SHORE

School Exam No: | | | |

Set: | |

Year 12
Mathematics Standard 2
Trial HSC Examination
2020

General Instructions

- Reading time – 10 minutes
- Working time – $2\frac{1}{2}$ hours
- Write using black pen
- Questions 1 to 15 will be answered on the multi-choice answer sheet provided
- Questions 16 to 20 will be written in the writing booklets provided
- NESA reference sheet will be provided
- Students are to bring approved scientific calculator and other appropriate equipment.
  No other materials such as class notes, textbooks or any other reference material are permitted

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

Total marks – 100

Section I Pages 2 – 8

15 marks

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

Section II Pages 9 – 48

85 marks

- Attempt Questions 16–20
- Allow about 2 hours 5 minutes for this section

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

Section I

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

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

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

1. What is the median of the data set shown?

   3 3 3 3 4 5 7 8

   A. 3

   B. 3.5

   C. 4.5

   D. 5

2. What will be the cost of running a 120-watt ceiling fan for 5 hours if the average cost of electricity is 28.679 c/kWh?

   A. $0.03

   B. $0.17

   C. $3.44

   D. $17.21

3. Which one of the following would have a probability of $\frac{1}{5}$?

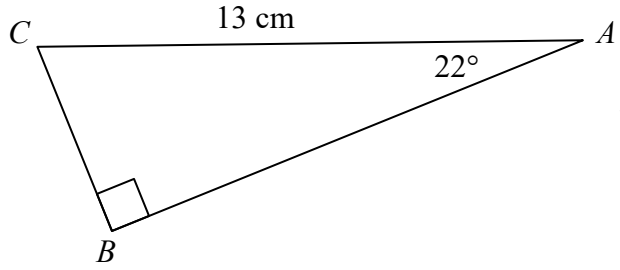
   A. Choosing a green marble from a bag containing 1 green marble and 4 blue marbles.

   B. Choosing a green marble from a bag containing 1 green marble and 5 blue marbles.

   C. Choosing a green marble from a bag containing 5 green marbles.

   D. Choosing two green marbles from a bag containing 5 blue marbles and 5 green marbles.

4. What is the length of side *AB* in the triangle, to the nearest centimetre?



NOT TO SCALE

A. 5 cm

B. 12 cm

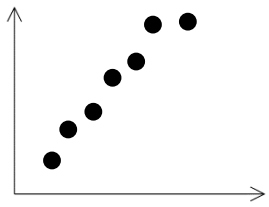
C. 14 cm

D. 35 cm

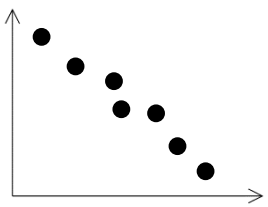
5. Ben correctly calculated Pearson's Correlation Coefficient for a set of data as –0.45.

Which of the graphs shown could represent this data set?

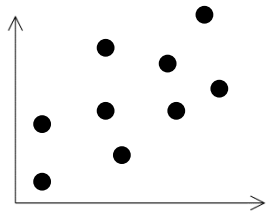
A.



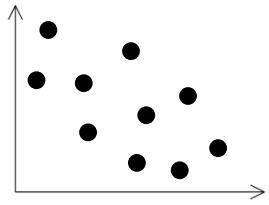
C.



B.



D.



6. In Year 12 at Simon's school, there are 160 day boys and 40 boarders. Simon wants to collect data about Year 12 students' experience of distance learning, so he selects a sample of 40 Year 12 students.

   Which one of these statements, about the sample Simon uses, is true?

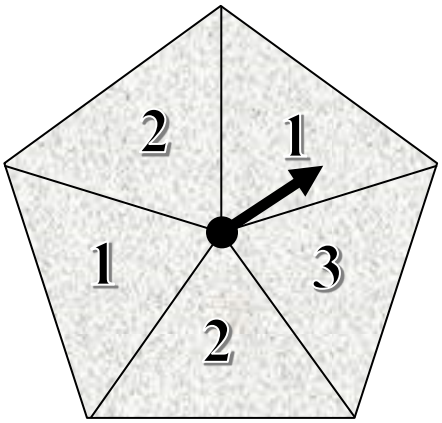
   A. Selecting only the 40 Year 12 boarders will introduce bias in the sample.

   B. Selecting the first 40 Year 12 boys from the roll is a systematic sample.

   C. Selecting 20 boarders and 20 day boys ensures no bias in the sample.

   D. Selecting 8 day boys and 32 boarders is a stratified sample.

7. A spinner was spun 50 times. The spinner and the results are shown below.



Number obtained	Frequency
1	18
2	22
3	10

   What is the relative frequency of getting a 2?

   A. $\frac{2}{5}$

   B. $\frac{11}{25}$

   C. $\frac{2}{3}$

   D. $\frac{11}{14}$

8. Which of the following correctly expresses p as the subject of $w = 3 - \frac{1}{2}p$?

A. $p = 6 - 2w$

B. $p = 3 - 2w$

C. $p = 6 + 2w$

D. $p = 3 + 2w$

9. Hazel used capture-recapture technique to estimate the population of bats in the local park. She captured 43 bats, tagged them and released them. One week later she captured 27 bats and found that 11 of them had been tagged.

Which one of the following statements is true?

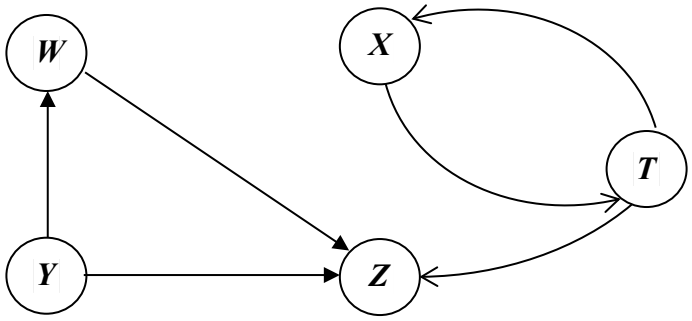
A. Hazel does not have enough data to estimate the population of bats.

B. Hazel can estimate that there are approximately 54 bats in the population.

C. Hazel can estimate that there are approximately 70 bats in the population.

D. Hazel can estimate that there are approximately 106 bats in the population.

10. A directed network is shown.



How many cycles are in the network?

A. 0

B. 1

C. 2

D. 3

11. Stefan paid $20 000 for new office equipment at the start of the 2015 financial year. At the start of each **following** financial year, he used flat rate (straight line) depreciation, to revalue this equipment. At the start of the 2019 financial year he revalued it at $12 600.

What was the annual flat rate of depreciation he used, as a percentage of the purchase price?

A. 3.7%

B. 6.3%

C. 9.25%

D. 10.9%

12. The predicted population (P) of the city of Plethora is modelled using the equation $P = M(1.02)^n$.

What is the predicted rate of growth of the population of Plethora?

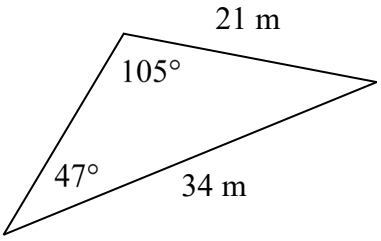
A. n%

B. M%

C. 2%

D. 102%

13. What is the area of the triangle, to the nearest square metre?



NOT TO SCALE

A. 168 m^2

B. 261 m^2

C. 315 m^2

D. 345 m^2

14. A table of future value interest factors for an annuity of $1 is shown.

Period	Interest rate per period				
	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

David invests in an annuity, by paying $500 into an account every 6 months for 2 years at an interest rate of 2% per annum.

Based on the information provided, what is the future value of David's annuity, to the nearest dollar?

A. $1005

B. $1010

C. $2030

D. $2060

15. Lucas used his new credit card to buy a laptop for $2199 on 17th January 2020. He made no other purchases with his credit card and there was no interest-free period. Interest was **compounded daily** at a rate of 18.99% per annum, including the date of purchase and the date of payment.

What amount did Lucas pay when he paid the account in full on 11th February 2020?

A. $2227.60

B. $2227.78

C. $2228.75

D. $2228.94

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Question Number
16

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Section II

75 marks
Attempt Questions 16–20
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.

Question 16 (17 marks) **Marks**

(a) Henry is employed as a bank clerk and earns $64 500 per annum.

(i) In the last tax year, he earned $152 of interest on his savings and his total tax deductions were $2110. **1**

Show that Henry's taxable income is $62 542.

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(ii) The table shows income tax payable. **2**

Taxable income	Tax on this income
0 - $18,200	Nil
$18,201 - $37,000	19c for each $1 over $18,200
$37,001 - $87,000	$3,572 plus 32.5c for each $1 over $37,000
$87,001 - $180,000	$19,822 plus 37c for each $1 over $87,000
$180,001 and over	$54,232 plus 45c for each $1 over $180,000

Calculate the tax Henry must pay on his income.

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Question 16 continues on page 11

(iii) Medicare Levy is charged at 2% of taxable income. Find the amount of Medicare Levy that Henry must pay. **1**

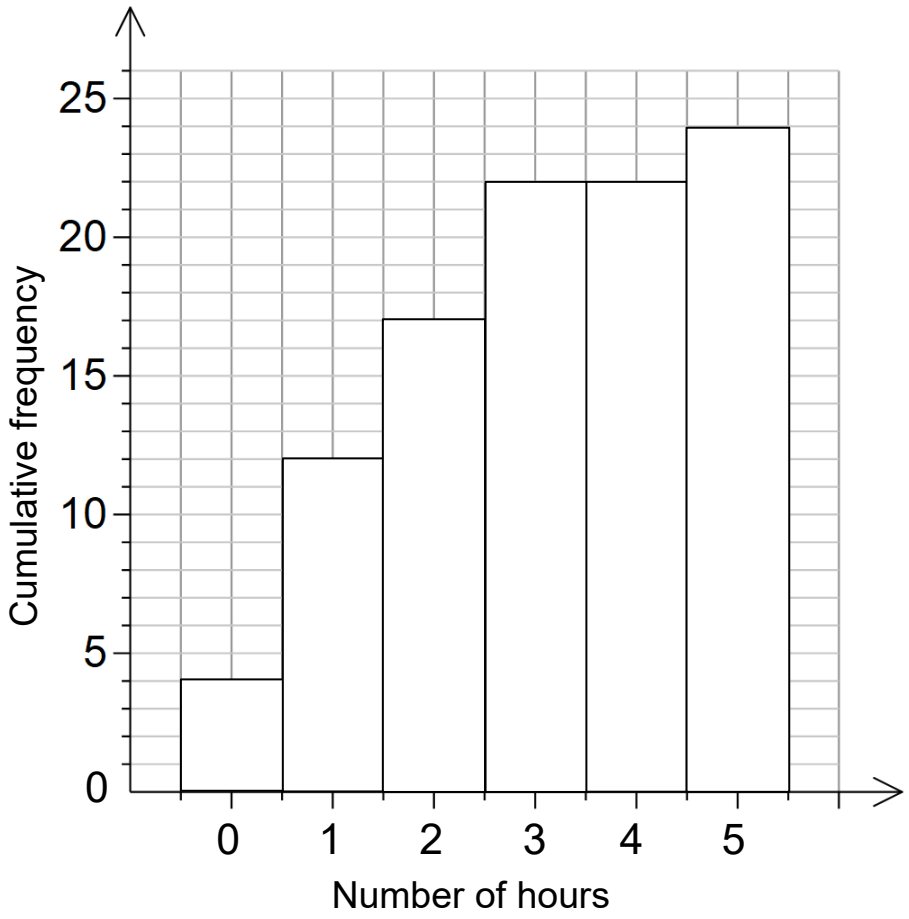
(iv) Tom tells Henry that because he has paid PAYG of $1150 per month, he will get a tax bill of $676.01. **4**

Is Tom correct? Justify your answer with suitable calculations.

(b) Solve the equation $x - 3 = \frac{x}{5} + 1$. **3**

Question 16 continues on page 12

(c) Matt surveyed Year 12 students about the hours they spent, on average each week, watching news programs on TV. He recorded his results in a cumulative frequency histogram, shown below.



(i) How many Year 12 students did Matt survey? **1**

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(ii) How many students watched news programs for an average of 3 hours each week? **1**

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Question 16 continues on page 13

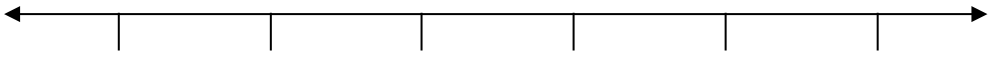
Question 16 (continued)

(iii) Draw an ogive on to the cumulative frequency histogram. **1**

(iv) Hence or otherwise, complete the table below. **1**

Lower extreme	0
Lower Quartile	1
Median (Q_2)	
Upper Quartile	3
Upper Extreme	5

(v) Draw a box plot on the number line below**.** **2**



End of Question 16

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

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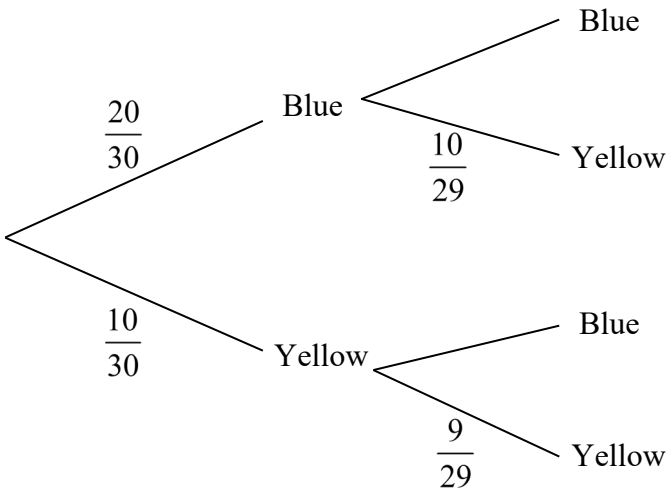
Question Number
17

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Question 17 (17 marks) **Marks**

(a) Millie has a collection of marbles in a bag. Twenty of them are blue and ten of them are yellow. Millie selects 2 marbles at random from the bag. A partially completed probability tree is shown.



(i) Complete the probability tree. **2**

(ii) What is the probability that Millie selects two yellow marbles? **1**

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(iii) What is the probability that Millie selects two marbles which are different colours? **2**

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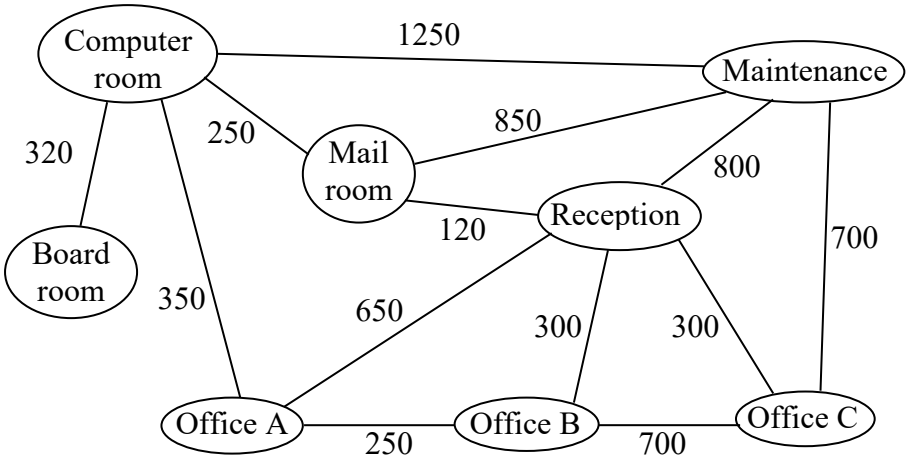
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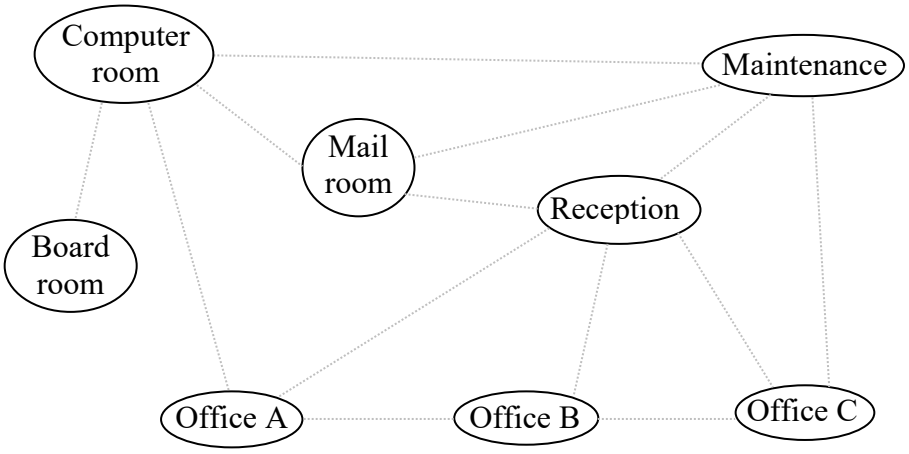
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Question 17 continues on page 19

(b) An office building is to have network cable installed so that all rooms are connected. Sophie drew a network diagram to show all the possible cables which could be installed to connect all of the rooms, as shown. Weights on the edges indicate the cost (in dollars) of installing each cable.



(i) Draw a minimum spanning tree including weights on the diagram below. **2**



(ii) What is the minimum cost to connect all of the rooms with network cable? **1**

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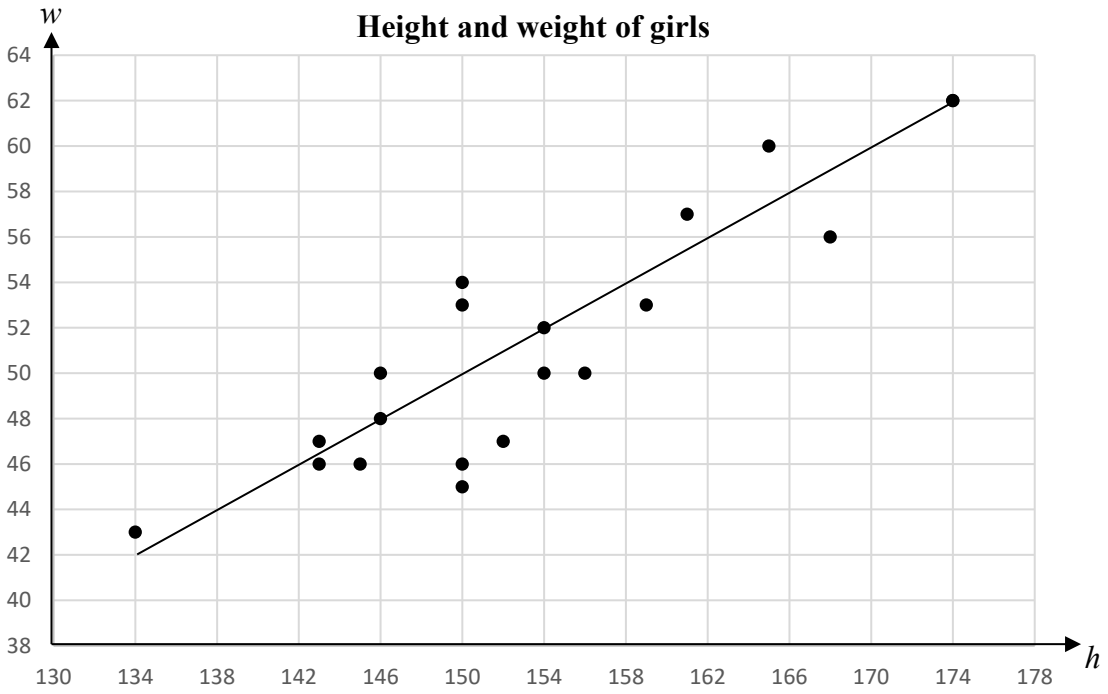
(iii) The cable connecting the Mail Room to Reception cannot be installed. If Sophie uses the next cheapest option, by how much will the total cost be increased? **1**

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Question 17 continues on page 20

(c) Naia recorded the height (h cm) and weight (w kg) of girls aged 12 to 14 years. She created a scatter plot of her data and included a line of best fit to model the relationship between the height and weight of girls.



(i) Determine the gradient of the line of best fit shown on the graph. **1**

(ii) Determine the equation of the line of best fit shown on the graph. **2**

Question 17 continues on page 21

(iii) Use the line of best fit on the graph to estimate the weight of a 13-year-old girl who has a height of 156 cm. **1**

(iv) Naia claims that Pearson's correlation coefficient for her data set is −1. Give **two** reasons why this cannot be correct. **2**

(d) A fridge is measured to be 70.2 cm to the nearest millimetre. What is the percentage error for this measurement? Give your answer to 2 decimal places. **2**

End of Question 17

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Question 17 Extra writing space
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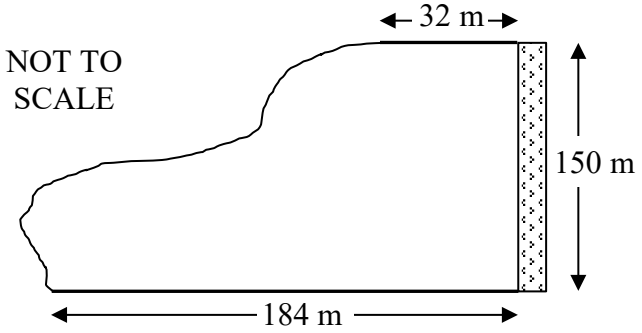
Question Number
18

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Question 18 (17 marks) **Marks**

(a) The diagram shows an irregularly-shaped paddock, with a straight wall forming one boundary.

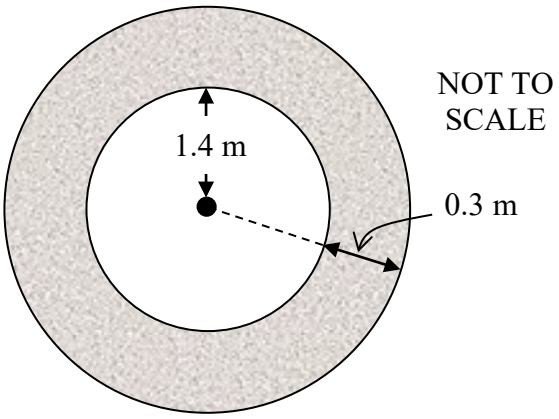


(i) Use the trapezoidal rule to estimate the area of the paddock. **2**

(ii) Fertiliser costs \$4.50 per 100 square metres. How much will it cost to fertilise the paddock? **2**

Question 18 continues on page 27

(b) A circular ornamental pond with radius 1.4 metres has a concrete path around it, with a uniform width of 0.3 metres, as shown in the diagram.



(i) What is the area of the concrete path, in square metres, to 2 decimal places? **2**

(ii) The concrete was made to a depth of 24 mm. What volume of concrete was used to create the path? Give your answer in cubic metres, to 2 decimal places. **2**

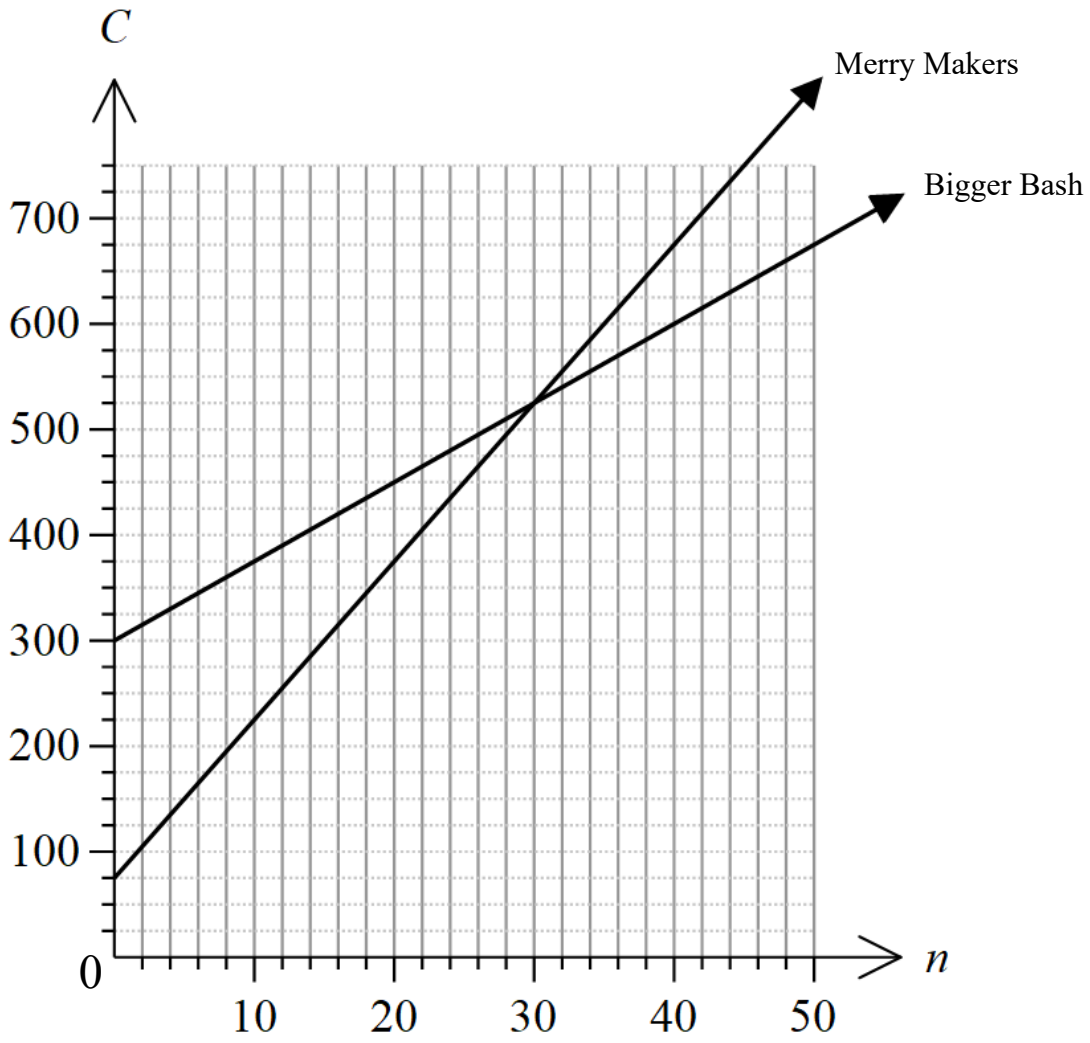
(iii) Using 1 m^3 = 1 kL, calculate the number of **litres** of concrete used. **1**

Question 18 continues on page 28

(c) Matthew is organising a party. He finds two companies which offer a venue with catering services. Each company calculates cost using a formula, where C is the cost in dollars and n is the number of people attending, as follows.

Merry Makers: $C = 15n + 75$
Bigger Bash: $C = 7.5n + 300$

These equations are graphed below.



(i) What is the meaning of the vertical intercept of each equation on the graph? **1**

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Question 18 continues on page 29

(ii) What is the cost in dollars, for 20 people attending a Merry Makers party? **1**

(iii) Matthew plans to have 38 people attend his party. Which company should he choose, if he wants the lowest cost? **1**

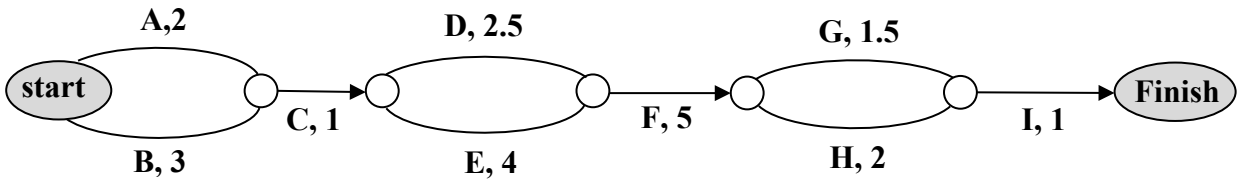
(iv) **Use the graph** to find the difference in the cost of Merry Makers and Bigger Bash, if 40 people attend a party. **1**

Question 18 continues on page 30

(d) Alex planned a project to re-tile his bathroom. He created a list of activities shown below.

Activity	Description	Time (hours)	Prerequisites
A	Remove tiles from side wall	2	start
B	Remove tiles from back wall	3	start
C	Prepare surfaces	1	A, B
D	Re-tile side wall	2.5	C
E	Re-tile back wall	4	C
F	Drying time	5	D, E
G	Grout side wall	1.5	F
H	Grout back wall	2	F
I	Clean up	1	G, H

Alex also drew a network diagram to represent his project, as shown.



(i) If his friend Matt completes activities A, E and G, while Alex completes the others, what is the minimum number of hours in which they can finish the project, if all of Alex's times are correct? Show your working. **2**

(ii) Alex has another friend, Lewis, who is an experienced tiler. Lewis will do activities B, D and H and he will take half of the time Alex allocated, to do each of these tasks. **2**

How much time will be saved on Alex's original plan if Lewis is helping him? Show your working.

End of Question 18

Question 18 Extra writing space
If you use this space, clearly indicate which question you are answering.

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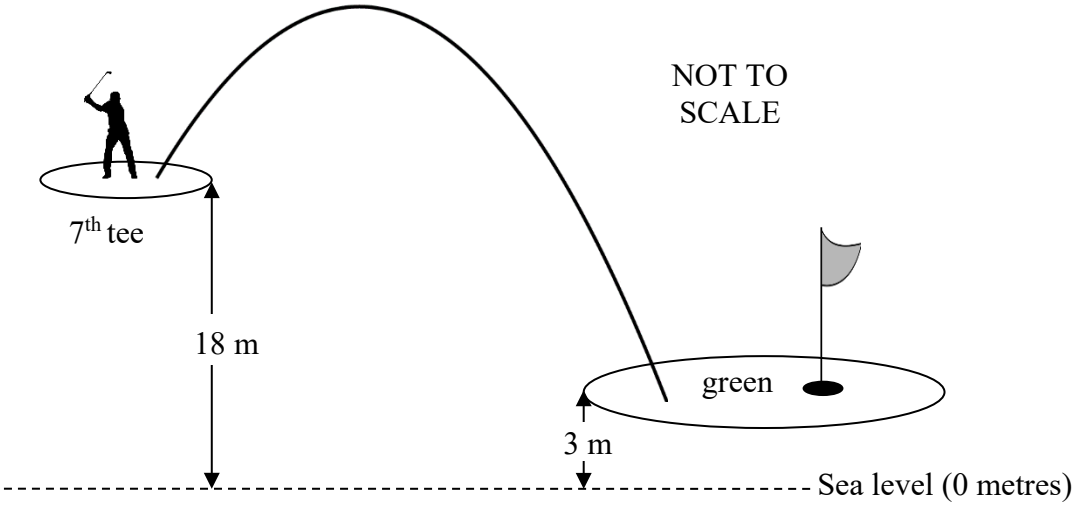
Question Number
19

Instructions

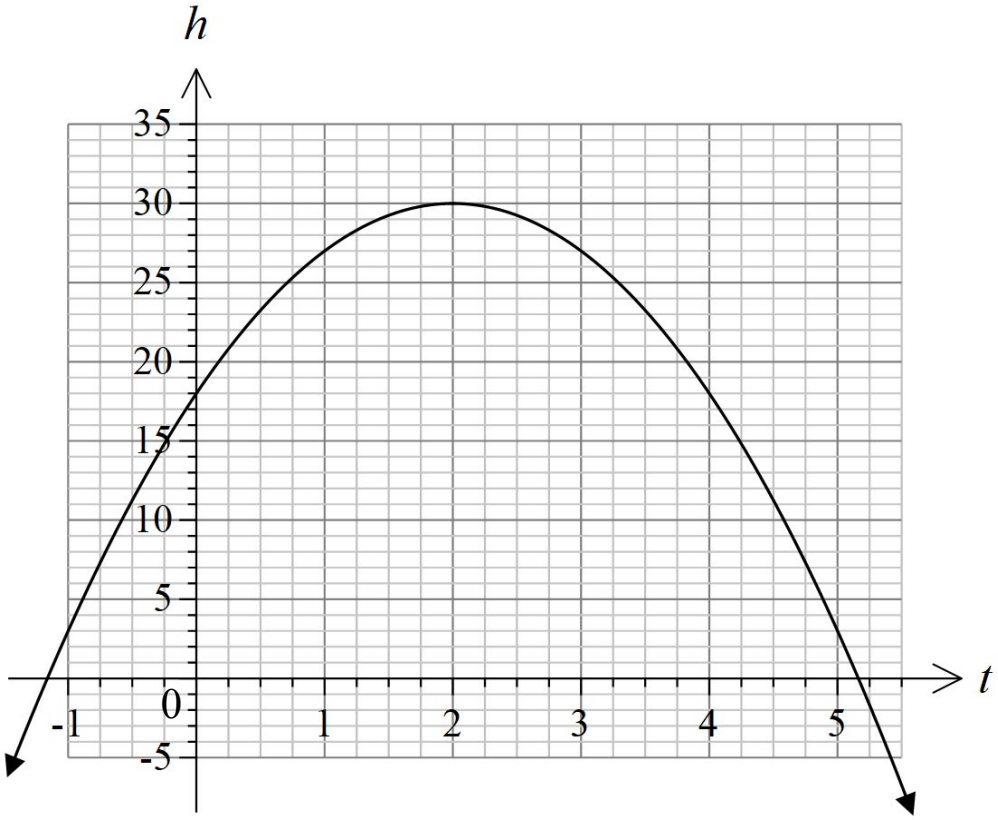
- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Question 19 (17 marks) **Marks**

(a) Hamish plays golf at Maw Park Golf Course. The diagram shows the flight of Hamish's ball from the 7th tee to the green. The tee is 18 metres above sea level and the green is 3 metres above sea level.



The graph shows the height, h, in metres, of the golf ball above sea level against the time, t, in seconds, from when Hamish first hits the ball. The equation of the graph is $h = -3t^2 + 12t + 18$.



Question 19 continues on page 35

Use the graph and the diagram to answer the following questions.

(i) What is the maximum height **above sea level** that the golf ball will reach? **1**

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(ii) After how many seconds does the golf ball land on the green? **1**

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(iii) What is the height of the ball above the **green** after 3 seconds? **1**

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(b) Ryan is at Queen's Cross Station. He observes that the number of minutes (m) until the next train can be estimated by counting the number of people (p) on the platform. **1**

Use Ryan's formula, $m = \frac{36}{p}$, to estimate the number of people that will be on the platform when the next train is 3 minutes away.

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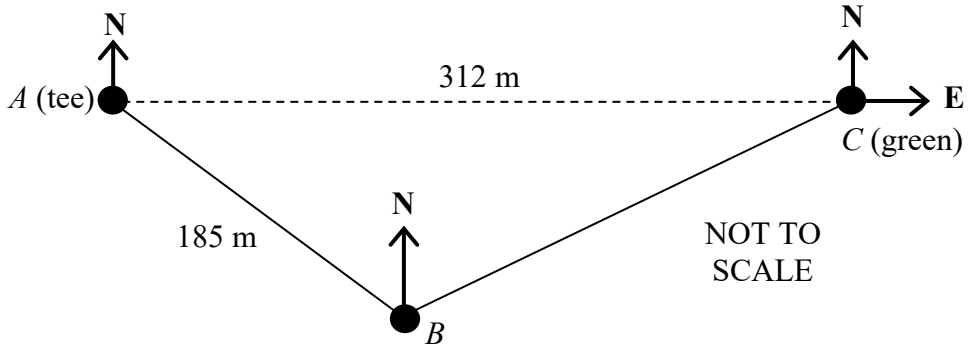
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Question 19 continues on page 36

(c) On the 8th hole at Royal Elms Golf Course, the green (C) is due east of the tee (A). Levi plays 2 shots. His first is from A to B, on a bearing of $135°$. His second is from B to C, as shown in the diagram.



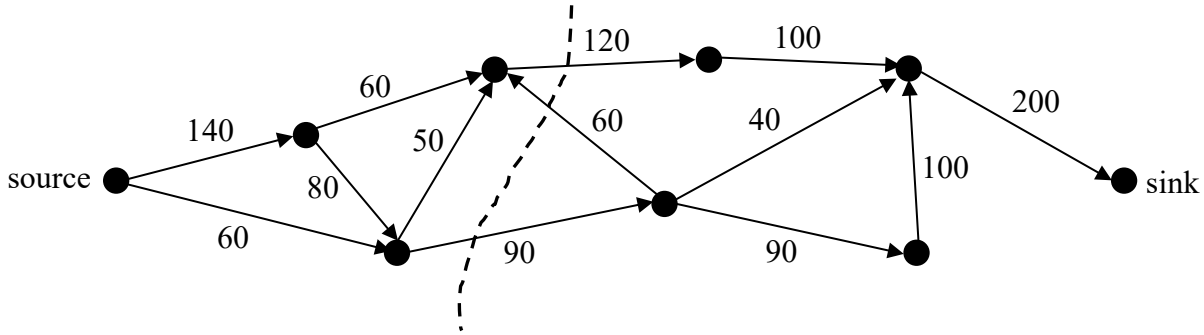
(i) Show that $\angle BAC = 45°$. **1**

(ii) What is the distance Levi must walk from B to C, after playing his second shot? Give your answer to the nearest metre. **2**

Question 19 continues on page 37

(iii) Use the sine rule to find the **obtuse** $\angle ABC$, to the nearest degree. **3**

(d) A network diagram is shown, along with a cut. Each vertex is a road junction and the numbers on the edges represent the number of cars per hour that can pass through the junctions.



(i) What is the capacity of the cut shown? **1**

(ii) What is the maximum flow for this network? **1**

Question 19 continues on page 38

(e) Charlie planned to fly from Singapore (0° N, 105° E) to Prague (50° N, 15° E) to visit his friend Jack.

(i) Show that the time difference between Singapore and Prague is 6 hours. **1**
For calculation of time differences, 15° = 1 hour time difference.

(ii) Jack rang Charlie prior to his flight, to check his planned arrival time. If he made the call from Prague at 7.40 pm on Saturday, what was the day and time in Singapore, when Charlie received the call? **2**

(iii) Charlie's flight arrived in Prague at 6.30 pm on Tuesday. If the flight took 13.5 hours, what was the day and time in Singapore when the flight left Singapore? **2**

End of Question 19

Question 19 Extra writing space
If you use this space, clearly indicate which question you are answering.

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Question Number
20

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
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- If you need more space, use the extra writing space at the back of this writing booklet.

Question 20 (17 marks) **Marks**

(a) The table shows the present value of a \$1 annuity for certain monthly interest rates and certain numbers of months.

Present values of \$1						
	Interest rates (per month)					
Months	**0.50%**	**0.60%**	**0.70%**	**0.80%**	**0.90%**	**1.00%**
50	44.1428	43.0862	42.0646	41.0765	40.1208	39.1961
100	78.5426	75.0339	71.7432	68.6548	65.7545	63.0289
150	105.3500	98.7226	92.6828	87.1705	82.1322	77.5201
200	126.2406	116.2873	107.4568	99.6018	92.5961	86.3314
250	142.5203	129.3113	117.8805	107.9479	99.2816	91.6889
300	155.2069	138.9683	125.2349	113.5515	103.5531	94.9466

Hamish plans to invest in an annuity of \$300 each month for 250 months. His investment will earn interest at the rate of 0.60% per month (7.2% per annum).

(i) Use the information in the table to calculate the present value of Hamish's annuity. **1**

(ii) Calculate the future value of Hamish's annuity. **2**

Question 20 continues on page 43

(iii) How much interest will Hamish earn on this annuity in 250 months? **2**

(iv) Hamish realises that he needs an additional \$10 000. **3**

How much more will he have to invest each month in the annuity, in order to have an additional \$10 000 after 250 months?

Question 20 continues on page 44

(b) The weights of packets of Chirpy Birdseed are normally distributed. The mean is 250 grams and the standard deviation is 1.5 grams.

(i) What is the z-score of a packet which weighs 247 grams? **1**

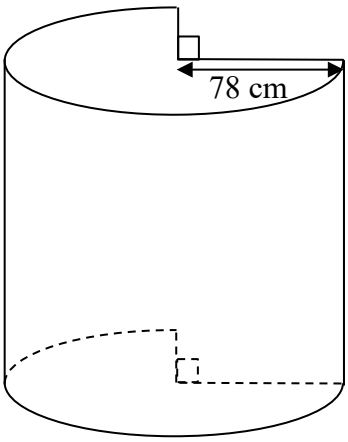
(ii) How much does a packet weigh if it has a z-score of 1.3? **2**

(iii) Will buys 300 packets of Chirpy Birdseed to sell in his pet shop. How many of these packets will weigh between 253 grams and 254.5 grams? **3**

Question 20 continues on page 45

(c) Vlad has a water tank on his property which is positioned so that all of the rainwater that falls on the roof of his house goes into the enclosed water tank. **3**

The water tank is in the shape of part of a cylinder with a radius of 78 cm, as shown in the diagram.



If 820 litres of rainwater go into the empty tank, what will be the height of water in the tank, to the nearest centimetre?

End of Paper ☺

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Question 20 Extra writing space
If you use this space, clearly indicate which question you are answering.

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SHORE

School Exam No: | | | |

Set: | |

Year 12
Mathematics Standard 2
Trial HSC Examination
2020

SOLUTIONS

General Instructions

- Reading time – 10 minutes
- Working time – $2\frac{1}{2}$ hours
- Write using black pen
- Questions 1 to 15 will be answered on the multi-choice answer sheet provided
- Questions 16 to 20 will be written in the writing booklets provided
- NESA reference sheet will be provided
- Students are to bring approved scientific calculator and other appropriate equipment.
  No other materials such as class notes, textbooks or any other reference material are permitted

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

Total marks – 100

Section I Pages 2 – 8

15 marks

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

Section II Pages 9 – 48

85 marks

- Attempt Questions 16–20
- Allow about 2 hours 5 minutes for this section

DO NOT REMOVE THIS PAPER FROM THE EXAMINATION ROOM

Section I

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

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

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

1. What is the median of the data set shown?

3 3 3 3 | 4 5 7 8

3·5

A. 3
B. 3.5
C. 4.5
D. 5

2. What will be the cost of running a 120-watt ceiling fan for 5 hours if the average cost of electricity is 28.679 c/kWh?

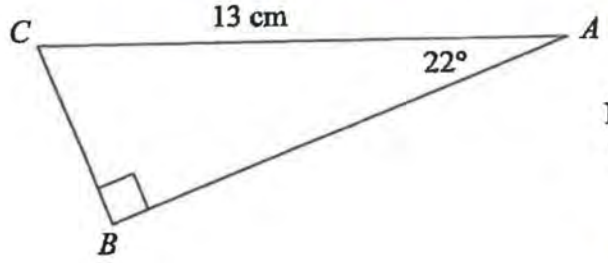
cost = 0.120 × 5 × 0.28679
= 0.172...
= $0.17

A. $0.03
B. $0.17
C. $3.44
D. $17.21

3. Which one of the following would have a probability of $\frac{1}{5}$?

A. Choosing a green marble from a bag containing 1 green marble and 4 blue marbles.
B. Choosing a green marble from a bag containing 1 green marble and 5 blue marbles.
C. Choosing a green marble from a bag containing 5 green marbles.
D. Choosing two green marbles from a bag containing 5 blue marbles and 5 green marbles.

4. What is the length of side *AB* in the triangle, to the nearest centimetre?



NOT TO SCALE

$\cos 22° = \frac{AB}{13}$

$AB = 13 \cos 22°$

$= 12.05\ldots$ cm

A. 5 cm

B. 12 cm

C. 14 cm

D. 35 cm

5. Ben correctly calculated Pearson's Correlation Coefficient for a set of data as –0.45.

Which of the graphs shown could represent this data set?

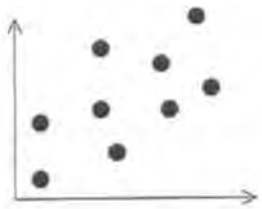
A.



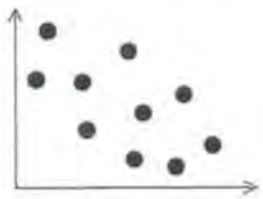
C.



B.



D.



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

A	4
B	5
C	3
D	3

6. In Year 12 at Simon's school, there are 160 day boys and 40 boarders. Simon wants to collect data about Year 12 students' experience of distance learning, so he selects a sample of 40 Year 12 students.

Which one of these statements, about the sample Simon uses, is true?

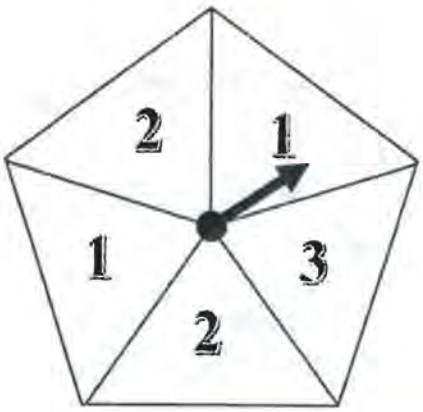
A. Selecting only the 40 Year 12 boarders will introduce bias in the sample.

B. Selecting the first 40 Year 12 boys from the roll is a systematic sample.

C. Selecting 20 boarders and 20 day boys ensures no bias in the sample.

D. Selecting 8 day boys and 32 boarders is a stratified sample.

7. A spinner was spun 50 times. The spinner and the results are shown below.



Number obtained	Frequency
1	18
2	22
3	10

What is the relative frequency of getting a 2?

A. $\frac{2}{5}$

B. $\frac{11}{25}$

C. $\frac{2}{3}$

D. $\frac{11}{14}$

Rel freq $= \frac{22}{50}$

$= \frac{11}{25}$

8. Which of the following correctly expresses p as the subject of $w=3-\frac{1}{2}p$?

A. $p=6-2w$

B. $p=3-2w$

C. $p=6+2w$

D. $p=3+2w$

$2w = 6 - p$

$p = 6 - 2w$

9. Hazel used capture-recapture technique to estimate the population of bats in the local park. She captured 43 bats, tagged them and released them. One week later she captured 27 bats and found that 11 of them had been tagged.

Which one of the following statements is true?

$\text{Bats} = \frac{27}{11} \times 43$

$= 105.5\ldots$

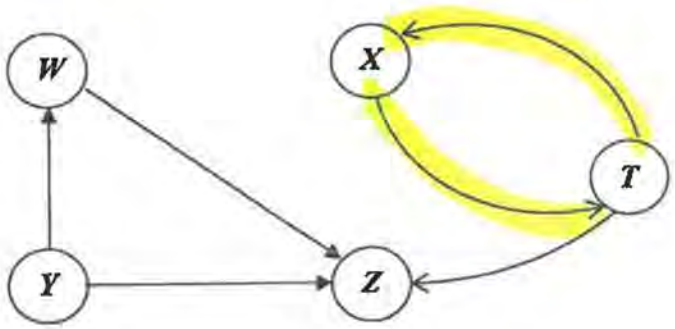
A. Hazel does not have enough data to estimate the population of bats.

B. Hazel can estimate that there are approximately 54 bats in the population.

C. Hazel can estimate that there are approximately 70 bats in the population.

D. Hazel can estimate that there are approximately 106 bats in the population.

10. A directed network is shown.



How many cycles are in the network?

A. 0

B. 1

C. 2

D. 3

11. Stefan paid $20 000 for new office equipment at the start of the 2015 financial year. At the start of each **following** financial year, he used flat rate (straight line) depreciation, to revalue this equipment. At the start of the 2019 financial year he revalued it at $12 600.

What was the annual flat rate of depreciation he used, as a percentage of the purchase price?

A. 3.7%
B. 6.3%
C. 9.25%
D. 10.9%

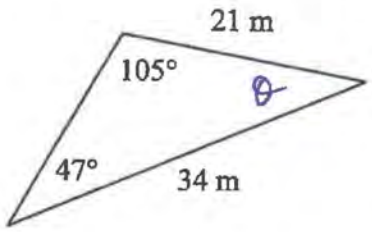
$dep = 20\,000 - 12\,600$
$= \$7400$
$r = \frac{7400}{4} \div 20\,000 \times 100\,\%$
$= 9.25\%$

12. The predicted population (P) of the city of Plethora is modelled using the equation $P = M(1.02)^n$.

What is the predicted rate of growth of the population of Plethora?

A. $n\%$
B. $M\%$
C. 2%
D. 102%

13. What is the area of the triangle, to the nearest square metre?



NOT TO SCALE

A. 168 m²
B. 261 m²
C. 315 m²
D. 345 m²

$\theta = 180 - (105 + 47)$
$= 28°$
$A = \frac{1}{2} ab \sin C$
$= \frac{1}{2} \times 21 \times 34 \sin 28°$
$= 167.6\ldots \text{ m}^2$

14. A table of future value interest factors for an annuity of $1 is shown.

Period	Interest rate per period				
	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

David invests in an annuity, by paying $500 into an account every 6 months for 2 years at an interest rate of 2% per annum.

$r = 1\%$ $n = 4$

Based on the information provided, what is the future value of David's annuity, to the nearest dollar?

A. $1005
B. $1010
C. $2030
D. $2060

$FVA = FVIF \times a$
$= 4.0604 \times 500$
$= \$2030.20$

15. Lucas used his new credit card to buy a laptop for $2199 on 17th January 2020. He made no other purchases with his credit card and there was no interest-free period. Interest was **compounded daily** at a rate of 18.99% per annum, including the date of purchase and the date of payment.

What amount did Lucas pay when he paid the account in full on 11th February 2020?

A. $2227.60
B. $2227.78
C. $2228.75
D. $2228.94

days $= 31 - 17 + 1 + 11$
$= 26$
$A = P(1+r)^n$
$= 2199\left(1 + \frac{0.1899}{365}\right)^{26}$
$= 2228.94\ldots$

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SHORE

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Year 12
Mathematics Standard 2
Trial HSC Examination
2020

Date

Question Number
16

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Section II

75 marks
Attempt Questions 16–20
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.

Question 16 (17 marks) **Marks**

(a) Henry is employed as a bank clerk and earns $64 500 per annum.

(i) In the last tax year, he earned $152 of interest on his savings and his total tax deductions were $2110. **1**

Show that Henry's taxable income is $62 542.

taxable income = 64500 + 152 − 2110
= $62542

(ii) The table shows income tax payable. **2**

Taxable income	Tax on this income
0 - $18,200	Nil
$18,201 - $37,000	19c for each $1 over $18,200
~~$37,001 - $87,000~~	$3,572 plus 32.5c for each $1 over $37,000
$87,001 - $180,000	$19,822 plus 37c for each $1 over $87,000
$180,001 and over	$54,232 plus 45c for each $1 over $180,000

Calculate the tax Henry must pay on his income.

tax payable = 3572 + 0.325(62542 − 37000)
= $11873.15

Question 16 continues on page 11

Question 16 (continued)

(iii) Medicare Levy is charged at 2% of taxable income. Find the amount of Medicare Levy that Henry must pay. **1**

$ML = 0.02 \times 62542$

$= \$1250.84$

(iv) Tom tells Henry that because he has paid PAYG of \$1150 per month, he will get a tax bill of \$676.01. **4**

Is Tom correct? Justify your answer with suitable calculations.

$PAYG = 1150 \times 12$

$= \$13800$

Tax payable $= 11873.15 + 1250.84$

$= \$13123.99$

$PAYG > \text{Tax payable}$

$\therefore \text{Refund} = 13800 - 13123.99$

$= \$676.01$

$\therefore$ Tom is incorrect, Henry will get a refund of \$676.01

(b) Solve the equation $x - 3 = \frac{x}{5} + 1$. **3**

$5x - 15 = x + 5$

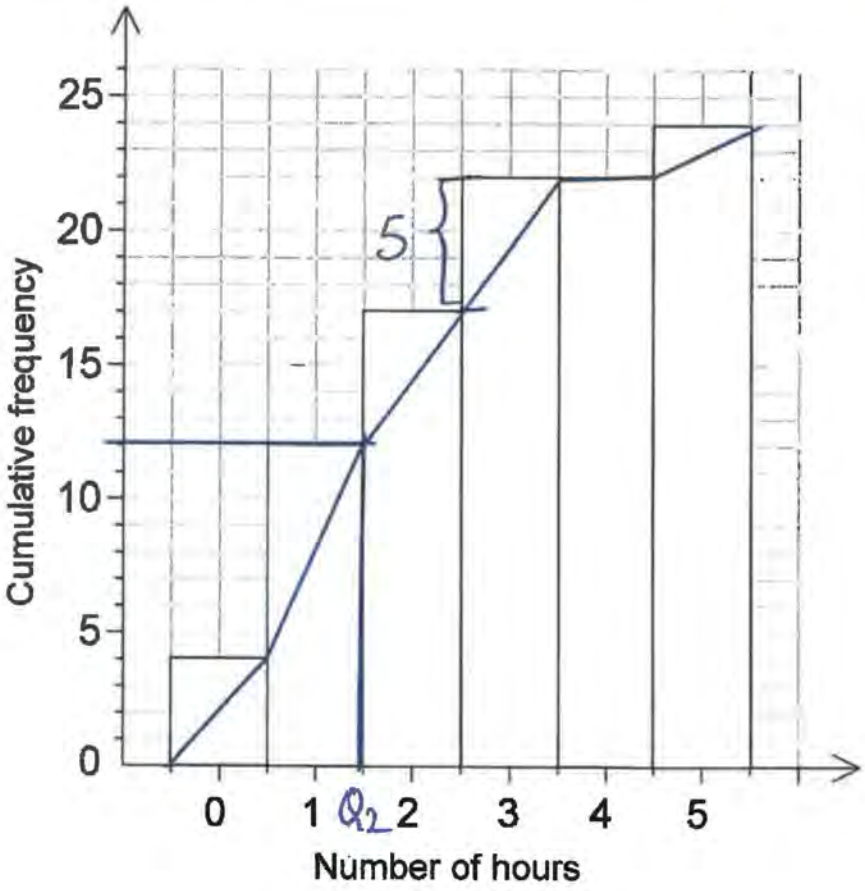
$4x - 15 = 5$

$4x = 20$

$x = 5$

Question 16 continues on page 12

(c) Matt surveyed Year 12 students about the hours they spent, on average each week, watching news programs on TV. He recorded his results in a cumulative frequency histogram, shown below.



(i) How many Year 12 students did Matt survey? **1**

24

(ii) How many students watched news programs for an average of 3 hours each week? **1**

5

Question 16 continues on page 13

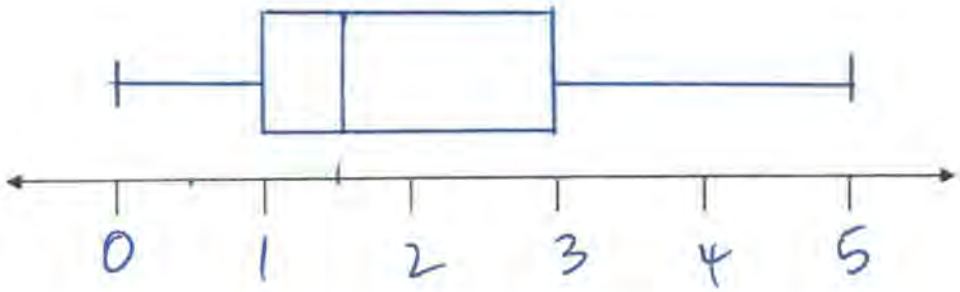
Question 16 (continued)

(iii) Draw an ogive on to the cumulative frequency histogram. ✓ **1**

(iv) Hence or otherwise, complete the table below. **1**

Lower extreme	0
Lower Quartile	1
Median (Q_2)	1.5
Upper Quartile	3
Upper Extreme	5

(v) Draw a box plot on the number line below. **2**



End of Question 16

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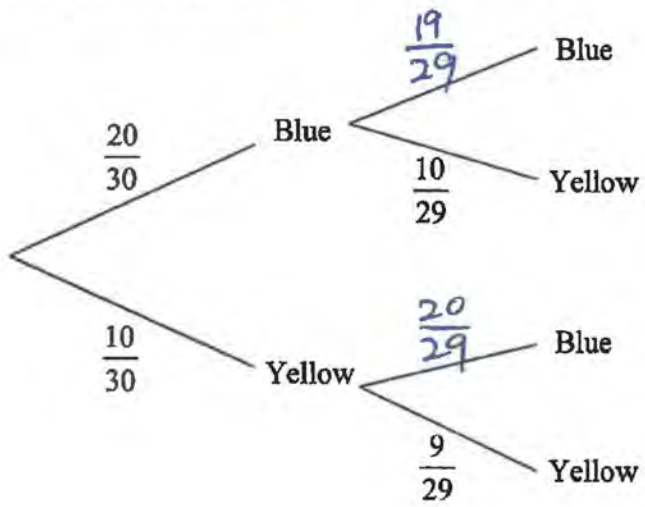
Question Number
17

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Question 17 (17 marks) **Marks**

(a) Millie has a collection of marbles in a bag. Twenty of them are blue and ten of them are yellow. Millie selects 2 marbles at random from the bag. A partially completed probability tree is shown.



(i) Complete the probability tree. ✓ **2**

(ii) What is the probability that Millie selects two yellow marbles? **1**

$P(YY) = \frac{10}{30} \times \frac{9}{29}$

$= \frac{3}{29}$

(iii) What is the probability that Millie selects two marbles which are different colours? **2**

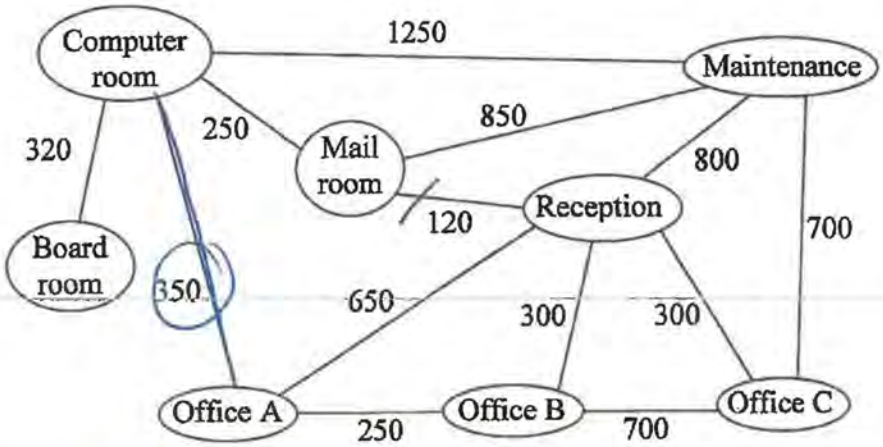
$P(BY, YB) = \frac{20}{30} \times \frac{10}{29} + \frac{10}{30} \times \frac{20}{29}$

$= \frac{40}{87}$

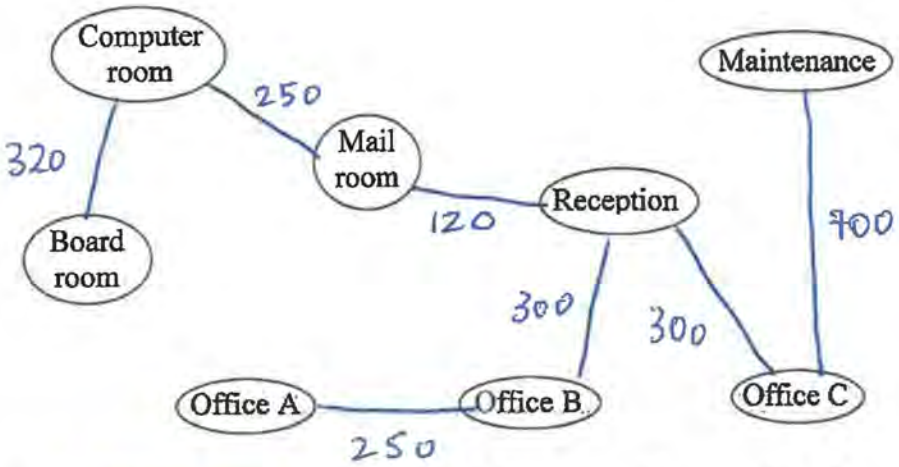
Question 17 continues on page 19

Question 17 (continued)

(b) An office building is to have network cable installed so that all rooms are connected. Sophie drew a network diagram to show all the possible cables which could be installed to connect all of the rooms, as shown. Weights on the edges indicate the cost (in dollars) of installing each cable.



(i) Draw a minimum spanning tree including weights on the diagram below. **2**



(ii) What is the minimum cost to connect all of the rooms with network cable? **1**

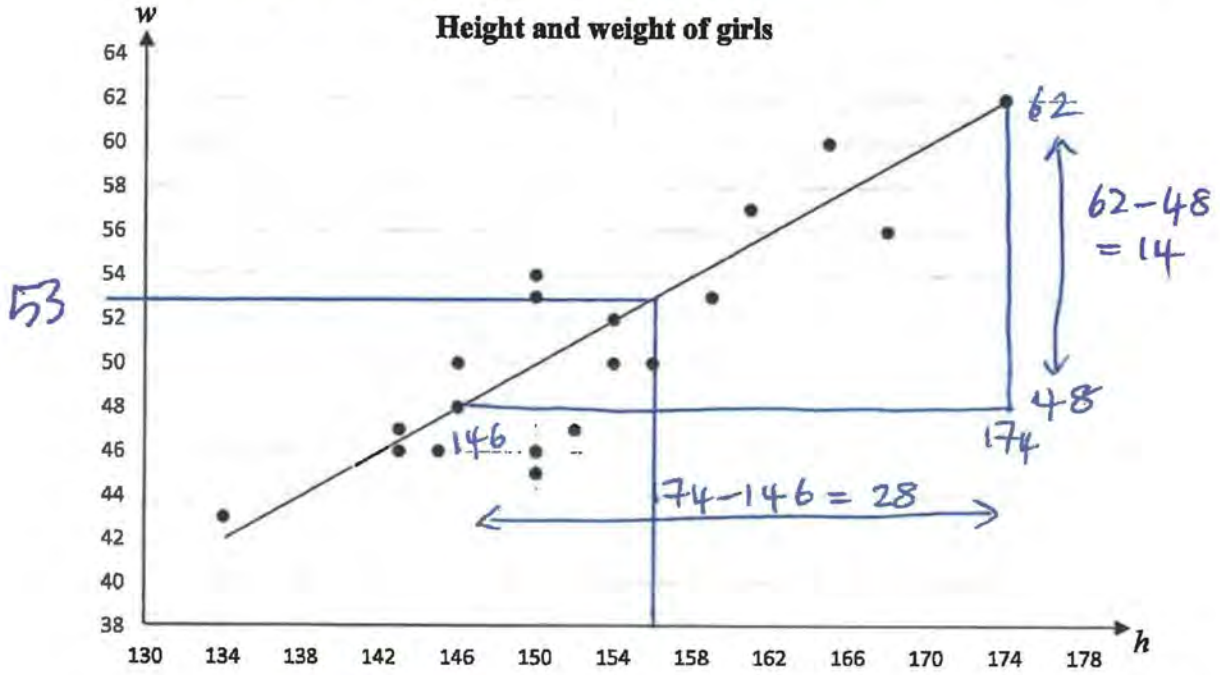
cost = 320 + 250 + 120 + 250 + 300 + 300 + 700
= $2240

(iii) The cable connecting the Mail Room to Reception cannot be installed. If Sophie uses the next cheapest option, by how much will the total cost be increased? **1**

increase = 350 − 120
= $230

Question 17 continues on page 20

(c) Naia recorded the height (h cm) and weight (w kg) of girls aged 12 to 14 years. She created a scatter plot of her data and included a line of best fit to model the relationship between the height and weight of girls.



(i) Determine the gradient of the line of best fit shown on the graph. **1**

$m = \frac{14}{28}$

$= \frac{1}{2}$

(ii) Determine the equation of the line of best fit shown on the graph. **2**

From graph:
(146, 48)

$y = mx + c$

$w = \frac{1}{2}h + c$

$48 = \frac{1}{2} \times 146 + c$

$48 - \frac{1}{2} \times 146 = c$

$c = -25$

$w = \frac{1}{2}h - 25$

Question 17 continues on page 21

(iii) Use the line of best fit on the graph to estimate the weight of a 13-year-old girl who has a height of 156 cm. **1**

53 kg

(iv) Naia claims that Pearson's correlation coefficient for her data set is -1. Give **two** reasons why this cannot be correct. **2**

① The gradient of line is positive

② The points are not all on the line

(d) A fridge is measured to be 70.2 cm to the nearest millimetre. What is the percentage error for this measurement? Give your answer to 2 decimal places. **2**

$$\%\text{ error} = \frac{0.05}{70.2} \times 100\ \%$$

$$= 0.0712\ldots$$

$$\doteq 0.07\ \%$$

End of Question 17

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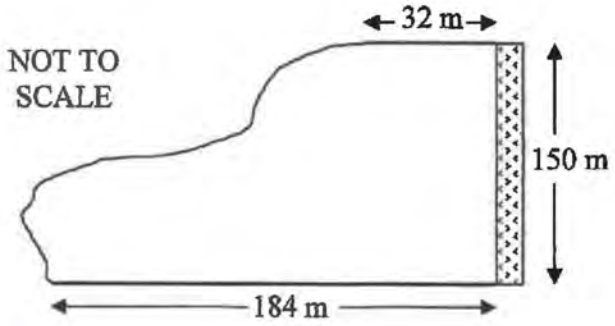
Question Number
18

Instructions

- **Complete all boxes** on the front cover of this writing booklet.
- Write using black pen.
- If you need more space, use the extra writing space at the back of this writing booklet.

Question 18 (17 marks) **Marks**

(a) The diagram shows an irregularly-shaped paddock, with a straight wall forming one boundary.



(i) Use the trapezoidal rule to estimate the area of the paddock. **2**

$A \approx \frac{h}{2}(d_f + d_L)$

$= \frac{150}{2}(184 + 32)$

$= 16\,200\ m^2$

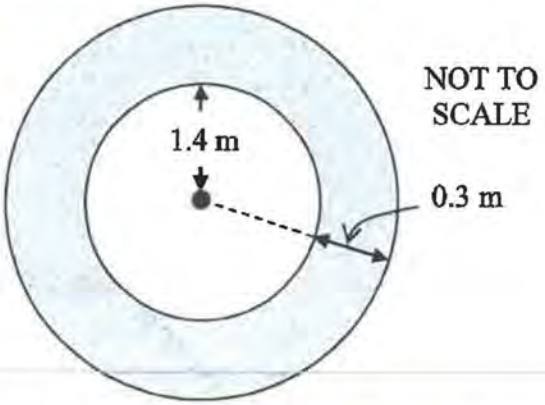
(ii) Fertiliser costs \$4.50 per 100 square metres. How much will it cost to fertilise the paddock? **2**

$\text{cost} = \frac{16\,200}{100} \times 4.5$

$= \$729$

Question 18 continues on page 27

(b) A circular ornamental pond with radius 1.4 metres has a concrete path around it, with a uniform width of 0.3 metres, as shown in the diagram.



(i) What is the area of the concrete path, in square metres, to 2 decimal places? **2**

$A = \pi(R^2 - r^2)$

$= \pi(1.7^2 - 1.4^2)$

$= 2.9216...$

$\doteq 2.92 \text{ m}^2$

(ii) The concrete was made to a depth of 24 mm. What volume of concrete was used to create the path? Give your answer in cubic metres, to 2 decimal places. **2**

$V = Ah$

$= 2.92 \times 0.024$

$= 0.07008$

$\doteq 0.07 \text{ m}^3$

(iii) Using 1 $\text{m}^3 = 1$ kL, calculate the number of **litres** of concrete used. **1**

$0.07 \text{ m}^3 = 0.07 \text{ kL}$

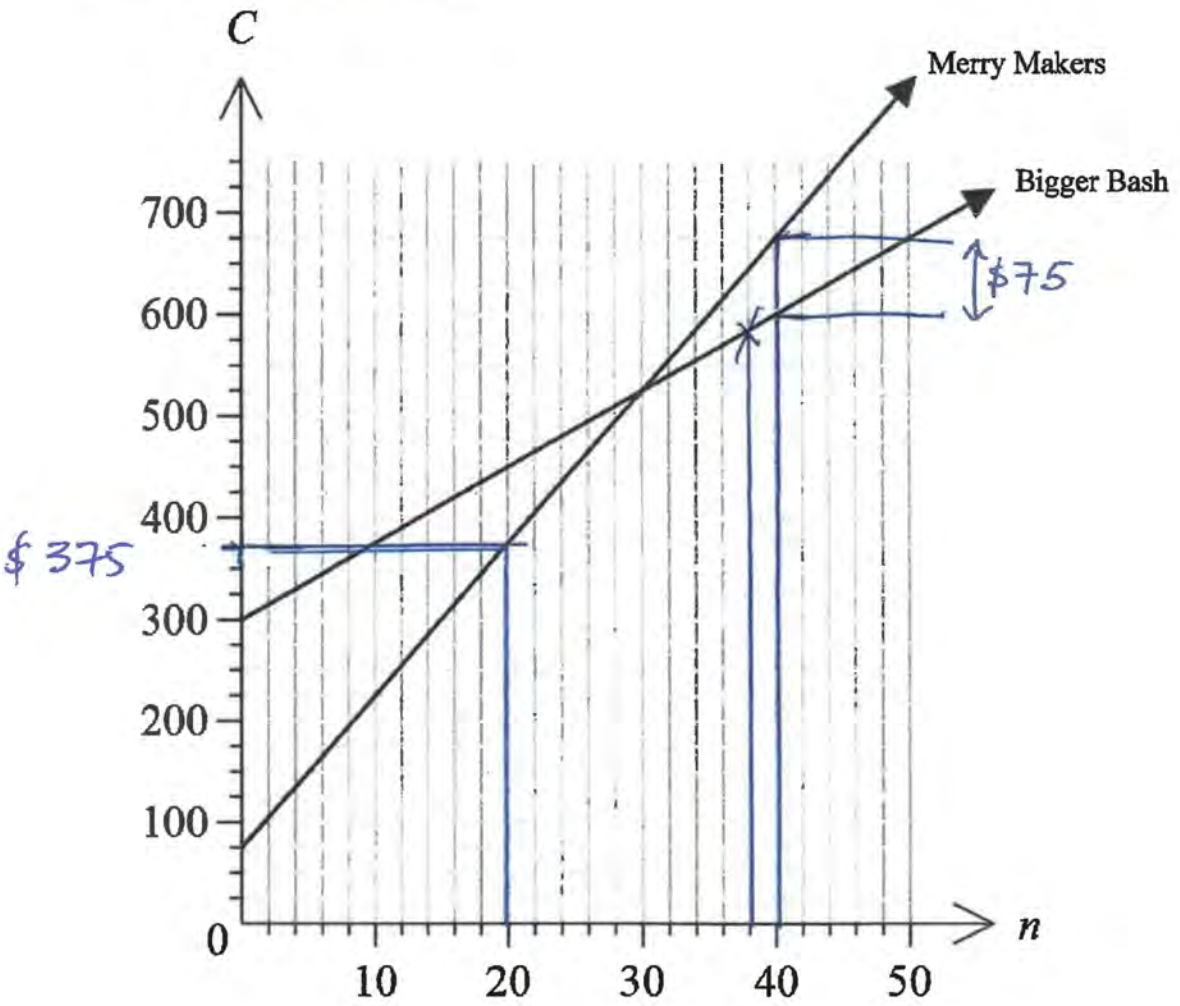
$= 70 \text{ L}$

Question 18 continues on page 28

(c) Matthew is organising a party. He finds two companies which offer a venue with catering services. Each company calculates cost using a formula, where C is the cost in dollars and n is the number of people attending, as follows.

Merry Makers: $C = 15n + 75$
Bigger Bash: $C = 7.5n + 300$

These equations are graphed below.



(i) What is the meaning of the vertical intercept of each equation on the graph? 1

cost of hiring the venue

Question 18 continues on page 29

(ii) What is the cost in dollars, for 20 people attending a Merry Makers party? **1**

cost = $375

(iii) Matthew plans to have 38 people attend his party. Which company should he choose, if he wants the lowest cost? **1**

Bigger Bash

(iv) **Use the graph** to find the difference in the cost of Merry Makers and Bigger Bash, if 40 people attend a party. **1**

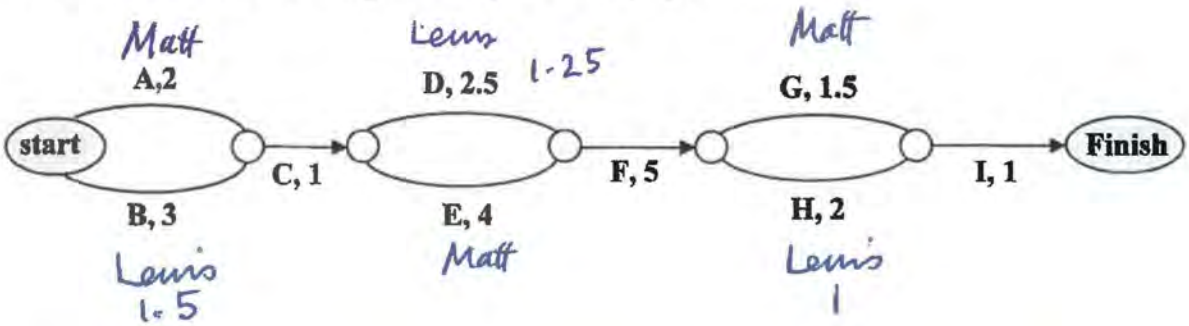
$75

Question 18 continues on page 30

(d) Alex planned a project to re-tile his bathroom. He created a list of activities shown below.

Activity	Description	Time (hours)	Prerequisites
A	Remove tiles from side wall	2	start
B	Remove tiles from back wall	3	start
C	Prepare surfaces	1	A, B
D	Re-tile side wall	2.5	C
E	Re-tile back wall	4	C
F	Drying time	5	D, E
G	Grout side wall	1.5	F
H	Grout back wall	2	F
I	Clean up	1	G, H

Alex also drew a network diagram to represent his project, as shown.



(i) If his friend Matt completes activities A, E and G, while Alex completes the others, what is the minimum number of hours in which they can finish the project, if all of Alex's times are correct? Show your working. **2**

time $= 3 + 1 + 4 + 5 + 2 + 1$

$= 16$ h

(ii) Alex has another friend, Lewis, who is an experienced tiler. Lewis will do activities B, D and H and he will take half of the time Alex allocated, to do each of these tasks. **2**

How much time will be saved on Alex's original plan if Lewis is helping him? Show your working.

new time $= 2 + 1 + 4 + 5 + 1.5 + 1$

$= 14.5$ h

$\therefore$ time saved $= 16 - 14.5$

$= 1.5$ h

End of Question 18

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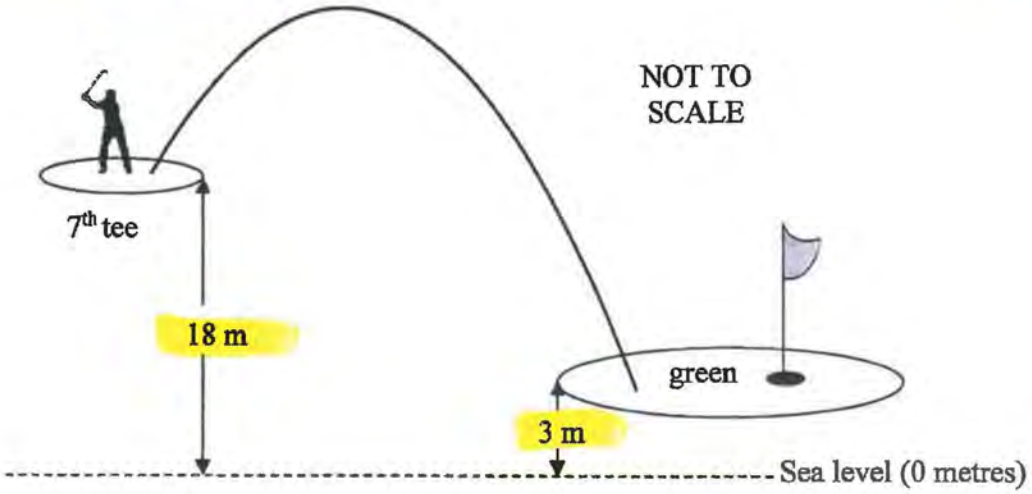
Question Number
19

Instructions

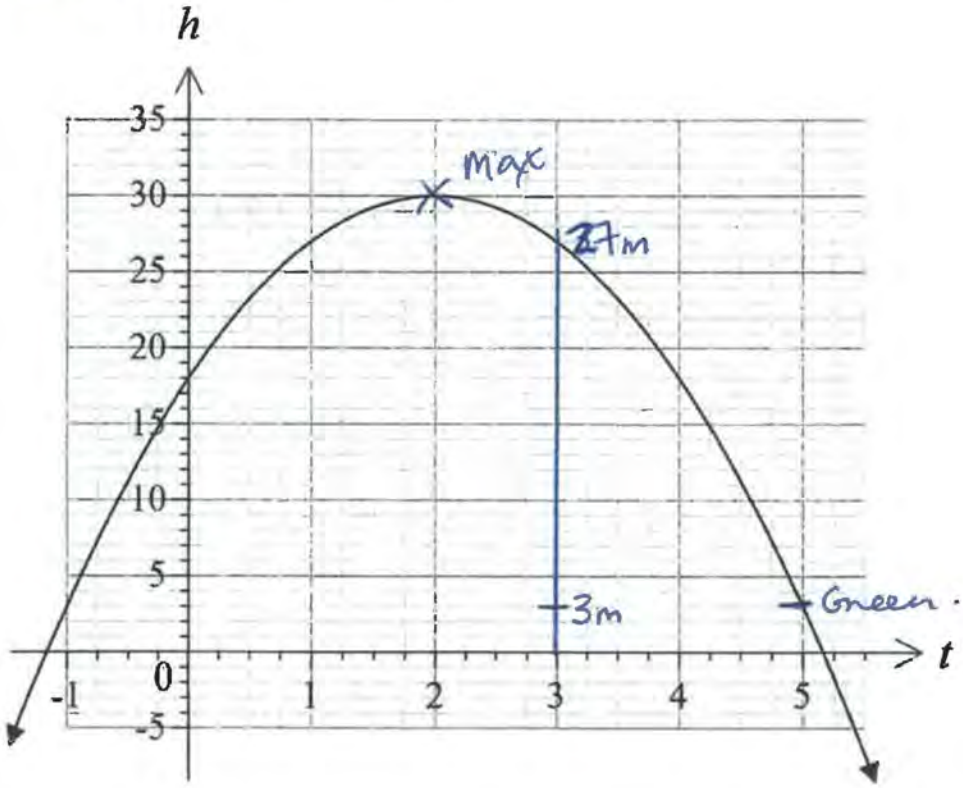
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Question 19 (17 marks) **Marks**

(a) Hamish plays golf at Maw Park Golf Course. The diagram shows the flight of Hamish's ball from the 7th tee to the green. The tee is 18 metres above sea level and the green is 3 metres above sea level.



The graph shows the height, h, in metres, of the golf ball above sea level against the time, t, in seconds, from when Hamish first hits the ball. The equation of the graph is $h = -3t^2 + 12t + 18$.



Question 19 continues on page 35

Question 19 continued

Use the graph and the diagram to answer the following questions.

(i) What is the maximum height **above sea level** that the golf ball will reach? 1

30 m

(ii) After how many seconds does the golf ball land on the green? 1

5s

(iii) What is the height of the ball above the **green** after 3 seconds? 1

$h = 27 - 3 = 24$ m

(b) Ryan is at Queen's Cross Station. He observes that the number of minutes (m) until the next train can be estimated by counting the number of people (p) on the platform. 1

Use Ryan's formula, $m = \frac{36}{p}$, to estimate the number of people that will be on the platform when the next train is 3 minutes away.

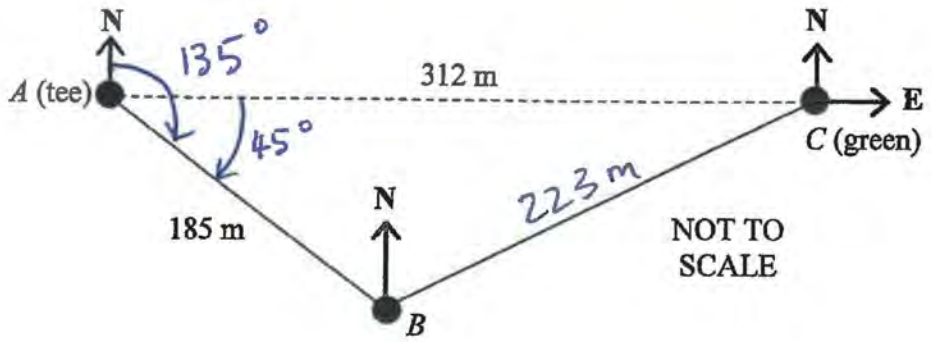
$3 = \frac{36}{p}$

$p = \frac{36}{3}$

$= 12$ people

Question 19 continues on page 36

(c) On the 8th hole at Royal Elms Golf Course, the green (C) is due east of the tee (A). Levi plays 2 shots. His first is from A to B, on a bearing of 135°. His second is from B to C, as shown in the diagram.



(i) Show that $\angle BAC = 45°$. **1**

$\angle BAC = 135 - 90$

$= 45°$

(ii) What is the distance Levi must walk from B to C, after playing his second shot? Give your answer to the nearest metre. **2**

$a^2 = b^2 + c^2 - 2bc \cos A$

$BC = \sqrt{185^2 + 312^2 - 2 \times 185 \times 312 \cos 45°}$

$= 223.4739...$

$\doteq 223$ m

Question 19 continues on page 37

(iii) Use the sine rule to find the **obtuse** $\angle ABC$, to the nearest degree. **3**

$$\frac{\sin ABC}{312} = \frac{\sin 45}{223}$$

$$\angle ABC = \sin^{-1}\left(\frac{312 \sin 45}{223}\right)$$

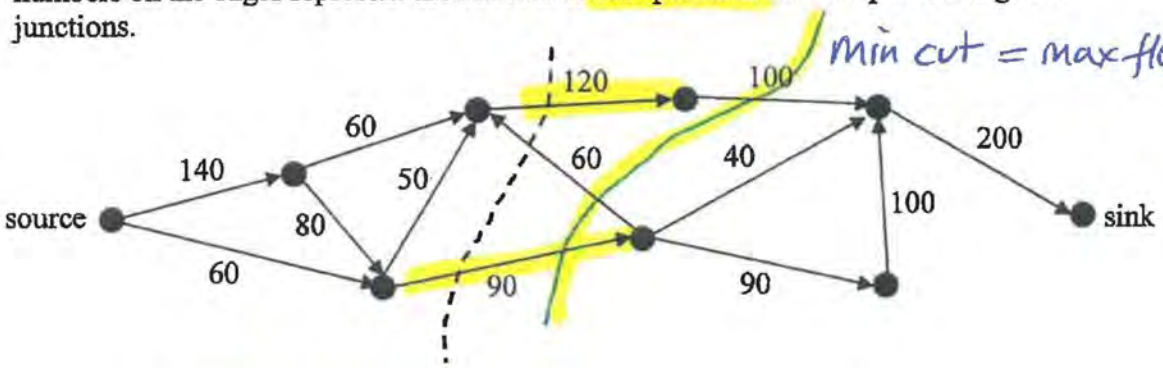
$$= 81.6168...$$

$$\therefore \text{obtuse } \angle = 180 - 81.616...$$

$$= 98.38...$$

$$\doteq 98^\circ$$

(d) A network diagram is shown, along with a cut. Each vertex is a road junction and the numbers on the edges represent the number of cars per hour that can pass through the junctions.



(i) What is the capacity of the cut shown? **1**

capacity = 90 + 120

= 210 cars / hour

(ii) What is the maximum flow for this network? **1**

max flow = 100 + 90

= 190 cars / hour

Question 19 continues on page 38

(e) Charlie planned to fly from Singapore (0° N, 105° E) to Prague (50° N, 15° E) to visit his friend Jack.

(i) Show that the time difference between Singapore and Prague is 6 hours. **1**
For calculation of time differences, 15° = 1 hour time difference.



∠ distance = 105 − 15
= 90°
time diff = $\frac{90}{15}$
= 6 hours.

(ii) Jack rang Charlie prior to his flight, to check his planned arrival time. If he made the call from Prague at 7.40 pm on Saturday, what was the day and time in Singapore, when Charlie received the call? **2**

P → S
7.40 pm Saturday + 6 h 1.40 am Sunday

(iii) Charlie's flight arrived in Prague at 6.30 pm on Tuesday. If the flight took 13.5 hours, what was the day and time in Singapore when the flight left Singapore? **2**

P → S (+6 h)
6.30 pm Tuesday 12.30 am Weds
− 12 h
12.30 pm Tues
− 1.5 h
11 am Tues

End of Question 19

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20

Instructions

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Question 20 (17 marks) **Marks**

(a) The table shows the present value of a \$1 annuity for certain monthly interest rates and certain numbers of months.

Present values of \$1						
	Interest rates (per month)					
Months	**0.50%**	**0.60%**	**0.70%**	**0.80%**	**0.90%**	**1.00%**
50	44.1428	43.0862	42.0646	41.0765	40.1208	39.1961
100	78.5426	75.0339	71.7432	68.6548	65.7545	63.0289
150	105.3500	98.7226	92.6828	87.1705	82.1322	77.5201
200	126.2406	116.2873	107.4568	99.6018	92.5961	86.3314
250	142.5203	129.3113	117.8805	107.9479	99.2816	91.6889
300	155.2069	138.9683	125.2349	113.5515	103.5531	94.9466

Hamish plans to invest in an annuity of \$300 each month for 250 months. His investment will earn interest at the rate of 0.60% per month (7.2% per annum).

(i) Use the information in the table to calculate the present value of Hamish's annuity. **1**

$PVA = PVIF \times a$

$= 129.3113 \times 300$

$= \$38\,793.39$

(ii) Calculate the future value of Hamish's annuity. **2**

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

$= 38\,793.39(1+0.006)^{250}$

$= 173\,082.4016$

$= \$173\,082.40$

Question 20 continues on page 43

Question 20 (continued)

(iii) How much interest will Hamish earn on this annuity in 250 months? **2**

$I = 173\,082.40 - 250 \times 300$

$= \$98\,082.40$

(iv) Hamish realises that he needs an additional \$10 000. **3**

How much more will he have to invest each month in the annuity, in order to have an additional \$10 000 after 250 months?

$\frac{FV}{(1+r)^n} = PV$

$PV = \frac{10\,000}{(1+0.006)^{250}}$

$= 2241.324\ldots$

$= \$2241.32$

$PVA = PVIF \times a$

$a = \frac{PVA}{PVIF}$

$= \frac{2241.32}{129.3113}$

$= 17.332\ldots$

$= \$17.33$

Question 20 continues on page 44

(b) The weights of packets of Chirpy Birdseed are normally distributed. The mean is 250 grams and the standard deviation is 1.5 grams.

(i) What is the z-score of a packet which weighs 247 grams? **1**

$$z = \frac{x - \bar{x}}{s}$$

$$= \frac{247 - 250}{1.5}$$

$$= -2$$

(ii) How much does a packet weigh if it has a z-score of 1.3? **2**

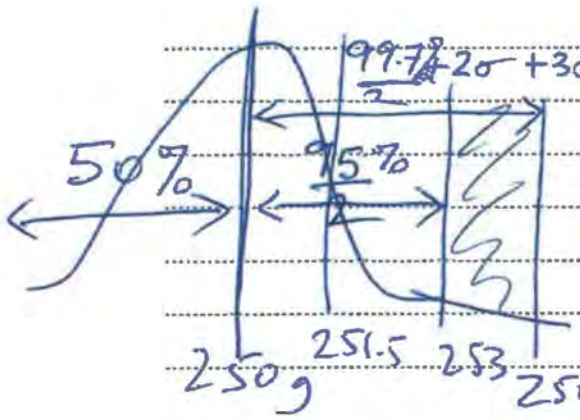
$$2 = \frac{x - \bar{x}}{s}$$

$$1.3 = \frac{x - 250}{1.5}$$

$$x = 1.5 \times 1.3 + 250$$

$$= 251.95$$

(iii) Will buys 300 packets of Chirpy Birdseed to sell in his pet shop. How many of these packets will weigh between 253 grams and 254.5 grams? **3**



$$\%\text{ pkts} = \frac{99.7}{2} - \frac{95}{2}$$

$$= 2.35\%$$

$$\therefore \text{packets} = \frac{2.35 \times 300}{100}$$

$$= 7.05$$

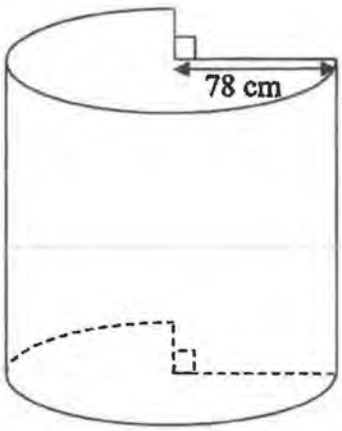
$$\doteq 7 \text{ packets}$$

Question 20 continues on page 45

Question 20 (continued)

(c) Vlad has a water tank on his property which is positioned so that all of the rainwater that falls on the roof of his house goes into the enclosed water tank. **3**

The water tank is in the shape of part of a cylinder with a radius of 78 cm, as shown in the diagram.



If 820 litres of rainwater go into the empty tank, what will be the height of water in the tank, to the nearest centimetre?

$V = \frac{3}{4}\pi r^2 h$ $\quad 820L = 0.82\,kL$

$= 0.82\,m^3$

$0.82 = \frac{3}{4}\pi \times 0.78^2 \times h$

$h = \frac{0.82 \times 4}{3\pi \times 0.78^2}$

$= 0.5720...$

$= 57\,cm$

End of Paper ☺