NAME: _____

Blacktown Boys' High School

Year 12 2020

Trial Examination

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided for this paper
- In Questions in Section II, show all relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 3-8)

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

Section II – 85 marks (pages 10-28)

- Attempt Questions 16 – 40
- Allow about 2 hours and 5 minutes for this section

Assessor: Villanueva

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Section I

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

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

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1 A circle has area 15 cm^2. Its radius is closest to:

A. 2.2 cm

B. 2.4 cm

C. 3.4 cm

D. 8.7 cm

2 Sarah's car uses 8 litres of petrol to travel 100 km. Petrol costs \$1.50 per litre. How far can she drive using \$30 worth of petrol?

A. 200 km

B. 250 km

C. 150 km

D. 300 km

3 Hugh invests \$12 000 in an account paying 4.8% p.a. interest, compounded monthly. What is the value of the investment after $1\frac{1}{2}$ years?

A. \$12 576

B. \$12 864

C. \$12 894

D. \$27 905

4 John works in a cake shop, and based on sales over two weeks, conducted a survey of the five most popular cakes. What type of data is this?

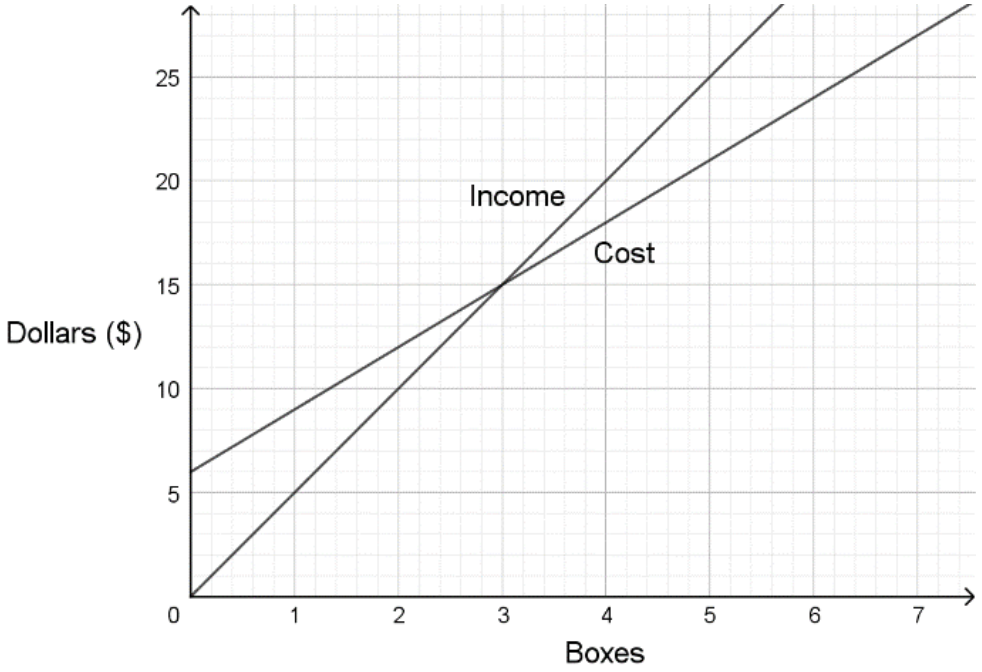
A. Categorical nominal

B. Categorical ordinal

C. Quantitative continuous

D. Quantitative discrete

5 The graph below shows the cost of producing boxes of chocolates and the income received from their sale.



Use the graph to determine the number of boxes that need to be sold to break even.

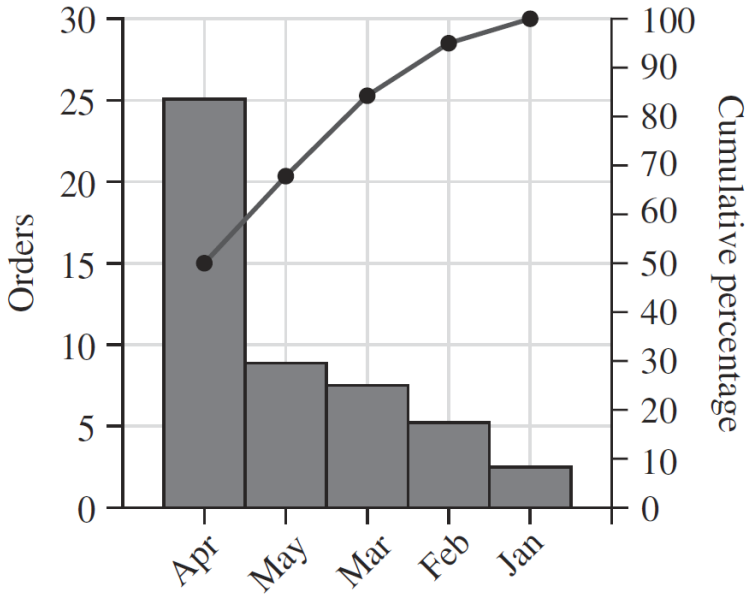
A. 5

B. 4

C. 3

D. 2

6 The Pareto chart below shows the order received by a business for five months.



What percentage of orders were received in May?

A. 69%

B. 45%

C. 30%

D. 18%

7 A box contains five red marbles and four blue marbles. Stella selects two marbles at random, with replacement.
The probability that at least one of the marbles that Stella selects is red is

A. $\frac{5}{9}$

B. $\frac{20}{21}$

C. $\frac{40}{81}$

D $\frac{65}{81}$

8 The compass bearing of Y from X is N32°W.
What is the compass bearing of X from Y?

A. N32°W

B. N58°E

C. S32°E

D. S58°W

9 The length of a path is measured as 10.0 metres, correct to one decimal place. The absolute error of the measurement is:

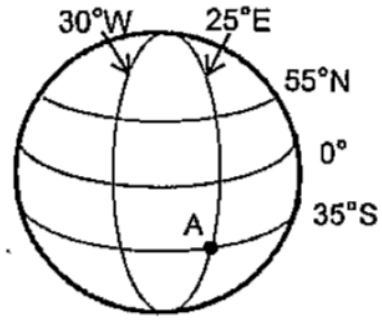
A. $5\ m$

B. $1\ m$

C. $0.5\ m$

D. $0.05\ m$

10 What is the position of town A on the Earth's surface?



Not to scale

A. $(35°S, 25°E)$

B. $(55°N, 30°W)$

C. $(25°E, 35°S)$

D. $(25°E, 55°N)$

11 Jessica solved the following equation, but has made two errors in her working. Which two steps contain an error from the previous line?

$$5(2x + 1) - 2(x + 3) = 12$$

Line 1 …$10x + 5 - 2x + 6 = 12$

Line 2 …$8x + 11 = 12$

Line 3 …$8x = 23$

Line 4 …$x = \frac{23}{8}$

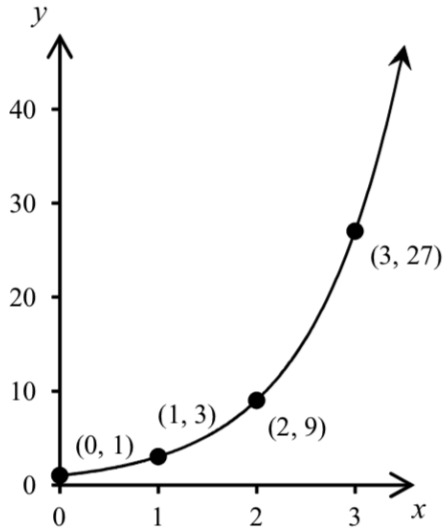
A. Lines 1 and 2

B. Lines 1 and 3

C. Lines 1 and 4

D. Lines 2 and 3

12 The following is the graph of a relationship between two quantities x and y.



What type of function would accurately model this data?

A. quadratic

B. hyperbolic

C. cubic

D. exponential

13 A 120 watt ceiling fan runs for 24 hours each day. If electricity is charged at $24.8c/kWh$, what is the cost of running the ceiling fan for 30 days, to the nearest cent?

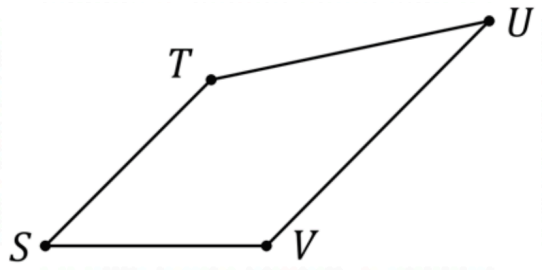
A. $15.68

B. $21.43

C. $86.40

D. $2142.73

14 Which of the following walks is a path in the above network diagram?



A. S-T-S-V

B. S-T-U-V

C. S-T-V-S

D. S-T-U-V-S

15 Otis obtained a personal loan of $30 000. He made a deposit of $2200 and agreed to payments of $820 per month for 4 years. What is the total amount paid for the loan?

A. $9360

B. $11 560

C. $39 360

D. $41 560

End of Section I

Mathematics Standard 2

Section II Answer Booklet

85 marks
Attempt Questions 16 - 40
Allow about 2 hours and 5 minutes for this section

Instructions

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

Question 16 (4 marks)

The first three chapters in a textbook have pages in the ratio 3:2:5.

(a) If there are 24 pages in the smallest chapter, how many pages are in the first three chapters of this textbook? **2**

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(b) The ratio of the number of pages of first three chapters to the whole textbook is 5:12. How many pages are there in the whole textbook? **2**

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Question 17 (2 marks)

What is the value of $\frac{a+b}{ab}$ if $a = -3.1$ and $b = -2.2$, correct to two decimal places? **2**

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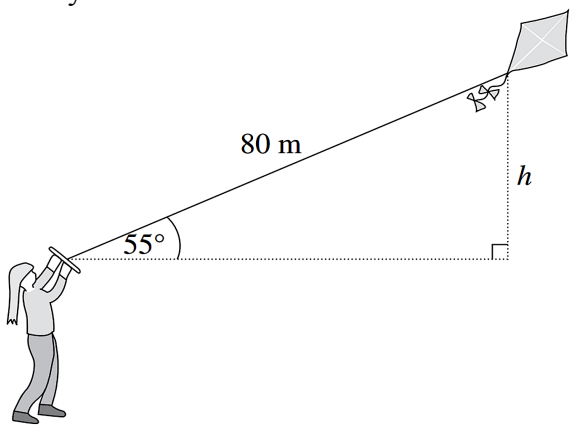
Question 18 (2 marks)

Jane is flying a kite that is attached to a string of length 80 metres. The kite flies at an angle of elevation of 55° from Jane's eye level. How high, to the nearest metre, is the kite above Jane's eye level? **2**



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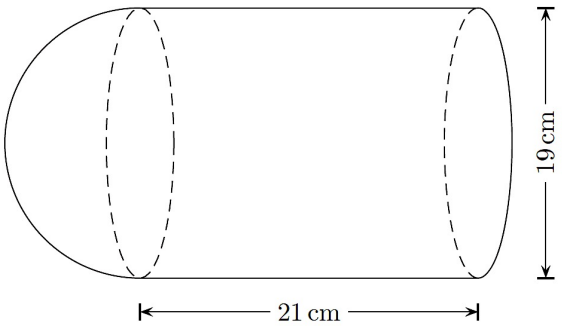
Question 19 (3 marks)

The solid shown is made of a closed cylinder and a hemisphere. **3**



What is the total volume?

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Question 20 (3 marks)

A box of candy contains 8 white chocolates and 15 milk chocolates. **3**
Bilal takes one chocolate at random and eats it. Nathan also takes a chocolate and eats it.
By drawing a probability tree diagram, or otherwise, find the probability that Bilal and Nathan eat different types of chocolates.

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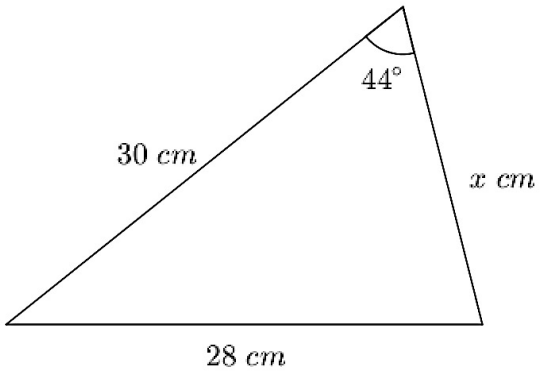
Question 21 (3 marks)

The area of the triangle shown is 250 cm^2. **3**



What is the value of x to the nearest whole number?

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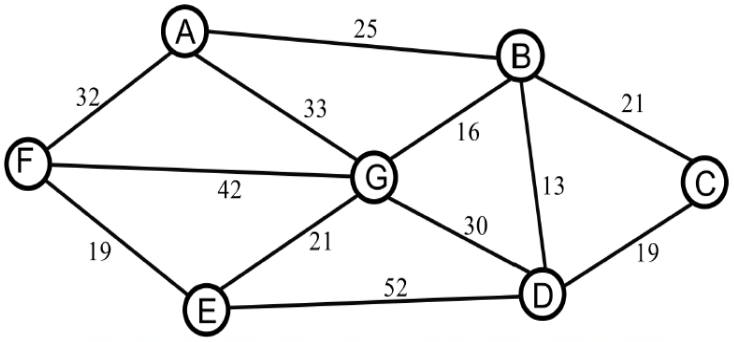
Question 22 (4 marks)

The network diagram below shows the distances between seven villages in a valley.



(a) Complete the table to represent the network. **2**

	A	**B**	**C**	**D**	**E**	**F**	**G**
A	-	25	-	-	-	32	33
B	25	-	21	13	-	-	16
C	-	21	-	19	-	-	-
D	-	13	19	-			
E	-	-	-	52			
F	32	-	-	-			
G	33	16	-	30			

(b) Describe the shortest path between F and D, and calculate its distance. **2**

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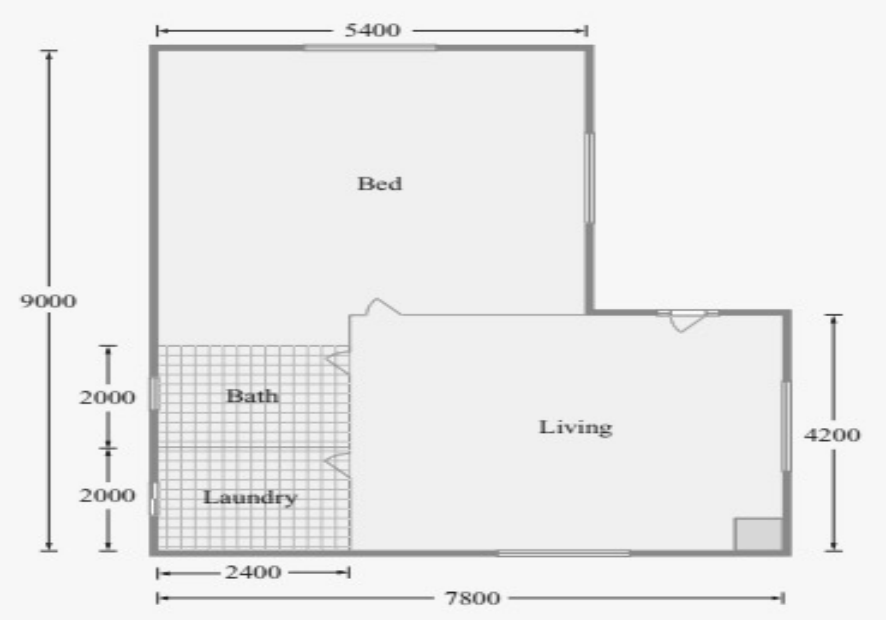
Question 23 (6 marks)

The measurements on the house plan below are in millimetres.



NOT TO SCALE

(a) What is the perimeter of the house plan? **1**

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(b) What is the area of the Bedroom, labelled 'Bed', in square metres? **3**

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Question 23 continues on the next page

(c) Maria decides the floor of the Bedroom is to be covered with square tiles. The tiles measure $30cm \times 20cm$. How many tiles will be needed to tile the Bedroom? **2**

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Question 24 (2 marks)

Samuel owns a credit card that has no annual fees and charges a flat rate of 18.25% p.a. interest on all purchases. Find the interest charged on \$1800 for 15 days. Answer correct to the nearest cent. **2**

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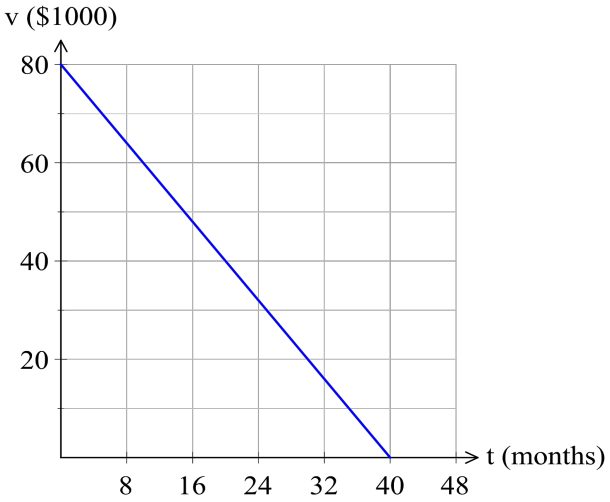
Question 25 (2 marks)

A new piece of equipment is purchased by a business for \$80000. Its value is depreciated each month using the graph below. **2**



What is the equation of the straight line in terms of v and t?

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Question 26 (3 marks)

Solve the following pairs of equations simultaneously. **3**

$$5x + 2y = 16$$
$$x - y = -1$$

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Question 27 (3 marks)

Benny takes out a loan of $58 000, borrowed at 6% per annum, compounding monthly, and makes regular payments of $810 per month.

(a) Show that the recurrence relation to model the situation is **1**

$$V_{n+1} = V_n \times (1 + 0.005) - 810.$$

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(b) What is the balance of the loan after he has made 2 payments? Give your answer to the nearest cent. **2**

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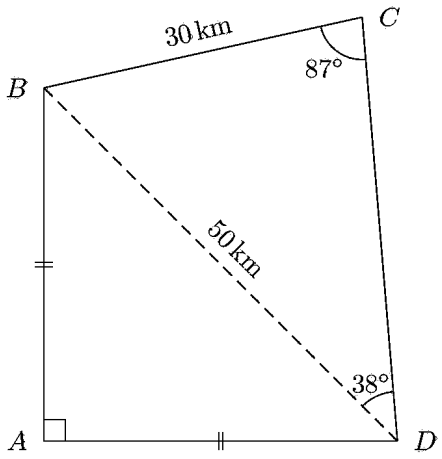
Question 28 (4 marks)

John cycles around a course. The course starts at D, passes through C, B, and A, and finishes at D. The distances AB and AD are equal.



(a) What is the length of CD, to the nearest kilometre? **2**

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(b) What is the total distance John cycles, to the nearest kilometre? **2**

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Question 29 (4 marks)

Adam throws a ball and it takes 4 seconds for it to reach the ground. The height it reaches is given by the formula:

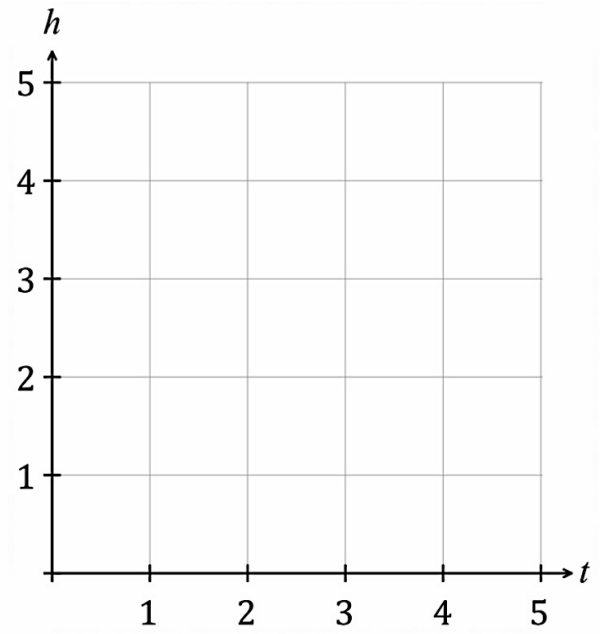
$$h = -t^2 + 4t$$

where h is the height and t is time in seconds.

(a) Complete the following table of values. **1**

t	0	1	2	3	4
h					

(b) Draw the graph of $h = -t^2 + 4t$ using the number plane below. **1**



(c) What is the maximum height reached by the ball? **1**

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(d) When is the maximum height reached? **1**

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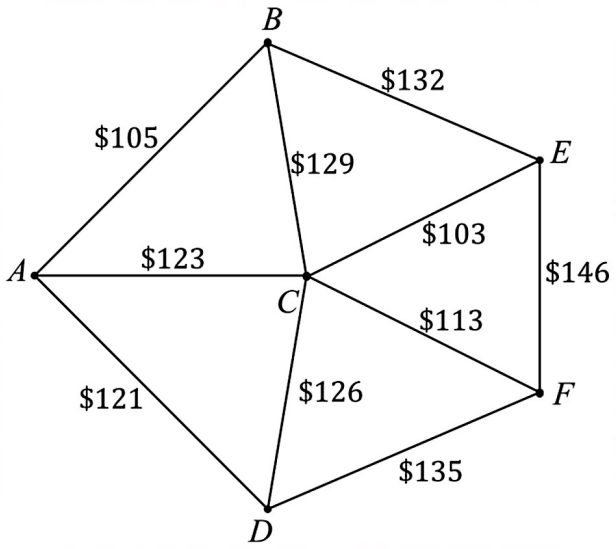
Questions 30 (3 marks)

The network diagram below shows the cost to lay pipes to certain parts of a garden.



(a) Draw a minimum spanning tree that will ensure all parts of the garden are connected by pipes, but also minimises the amount of pipes required. **2**

(b) What is the minimum cost of pipes to connect all parts of the garden? **1**

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Question 31 (4 marks)

The table below gives the present value of an annuity of \$1 at the given interest rate for the given period.

Present Value Interest Factors (PVA)								
\$1	Interest Rate Per Period							
N	1%	2%	3%	4%	5%	6%	7%	8%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9269
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121
5	4.8545	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101

(a) Jesse plans to invest \$7500 per year for 8 years in an annuity. His investment will earn interest at the rate of 6% per annum. Calculate the present value of his annuity. **2**

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(b) Shaon takes out a loan of \$12000 to buy a car. This loan is to be repaid over 5 years at an interest rate of 8% per year. Use the PVA table to find his yearly repayments. **2**

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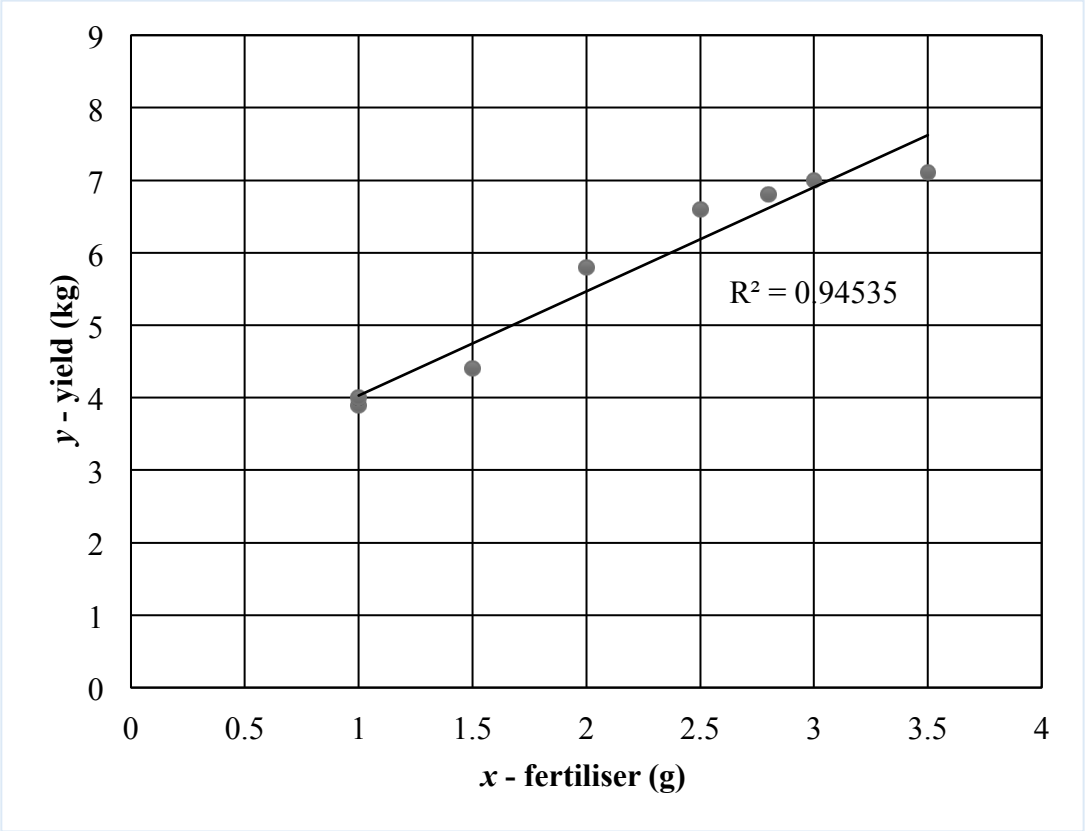
Question 32 (5 marks)

A biologist assumes that there is a linear relationships between the amount of fertiliser supplied to tomato plants and the subsequent yield of tomatoes obtained.

Eight tomato plants, of the same variety, were selected at random and treated, weekly, with a solution in which x grams of fertiliser was dissolved in a fixed quantity of water. The yield, y kilograms, of tomatoes was recorded.

Plant	A	B	C	D	E	F	G	H
x	1.0	1.0	1.5	2.0	2.5	2.8	3.0	3.5
y	3.9	4.0	4.4	5.8	6.6	6.8	7.0	7.1



(a) Use the scatterplot to describe the association between 'yield' and 'fertiliser' in terms of strength and direction. **1**

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Question 32 continues on the next page

(b) Determine the equation of the least-squares regression line for this data. Round your values to two significant figures. **2**

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(c) A plant with 2.2 grams of fertiliser was not recorded by accident. **1**

Calculate the predicted yield for this plant using your answer in part (b).

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(d) Explain why you should not extrapolate from this data to find the yield for high rates of fertiliser usage. **1**

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Question 33 (2 marks)

Perth in Western Australia is 8 hours ahead of Greenwich in England. Santiago in Chile is 3 hours behind Greenwich. **2**
What is the day and time in Perth when it is 8pm on Thursday in Santiago?

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Question 34 (3 marks)

When a force is applied to a certain object, its acceleration (a) varies inversely as its mass (m). When the acceleration of an object $12m/s^2$, the corresponding mass is $3kg$.

(a) Find the constant of variation. **1**

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(b) Find the acceleration of a $1.5kg$ object. **1**

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(c) Find the mass of an object when the acceleration is $6m/s^2$. **1**

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Question 35 (2 marks)

Malik's normal rate of pay is \$19.75 per hour. In one week he worked 17 hours at the normal rate, 7 hours at time-and-a-half and 2 hours double time. He was also paid a wet weather allowance of \$65 for the week. **2**
What were his total earnings for the week?

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Question 36 (4 marks)

Aniket has earned a gross annual salary of \$82 500 in the 2019-20 and his employer has paid \$26 400 PAYG tax on his behalf. Aniket has calculated that his total allowable deductions were \$1130 for work-related travel, \$220 for stationary and \$460 for union fees. Aniket must pay the medicare levy of 2% on his taxable income. **4**

Using the tax table provided by the ATO below, determine how much Aniket's tax refund or tax liability will be.

Taxable income	Tax payable
0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$90 000	\$3572 plus 32.5c for each \$1 over \$37 000
\$90 001 – \$180 000	\$20 797 plus 37c for each \$1 over \$90 000
\$180 001 and over	\$54 097 plus 45c for each \$1 over \$180 000

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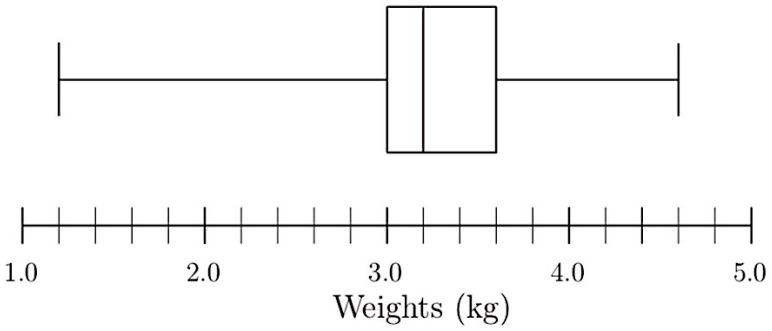
Question 37 (4 marks)

The birth weight of babies born in Australia during 2019 is presented in the following box-and-whisker diagram.



(a) What is the weight of the heaviest baby born in 2019? **1**

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(b) Find the interquartile range. **1**

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(c) Calculate the upper limit for outliers in this data set. **1**

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(d) Describe the shape of the distribution of weights. **1**

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Question 38 (4 marks)

Janet has 3 bottles of beer over two and a half hours. A bottle of beer is 0.8 standard drinks and she weighs $56kg$. The formula to calculate her Blood Alcohol Content is:

$$BAC_{female} = \frac{10N - 7.5H}{5.5M}$$

where N is the number of standard drinks consumed,
H is the number of hours drinking, and
M is the person's mass in kilograms.

(a) Calculate Janet's Blood Alcohol Content after two and a half hours. **2**

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(b) If Janet has no more alcohol, determine how much longer she must wait until her Blood Alcohol Content returns to zero. **2**

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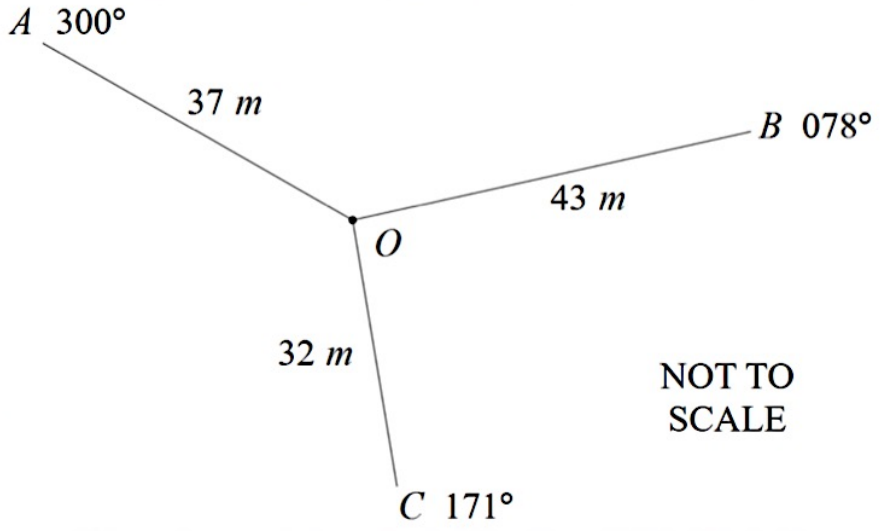
Question 39 (3 marks)

The diagram shows the results of a compass radial survey of a triangular area of land.



(a) Find the size of angle BOC. **1**

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(b) Find the length of BC to the nearest metre. **2**

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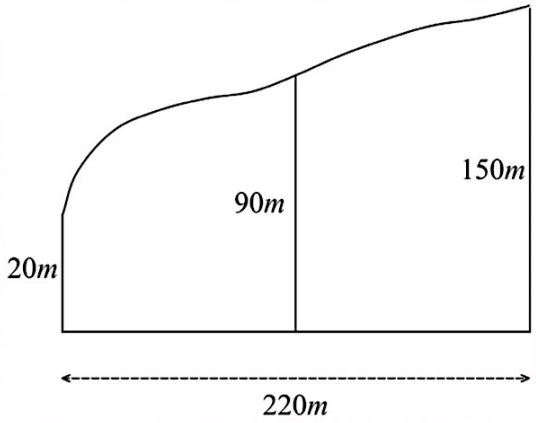
Question 40 (6 marks)

The diagram below shows a survey of the land Alfred will build his house on.



(a) Use two applications of the trapezoidal rule to estimate the area of the land to the nearest square metre. **3**

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(b) Alfred plans on grading the land so that it serves as the main catchment area for a pond at its lowest elevation. To maintain the water level in the pond, it is estimated that at least 10 megalitres of rain must flow into the pond each year. $(1\text{ML} = 1{,}000{,}000\text{ L})$
If 45% of the rain that falls on the land flows into the pond, calculate the amount of rainfall, in millimetres, must fall on the land each year, to maintain the water level in the pond. Round your answer to the nearest 10 mm. **3**

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End of paper

Section II extra writing space

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

Year 12 Mathematics Standard 2 Section I - Answer Sheet

Student Name/Number _____

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

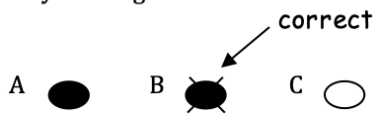
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

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

A ● B ⊗ C ○ D ○

- If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word correct and drawing an arrow as follows.



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

NAME: SOLUTIONS

Blacktown Boys' High School

Year 12 2020

Trial Examination

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided for this paper
- In Questions in Section II, show all relevant mathematical reasoning and/or calculations

Total marks: 100

Section I – 15 marks (pages 3-8)

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

Section II – 85 marks (pages 10-28)

- Attempt Questions 16 – 40
- Allow about 2 hours and 5 minutes for this section

Assessor: Villanueva

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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.

---

1 A circle has area 15 cm^2. Its radius is closest to:

(A.) 2.2 cm

B. 2.4 cm

C. 3.4 cm

D. 8.7 cm

2 Sarah's car uses 8 litres of petrol to travel 100 km. Petrol costs \$1.50 per litre. How far can she drive using \$30 worth of petrol?

A. 200 km

(B.) 250 km

C. 150 km

D. 300 km

3 Hugh invests \$12 000 in an account paying 4.8% p.a. interest, compounded monthly. What is the value of the investment after $1\frac{1}{2}$ years?

A. \$12 576

B. \$12 864

(C.) \$12 894

D. \$27 905

4 John works in a cake shop, and based on sales over two weeks, conducted a survey of the five most popular cakes. What type of data is this?

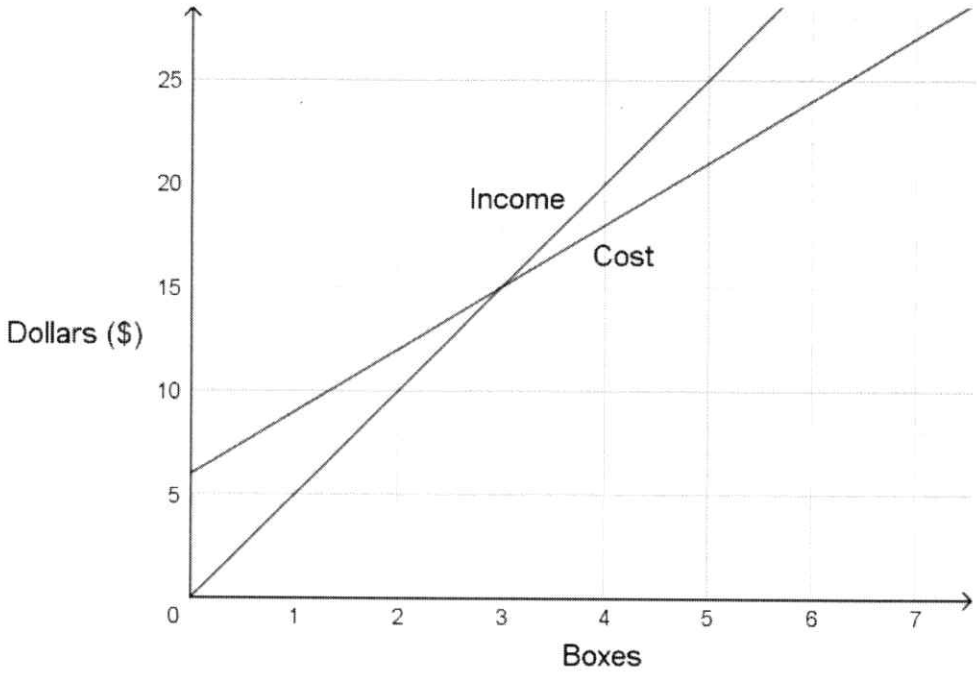
A. Categorical nominal

B. Categorical ordinal

C. Quantitative continuous

D. Quantitative discrete

5 The graph below shows the cost of producing boxes of chocolates and the income received from their sale.



Use the graph to determine the number of boxes that need to be sold to break even.

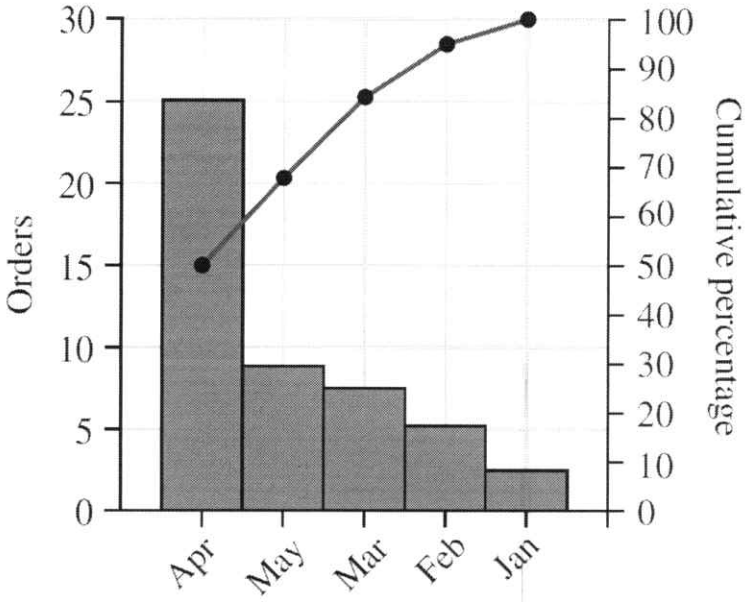
A. 5

B. 4

C. 3

D. 2

6 The Pareto chart below shows the order received by a business for five months.



What percentage of orders were received in May?

A. 69%

B. 45%

C. 30%

D. 18%

7 A box contains five red marbles and four blue marbles. Stella selects two marbles at random, with replacement.
The probability that at least one of the marbles that Stella selects is red is

A. $\frac{5}{9}$

B. $\frac{20}{21}$

C. $\frac{40}{81}$

D $\frac{65}{81}$

8 The compass bearing of Y from X is N32°W.
What is the compass bearing of X from Y?

A. N32°W

B. N58°E

C. S32°E

D. S58°W

9 The length of a path is measured as 10.0 metres, correct to one decimal place. The absolute error of the measurement is:

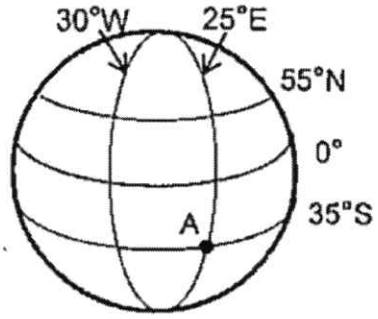
A. $5\ m$

B. $1\ m$

C. $0.5\ m$

D. $0.05\ m$

10 What is the position of town A on the Earth's surface?



Not to scale

A. $(35°S, 25°E)$

B. $(55°N, 30°W)$

C. $(25°E, 35°S)$

D. $(25°E, 55°N)$

11 Jessica solved the following equation, but has made two errors in her working. Which two steps contain an error from the previous line?

$$5(2x + 1) - 2(x + 3) = 12$$

Line 1 $\ldots 10x + 5 - 2x + 6 = 12$

Line 2 $\ldots 8x + 11 = 12$

Line 3 $\ldots 8x = 23$

Line 4 $\ldots x = \frac{23}{8}$

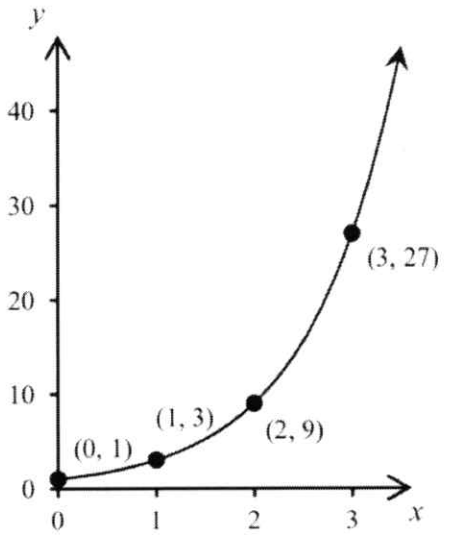
A. Lines 1 and 2

B. Lines 1 and 3

C. Lines 1 and 4

D. Lines 2 and 3

12 The following is the graph of a relationship between two quantities x and y.



What type of function would accurately model this data?

A. quadratic

B. hyperbolic

C. cubic

D. exponential

13 A 120 watt ceiling fan runs for 24 hours each day. If electricity is charged at $24.8c/kWh$, what is the cost of running the ceiling fan for 30 days, to the nearest cent?

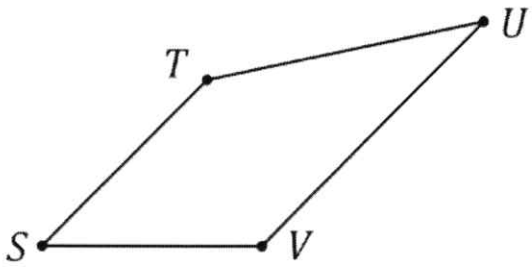
A. $15.68

B. $21.43

C. $86.40

D. $2142.73

14 Which of the following walks is a path in the above network diagram?



A. S-T-S-V

B. S-T-U-V

C. S-T-V-S

D. S-T-U-V-S

15 Otis obtained a personal loan of $30 000. He made a deposit of $2200 and agreed to payments of $820 per month for 4 years. What is the total amount paid for the loan?

A. $9360

B. $11 560

C. $39 360

D. $41 560

End of Section I

Mathematics Standard 2

Section II Answer Booklet

85 marks
Attempt Questions 16 - 40
Allow about 2 hours and 5 minutes for this section

Instructions

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

Question 16 (4 marks)

The first three chapters in a textbook have pages in the ratio 3:2:5.

(a) If there are 24 pages in the smallest chapter, how many pages are in the first three chapters of this textbook? **2**

3 : 2 : 5 → 10

? : 24 : ?

24 ÷ 2 = 12 (1)

12 × 10 = 120 pages (1)

(b) The ratio of the number of pages of first three chapters to the whole textbook is 5:12. How many pages are there in the whole textbook? **2**

120 ÷ 5 = 24 (1)

12 × 24 = 288 pages (1)

Question 17 (2 marks)

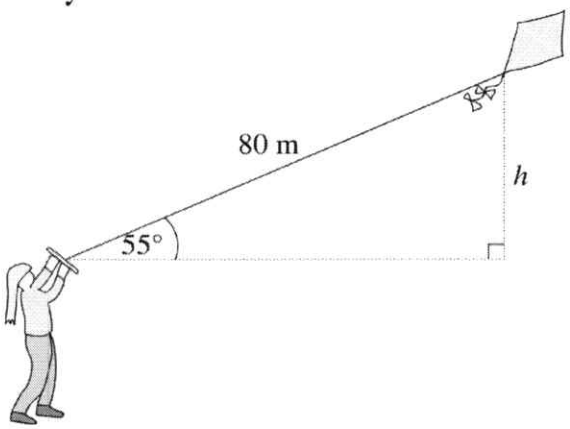
What is the value of $\frac{a+b}{ab}$ if $a = -3.1$ and $b = -2.2$, correct to two decimal places? **2**

$\frac{(-3.1)+(-2.2)}{(-3.1)(-2.2)} = -0.777$ (1) correct substitution

$= -0.78$ (1) correct rounding

Question 18 (2 marks)

Jane is flying a kite that is attached to a string of length 80 metres. The kite flies at an angle of elevation of 55° from Jane's eye level. How high, to the nearest metre, is the kite above Jane's eye level? **2**



NOT TO SCALE

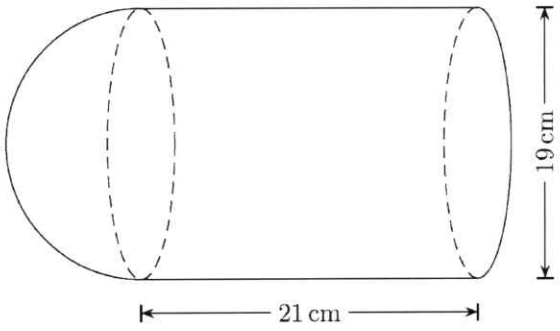
$\sin\theta = \frac{O}{H}$

$\sin 55 = \frac{h}{80}$ (1) $h = 65.53$

$h = 80\sin 55°$ $\therefore$ 66 m (1)

Question 19 (3 marks)

The solid shown is made of a closed cylinder and a hemisphere. **3**



What is the total volume?

$V = \pi r^2 h + \frac{2}{3}\pi r^3$ (1)

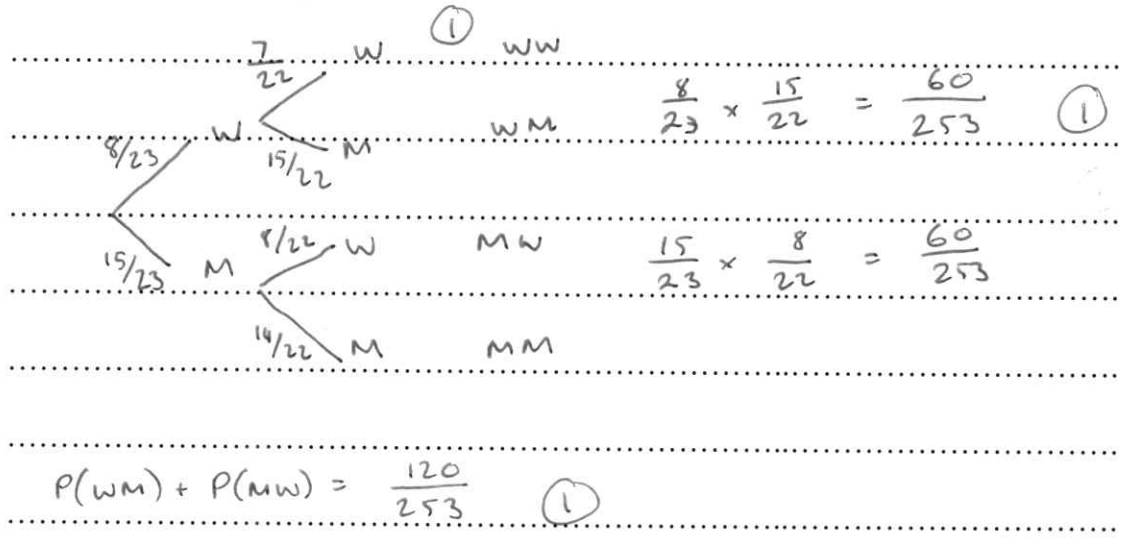
$V = \pi (9.5)^2 (21) + \frac{2}{3}\pi (9.5)^3$ (1)

$V = 7749.785$ (1)

$V = 7749.79 \text{ cm}^3$ (2 d.p.)

Question 20 (3 marks)

A box of candy contains 8 white chocolates and 15 milk chocolates. **3**
Bilal takes one chocolate at random and eats it. Nathan also takes a chocolate and eats it.
By drawing a probability tree diagram, or otherwise, find the probability that Bilal and Nathan eat different types of chocolates.



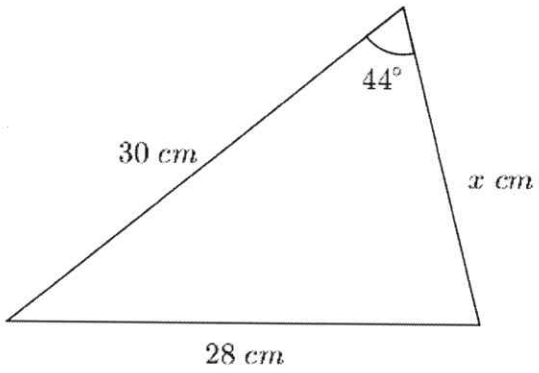
$\frac{8}{23} \times \frac{15}{22} = \frac{60}{253}$ (1)

$\frac{15}{23} \times \frac{8}{22} = \frac{60}{253}$

$P(WM) + P(MW) = \frac{120}{253}$ (1)

Question 21 (3 marks)

The area of the triangle shown is 250 cm^2. **3**



What is the value of x to the nearest whole number?

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

$250 = \frac{1}{2}(x)(30)\sin 44$ (1)

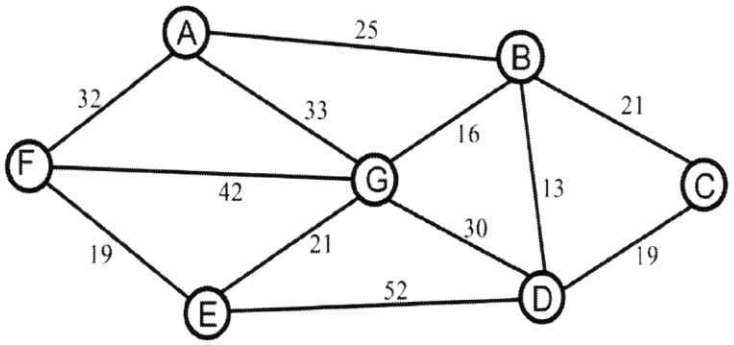
$x = 250 \div 15\sin 44$ (1)

$x = 23.99$ cm

$x = 24$ cm (1)

Question 22 (4 marks)

The network diagram below shows the distances between seven villages in a valley.



(a) Complete the table to represent the network. **2**

	A	B	C	D	E	F	G
A	-	25	-	-	-	32	33
B	25	-	21	13	-	-	16
C	-	21	-	19	-	-	-
D	-	13	19	-	52	–	30
E	-	-	-	52	–	19	21
F	32	-	-	-	19	–	42
G	33	16	-	30	21	42	–

① Half correct
② all correct

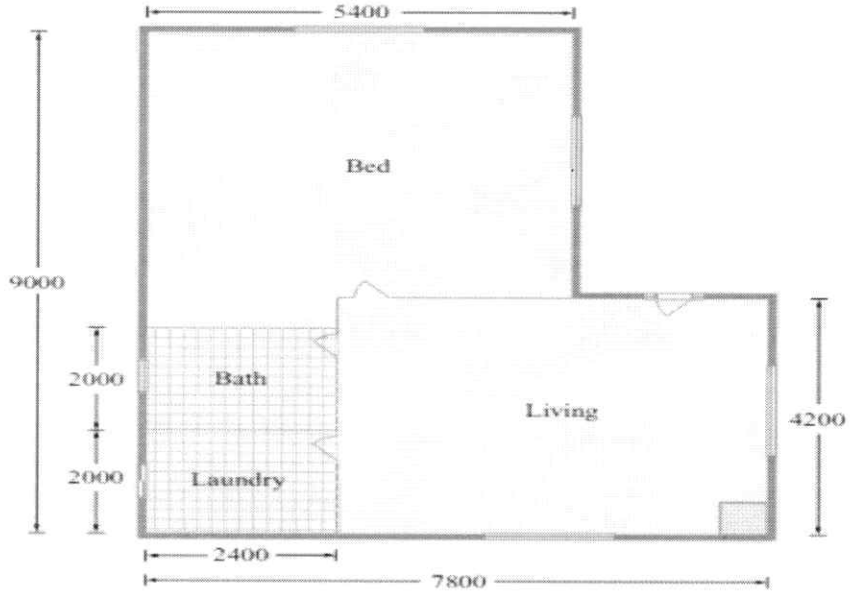
(b) Describe the shortest path between F and D, and calculate its distance. **2**

FE GBD ①

19 + 21 + 16 + 13 = 69 ①

Question 23 (6 marks)

The measurements on the house plan below are in millimetres.



NOT TO SCALE

(a) What is the perimeter of the house plan? **1**

$9000 \times 2 + 7800 \times 2 = 33\,600$ mm

(b) What is the area of the Bedroom, labelled 'Bed', in square metres? **3**

$A = (4800 \times 5400) + (2400 \times 200)$ ① Some progress

$= 264\,000\,00$ mm^2 ① Correct Area

$\div 10^2 \div 100^2$ ① Correct conversion

$= 26.4\ m^2$

Question 23 continues on the next page

(c) Maria decides the floor of the Bedroom is to be covered with square tiles. The tiles measure $30cm \times 20cm$. How many tiles will be needed to tile the Bedroom? **2**

$0.3 \times 0.2 = 0.06$ (1)

$26.4 \div 0.06 = 440$ tiles (1)

Question 24 (2 marks)

Samuel owns a credit card that has no annual fees and charges a flat rate of 18.25% p.a. interest on all purchases. Find the interest charged on \$1800 for 15 days. Answer correct to the nearest cent. **2**

$I = Prn$

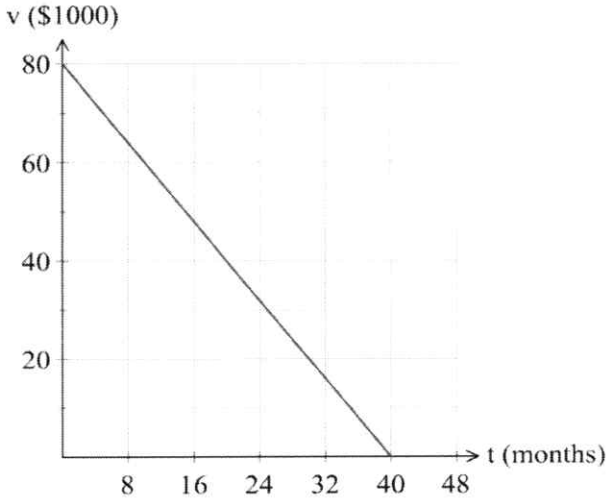
$= 1800 \times \frac{18.25}{365}\% \times 15$ (1) some progress

$= 13.5$

$\therefore$ interest $= \$13.50$ (1)

Question 25 (2 marks)

A new piece of equipment is purchased by a business for \$80000. Its value is depreciated each month using the graph below. **2**



What is the equation of the straight line in terms of v and t?

$m = -\frac{80}{40}$ $V = -2t + 80$ (1)

$= -2$ (1)

Question 26 (3 marks)

Solve the following pairs of equations simultaneously. **3**

$$5x + 2y = 16 \quad (1)$$
$$x - y = -1 \quad (2)$$

(2) × 2 : $2x - 2y = -2$ (2a)

(1) + (2a)

$5x + 2y = 16$

$+ \quad 2x - 2y = -2$

$7x = 14$

$x = 2$

Sub $x = 2$ into (2)

$2 - y = -1$

$-y = -3$

$y = 3$

(1) some progress

(1) finds value of 1 coordinate

$\therefore \quad x = 2, \; y = 3$

(1) finds value of 2nd coordinate

Question 27 (3 marks)

Benny takes out a loan of \$58 000, borrowed at 6% per annum, compounding monthly, and makes regular payments of \$810 per month.

(a) Show that the recurrence relation to model the situation is **1**

$$V_{n+1} = V_n \times (1 + 0.005) - 810.$$

$\frac{6}{12}\% = 0.5\%$

$r = 0.005$

$\therefore \; V_{n+1} = V_n \times (1 + 0.005) - 810$

(b) What is the balance of the loan after he has made 2 payments? Give your answer to the nearest cent. **2**

$V_1 = 58\,000 \times (1 + 0.005) - 810$

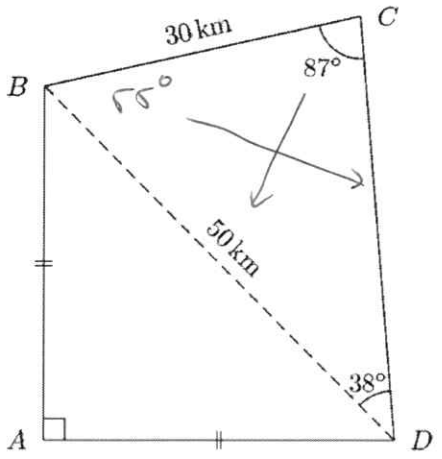
$= 57\,480$ (1)

$V_2 = 57\,480 \times (1 + 0.005) - 810$

$= \$56\,957.40$ (1)

Question 28 (4 marks)

John cycles around a course. The course starts at D, passes through C, B, and A, and finishes at D. The distances AB and AD are equal.



$180 - 87 - 38 = 55°$

(a) What is the length of CD, to the nearest kilometre? **2**

$\frac{CD}{\sin 55} = \frac{50}{\sin 87}$ (1)

OR

$CD \times \sin 87 = 50 \sin 55$

$CD = \frac{50 \sin 55}{\sin 87}$

$CD = 41.01$ km (1) $\therefore$ 41 km

$CD^2 = 30^2 + 50^2 - 2(30)(50)\cos 55°$

(b) What is the total distance John cycles, to the nearest kilometre? **2**

$50^2 = 2x^2$

$1250 = x^2$

$x = \sqrt{1250}$

$x = 35.355$ (1)

Distance $= 35.355 + 30$

$+30 + 41.01$

$= 141.7206$

$= 142$ km (1)

Question 29 (4 marks)

Adam throws a ball and it takes 4 seconds for it to reach the ground. The height it reaches is given by the formula:

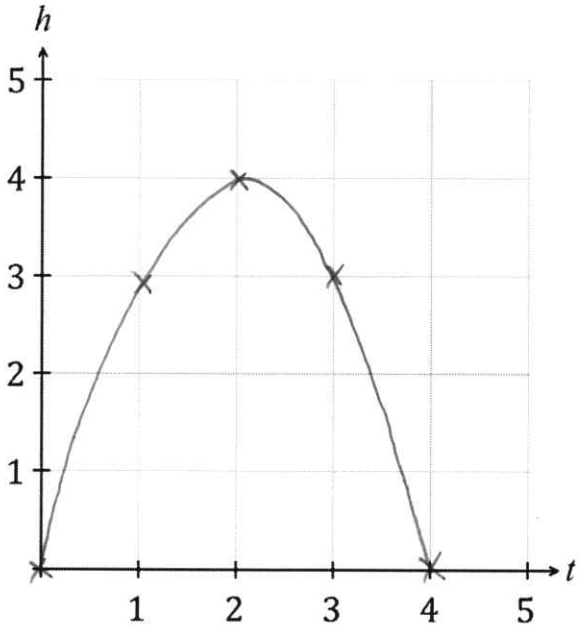
$$h = -t^2 + 4t$$

where h is the height and t is time in seconds.

(a) Complete the following table of values. **1**

t	0	1	2	3	4
h	0	3	4	3	0

(b) Draw the graph of $h = -t^2 + 4t$ using the number plane below. **1**



(c) What is the maximum height reached by the ball? **1**

4 m

.....

.....

(d) When is the maximum height reached? **1**

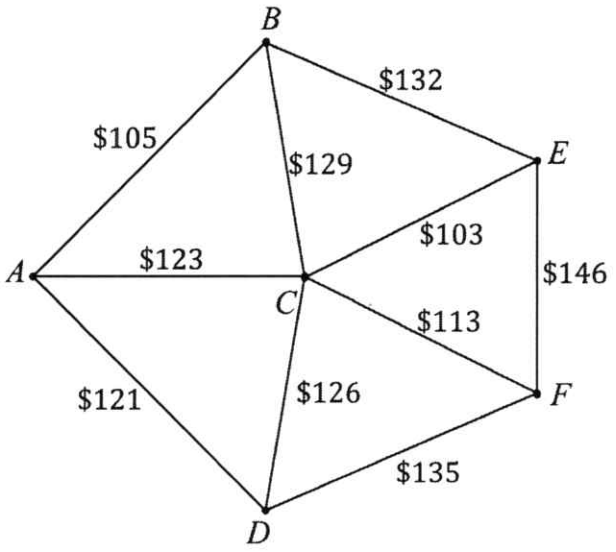
2 seconds

.....

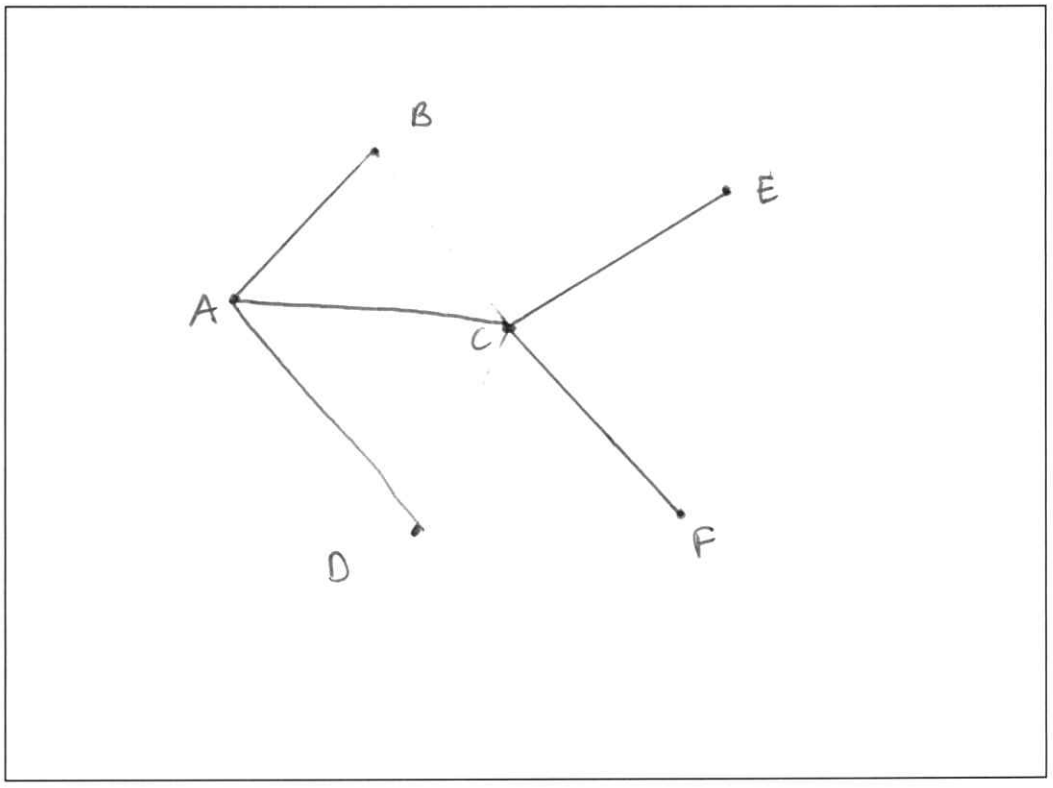
.....

Questions 30 (3 marks)

The network diagram below shows the cost to lay pipes to certain parts of a garden.



(a) Draw a minimum spanning tree that will ensure all parts of the garden are connected by pipes, but also minimises the amount of pipes required. **2**



① some progress

(b) What is the minimum cost of pipes to connect all parts of the garden? **1**

105 + 121 + 123 + 103 + 113 = 565

Question 31 (4 marks)

The table below gives the present value of an annuity of $1 at the given interest rate for the given period.

Present Value Interest Factors (PVA)								
$1	Interest Rate Per Period							
N	1%	2%	3%	4%	5%	6%	7%	8%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9269
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121
5	4.8545	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101

(a) Jesse plans to invest $7500 per year for 8 years in an annuity. His investment will earn interest at the rate of 6% per annum. Calculate the present value of his annuity. **2**

$6.2098 \times 7500 = \$46573.50$

(1) (1)

(b) Shaon takes out a loan of $12000 to buy a car. This loan is to be repaid over 5 years at an interest rate of 8% per year. Use the PVA table to find his yearly repayments. **2**

Let M be the yearly repayments

5 years at 8% gives the factor of 3.9927 (1)

$3.9927M = 12000$

$M = \frac{12000}{3.9927}$

$M = \$3005.48501$

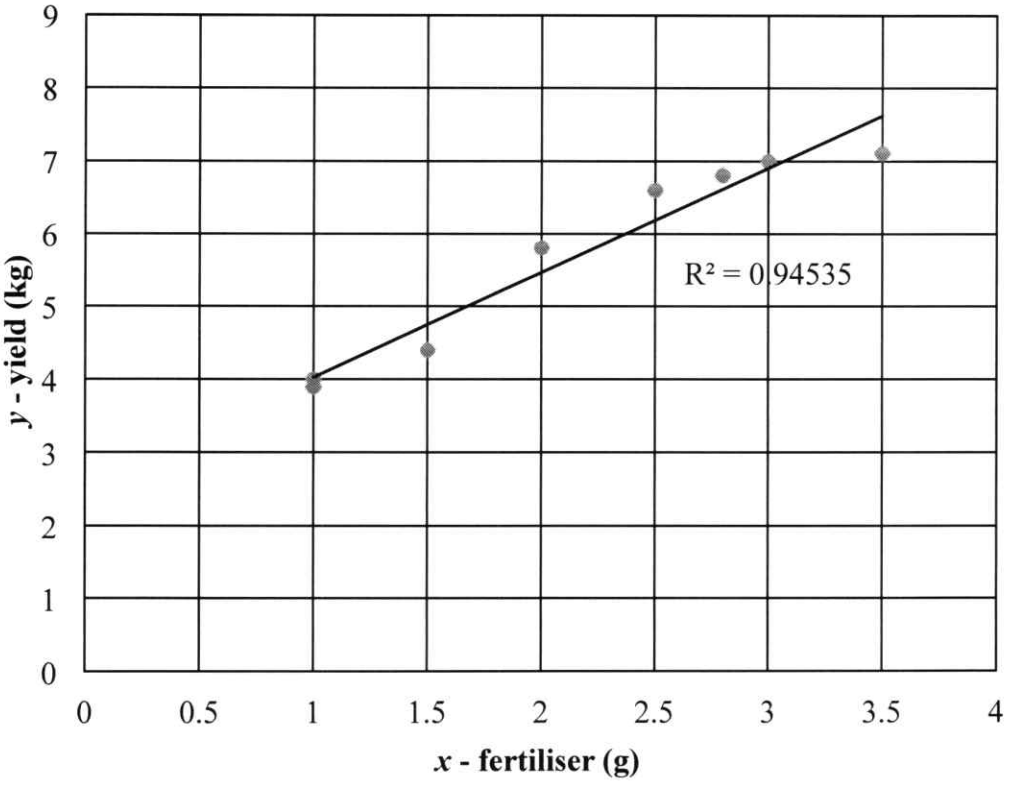
$M = \$3005.49$ (1)

Question 32 (5 marks)

A biologist assumes that there is a linear relationships between the amount of fertiliser supplied to tomato plants and the subsequent yield of tomatoes obtained.

Eight tomato plants, of the same variety, were selected at random and treated, weekly, with a solution in which x grams of fertiliser was dissolved in a fixed quantity of water. The yield, y kilograms, of tomatoes was recorded.

Plant	A	B	C	D	E	F	G	H
x	1.0	1.0	1.5	2.0	2.5	2.8	3.0	3.5
y	3.9	4.0	4.4	5.8	6.6	6.8	7.0	7.1



(a) Use the scatterplot to describe the association between 'yield' and 'fertiliser' in terms of strength and direction. **1**

Strong, positive

.....

.....

Question 19 continues on the next page

Question 19 (continued)

(b) Determine the equation of the least-squares regression line for this data. Round your values to two significant figures. **2**

$y = mx + c$

$m = r\frac{s_y}{s_x}$

$s_y = 1.299$ or 1.389

$s_x = 0.87$ or 0.94

$r = 0.972$

$m = 1.4$

$y = A + Bx$ OR $m = \frac{5.5 - 4}{2 - 1} = 1.5$

$A = 2.5920...$ $y - 4 = 1.5(x - 1)$

$B = 1.4371...$ $y = 1.5x + 2.5$

$y = 1.4x + 2.6$

(c) A plant with 2.2 grams of fertiliser was not recorded by accident. **1**

Calculate the predicted yield for this plant using your answer in part (b).

$C = \bar{y} - m\bar{x}$

$C = 5.7 - 1.4(2.1625)$

$= 2.6725$

$y = 1.4 \times 2.2 + 2.6$ OR $y = 1.5 \times 2.2 + 2.5$

$y = 5.68\,kg$ $y = 5.8\,kg$

(d) Explain why you should not extrapolate from this data to find the yield for high rates of fertiliser usage. **1**

There could be a point where fertiliser will not produce extra yield. Reasons could include: high volume of fertiliser may cause damage to the plant. Other factors may limit yield eg. sunlight/water. plants may not be able to absorb fertiliser at that rate.

Question 33 (2 marks)

Perth in Western Australia is 8 hours ahead of Greenwich in England. Santiago in Chile is 3 hours behind Geenwich. **2**
What is the day and time in Perth when it is 8pm on Thursday in Santiago?

Chile — Greenwich — Perth

3 hrs — 0 — 8 hrs

11 hour difference (1)

8pm Thurs + 11 hrs = 7am Friday (1)

Question 34 (3 marks)

When a force is applied to a certain object, its acceleration (a) varies inversely as its mass (m). When the acceleration of an object $12m/s^2$, the corresponding mass is $3kg$.

(a) Find the constant of variation. **1**

$y = \frac{k}{x} \Rightarrow a = \frac{k}{m}$

$12 = \frac{k}{3}$

$k = 36$

(b) Find the acceleration of a $1.5kg$ object. **1**

$a = \frac{36}{m}$

$a = 36/1.5$

$a = 24\ m/s^2$

(c) Find the mass of an object when the acceleration is $6m/s^2$. **1**

$6 = \frac{36}{m}$

$m = 6\ kg$

Question 35 (2 marks)

Malik's normal rate of pay is \$19.75 per hour. In one week he worked 17 hours at the normal rate, 7 hours at time-and-a-half and 2 hours double time. He was also paid a wet weather allowance of \$65 for the week. What were his total earnings for the week? **2**

$(19.75 \times 17) + (19.75 \times 1.5 \times 7) + (19.75 \times 2 \times 2) + 65$ (1) some progress

$= \$687.125$

$= \$687.13$ (1)

Question 38 (4 marks)

Aniket has earned a gross annual salary of \$82 500 in the 2019-20 and his employer has paid \$26 400 PAYG tax on his behalf. Aniket has calculated that his total allowable deductions were \$1130 for work-related travel, \$220 for stationary and \$460 for union fees. Aniket must pay the medicare levy of 2% on his taxable income. **4**

Using the tax table provided by the ATO below, determine how much Aniket's tax refund or tax liability will be.

Taxable income	Tax payable
0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$90 000	\$3572 plus 32.5c for each \$1 over \$37 000
\$90 001 – \$180 000	\$20 797 plus 37c for each \$1 over \$90 000
\$180 001 and over	\$54 097 plus 45c for each \$1 over \$180 000

$82\,500 - 1130 - 220 - 460 = \$80\,690$ (1) Taxable income

$80\,690 - 37\,000 = 43\,690$

$43\,690 \times 0.325 = 14199.25$

Tax payable $= 14199.25 + 3572$

$= \$17771.25$ (1)

Medicare levy $= 80\,690 \times 2\%$

$= \$1613.8$ (1)

Total tax $= \$19385.05$

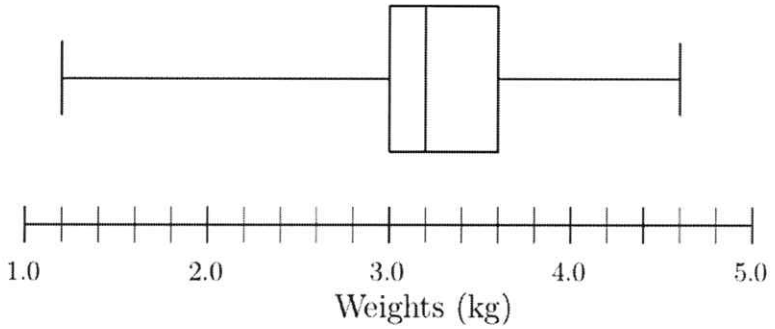
∴ Tax refund

$26\,400 - 19385.05$

$= \$7014.95$ (1)

Question 37 (4 marks)

The birth weight of babies born in Australia during 2019 is presented in the following box-and-whisker diagram.



(a) What is the weight of the heaviest baby born in 2019? **1**

4.6 kg

(b) Find the interquartile range. **1**

3.6 − 3.0 = 0.6 kg

(c) Calculate the upper limit for outliers in this data set. **1**

$Q_3 + 1.5(IQR)$

$3.6 + 1.5(0.6) = 4.5$ kg

(d) Describe the shape of the distribution of weights. **1**

Negatively skewed

Question 38 (4 marks)

Janet has 3 bottles of beer over two and a half hours. A bottle of beer is 0.8 standard drinks and she weighs $56kg$. The formula to calculate her Blood Alcohol Content is:

$$BAC_{female} = \frac{10N - 7.5H}{5.5M}$$

where N is the number of standard drinks consumed,
H is the number of hours drinking, and
M is the person's mass in kilograms.

(a) Calculate Janet's Blood Alcohol Content after two and a half hours. **2**

$BAC = \frac{10(0.8 \times 3) - 7.5(2.5)}{5.5(56)}$ (1)

$= 0.017$ (1)

(b) If Janet has no more alcohol, determine how much longer she must wait until her Blood Alcohol Content returns to zero. **2**

$0 = \frac{24 - 7.5H}{5.5(56)}$

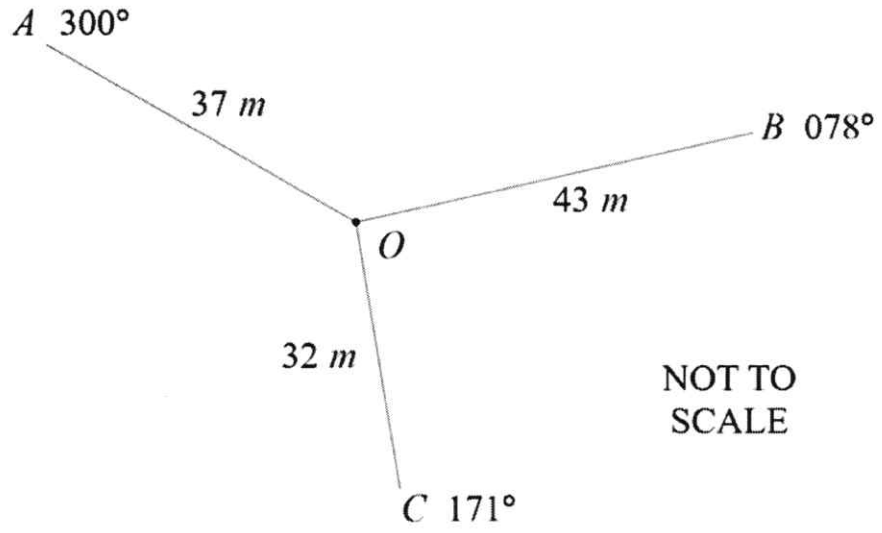
$24 - 7.5H = 0$

$24 = 7.5H$

$H = 3.2$ $\therefore$ 3.2 hours.

Question 39 (3 marks)

The diagram shows the results of a compass radial survey of a triangular area of land.



(a) Find the size of angle BOC. **1**

93°

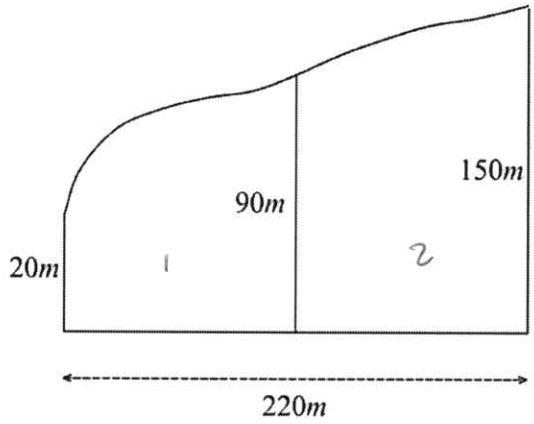
(b) Find the length of BC to the nearest metre. **2**

$BC = \sqrt{32^2 + 43^2 - 2(32)(43)\cos 93^\circ}$ (1)

$= 54.93$ m (1)

Question 40 (6 marks)

The diagram below shows a survey of the land Alfred will build his house on.



(a) Use two applications of the trapezoidal rule to estimate the area of the land to the nearest square metre. **3**

$A_1 = \frac{1}{2} \times 110 \times (20 + 90)$

$= 6050 \text{ m}^2$ (1) Some progress

$A_2 = \frac{1}{2} \times 110 \times (90 + 150)$

$= 13\,200 \text{ m}^2$ (1)

Area $= 6050 + 13\,200$

$= 19250 \text{ m}^2$ (1)

(b) Alfred plans on grading the land so that it serves as the main catchment area for a pond at its lowest elevation. To maintain the water level in the pond, it is estimated that at least 10 megalitres of rain must flow into the pond each year. (1ML = 1,000,000 L) **3**
If 45% of the rain that falls on the land flows into the pond, calculate the amount of rainfall, in millimetres, must fall on the land each year, to maintain the water level in the pond. Round your answer to the nearest 10 mm.

$V = 10\,000\,000 \text{ L} = 10\,000 \text{ m}^3$

Rain Volume $= \frac{10\,000}{45\%} = 22222.22$

$V = A \times h$

$22222.22 = 19250 \times h$

$h = 1.544010 \text{ m}$

$= 1154 \text{ mm}$

$= 1150 \text{ mm}$

End of paper

Section II extra writing space

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

Year 12 Mathematics Standard 2 Section I - Answer Sheet

Student Name/Number _____

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

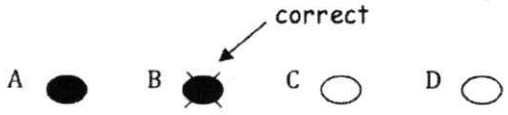
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

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

A ● B ⊗ C ○ D ○

- If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word correct and drawing an arrow as follows.



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