Questions 16-22 (17 marks)
Booklet B — Attempt Questions 23-26 (17 marks)
Booklet C — Attempt Questions 27-31 (17 marks)
Booklet D — Attempt Questions 32-34 (17 marks)
Booklet E — Attempt Questions 35-37 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Section II

85 marks
Attempt Questions 16–37
Allow about 2 hours and 5 minutes for this section

Answer the questions in the spaces provided.

Your responses should include relevant mathematical reasoning and/or calculations.

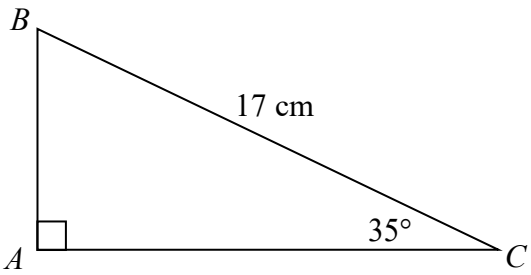
Extra writing space is provided at the end of each question booklet. If you use this space, clearly indicate which question you are answering.

Assume 52 weeks in a year, and 365 days in a year where necessary.

Booklet A: Questions 16 – 22 (17 marks)

Question 16 (2 marks)

Consider the right-angled triangle, ABC, shown below. **2**



NOT TO SCALE

Find the length of side AB, to 2 decimal places.

$\sin 35° = \frac{AB}{17}$

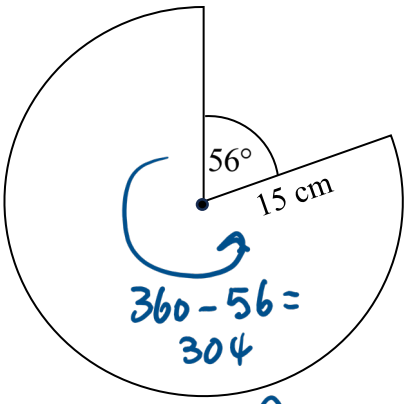
$AB = 17 \sin 35°$

$= 9.7507...$

$\doteq 9.75 \text{ cm}$

Question 17 (2 marks)

Find the area of this sector, to one decimal place. **2**



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

$= \frac{304}{360} \times \pi \times 15^2$

$= 596.902...$

$\doteq 596.9 \text{ cm}^2$

Question 18 (2 marks)

Toby used his new credit card on May 5th to make a single purchase of $340. **2**

His credit card charges interest at a rate of 0.055% per day, compounding daily. Interest is charged from the day of purchase (included) to the day of payment (included).

Toby made no other purchases and paid the balance on the card on 15th June. What was the balance that Toby paid?

days $= 31 - 5 + 1 + 15$

$= 42$ days

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

$= 340(1 + 0.00055)^{42}$

$= 347.943...$

$= \$347.94$

Question 19 (2 marks)

Luke models the population, R, of rabbits on his property using the function $R = 400(1.3)^n$, where n is the number of years that have passed.

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

400

(b) What will be the population of rabbits after 4 years? **1**

$R = 400(1.3)^4$

$= 1142.44$

$= 1142$ rabbits

Question 20 (3 marks)

Will discovers that the time it takes to clean all the rooms in the Marada Hotel is inversely proportional to the number of cleaners he uses. When there are 15 cleaners, it takes 3 hours to clean all the rooms.

(a) By first finding the constant of proportionality, k, write an equation for the relationship between time, t, and the number of cleaners, n. **2**

$t = \frac{k}{n}$

$3 = \frac{k}{15}$

$k = 45$

$\therefore$ equation is $t = \frac{45}{n}$

(b) How long will it take 7 cleaners to clean all the hotel rooms? Give your answer in hours and minutes. **1**

$t = \frac{45}{7}$

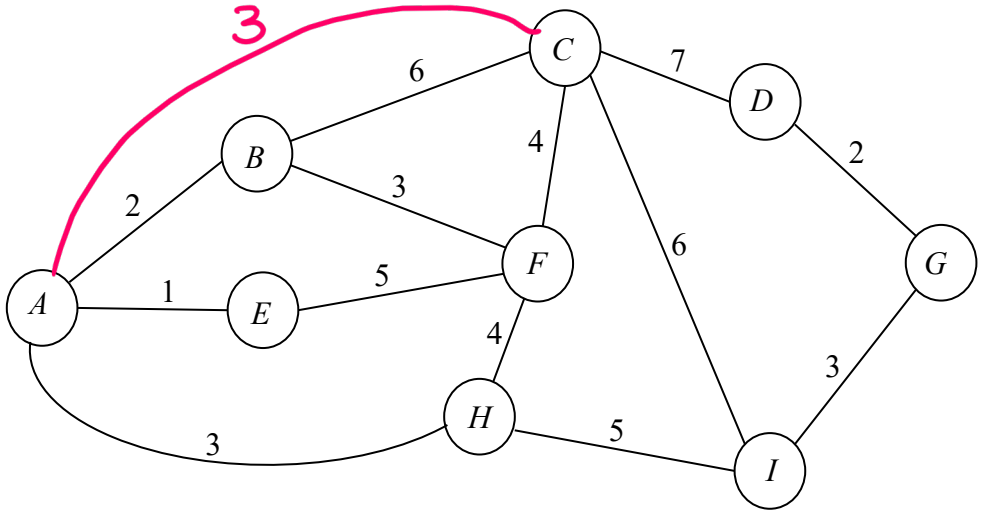
$= 6.4285...h$

$= 6h\ 25min\ 42.86s$

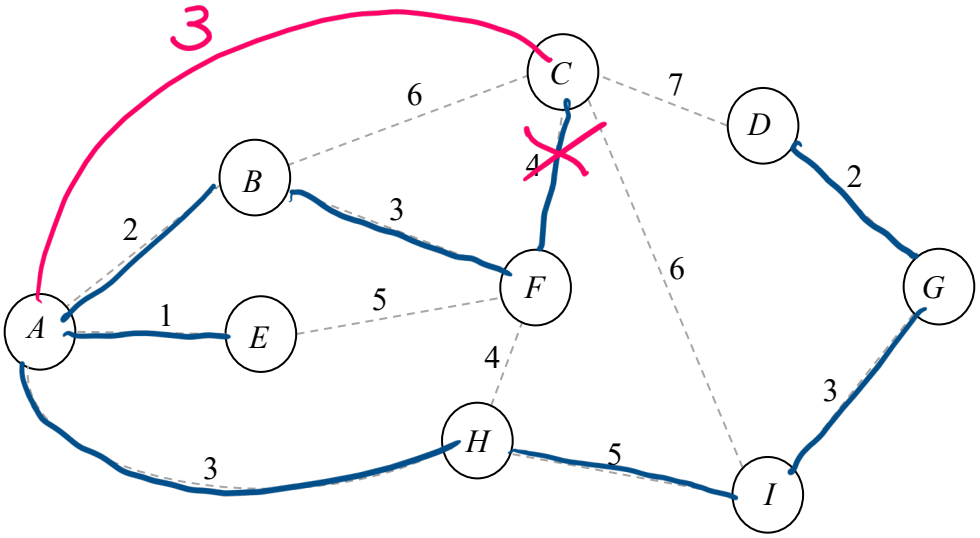
$\doteq 6h\ 26\ min$

Question 21 (4 marks)

Consider the network below with vertices A to I.



(a) Draw a minimum spanning tree on the outline of the network diagram below. **2**



(b) What is the total edge weight of the minimum spanning tree? **1**

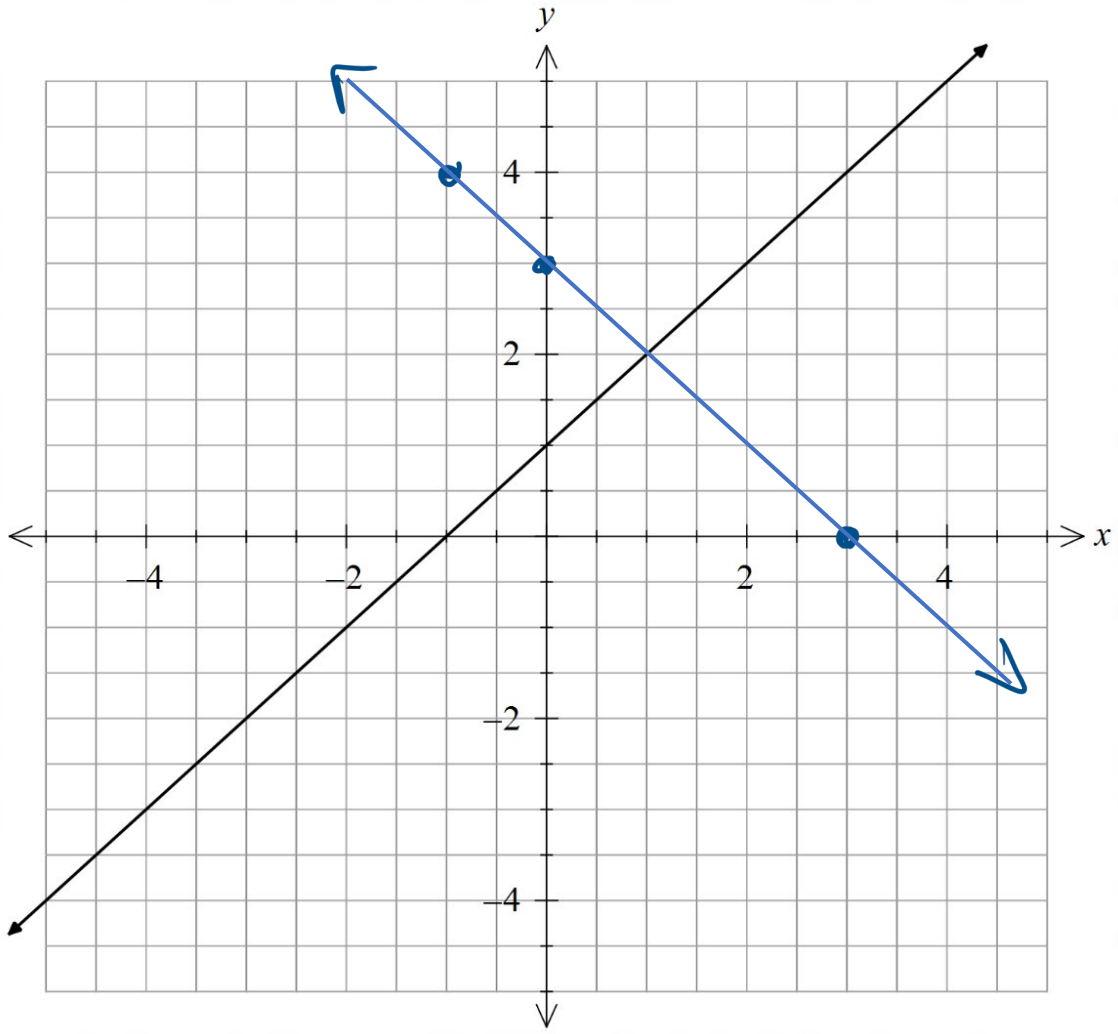
weight = 2+1+3+3+4+5+3+2
= 23

(c) A new edge with a weight of 3 is added, connecting vertices A and C. How will this change the total weight of the minimum spanning tree? **1**

It will reduce the total by 1, to 22

Question 22 (2 marks)

Sophie is solving two equations simultaneously. She has plotted the first equation on the grid below.



Sophie also created the table of values, below, for the second equation.

x	−1	0	3
y	4	3	0

(a) Use the table of values to plot the second equation on the grid above. **1**

(b) What is the solution to the two equations simultaneously? **1**

$x = 1, \ y = 2$

End of Booklet A

Questions 16 – 22 Extra writing space
If you use this space, clearly indicate which question you are answering.

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2023 **YEAR 12 HSC TRIAL**

Examination Number:

Set:

Mathematics Standard 2

Section II Answer Booklet B

Booklet B — Attempt Questions 23-26 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Booklet B: Questions 23 – 26 (17 marks)

Question 23 (4 marks)

The stem-and-leaf plot shows the number of house plants owned by each of the students in a study group. **4**

0	1	8	9
1	5	6	6
2	1	2	2
3	1	9	

7 | 8

Are there outliers in this dataset and if so, what are they? Show suitable calculations to justify your answer(s).

13 scores $Q_2 = 17$

$Q_1 = \frac{9+15}{2}$

$= 12$

$Q_3 = 22$

$IQR = 22 - 12$

$= 10$

outlier $> Q_3 + 1.5 \times IQR$

$= 22 + 1.5 \times 10$

$= 37$

$\therefore$ 39 is an outlier

outlier $< Q_1 - 1.5 \times IQR$

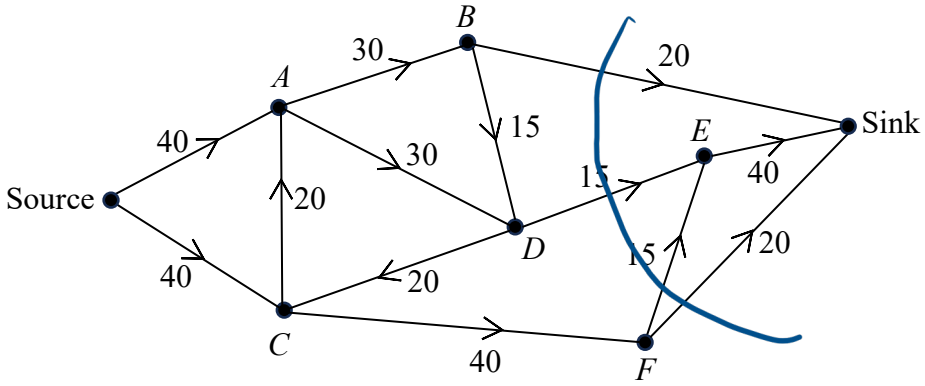
$= 12 - 1.5 \times 10$

$= -3$

$\therefore$ 1 is NOT an outlier

Question 24 (3 marks)

A zoo has 6 special animal exhibits connected by one-way paths. A network diagram is shown, with vertices A, B, C, D, E and F, representing the exhibits. The maximum number of people who can pass along each path at one time is also shown as the edge weight.



(a) Draw a minimum cut and use it to determine the maximum flow of this network. **2**

max flow = 20 + 15 + 15 + 20
= 70

(b) The manager of the zoo wants to increase the flow of people along the paths. She decides she will increase the capacity of the path connecting C to F. **1**

Give a reason why this will not increase the maximum flow of the network.

(1) → It is not on a minimum cut.

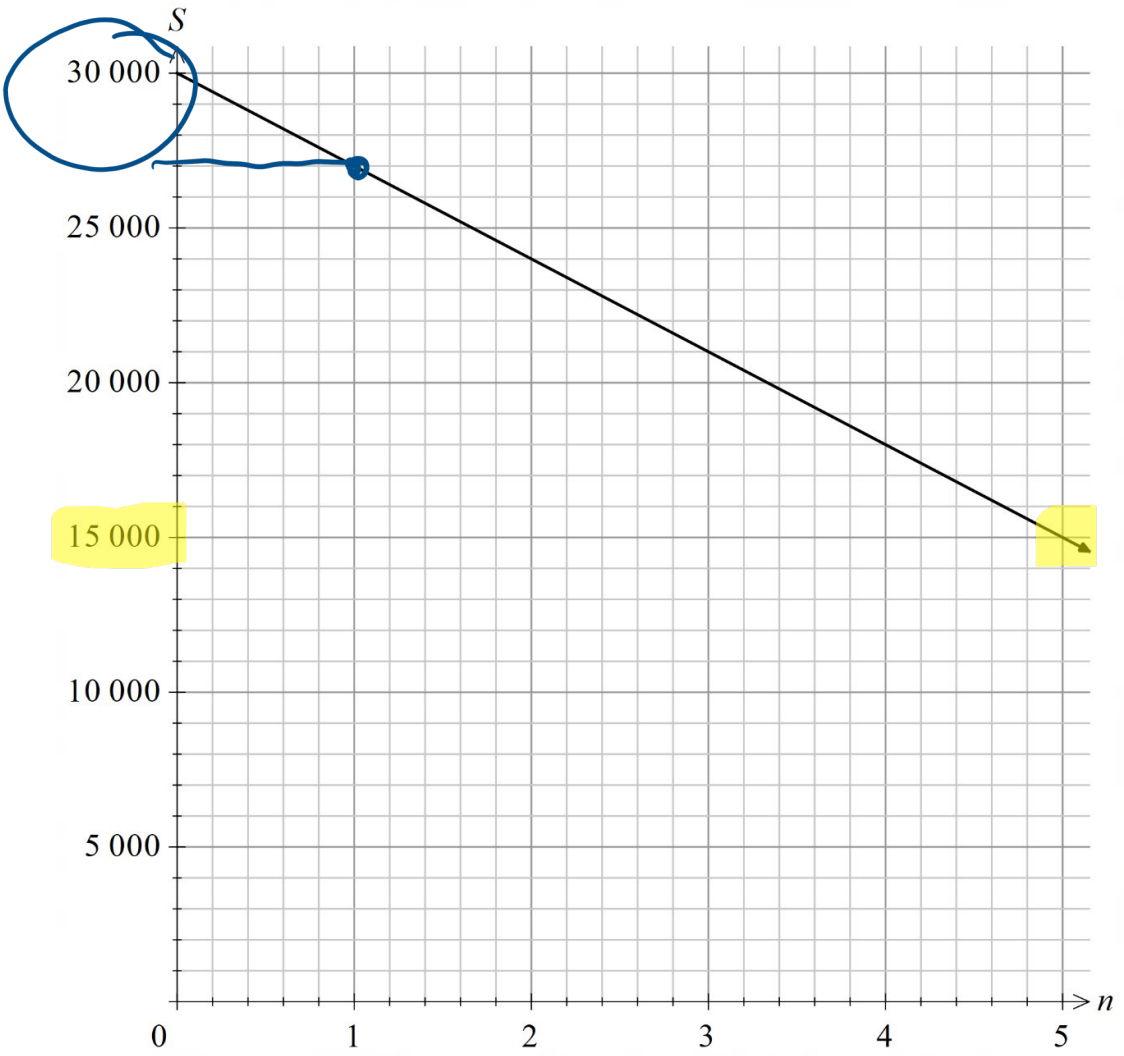
OR (2) → CF is not at capacity currently, so no point increasing it.

OR (3) Inflow to F along CF is 40.
outflow from F is only 35.
increasing CF will not work because outflow is still only 35

Question 25 (6 marks)

Lachlan bought a new car, 10 years ago. For the first 5 years, he used the straight line depreciation method to depreciate the car's value. He then used the declining balance method.

Graph 1: shows the salvage value ($\$S$) of his car after n years (for the first 5 years).



(a) What was the value of Lachlan's car when he bought it 10 years ago? **1**

$30 000

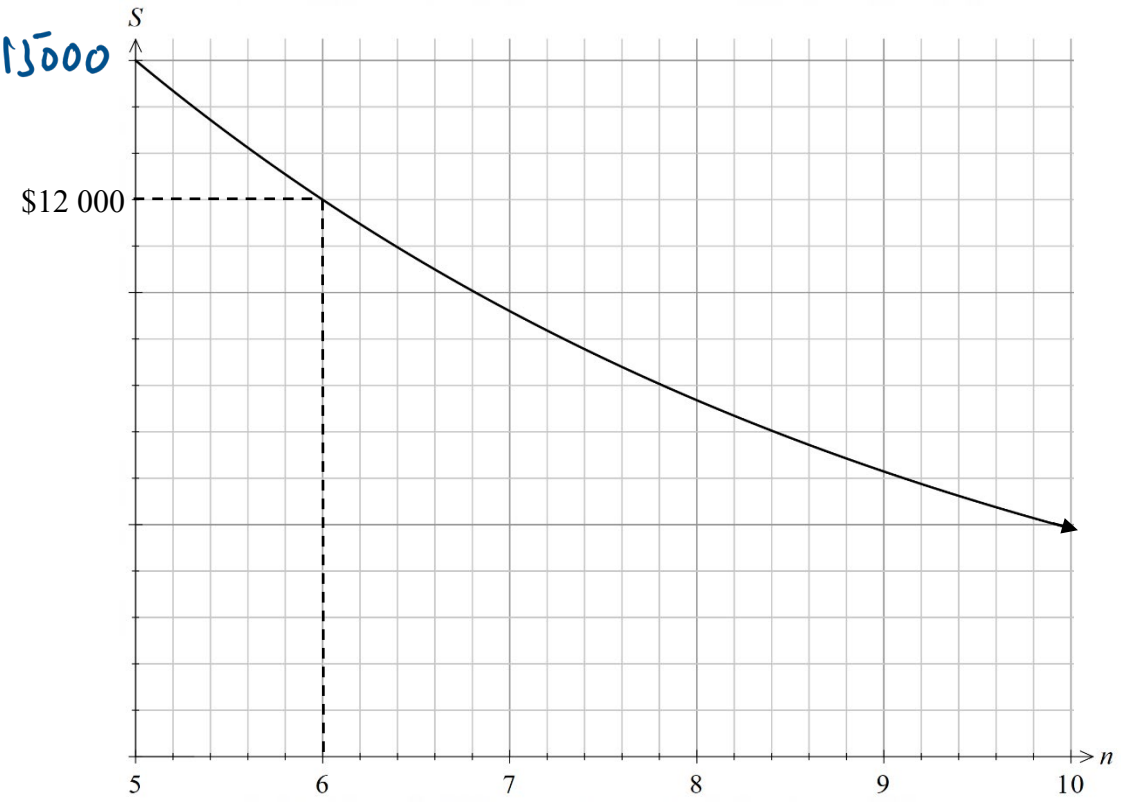
(b) In the **first** 5 years, by how much did his car depreciate each year? **1**

$ 3000

Question 25 continues on the following page

Question 25 (continued)

Graph 2: shows the salvage value ($\$S$) of the car for the second 5 years. Some of the values on the vertical axis are missing.



(c) What was the rate of depreciation that Lachlan used in the **second** 5 years? **2**

$S = V_0(1-r)^n$

$12000 = 15000(1-r)^1$

$\frac{12000}{15000} = 1-r$

$r = 1 - \frac{12000}{15000}$

$= 0.2$

$= 20\%$ p.a.

OR

$D = 3000$ in 1st year

$r = \frac{3000}{15000} \times 100$

$= 20\%$

(d) What will be the salvage value of the car 12 years after Lachlan bought it, if he continues to depreciate it using the declining balance method? **2**

$S = V_0(1-r)^n$

$= 15000(1-0.2)^7$

$= 3145.728...$

$= \$3145.73$

Question 26 (4 marks)

The table shows the future values of an annuity of $1.

Periods	Interest rate per period						
	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%
5	5.1010	5.1523	5.2040	5.2563	5.3091	5.3625	5.4163
6	6.1520	6.2296	6.3081	6.3877	6.4684	6.5502	6.6330
7	7.2135	7.3230	7.4343	7.5474	7.6625	7.7794	7.8983
8	8.2857	8.4328	8.5830	8.7361	8.8923	9.0517	9.2142
9	9.3685	9.5593	9.7546	9.9545	10.1591	10.3685	10.5828
10	10.4622	10.7027	10.9497	11.2034	11.4639	11.7314	12.0061

Zac is saving for his dream holiday and needs approximately $18 000. He opens an annuity account which is paying 2.5% interest per annum.

(a) How much must Zac deposit each year if he wants to have saved $18 000 in 6 years time? **2**

$FVA = a \times X$

$18000 = a \times 6.3877$

$a = \frac{18000}{6.3877}$

$= 2817.915...$

$= \$2817.92$

(b) If Zac decided instead, to invest in an account earning compound interest at 2.5% per annum, for 6 years, how much would he have to invest in the account, as a lump sum, to have $18 000 in 6 years time? **2**

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

$18000 = PV(1+0.025)^6$

$PV = \frac{18000}{1.025^6}$

$= 15\,521.343...$

$= \$15\,521.34$

End of Booklet B

Questions 23 – 26 Extra writing space

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2023 YEAR 12 HSC TRIAL

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Mathematics Standard 2

Section II Answer Booklet C

Booklet C — Attempt Questions 27-31 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Booklet C: Questions 27 – 31 (17 marks)

Question 27 (4 marks)

Packets of nuts contain almonds, brazil nuts and cashews in the ratio 7 : 3 : 5. There are different sizes of packet.

(a) In a 450 g packet, how many grams of brazil nuts will there be? **2**

A : B : C
7 : 3 : 5
Brazils are 3 parts in 15.

$$\text{Brazils} = \frac{3}{15} \times 450$$

$$= 90\text{ g}$$

(b) In a differently sized packet, there are 140 g of almonds. How many grams of cashews will be in this packet? **2**

A : B : C
7 : 3 : 5
140g x

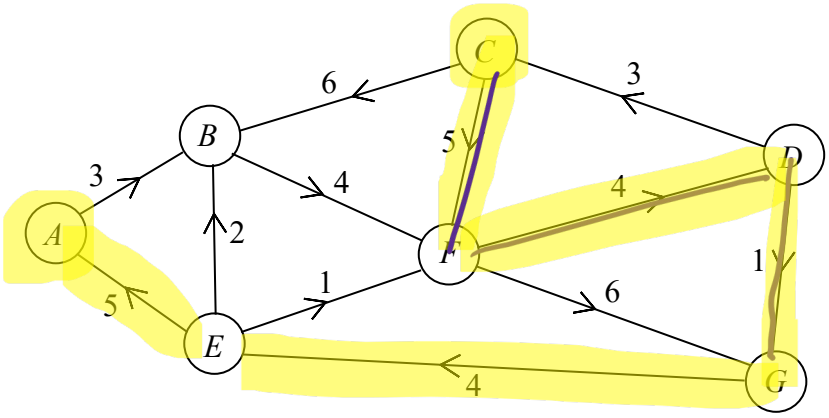
$$\frac{140}{7} = \frac{x}{5}$$

$$x = \frac{5 \times 140}{7}$$

$$= 100\text{ g}$$

Question 28 (2 marks)

Consider the directed network shown, with vertices A, B, C, D, E, F and G. **2**



What is the shortest path from vertex C to vertex A? State the path and its total weight.

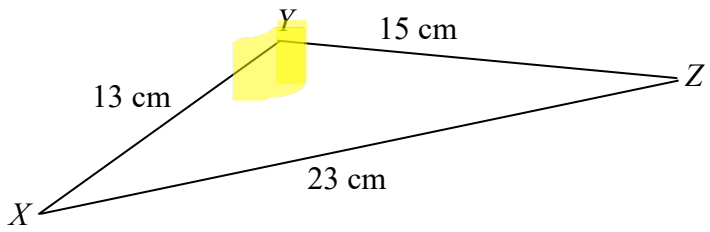
Shortest path = CFDGEA

= 5+4+1+4+5

= 19

Question 29 (3 marks)

Find the size of $\angle XYZ$. Give your answer to the nearest minute. **3**



NOT TO SCALE

$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$

$\angle XYZ = \cos^{-1}\left(\frac{13^2 + 15^2 - 23^2}{2 \times 13 \times 15}\right)$

$= 110.252\ldots$

$= 110^\circ\ 15'\ 8''$

$= 110^\circ\ 15'$

Question 30 (3 marks)

Sydney is 10 hours ahead of Coordinated Universal Time (UTC +10), and Toronto is 4 hours behind Coordinated Universal Time (UTC – 4). **3**

Ronan travels from Sydney to Toronto. His non-stop flight leaves Sydney at 1.50 pm on Friday, local time and arrives in Toronto at 7.41 pm, Toronto time, on the same day.

How long was the flying time?

Toronto +14h Sydney

11.50 pm Thur	1.50 pm Friday
7.41 pm Fri	

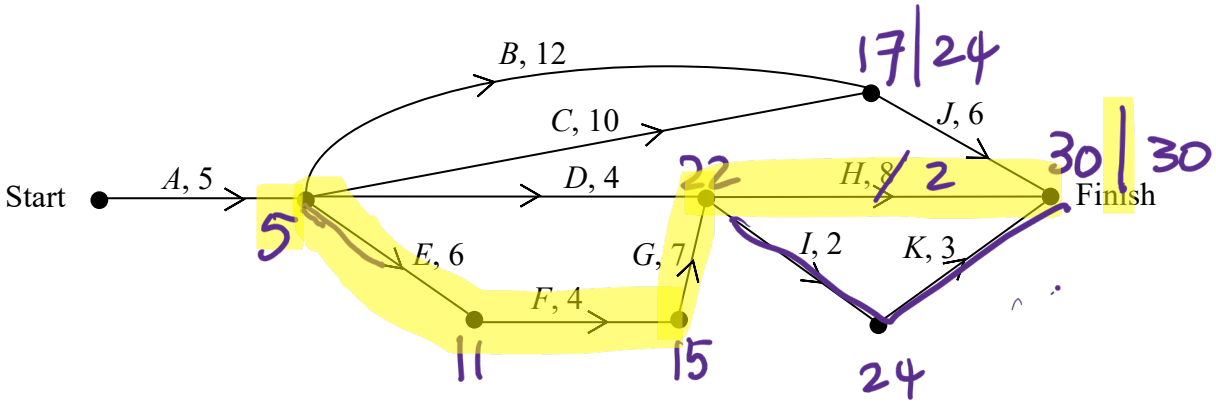
11.50 pm → 12.00 am → 12 pm → 7.41 pm

+10 mins +12 h +7 h 41

= 19 h 51 min

Question 31 (5 marks)

Jasper is undertaking a project, which requires the completion of activities *A* to *K*. He uses the network diagram below, which shows these activities and their completion times in minutes.



(a) What is the minimum time it will take Jasper to complete his project? **1**

30 mins

(b) State the critical path for this project. **2**

A E F G H

(c) Which activity has the greatest float time?.State the activity and its float time. **1**

Activity D, float time = 22-9
= 13 min

OR float time = 17-4
= 13 mins

(d) Jasper realises that he can complete activity *H* in 2 minutes, instead of 8. What will be the impact of this on the minimum time it takes for him to complete the project? **1**

It will take 27 mins,
3 mins less than 30 mins

27

End of Booklet C

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Questions 27 – 31 Extra writing space
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2023 YEAR 12 HSC TRIAL

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Mathematics Standard 2

Section II Answer Booklet D

Booklet D — Attempt Questions 32-34 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

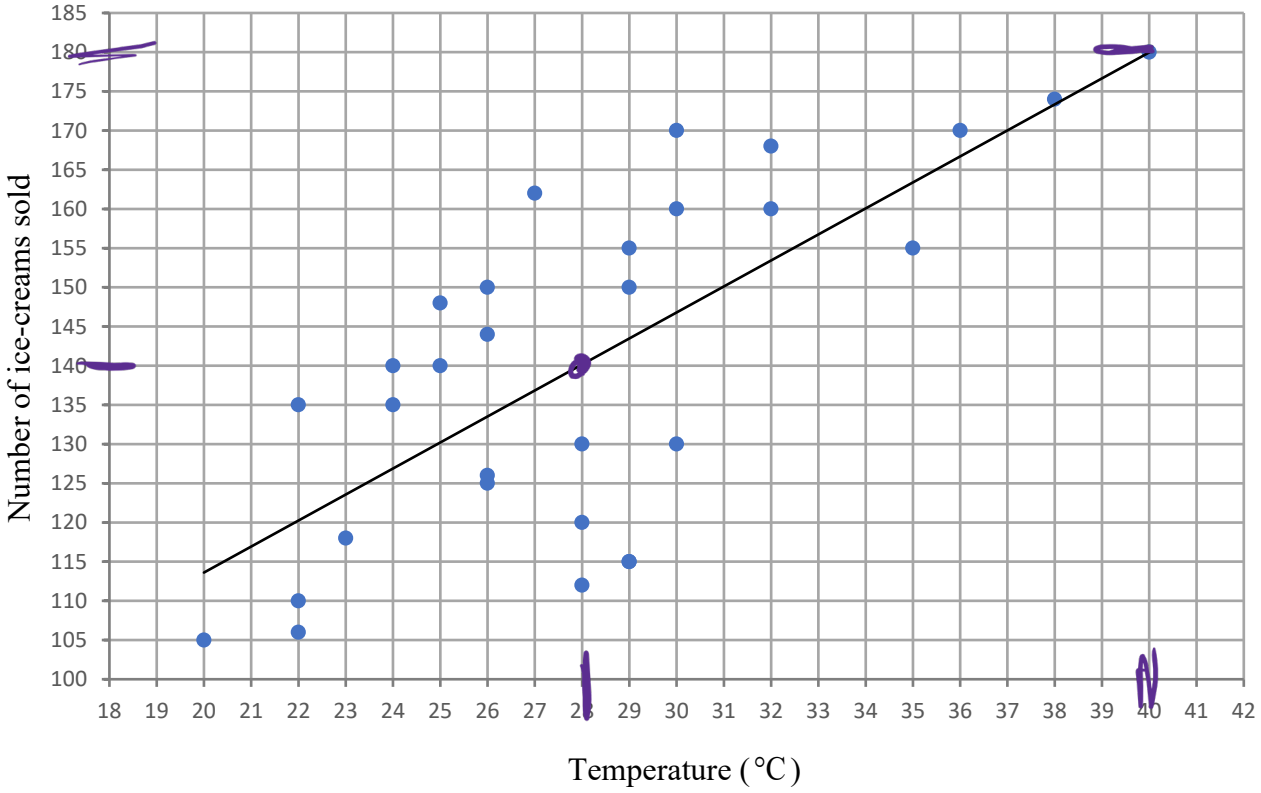
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Booklet D: Questions 32 – 34 (17 marks)

Question 32 (4 marks)

Orlando collected data over 30 days, between 12 pm and 3 pm, on how many ice-creams are sold, and the average temperature outside.

The graph shows the data along with the regression line.



(a) Show that the gradient of the regression line is approximately 3.33. **1**

$$m = \frac{180 - 140}{40 - 28}$$

$$= \frac{40}{12}$$

$$= 3.333\ldots$$

$$\doteq 3.33$$

Question 32 continues on the following page

Question 32 (continued)

(b) Interpret the value of this gradient in the given context. **1**

For every 1°C increase, 3.33 more icecreams are sold

(c) Use the graph to predict the number of ice-creams that would be sold if the outside temperature is 28°C. **1**

140 icecreams

(d) The correlation coefficient of the data is $r = 0.72$ (to 2 decimal places). **1**

Describe the correlation in Orlando's data set.

moderate positive

End of Question 32

Question 33 (8 marks)

A table of **present values** for an annuity of $1 is shown.

	Interest rate per period					
Period	**1%**	**2%**	**3%**	**4%**	**5%**	**6%**
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173

(a) Nathan invests $1500 at the end of every year for 3 years, in an annuity paying interest at 4% per annum, compounding annually. **1**

Use the table to find the present value of Nathan's annuity.

$PVA = a \times X$

$= 1500 \times 2.7751$

$= \$4162.65$

(b) Nathan calculated the future value of his annuity to be $4682.42. How much interest did his annuity earn over three years? **1**

$I = 4682.42 - 3 \times 1500$

$= \$182.42$

Question 33 continues on the following page

Question 33 (continued)

(c) Spencer thinks that his own investment will earn more interest than Nathan's, because he is going to invest $720 at the end of every 6 months for 3 years, at a rate of 4% per annum, compounding 6 monthly. **3**

Is Spencer correct? Justify your answer with suitable working.

$PVA = a \times X$
$= 720 \times 5.6014$
$= 4033.008$
$= \$4033.01$
$FV = PV(1+r)^n$
$= 4033.01(1+0.02)^6$
$= 4541.824...$
$\therefore I = 4541.82 - 6 \times 720$
$= \$221.82$
Spencer is correct as $221.82 ~~$1.82~~

(d) Jackson wishes to invest an amount at the end of every year in an annuity paying 5% per annum, compounding annually. He wants a future value of $10 000. **3**

If he invests in the annuity for 6 years, how much must he invest at the end of every year?

$PV = \frac{FV}{(1+r)^n}$
$= \frac{10\,000}{(1+0.05)^6}$
$= 7462.1539...$
$= \$7462.15$
$PVA = a \times X$
$a = \frac{7462.15}{5.0757}$
$= 1470.171...$
$= \$1470.17$

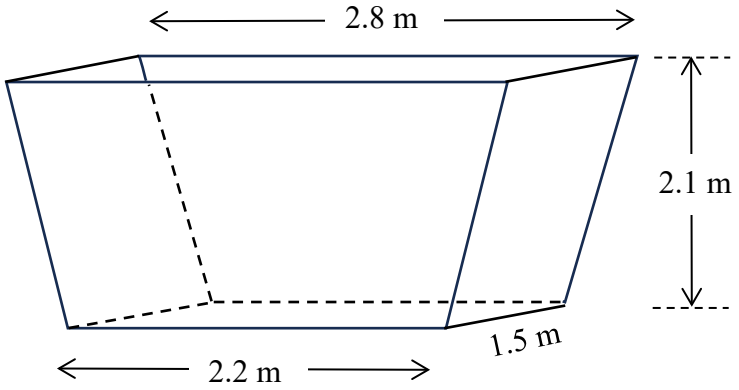
End of Question 33

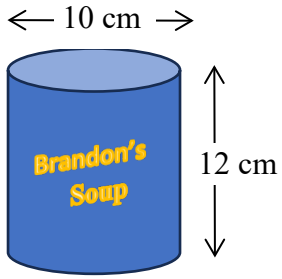
Question 34 (5 marks)

Brandon's factory makes soup, which is sold in cans. **5**

Soup mixture is made in a large vat which is in the shape of a trapezoidal prism. Each soup can is cylindrical. The diagrams show both the vat and one cylindrical can.

NOT TO SCALE





How many cans can be filled with soup from one full vat of soup mixture?

VAT $V = Ah$

$= \frac{h}{2}(a+b) \times h$

$= \frac{2.1}{2}(2.2+2.8) \times 1.5$

$= 7.875 \text{ m}^3$

Can $V = \pi r^2 h$

$= \pi \times 5^2 \times 12$

$= 942.477\ldots \text{ cm}^3$

VAT $= 7.875$ kL

1 can $= 942.477\ldots$ mL

$\therefore$ cans $= \frac{7875000}{942.477\ldots}$

$= 8355.63\ldots$

$\doteq 8356$ cans

End of Booklet D

Questions 32 – 34 Extra writing space
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2023 YEAR 12 HSC TASK 3

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Mathematics Standard 2

Section II Answer Booklet E

Booklet E — Attempt Questions 35-37 (17 marks)

Instructions

- Write your Examination Number and Set at the top of this page.
- 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 on the back of the booklet. If you use this space, clearly indicate which question you are answering.

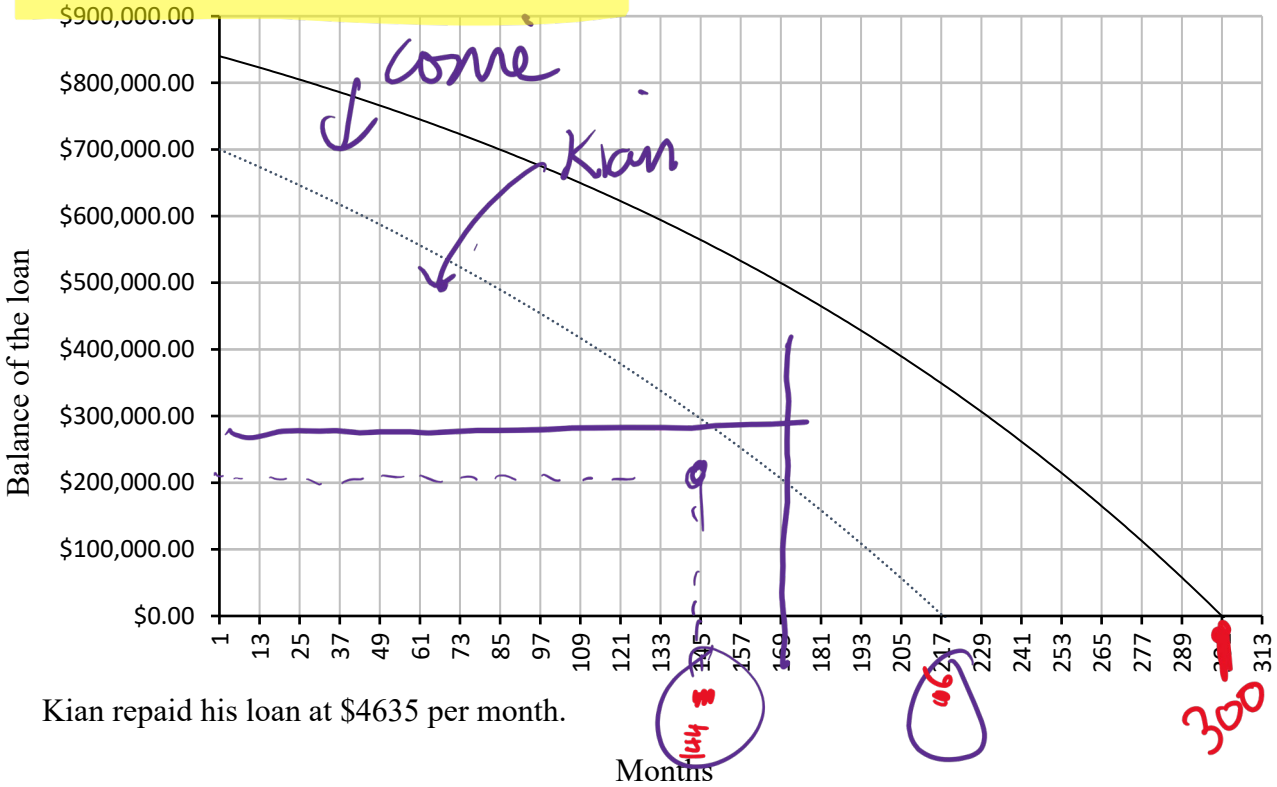
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Booklet E: Questions 35 – 37 (17 marks)

Question 35 (6 marks)

Corrie took out a loan for $840 000 and Kian took out a loan at the same time for a different amount. The graph shows the balance of both loans, as they were repaid monthly.

Corrie's repayment was $4950 per month.



Kian repaid his loan at $4635 per month.

(a) How much did **Kian** borrow? **1**

$700 000

(b) After how many months had **Kian** repaid $400 000 of his loan? **1**

144 months

Question 35 continues on the following page

(c) How much did **Kian** pay, in total, for his loan? **1**

loan cost = 4635 × 216

= $1 001 160

(d) After 168 months, **Corrie** paid off the balance of his loan as a lump sum. **3**

How much did he save on the total cost of his loan by doing this?

cost before = 300 × 4950 2

= $1485000

cost after = 500000 + 168 × 4950

= $133 1600

∴ saving = 1485000 − 133 1600

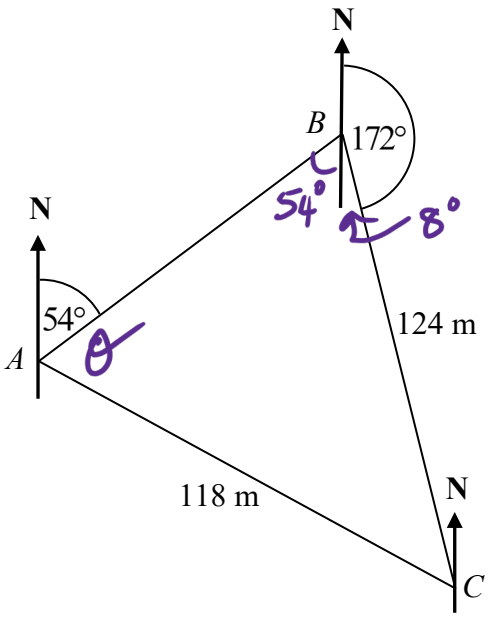
= $153 400

End of Question 35

Question 36 (6 marks)

Finn walked around the perimeter of his triangular piece of land. He started at the apple tree (A) and walked to the Beech tree (B) on a bearing of 54°. He then walked 124 metres to the cherry tree (C), on a bearing of 172°.

He drew a diagram, shown below.



NOT TO SCALE

(a) Show that $\angle ABC$ is 62°. **1**

$\angle ABC = 180 - 172 + 54$

$= 62°$

Question 36 continues on the following page

Question 36 (continued)

(b) What is the area of Finn's piece of land? Give your answer to the nearest square metre. **4**

$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

$$\frac{\sin\theta}{124} = \frac{\sin 62}{118}$$

$$\theta = \sin^{-1}\left(\frac{124 \sin 62}{118}\right)$$

$$= 68.101\ldots$$

$$\therefore \angle C = 180 - 68.101\ldots - 62$$

$$= 49.898\ldots^{\circ}$$

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

$$= \frac{1}{2} \times 118 \times 124 \sin 49.898\ldots^{\circ}$$

$$= 5596.076\ldots$$

$$\doteq 5596\ m^2$$

(c) What is the bearing of the apple tree, A, from the cherry tree, C? **1**

$$\text{bearing} = 360 - 49.898\ldots - 8$$

$$= 302.102\ldots$$

$$\doteq 302^{\circ}$$

End of Question 36

Question 37 (5 marks)

The lifespan of ReadyEver batteries is normally distributed with a mean of 940 hours and a standard deviation of 30 hours.

The table gives the probability that a ReadyEver battery chosen at random will have a z-score that lies below z for certain values of z.

z	.00	.01	.02	.03	.04
1.0	.84134	.84375	.84614	.84849	.85083
1.1	.86433	.86650	.86864	.87076	.87286
1.2	.88493	.88686	.88877	.89065	.89251

(a) What is the probability that a ReadyEver battery will have a z-score below 1.1? **1**

$P(z < 1.1) = 86.433\%$

(b) What is the z-score for a ReadyEver battery which has a lifespan of 976.9 hours? **2**

$$z = \frac{x - \mu}{\sigma}$$

$$= \frac{976.9 - 940}{30}$$

$$= 1.23$$

(c) What is the probability that a ReadyEver battery chosen at random will have a lifespan greater than 976.9 hours? **2**

$P(\text{lifespan} > 976.9\text{h}) = 1 - 0.89065$

$= 0.10935$

$= 10.935\%$

End of Paper ☺

Questions 35 – 37 Extra writing space
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