Student Number:
Teacher:

St George Girls High School

Mathematics Standard 2

2026 Trial HSC Examination

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 at the back of this booklet
- For questions in **Section I**, use the Multiple-Choice answer sheet provided at the back of this booklet.
  For questions in **Section II:**
  - Answer the question in the spaces provided.
  - **Show relevant mathematical reasoning** and/or calculations.
  - **Extra writing space** is provided at the back of this booklet on pages 36-39. If you use this space, clearly indicate which question you are answering.
  - Marks may not be awarded for incomplete or poorly presented solutions or where multiple solutions are provided.

Total marks: 100

Section I – 15 marks (pages 2 to 8)

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

Section II – 85 marks (pages 9 to 35)

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

Section I

15 marks
Attempt Questions 1 – 15
Allow about 25 minutes for this section
Use the multiple-choice answer sheet for Questions 1 – 15.

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1. Which of the following is NOT continuous data?

(A) The distance travelled during a trip.

(B) The number of students in a classroom.

(C) The mass of a parcel.

(D) The height of a tree.

2. A metal rod is manufactured with a minimum allowable length of 24.6 mm and a maximum allowable length of 25.0 mm. The machine's upper and lower bounds for the rod's length could best be written as:

(A) $24.6 \text{ mm} \pm 0.2 \text{ mm}$

(B) $24.8 \text{ mm} \pm 0.2 \text{ mm}$

(C) $24.8 \text{ mm} \pm 0.4 \text{ mm}$

(D) $25.0 \text{ mm} \pm 0.2 \text{ mm}$

3. Linda earns \$980 for one holiday week, which includes 17.5% holiday loading. Which is the correct expression for one week's normal pay?

(A) $\$980 - 17.5$

(B) $\$980 \times 0.825$

(C) $\$980 - (980 \times 0.175)$

(D) $\$980 \div 1.175$

4. A company is designing a vinyl wrap to cover the curved surface of a cylindrical drink bottle. The bottle has a diameter of 10 cm and a height of 18 cm.
What is the area of vinyl required to cover the curved surface only (no top or base)?

(A) 180 cm^2

(B) 283 cm^2

(C) 565 cm^2

(D) 1131 cm^2

5. Alex is paid an ordinary hourly rate of $22.40 before tax. From Monday to Friday, he works 18 hours at the ordinary rate. On Saturday, he works 5 hours paid at time-and-a-half, and on Sunday he works 4 hours paid at double time.
Alex's total pay (before tax) for the week is:

(A) $705.60

(B) $750.40

(C) $784.00

(D) $851.20

6. Light travels at a speed of 3.0×10^8 metres per second.
How many kilometres does light travel in 36 hours, correct to 2 significant figures?

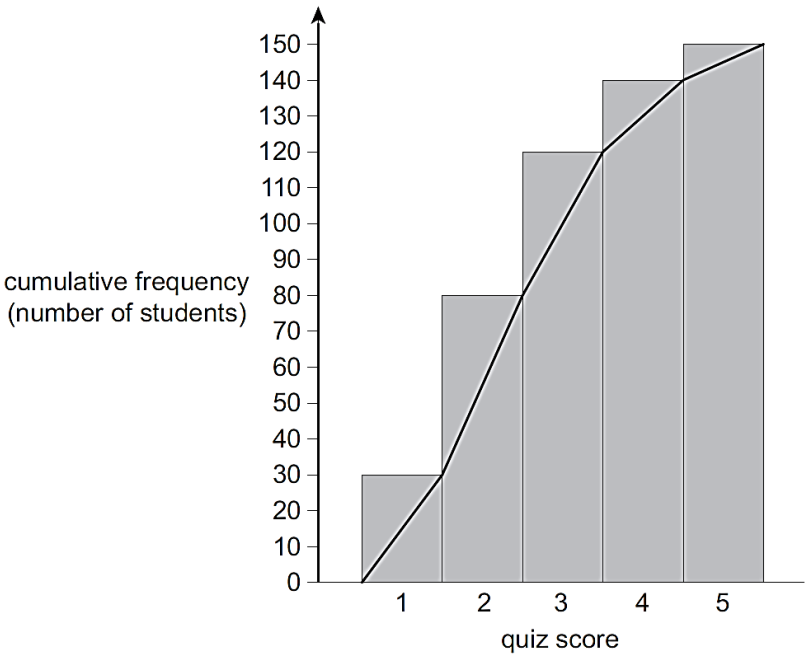
(A) 1.1×10^{11} km

(B) 3.2×10^{10} km

(C) 3.9×10^{10} km

(D) 3.9×10^{13} km

7. A group of 150 students completed a short Mathematics quiz.
The cumulative frequency graph of their scores are below.



Which of the following identifies the median and mode of the student's scores?

(A) Median 2 Mode 2

(B) Median 2 Mode 3

(C) Median 3 Mode 2

(D) Median 3 Mode 3

8. A new law is proposed in NSW and a survey of 1200 people is conducted.
Of the 1200 people surveyed, 672 confirmed that they were in favour of this proposed law.
Based on this survey, approximately how many of the 1 480 000 voters from this state are expected to vote in favour of this new law?

(A) 828 800

(B) 945 600

(C) 740 000

(D) 525 500

9. On a farm, the ratio of dogs to cows to sheep is $2 : 9 : 14$.
If the total number of dogs and cows is 33, how many more sheep than cows are on this farm?

(A) 9

(B) 15

(C) 18

(D) 27

10. In a household of 5 people, each person uses a 1500W electric kettle for an average of 12 minutes every day.
The cost of electricity is 37.15 cents per kWh when the kettle is being used.
What is the cost of the electricity used by this kettle in 10 weeks?

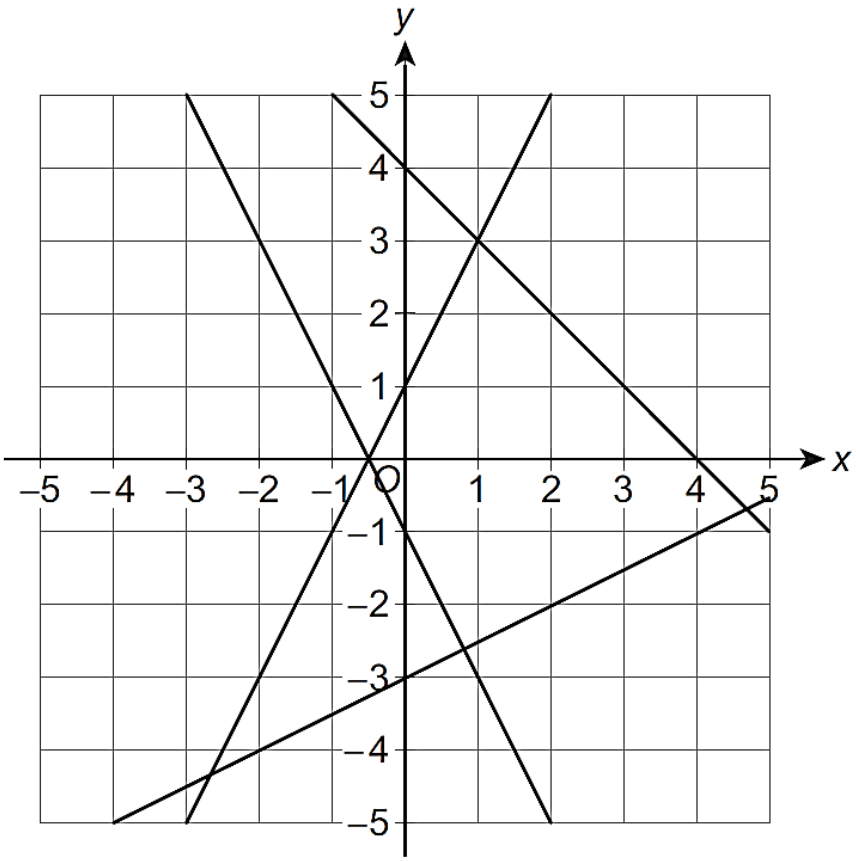
(A) $37.15

(B) $39.01

(C) $390.08

(D) $39 000

11. The graphs of four linear equations are shown below.



Which pair of simultaneous linear equations has the solution (1, 3)?

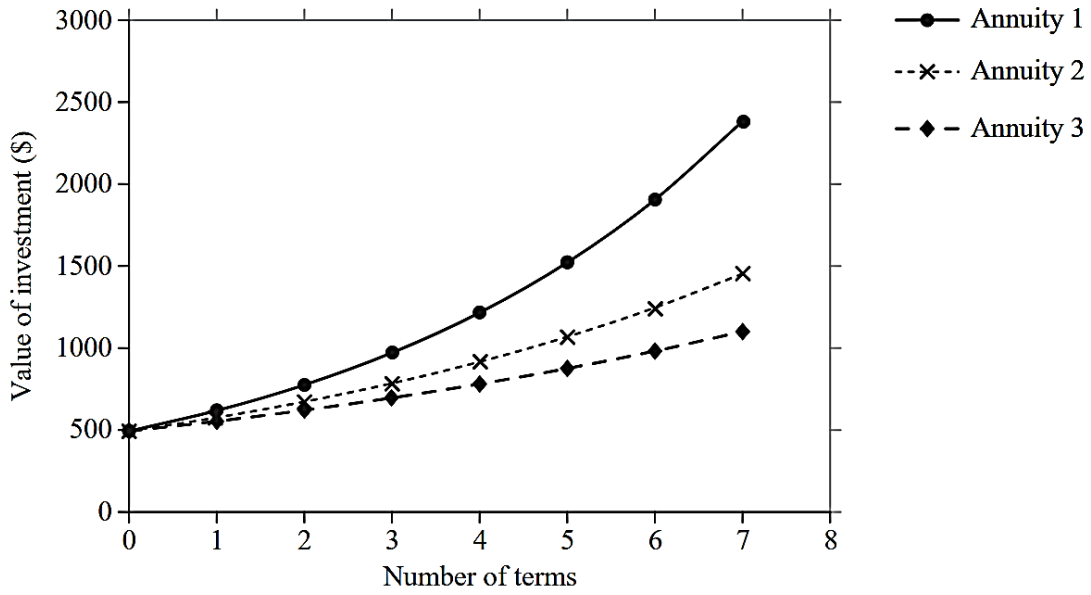
(A) $y = 4 - x$ and $y = -2x - 1$

(B) $y = 2x + 1$ *and* $y = \frac{1}{2}x - 3$

(C) $y = 2x + 1$ and $y = 4 - x$

(D) $y = \frac{1}{2}x - 3$ and $y = -2x + 1$

12. The graph shows the value of three different annuities over time.



Which of the following statements gives a plausible explanation for the different values after seven terms?

(A) Annuity 2 and Annuity 3 have higher interest rates than Annuity 1.

(B) Annuity 2 and Annuity 3 have a lower initial value than Annuity 1.

(C) Annuity 1 and Annuity 2 have shorter interest terms than Annuity 3.

(D) Annuity 1 and Annuity 2 have higher regular deposits than Annuity 3.

13. A $15 000 commercial oven was purchased for a school's hospitality kitchen. After 3 years, its value is $10 935. The oven depreciates using the declining balance method.
What is the annual rate of depreciation, correct to the nearest whole percentage?

(A) 8%

(B) 10%

(C) 12%

(D) 15%

14. B boxes of nails in a factory were inspected and found to be normally distributed with a mean of r nails.
The probability that a box had between $r + k$ and $r + 2k$ nails was 9%.
The probability that a box had between $r - 2k$ and $r + 2k$ nails was 54%.
Given that 5508 boxes were inspected to have more than $r - k$ nails, how many boxes inspected had more than $r + k$ nails?

(A) 2430

(B) 2592

(C) 2673

(D) 3321

15. The vertices of O, A and B of an equilateral triangle represent three bus stops.
The bearing of A from O is 330°.
Which of the following could be the bearing of B from A?

(A) 030°

(B) 060°

(C) 210°

(D) 270°

END OF SECTION I

Section II
85 marks
Attempt questions 16 - 39
Allow about 2 hours and 5 minutes for this section.
Answer each question in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.

Questions 16 (2 marks) **Marks**

Kayne and Aria leave from the same location at the same time and jog in the same direction. If Kayne jogs at an average speed of 10 km/h and Aria at 7 km/h, calculate how far Aria is behind Kayne after 40 minutes. **2**

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Questions 17 (3 marks)

Solve the following equation: **3**

$$\frac{4x-7}{6} + 2 = \frac{9-3x}{4}$$

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Questions 18 (2 marks) **Marks**

The mass in grams of eight Granny Smith apples picked off a tree are shown.

161 179 183 186 189 193 197 207

Would the mass of the lightest apple be considered to be an outlier? **2**
Justify your answer with calculations.

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Questions 19 (2 marks)

Emily looked at her receipt for groceries from the supermarket and noted that she had paid GST of 10% on some items she bought, and no GST on other items.
Emily paid a total of $35.33 for her groceries including GST.
The only item she bought that was GST-free was a bunch of grapes for $7.94.
The items she bought that included GST were chocolate for $9.00, a frozen pizza for $7.50 and some cat litter.
What was the total amount of GST that Emily paid? **2**

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Questions 20 (2 marks) **Marks**

A company has decided to distribute $63 million of its profits as dividends.
The company has issued 210 million shares, and each share is valued at $174.62.
Calculate the dividend yield (as a percentage) of each share to the nearest 2 decimal places. **2**

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Questions 21 (3 marks)

Susan travels from city P (UTC – 7) to city Q (UTC – 3).
The flight between these two cities took 6 hours.
The flight arrived at city Q at 3:30 a.m. local time on Thursday the 4th of October.
On what day and what time did Susan's flight leave city P for this journey? **3**

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Questions 22 (4 marks) **Marks**

Jenny weighs 74 kg. She ate 143 g of trout and 48 g of noodles.
The labels on these products indicate that the trout has 220 kJ of energy in a 55 g serve, and the noodles has 1020 kJ in a 120 g serve.

(a) Calculate the number of kJ in her trout and noodles. **2 3**

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(b) The table below contains information indicating the number of kilocalories used each minute in a variety of exercises for different body masses. **2**

Activity	56 kg	62 kg	74 kg
Volleyball	2.8	3.2	3.7
Dancing	7.5	9.5	10.0
Tennis	6.1	7.8	8.1

1 kilocalorie is equivalent to 4.184 kilojoules

For how many minutes must Jenny play tennis in order to use all the energy in the trout and the noodles? (Answer to the nearest minute.)

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Questions 23 (5 marks) **Marks**

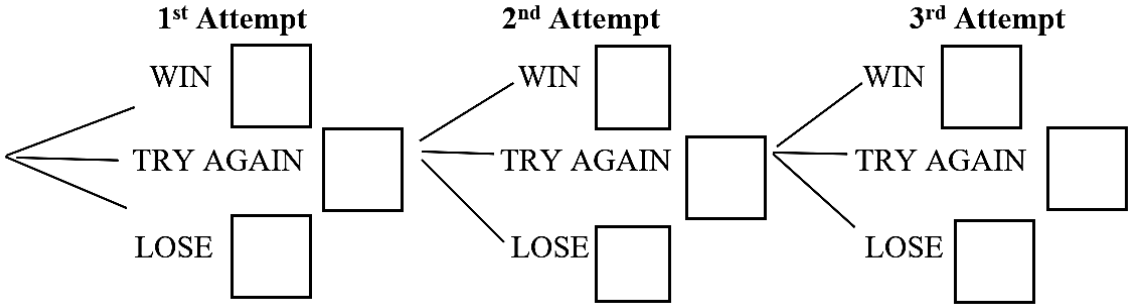
In a game, Joe has three attempts to roll two dice, each with faces numbered 1 to 6.
In any attempt she will:
- WIN A PRIZE if the sum of the topmost faces is at least 8.
- TRY AGAIN if the sum of the topmost faces is 5, 6 or 7.
- LOSE if the sum of the topmost faces is 4 or less.

If Joe wins a prize, or loses, the game is over.

(a) Complete the table, using W for win, T for try again and L for lose. **2**

		1st die					
		1	2	3	4	5	6
2nd die	1						
	2						
	3						
	4						
	5						
	6						

(b) Fill in the probabilities in the probability tree below. **1**



(c) What is the probability that Joe wins a prize in this game? **2**

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Questions 24 (3 marks) **Marks**

A new laptop is purchased for $2450 using a credit card.
The credit card has an interest-free period of 55 days from and including the date of purchase. After this period ends, interest is charged on the purchase made, compounding daily at a rate of 15.4% per annum, from and including the day following the interest-free period.
The full payment for the laptop is made on the 90th day from the date of purchase.
There were no other purchases on this credit card.
What was the total interest charged when the account was paid in full? **3**

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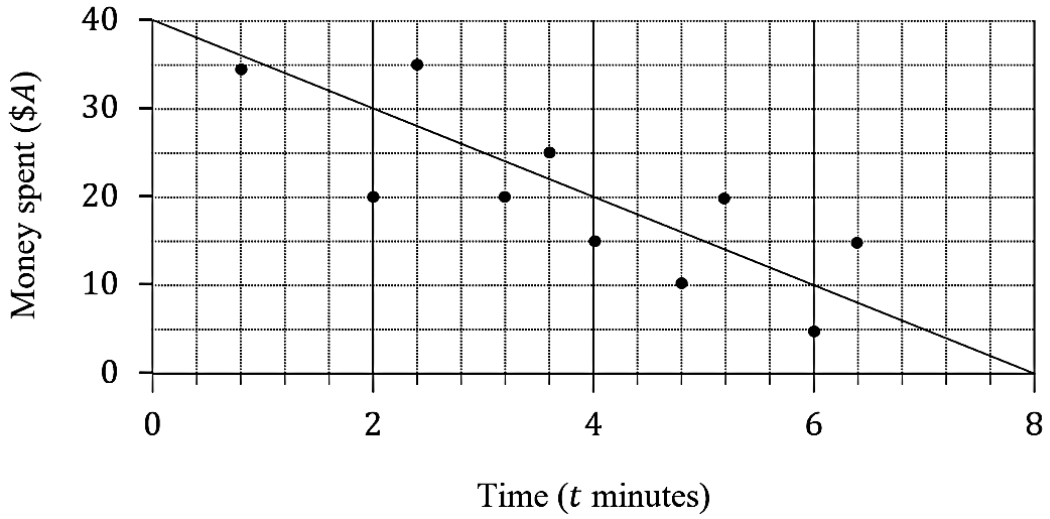
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Questions 25 (3 marks) **Marks**

A shopkeeper notes how much money, $\$A$, customers have spent in the store and how many minutes, t, it took them to decide what they wanted to buy.
The diagram shows the dataset and a line of best fit.



(a) Find the equation of the line of best fit. **2**

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(b) Suppose another customer spent \$20 after taking 7 minutes to decide what they wanted to buy. A new line of best fit is created to account for this extra customer. **1**
Describe how the gradient of the line of best fit would change from the answer found in part (a).

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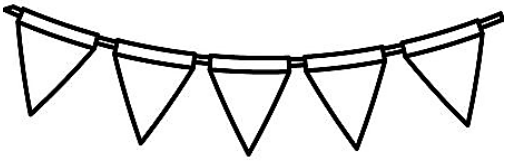
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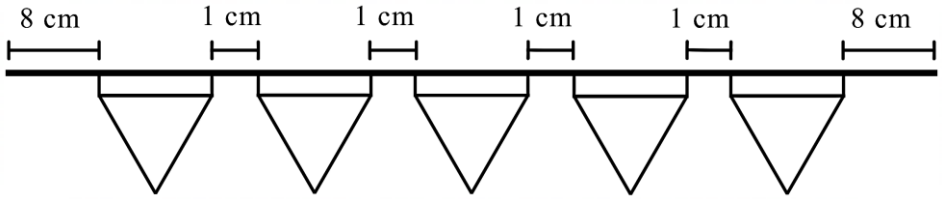
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Questions 26 (3 marks)

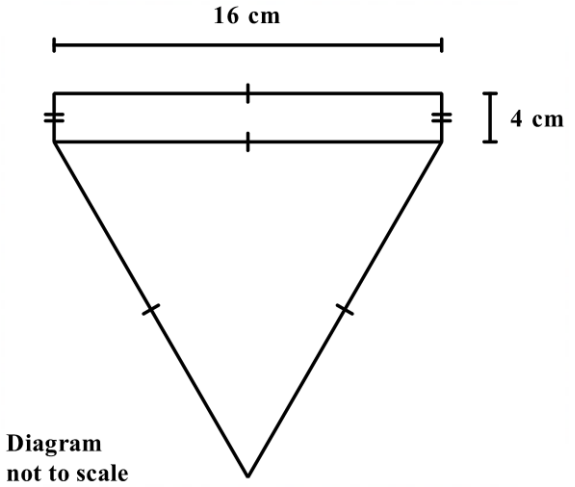
Buntings can be made from indiviudal flags held together with string, as shown below.



The diagram below shows five identical flags on a 1 metre length of string. There is a 1 cm gap between each flag and 8 cm at each end of the string to tie the bunting on display.



The material for one flag consists of two shapes, a rectangle and an equilateral triangle. The diagram below shows the shape and dimension of one flag.



(a) Determine whether or not it is suitable to have six identical flags on the 1 metre length of string. Justify your statement with relevant calculations. **1**

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Questions 26 (continued) **Marks**

(b) Calculate the area of one flag to the nearest 2 decimal places. **2**

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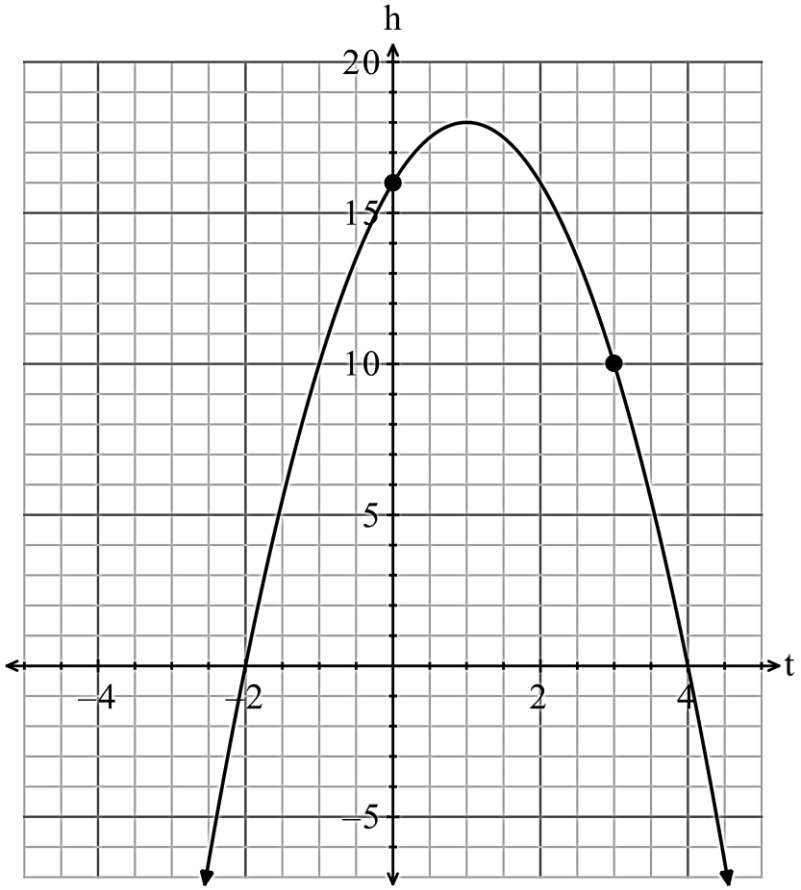
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Questions 27 (5 marks) **Marks**

After a ball is thrown off a building, the height of the ball can be modelled by the equation below.

$$h = at^2 + 4t + c$$

t is time in seconds after the ball is thrown off the building, and h is the height of the ball above the ground in metres.
The graph shows the height of the ball above the ground after t seconds.
Two points are also shown on the graph.



(a) Only a part of the graph applies to this model. Find all values of t that are **not** suitable to use with this model and explain why these values are not suitable. **2**

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Questions 27 (continued) **Marks**

(b) Using the information provided, find the values of a and c. **3**

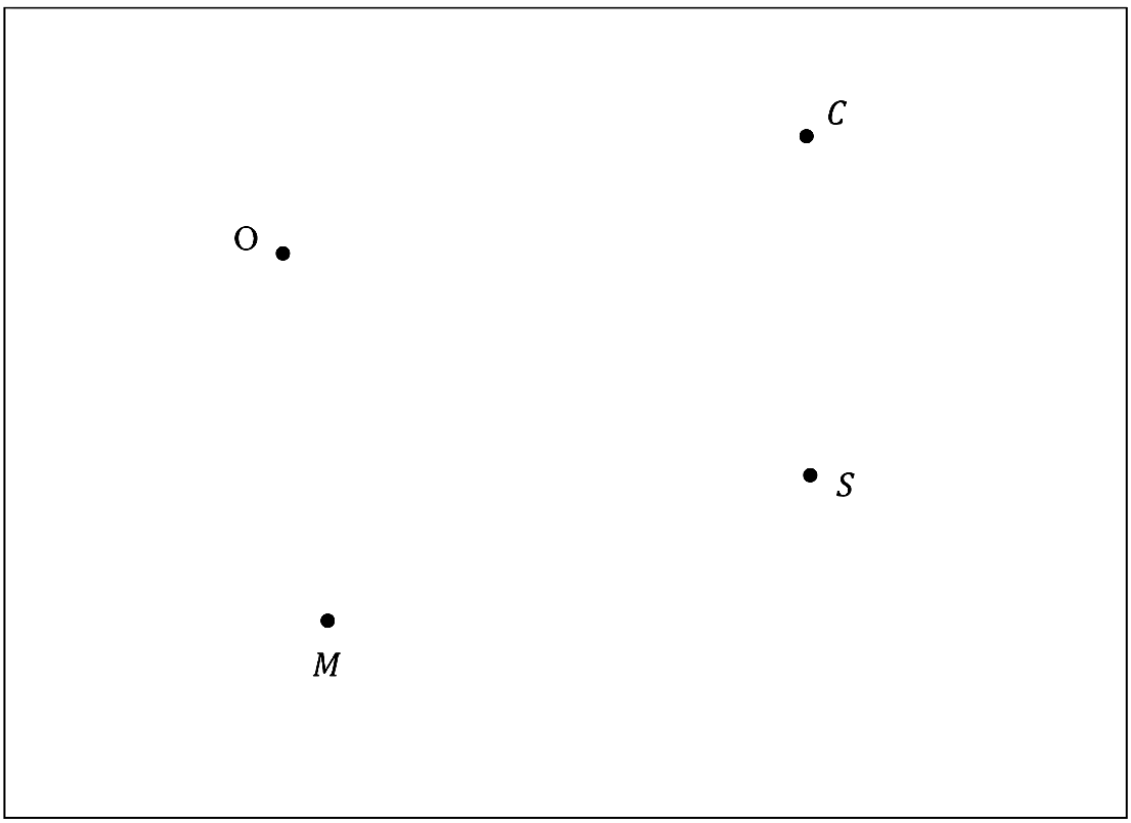
Hence or otherwise, find the height of the ball when $t = 2.75$ seconds.

Questions 28 (4 marks) **Marks**

The network shown in the table below gives the cost of flights between four airports. For example, the cost between Sydney and Coff Harbour is $205.

City	Sydney (S)	Coff Harbour (C)	Orange (O)	Melbourne (M)
(S)	-	$205	$231	$174
(C)	$205	-	-	$593
(O)	$231	-	-	$499
(M)	$174	$593	$499	-

(a) Using the vertices given, draw a weighted network diagram to represent the information shown in the table. **2**



Questions 28 (continued) **Marks**

(b) A passenger had to fly from Orange to Coffs Harbour in an emergency. They intended to take the cheapest route, but when they went to book the flights they found that all the Orange to Sydney services had been cancelled for the day. They booked the cheapest route that did NOT include a flight from Orange to Sydney. What was the percentage increase in the cost of their flights due to the cancelled services? Answer as a percentage correct to 1 decimal place. **2**

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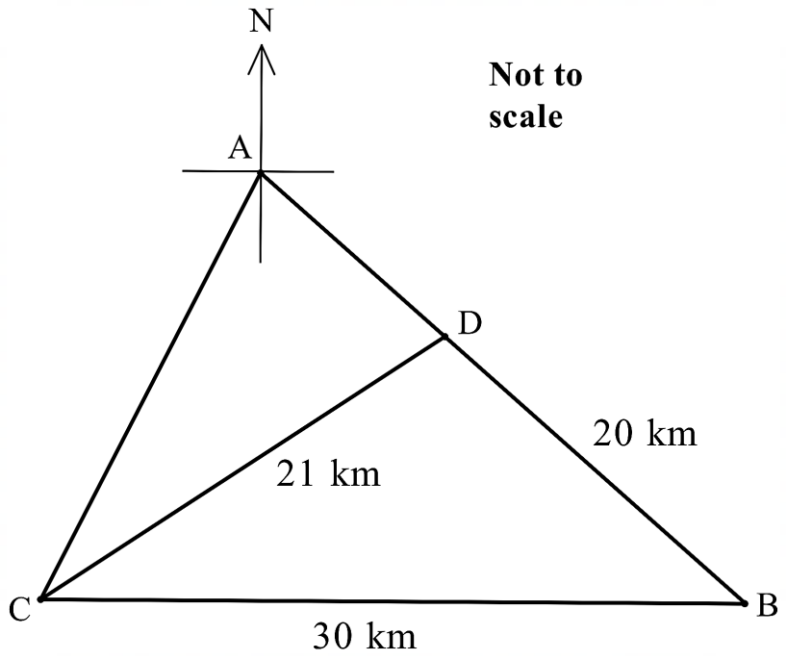
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Questions 29 (3 marks) **Marks**

In the diagram below, AB is a road running in the south-east direction, C is an observatory on a bearing of 205° from A, and $BC = 30$ km.
A man travels along the road from B to A. After walking 20 km to D, he is 21 km from C.
Calculate how far the man is from A. Give your answer correct to the nearest kilometre. **3**



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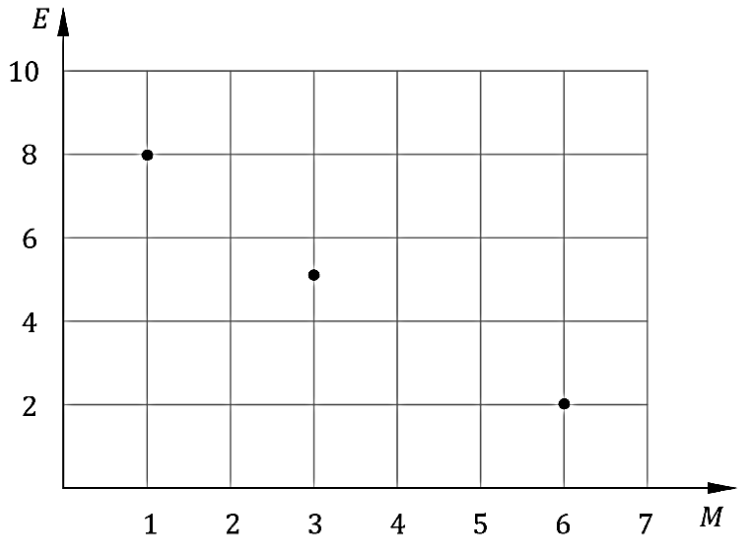
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Questions 30 (3 marks) **Marks**

A set of bivariate data was collected by recording the marks students received in a Music quiz, M, and an Economics quiz, E. In each quiz students gained either 0 marks or 1 mark for each question. The graph shows a scatterplot of these measurements.



(a) Calculate Pearson's correlation coefficient for the data, correct to 2 decimal places. **1**

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(b) Identify the direction and strength of the linear association between M and E. **1**

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(c) Another student was absent for the Economics quiz but achieved 10 marks in the Music quiz. **1**
By creating a line of best fit or otherwise, explain why the student's Economics mark could not be estimated using the association between M and E for the other students.

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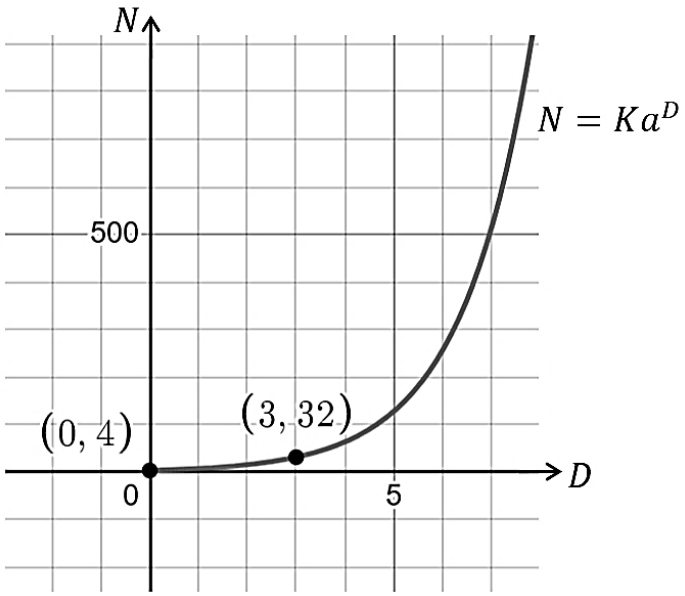
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Questions 31 (3 marks) **Marks**

A flu virus spreads in a little town on an island.
The number of people N infected D days after the virus started to spread can be modelled by the equation $N = Ka^D$, where K and a are constants.
The graph shows the number of people N infected after D days.



Using the information shown on the graph, find the number of people infected after 10 days. **3**

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Questions 32 (4 marks) **Marks**

The Australian income tax table for the 1999 – 2000 financial year is shown.

Taxable income	Tax on this income
0 –$5400	Nil
$5401–$20 700	20 cents for each $1 over $5400
$20 701–$38 000	$3060 plus 34 cents for each $1 over $20 700
$38 001–$50 000	$8942 plus 43 cents for each $1 over $38 000
$50 001 and over	$14 102 plus 47 cents for each $1 over $50 000

Australia uses a progressive tax system in which the amount of tax an individual pays depends on their taxable income.
Leanne pays $4216 in income tax under Australia's progressive tax system.

(a) Determine Leanne's total taxable income under the progressive tax system. **2**

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(b) If this system were replaced by a 15% flat rate tax system, individuals would be taxed at a rate of 15% regardless of their income. Calculate the amount of income tax Leanne would pay under the 15% flat rate system. **1**

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(c) Hence, determine whether Leanne would save money under the flat rate system and by how much. **1**

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Questions 33 (4 marks) **Marks**

The table shows the number of hours that 12 students spent studying in the week leading up to a test and the score that each student achieved.

Hours spent studying	1	2	2	3	3	4	4	5	5	6	7	8
Score	52	55	58	61	63	67	65	72	70	78	82	88

(a) Find the equation of the least-squares regression line. Give answers to 2 decimal places. **2**

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(b) Interpret the y - intercept of the least-squares regression line found in part (a) in the context of the dataset and explain the limitations of using this value. **2**

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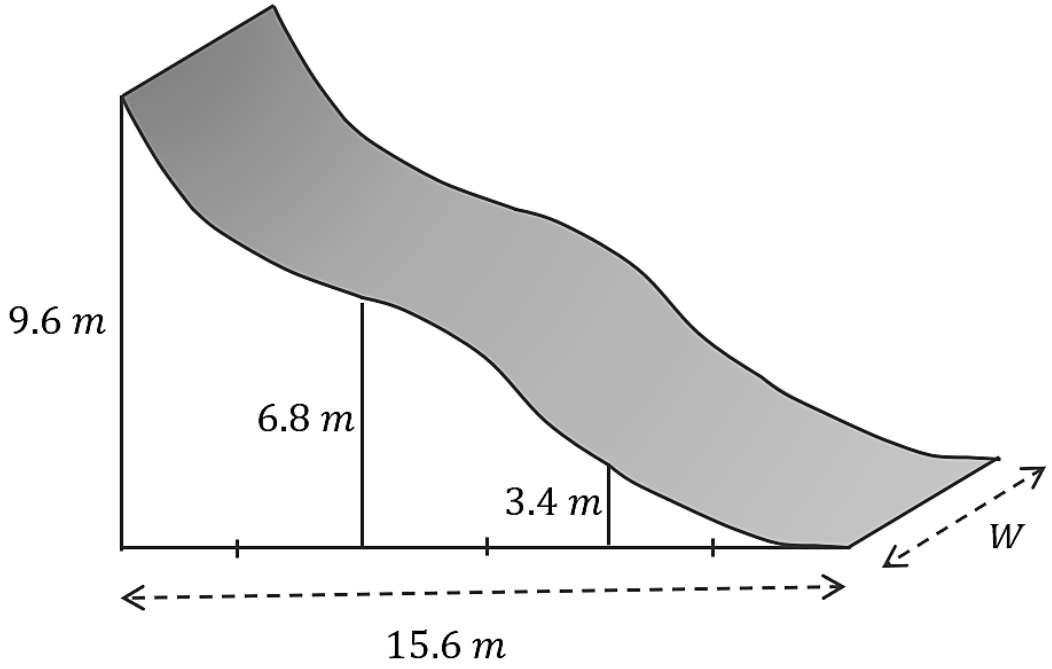
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Questions 34 (4 marks) **Marks**

The diagram shows a slide in a fun park. The slide has a curved surface on the top and a uniform cross-sectional area in the front as shown.
Also, its left side and its base are rectangular faces.



(a) Use three applications of the trapezoidal rule to find an approximate area for the cross section. **2**

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(b) If the curved area on the top is 169.68 m^2 and the total surface area of the slide (including the base) is 537.36 m^2, what is an approximate value of the width W? **2**

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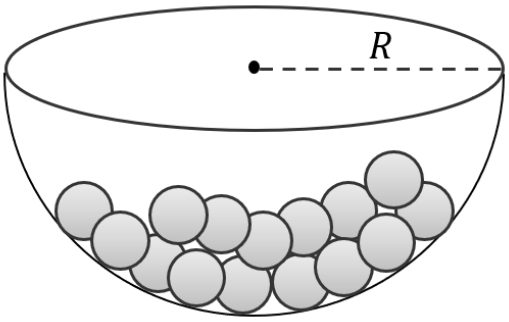
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Questions 35 (4 marks) **Marks**

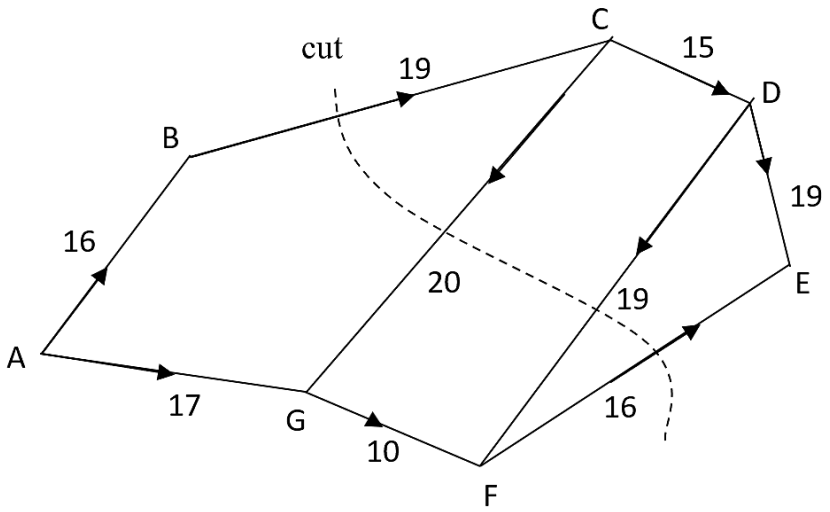
Peter placed 15 identical small spherical marbles each of radius 2 cm in a large hemispherical bowl of radius R.



The volume of the empty space in the bowl is $992\ \pi\ cm^3$. **4**
What is the radius R of the hemispherical bowl?

Questions 36 (5 marks) **Marks**

Water is to be pumped through a field, from the source at A to the sink at E, using a series of pipes from pumping station locations, labelled A to G.
The network diagram below shows the maximum flow rate through each of these pipes, measured in thousands of litres per hour.



(a) What is the capacity of the cut shown in the diagram? **1**

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(b) Calculate the maximum flow of this network. **2**

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(c) The owners of this field want to increase the flow of water through one of the pipes in order to increase the maximum flow of this network. **2**
Which pipe should they choose, and what is the minimum amount by which its flow should be increased in order to maximise the amount of water flowing through this network?

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Questions 37 (5 marks) **Marks**

The activity table shows the tasks required to complete a construction project.

Activity	*Prerequisite/s*	*Duration (days)*
A	–	4
B	*A*	6
C	*A*	5
D	*B*, *C*	3
E	*C*	4
F	*D*, *E*	2

Activity C is delayed by two days.
Determine the new critical path to describe how this delay affects the project's completion time.
Construct a network diagram to support your answer. **5**

Explanation:

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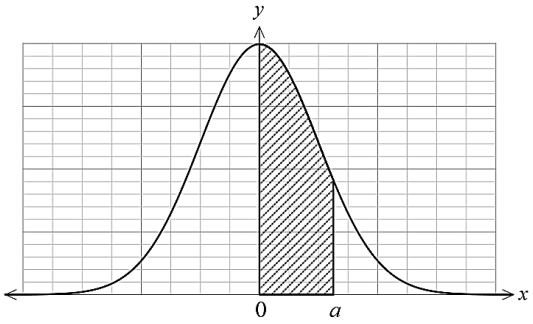
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Questions 38 (5 marks) **Marks**

The table below shows the percentage of scores which lie between $z = 0$ and $z = a$, where a is a positive value, for a normal distribution. Symmetry properties of the distribution can be used to determine other percentages.



z-score	Percentage	z-score	Percentage	z-score	Percentage
0.0	0.00	1.0	34.13	2.0	47.72
0.1	3.98	1.1	36.43	2.1	48.21
0.2	7.93	1.2	38.49	2.2	48.61
0.3	11.79	1.3	40.32	2.3	48.93
0.4	15.54	1.4	41.92	2.4	49.18
0.5	19.15	1.5	43.32	2.5	49.38
0.6	22.57	1.6	44.52	2.6	49.53
0.7	25.80	1.7	45.54	2.7	49.65
0.8	28.81	1.8	46.41	2.8	49.74
0.9	31.59	1.9	47.13	2.9	49.81

The ages (in years) of the members of the Martin Bay Tennis Club are normally distributed with a mean of 32 and a standard deviation of 16.0.

(a) Convert an age of 48 to a z-score. **1**

……

……

(b) What percentage of the members are aged less than 48? **1**
Answer as a whole percentage.

……

……

……

……

……

……

Questions 38 (continued) **Marks**

(c) If there are 60 members of the club, how many of them are aged between 8 and 40? **3**

Questions 39 (4 marks) **Marks**

The tables below show the future values and present values of annuities of $1 for a variety of periods and interest rates. Contributions are made at the end of each period.

Future Value of an Annuity of $1.00

Years	Interest Rate Per Annum							
	5%	6%	7%	8%	9%	10%	11%	12%
6	6.802	6.975	7.153	7.336	7.523	7.716	7.913	8.115
7	8.142	8.394	8.654	8.923	9.200	9.487	9.783	10.089
8	9.549	9.897	10.260	10.637	11.028	11.436	11.859	12.300
9	11.027	11.491	11.978	12.488	13.021	13.579	14.164	14.776
10	12.578	13.181	13.816	14.487	15.193	15.937	16.722	17.549
11	14.207	14.972	15.784	16.645	17.560	18.531	19.561	20.655
12	15.917	16.870	17.888	18.977	20.141	21.384	22.713	24.133

Present Value of an Annuity of $1.00

Months	Interest Rate Per Month							
	0.2%	0.3%	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%
8	7.928	7.893	7.858	7.823	7.788	7.754	7.720	7.685
9	8.911	8.866	8.823	8.779	8.736	8.693	8.650	8.608
10	9.891	9.837	9.783	9.730	9.678	9.626	9.574	9.522
11	10.869	10.805	10.741	10.677	10.614	10.552	10.490	10.428
12	11.845	11.769	11.694	11.619	11.545	11.471	11.399	11.327
13	12.820	12.731	12.643	12.556	12.470	12.385	12.300	12.217
14	13.792	13.690	13.589	13.489	13.390	13.292	13.195	13.099

Jane invested $3500 at the end of each year for 12 years into an annuity with an interest rate of 9% per annum. After 5 years, she decided to invest in an additional annuity at 6% per annum, making equal annual contributions at the end of each year for the next 7 years. She wants the total value of both annuities after 12 years to be $100 000.

To fund the annual contributions to the second annuity, Jane borrows each contribution amount at an interest rate of 6% per annum and repays it in 12 equal monthly instalments over the following year.

Calculate the amount Jane must pay back each month for the contributions to the additional annuity. **4**

Questions 39 (continued)

End of Examination

Section II extra writing space

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

Section II extra writing space

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

Section II extra writing space

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

Section II extra writing space

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

Student Number:
Teacher: ANSWERS

St George Girls High School

Mathematics Standard 2

2026 Trial HSC Examination

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 at the back of this booklet
- For questions in **Section I**, use the Multiple-Choice answer sheet provided at the back of this booklet.
  For questions in **Section II:**
  - Answer the question in the spaces provided.
  - **Show relevant mathematical reasoning** and/or calculations.
  - **Extra writing space** is provided at the back of this booklet on pages 36-39. If you use this space, clearly indicate which question you are answering.
  - Marks may not be awarded for incomplete or poorly presented solutions or where multiple solutions are provided.

Total marks: 100

Section I – 15 marks (pages 2 to 8)

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

Section II – 85 marks (pages 9 to 35)

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

Student Number:	Trial 2026
Teacher:	STANDARD 2

Section I
Mathematics Standard 2
2026 HSC Trial Examination

Multiple-choice Answer Sheet - Questions 1 – 15

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

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

A ○ **B** ● **C** ○ **D** ○

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

A ● **B** ⊗ **C** ○ **D** ○

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

correct

A ⊗ **B** ⊗ **C** ○ **D** ○

1.	**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** ○

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. Which of the following is NOT continuous data?

→ measured

(A) The distance travelled during a trip.

(B) The number of students in a classroom.

(C) The mass of a parcel.

(D) The height of a tree.

2. A metal rod is manufactured with a minimum allowable length of 24.6 mm and a maximum allowable length of 25.0 mm. The machine's upper and lower bounds for the rod's length could best be written as:

$\frac{25.0 - 24.6}{2}$
$= \frac{0.4}{2}$
$= 0.2$

24.6 | 24.6 + 0.2 = 24.8 | 25.0

(A) 24.6 mm ± 0.2 mm

(B) 24.8 mm ± 0.2 mm

(C) 24.8 mm ± 0.4 mm

(D) 25.0 mm ± 0.2 mm

3. Linda earns \$980 for one holiday week, which includes 17.5% holiday loading. Which is the correct expression for one week's normal pay?

100 + 17.5
= 117.5%
= 1.175

(A) \$980 − 17.5

(B) \$980 × 0.825

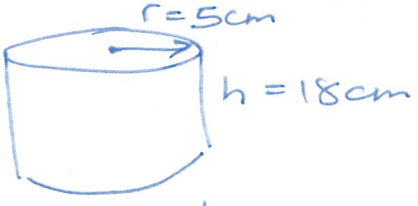
(C) \$980 − (980 × 0.175)

(D) \$980 ÷ 1.175
= 834.0425532

1 week = $\frac{\$980}{1.175}$

OR 117.5% of normal pay = \$980
100% " = $\frac{980}{117.50} \times 100$
= 834.0425532

4. A company is designing a vinyl wrap to cover the curved surface of a cylindrical drink bottle. The bottle has a diameter of 10 cm and a height of 18 cm.
What is the area of vinyl required to cover the curved surface only (no top or base)?



(A) 180 cm^2

(B) 283 cm^2

(C) 565 cm^2

(D) 1131 cm^2

$A = 2\pi rh$
$= 2\pi \times 5 \times 18$
$= 565.4866776$
$= 565\ cm^2$

5. Alex is paid an ordinary hourly rate of \$22.40 before tax. From Monday to Friday, he works 18 hours at the ordinary rate. On Saturday, he works 5 hours paid at time-and-a-half, and on Sunday he works 4 hours paid at double time.
Alex's total pay (before tax) for the week is:

(A) \$705.60

(B) \$750.40

(C) \$784.00

(D) \$851.20

Total pay
$= 18 \times \$22.40 + 5 \times 1.5 \times \$22.40 + 4 \times 2 \times \$22.40$
$= \$750.40$

6. Light travels at a speed of 3.0×10^8 metres per second.
How many kilometres does light travel in 36 hours, correct to 2 significant figures?

(A) 1.1×10^{11} km

(B) 3.2×10^{10} km

(C) 3.9×10^{10} km

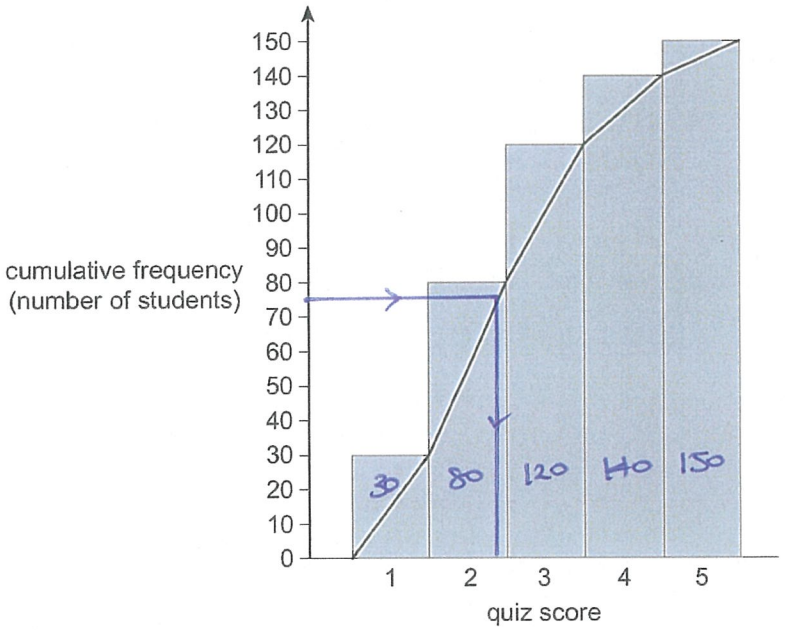
(D) 3.9×10^{13} km

36 hours $= 36 \times 60 \times 60$ seconds
$= 129\,600$ seconds

$3.0 \times 10^8 \times 129\,600$ m
$= \frac{3.888 \times 10^3}{1000}$ km
$= 3.888 \times 10^{10}$
$= 3.9 \times 10^{10}$

7. A group of 150 students completed a short Mathematics quiz.
The cumulative frequency graph of their scores are below.

$\frac{150}{2} = 75$



∴ median = 2

Which of the following identifies the median and mode of the student's scores?

(A) Median 2 Mode 2

(B) Median 2 Mode 3

(C) Median 3 Mode 2

(D) Median 3 Mode 3

x	f	cf
1	30	30
2	50	80
3	40	120
4	20	140
5	10	150
	150	

∴ mode = 2

8. A new law is proposed in NSW and a survey of 1200 people is conducted.
Of the 1200 people surveyed, 672 confirmed that they were in favour of this proposed law.
Based on this survey, approximately how many of the 1 480 000 voters from this state are expected to vote in favour of this new law?

(A) 828 800

(B) 945 600

(C) 740 000

(D) 525 500

$\frac{672}{1200} = \frac{x}{1480\,000}$

$x = \frac{672}{1200} \times 1480\,000$

$= 828\,800$

9. On a farm, the ratio of dogs to cows to sheep is 2 : 9 : 14.
If the total number of dogs and cows is 33, how many more sheep than cows are on this farm?

D C S

(A) 9
(B) 15
(C) 18
(D) 27

2 : 9 = 11 parts

$\frac{33}{11} = 3$

∴ Dogs = 2 × 3 = 6
Cows = 9 × 3 = 27
Sheep = 14 × 3 = 42

∴ 42 − 27 = 15

10. In a household of 5 people, each person uses a 1500W electric kettle for an average of 12 minutes every day.
The cost of electricity is 37.15 cents per kWh when the kettle is being used.
What is the cost of the electricity used by this kettle in 10 weeks?

(A) $37.15
(B) $39.01
(C) $390.08
(D) $39 000

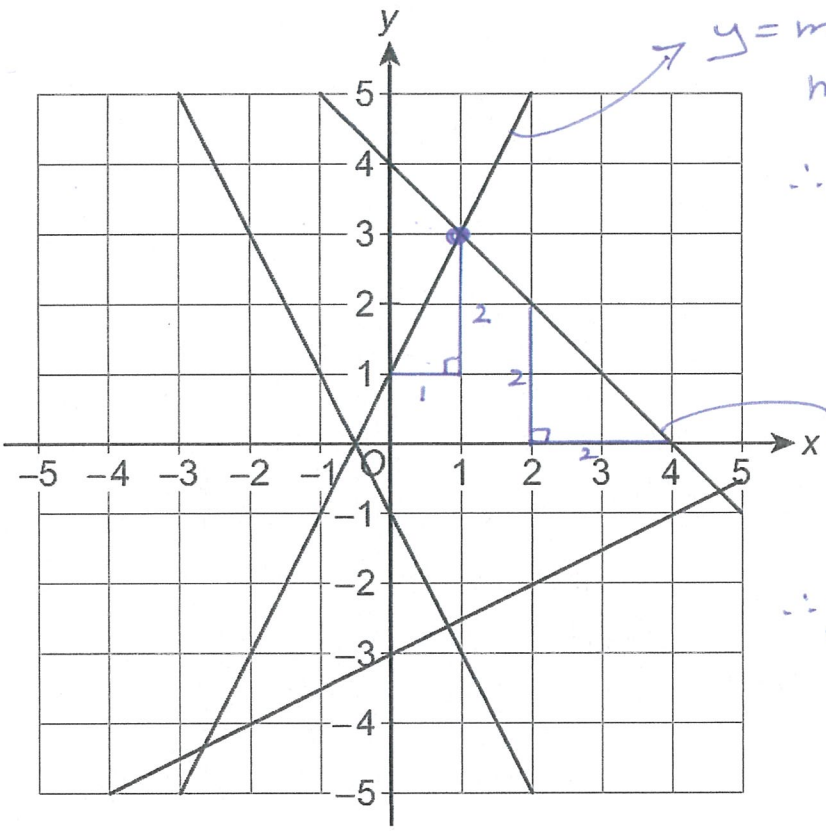
Cost

$= \frac{12}{60} \times 7 \times 10 \times \frac{1500}{1000} \times \frac{37.15}{100} \times 5$

$= 39.0075$

$= \$39.01$

11. The graphs of four linear equations are shown below.



$y = mx + 1$

$m = \frac{2}{1}$

$\therefore y = 2x + 1$

$y = mx + 4$

$m = -\frac{2}{2}$

$= -1$

$\therefore y = -x + 4$

$= 4 - x$

Which pair of simultaneous linear equations has the solution (1, 3)?

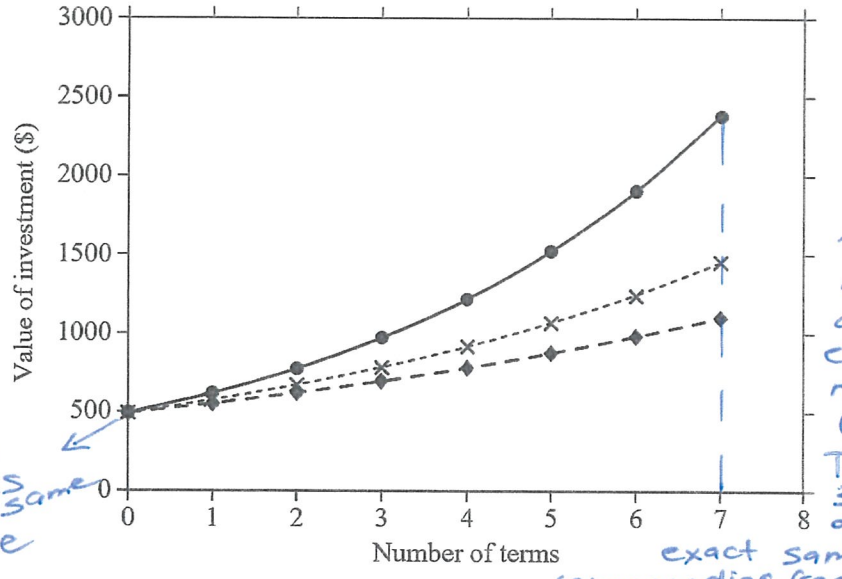
(A) $y = 4 - x$ and $y = -2x - 1$

(B) $y = 2x + 1$ and $y = \frac{1}{2}x - 3$

(C) $y = 2x + 1$ and $y = 4 - x$

(D) $y = \frac{1}{2}x - 3$ and $y = -2x + 1$

12. The graph shows the value of three different annuities over time.



all 3 annuities have the same initial value

Not (c): The data points for all 3 annuities are recorded at the exact same whole number intervals (term 0 to term 7). This shows that all 3 investments are operating on the exact same timeline and compounding frequency, meaning differences in term lengths cannot be the reason for varied growth.

Which of the following statements gives a plausible explanation for the different values after seven terms?

If annuity 2 & 3 had higher interest rates, or higher deposits, they would grow faster and be higher than annuity 1.

(A) Annuity 2 and Annuity 3 have higher interest rates than Annuity 1. ✗
Instead they are lower.

(B) Annuity 2 and Annuity 3 have a lower initial value than Annuity 1. ✗
all 3 annuities begin at exactly $500 at 0 terms.

(C) Annuity 1 and Annuity 2 have shorter interest terms than Annuity 3. ✗
all 3 annuities are plotted against the exact same x-axis (Number of terms)

(D) Annuity 1 and Annuity 2 have higher regular deposits than Annuity 3. ✓
Higher regular deposits lead to a faster increase in the total value of an investment over time.

13. A $15 000 commercial oven was purchased for a school's hospitality kitchen. After 3 years, its value is $10 935. The oven depreciates using the declining balance method.

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

What is the annual rate of depreciation, correct to the nearest whole percentage?

$10935 = 15000(1-r)^3$

$0.729 = (1-r)^3$

$\sqrt[3]{0.729} = 1-r$

$r = 1 - \sqrt[3]{0.729}$

$= 0.1$

$= 10\%$

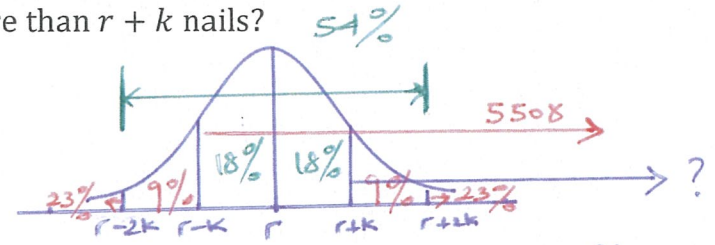
(A) 8%

(B) 10%

(C) 12%

(D) 15%

14. B boxes of nails in a factory were inspected and found to be normally distributed with a mean of r nails.
The probability that a box had between $r + k$ and $r + 2k$ nails was 9%.
The probability that a box had between $r - 2k$ and $r + 2k$ nails was 54%.
Given that 5508 boxes were inspected to have more than $r - k$ nails, how many boxes inspected had more than $r + k$ nails?



(A) 2430

(B) 2592

(C) 2673

(D) 3321

$18+18+9+23 = 68\%$

68% of boxes = 5508

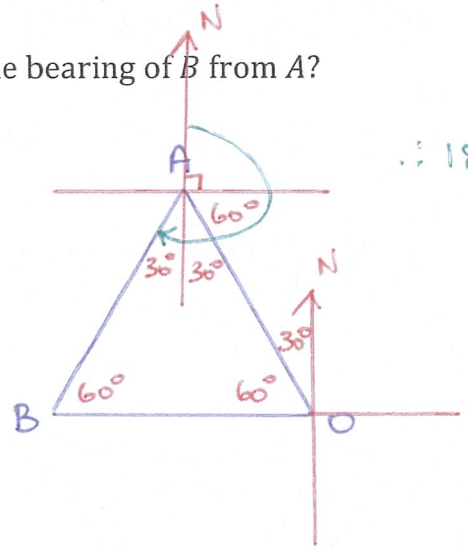
1% " $= \frac{5508}{68} = 81$

$9\%+23\% = 32\%$

$= 32 \times 81$

$= 2592$

15. The vertices of O, A and B of an equilateral triangle represent three bus stops.
The bearing of A from O is 330°.
Which of the following could be the bearing of B from A?



$\therefore 180^\circ + 30^\circ$

$= 210^\circ$

(A) 030°

(B) 060°

(C) 210°

(D) 270°

END OF SECTION I

Section II
85 marks
Attempt questions 16 - 39
Allow about 2 hours and 5 minutes for this section.
Answer each question in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.

Questions 16 (2 marks) **Marks**

Kayne and Aria leave from the same location at the same time and jog in the same direction. If Kayne jogs at an average speed of 10 km/h and Aria at 7 km/h, calculate how far Aria is behind Kayne after 40 minutes. $D = S \times T$

2

Kayne's distance − Aria's distance

$= 10 \times \frac{40}{60} - 7 \times \frac{40}{60}$

$= 6\frac{2}{3} - 4\frac{2}{3}$

$= 2$ km

Questions 17 (3 marks)

Solve the following equation:

$$\frac{12^{2}}{1} \times \frac{4x-7}{6} + 2^{\times 12} = \frac{9-3x}{4} \times \frac{12^{3}}{1}$$

(1) must have correct method as first step.

Method 1:

$2(4x-7) + 24 = 3(9-3x)$

$8x - 14 + 24 = 27 - 9x$ (1)

$17x = 17$

$x = 1$ (1)

(Method 2)

$\frac{16x - 28}{24} + \frac{48}{24} = \frac{54 - 18x}{24}$

$16x + 20 = 54 - 18x$

$16x + 18x = 54 - 20$

$34x = 34$

$x = 1$

3

Questions 18 (2 marks) **Marks**

The mass in grams of eight Granny Smith apples picked off a tree are shown.

161 | 179 | 183 | 186 | 189 | 193 | 197 | 207

Would the mass of the lightest apple be considered to be an outlier? Justify your answer with calculations. **2**

$Q_1 = \frac{179+183}{2} = 181$ $Q_3 = \frac{193+197}{2} = 195$

$IQR = Q_3 - Q_1$
$= 195 - 181$
$= 14$ (1)

An outlier is below
$Q_1 - 1.5 \times IQR$ (1)
$= 181 - 1.5 \times 14$
$= 160$
$161 > 160$
$\therefore$ 161 is not an outlier. (1)

generally well done

Questions 19 (2 marks)

Emily looked at her receipt for groceries from the supermarket and noted that she had paid GST of 10% on some items she bought, and no GST on other items.
Emily paid a total of \$35.33 for her groceries including GST.
The only item she bought that was GST-free was a bunch of grapes for \$7.94.
The items she bought that included GST were chocolate for \$9.00, a frozen pizza for \$7.50 and some cat litter.
What was the total amount of GST that Emily paid? **2**

Cost of taxable groceries $= \$35.33 - \$7.94$
$= \$27.39$ (1)

$\therefore GST = \frac{\$27.39}{11}$
$= \$2.49$ (1)

OR \$27.39 has 10% GST included
110% = \$27.39
10% = $\frac{\$27.39}{11}$
$= \$2.49$

choc +GST = 9×1.1 = \$9.90
Pizz +GST = 7.5×1.1 = \$8.25
Cat litter with GST = $9.24 \div 1.1$ = \$8.40
for 1
$= 9 + 0.75 + 0.8$
$= \$2$ +0

Questions 20 (2 marks) **Marks**

A company has decided to distribute $63 million of its profits as dividends.
The company has issued 210 million shares, and each share is valued at $174.62.
Calculate the dividend yield (as a percentage) of each share to the nearest 2 decimal places. **2**

Value of one share = $\frac{63\,000\,000}{210\,000\,000}$ ← ½ mk if proceeding correctly but made a subsequent error.

= $0.30 (1)

Dividen yield = $\frac{\text{dividend per share}}{\text{share price}} = \frac{\$0.30}{\$174.62} \times 100$

= 0.17180 16 26 %

= 0.17% (1)

Questions 21 (3 marks)

Susan travels from city P (UTC – 7) to city Q (UTC – 3).
The flight between these two cities took 6 hours.
The flight arrived at city Q at 3:30 a.m. local time on Thursday the 4th of October.
On what day and what time did Susan's flight leave city P for this journey? **3**

P Q 3.30am Thursday 4th oct.

-7 -3 0

Time difference = 4 hours (1)

P is 4 hours behind Q

= 3.30 am Thurs 4th oct − 4 hrs

= 11.30pm Wed 3rd oct (1) 2 to here

P is west of Q ∴ behind time

Leaves City P = 11.30pm Wed 3rd Oct − 6hrs

= 5.30pm Wed 3rd oct.

OR Starting time of flight according to Q time : 3

0:30 − 6:00

= 27:30 − 6:00

= 21:30 wed 3rd oct (9.30pm) (ie flight left P at 9.30pm wed 3rd oct Q time)

Q is 4 hours ahead of P:

21:30 − 4:00 = 17:30

∴ 5.30pm 3rd oct (flight start time according to local time at P).

Questions 22 (4 marks) **Marks**

Jenny weighs 74 kg. She ate 143 g of trout and 48 g of noodles.
The labels on these products indicate that the trout has 220 kJ of energy in a 55 g serve, and the noodles has 1020 kJ in a 120 g serve.

(a) Calculate the number of kJ in her trout and noodles. **2**

Number of kJ in trout and noodles

$= \frac{220}{55} \times 143 + \frac{1020}{120} \times 48$

$= 4 \times 143 + 8.5 \times 48$

$= 572 + 408$

$= 980$ kJ

(b) The table below contains information indicating the number of kilocalories used each minute in a variety of exercises for different body masses. **2**

Activity	56 kg	62 kg	74 kg
Volleyball	2.8	3.2	3.7
Dancing	7.5	9.5	10.0
Tennis	6.1	7.8	8.1

1 kilocalorie is equivalent to 4.184 kilojoules

For how many minutes must Jenny play tennis in order to use all the energy in the trout and the noodles? (Answer to the nearest minute.)

Tennis = 8.1 kilocalories / minute

$= 8.1 \times 4.184$ kJ/min

$= 33.8904$ kJ/min

No. of minutes needed $= \frac{980}{33.8904}$

$= 28.91674338$

$= 29$ minutes.

Questions 23 (5 marks) **Marks**

In a game, Joe has three attempts to roll two dice, each with faces numbered 1 to 6.
In any attempt she will:
- WIN A PRIZE if the sum of the topmost faces is at least 8.
- TRY AGAIN if the sum of the topmost faces is 5, 6 or 7.
- LOSE if the sum of the topmost faces is 4 or less.

If Joe wins a prize, or loses, the game is over.

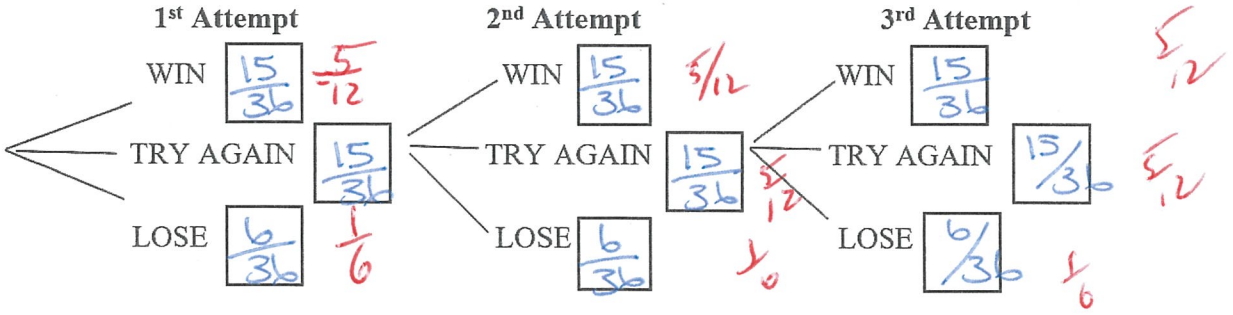
(a) Complete the table, using W for win, T for try again and L for lose. **2**

		1st die					
		1	2	3	4	5	6
2nd die	1	L	L	L	T	T	T
	2	L	L	T	T	T	W
	3	L	T	T	T	W	W
	4	T	T	T	W	W	W
	5	T	T	W	W	W	W
	6	T	W	W	W	W	W

generally well done

$n(S) = 6 \times 6 = 36$

(b) Fill in the probabilities in the probability tree below. **1**



(c) What is the probability that Joe wins a prize in this game? **2**

$P(W) + P(TW) + P(TTW)$

$= \frac{15}{36} + \frac{15}{36} \times \frac{15}{36} + \frac{15}{36} \times \frac{15}{36} \times \frac{15}{36}$ (1)

$= \frac{15}{36} + \frac{25}{144} + \frac{125}{1728}$

$= \frac{1145}{1728} = 66.26157407\%$ (1)

13

*(b)(c) students really had difficulties realising the probability did not change at end attempts.

5

Questions 24 (3 marks) **Marks**

A new laptop is purchased for $2450 using a credit card.
The credit card has an interest-free period of 55 days from and including the date of purchase. After this period ends, interest is charged on the purchase made, compounding daily at a rate of 15.4% per annum, from and including the day following the interest-free period.
The full payment for the laptop is made on the 90th day from the date of purchase.
There were no other purchases on this credit card.
What was the total interest charged when the account was paid in full? **3**

No. of interest charged days = 90 − 55 ✓
= 35 days

Interest = A − P ①

$= 2450\left(1 + \frac{15.4\%}{365}\right)^{35} - 2450$ ①

= 36.44016149

= $36.44 ①

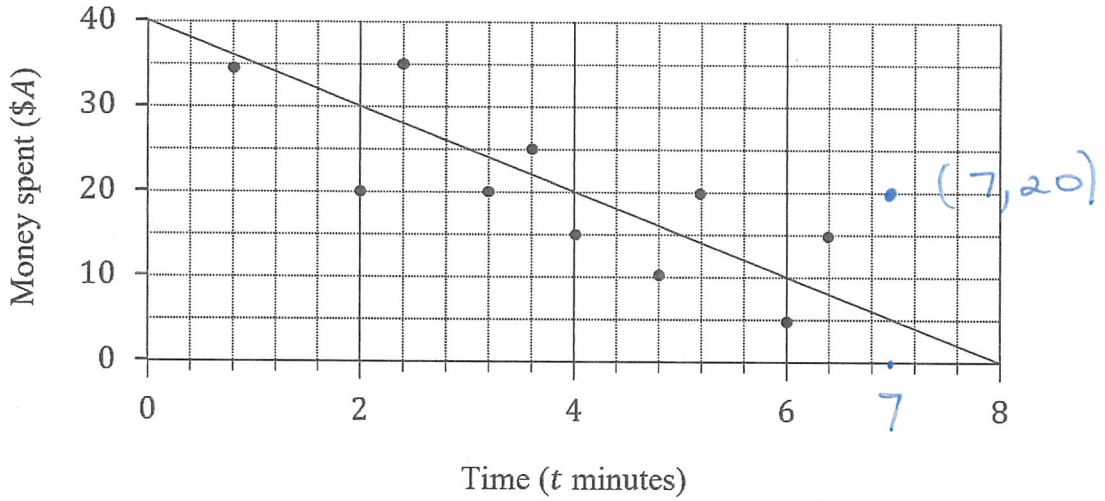
Interest owed = Final accumulated amount − original principal amount

∴ I = P − A

The number of days proved difficult...
There were 90 days

Questions 25 (3 marks) **Marks**

A shopkeeper notes how much money, $\$A$, customers have spent in the store and how many minutes, t, it took them to decide what they wanted to buy.
The diagram shows the dataset and a line of best fit.



(a) Find the equation of the line of best fit. **2**

$y = mx + c$
$A = mt + c$
$c = 40$
$m = -\frac{40}{8}$
$= -5$
$\therefore A = -5t + 40$
gave $y = -5x + 40$ (1½)

(b) Suppose another customer spent \$20 after taking 7 minutes to decide what they wanted to buy. A new line of best fit is created to account for this extra customer. **1**
Describe how the gradient of the line of best fit would change from the answer found in part (a).

- Adding the point (7, 20) would cause the gradient to increase
- the gradient becomes less negative
- the line becomes flatter / shallower
- new gradient is more than −5

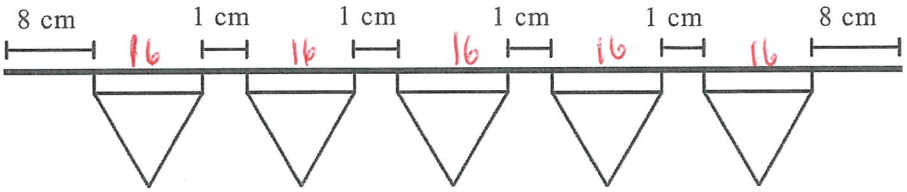
confusion about negative numbers than sound smaller than other negative numbers, are in fact bigger. eg $-4 > -5$

Questions 26 (3 marks)

Buntings can be made from indiviudal flags held together with string, as shown below.



The diagram below shows five identical flags on a 1 metre length of string. There is a 1 cm gap between each flag and 8 cm at each end of the string to tie the bunting on display.



The material for one flag consists of two shapes, a rectangle and an equilateral triangle. The diagram below shows the shape and dimension of one flag.

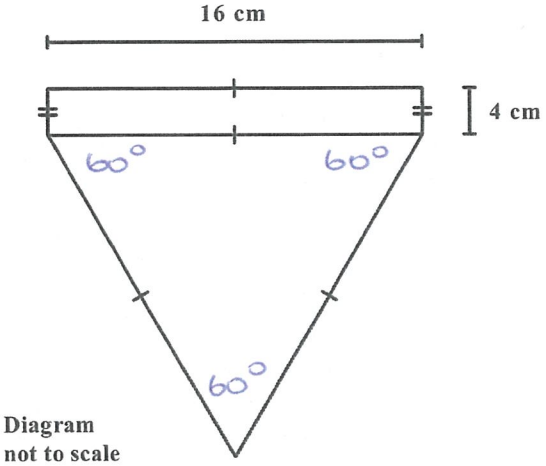


Diagram not to scale

(a) Determine whether or not it is suitable to have six identical flags on the 1 metre length of string. Justify your statement with relevant calculations. **1**

$6 \times 16 + 2 \times 8 + 5 \times 1$

$= 117 > 100$ cm

∴ not suitable to have 6 flags on the 1m string.

Some students only did 2 of these 3 steps

Questions 26 (continued) **Marks**

(b) Calculate the area of one flag to the nearest 2 decimal places. **2**

Area $= 4 \times 16 + \frac{1}{2} \times 16 \times 16 \times \sin 60^\circ$ (1)

4×16 or $\frac{1}{2} \times 16\sqrt{16^2 - 8^2}$

$= 64 + 128 \sin 60^\circ$

$= 174.85125\ldots 7$

$= 174.85 \text{ cm}^2$ (1)

If only 4×16 correct gains $\frac{1}{2}$

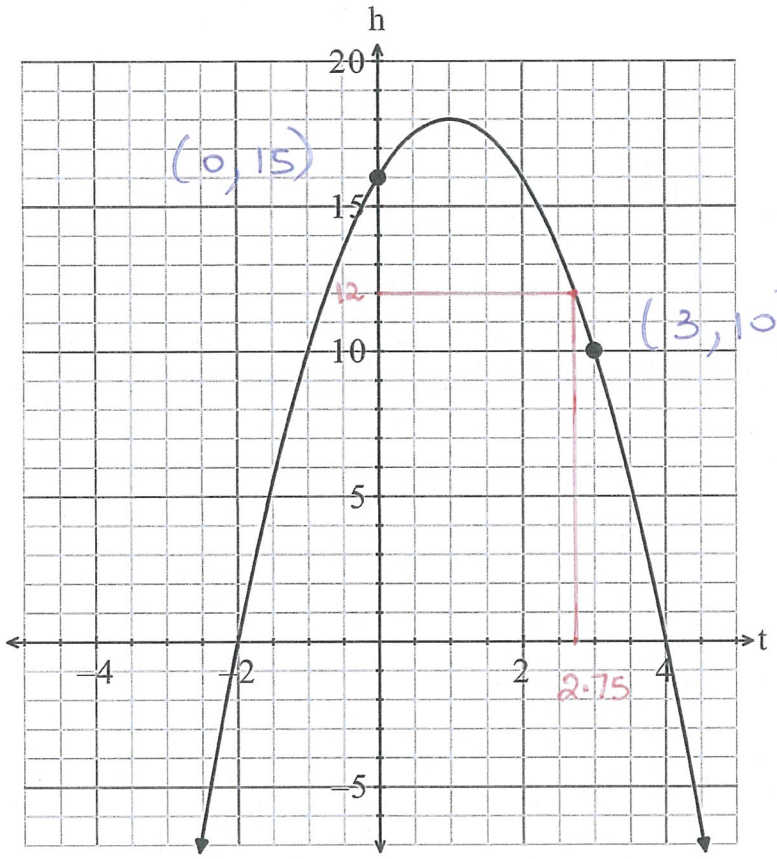
Generally well done.

Questions 27 (5 marks) **Marks**

After a ball is thrown off a building, the height of the ball can be modelled by the equation below.

$$h = at^2 + 4t + c$$

t is time in seconds after the ball is thrown off the building, and h is the height of the ball above the ground in metres.
The graph shows the height of the ball above the ground after t seconds.
Two points are also shown on the graph.



(a) Only a part of the graph applies to this model. Find all values of t that are **not** suitable to use with this model and explain why these values are not suitable. **2**

- values of $t < 0$, because time cannot be negative
- values of $t > 4$, because the ball hits the ground at $t = 4$ (it can't hit below ground).

most achieved at least 1 mark.

Questions 27 (continued)

Marks

(b) Using the information provided, find the values of a and c. **3**

Hence or otherwise, find the height of the ball when $t = 2.75$ seconds.

when $t=0$, $h=16$

$\therefore c=16$

ie $h = at^2 + 4t + 16$ (1)

when $t=3$, $h=10$:

$10 = a(3)^2 + 4(3) + 16$

$10 = 9a + 12 + 16$

$-18 = 9a$

$\therefore a = -2$

$\therefore h = -2t^2 + 4t + 16$ (1)

When $t=2.75$: $h = -2(2.75)^2 + 4(2.75) + 16$

$= 11.875$ m (1)

or from graph $h \doteqdot 12$ m

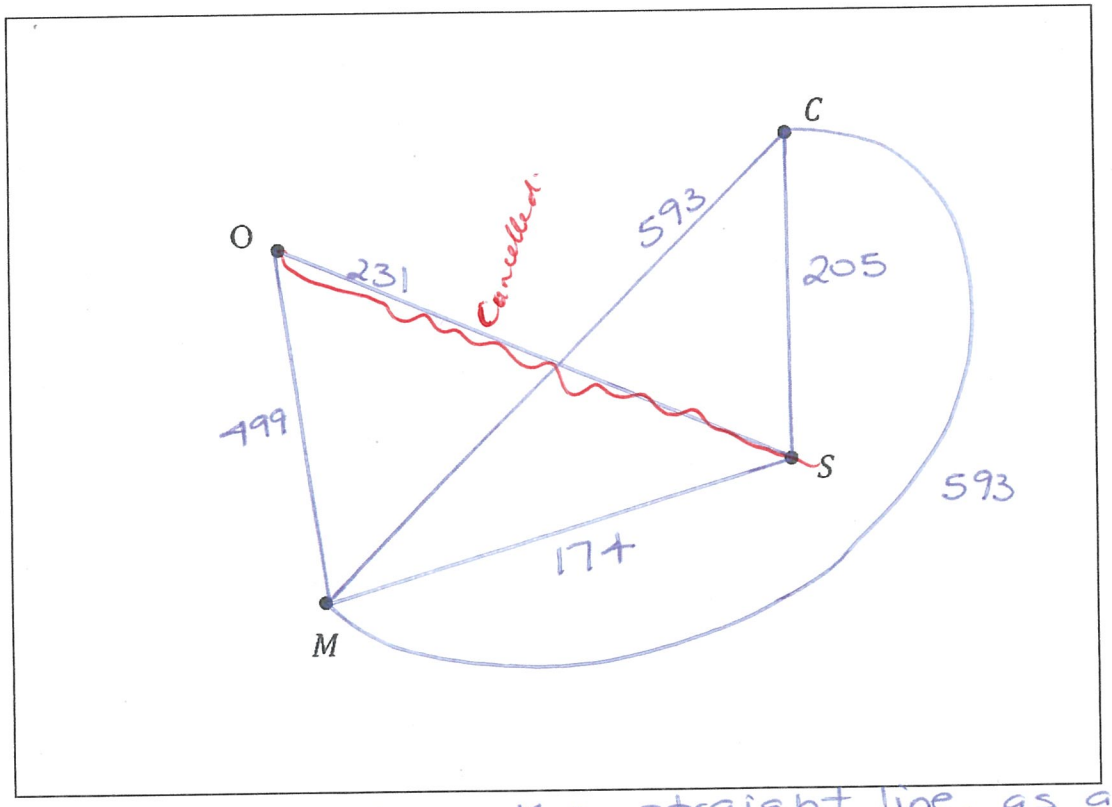
this was difficult for many students.

Questions 28 (4 marks) **Marks**

The network shown in the table below gives the cost of flights between four airports. For example, the cost between Sydney and Coff Harbour is $205.

City	Sydney (S)	Coff Harbour (C)	Orange (O)	Melbourne (M)
(S)	-	$205	$231	$174
(C)	$205	-	-	$593
(O)	$231	-	-	$499
(M)	$174	$593	$499	-

(a) Using the vertices given, draw a weighted network diagram to represent the information shown in the table. **2**



• MC can be the straight line as above

OR • MC can be curved as above

✱ this part was well done

Questions 28 (continued) **Marks**

(b) A passenger had to fly from Orange to Coffs Harbour in an emergency. They intended to take the cheapest route, but when they went to book the flights they found that all the Orange to Sydney services had been cancelled for the day. They booked the cheapest route that did NOT include a flight from Orange to Sydney. What was the percentage increase in the cost of their flights due to the cancelled services? Answer as a percentage correct to 1 decimal place. **2**

O → M → S → C = $499 + $174 + $205 ½
= $878

O → S → C = $231 + $205 ½
= $436

Extra cost = $878 − $436 ½
= $442

Percentage increase = $\frac{442}{436} \times 100$

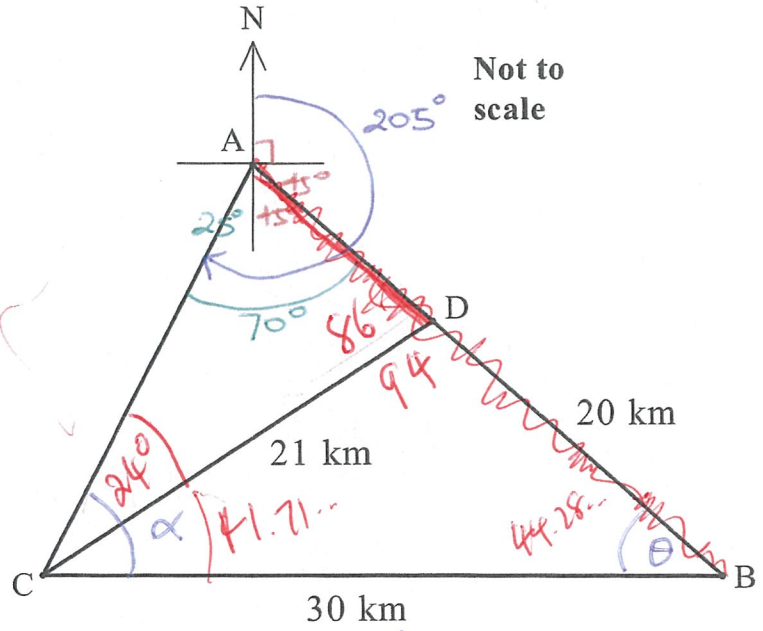
= 101.376 1468 % ½

= 101.4 %

Students didn't always calculate the extra cost correctly and/or found percentage increase difficult.

Questions 29 (3 marks) **Marks**

In the diagram below, AB is a road running in the south-east direction, C is an observatory on a bearing of 205° from A, and $BC = 30$ km.
A man travels along the road from B to A. After walking 20 km to D, he is 21 km from C.
Calculate how far the man is from A. Give your answer correct to the nearest kilometre. **3**



AD = ?

AD = AB − DB

let $A\hat{B}C = \theta$ and $A\hat{C}B = \alpha$

In ΔBDC...

$\cos\theta = \frac{20^2 + 30^2 - 21^2}{2 \times 20 \times 30}$

$= \frac{859}{1200}$

$\theta = 44.288446446°$ (1)

$44° 17' 18.47''$

In ΔABC...

$\alpha = 180° - 70° - \theta$

$= 65.71153554°$ (1)

$\approx 65° 42'$

In ΔABC...

$\frac{AB}{\sin\alpha} = \frac{30}{\sin 70°}$

$AB = \frac{30\sin\alpha}{\sin 70°}$ (½)

$AD = AB - DB$

$= \frac{30\sin\alpha}{\sin 70°} - 20$

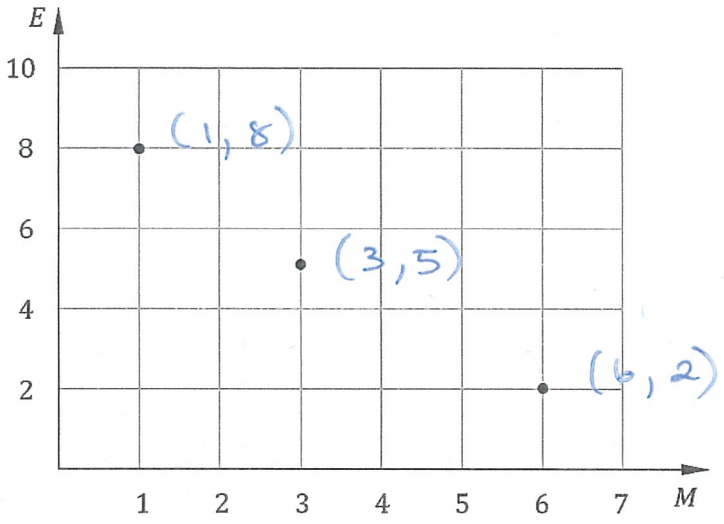
$= 9.099497734$

$\therefore AD = 9$ km (½)

other methods also used. Many found this challenging and only achieved part marks.

Questions 30 (3 marks) **Marks**

A set of bivariate data was collected by recording the marks students received in a Music quiz, M, and an Economics quiz, E. In each quiz students gained either 0 marks or 1 mark for each question. The graph shows a scatterplot of these measurements.



(a) Calculate Pearson's correlation coefficient for the data, correct to 2 decimal places. **1**

$r = -0.993399\,2678$

$= -0.99$

(b) Identify the direction and strength of the linear association between M and E. **1**

Direction : Negative (as Music marks increase, Economics marks decrease)

Strength : Strong (the value of r is very close to -1)

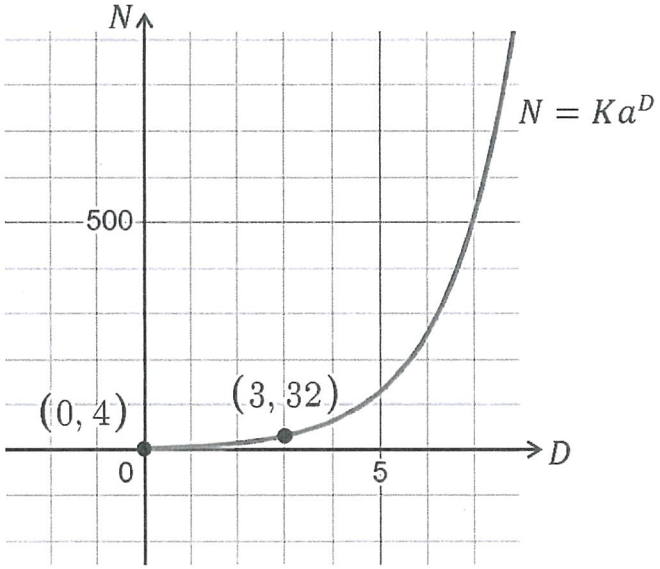
(c) Another student was absent for the Economics quiz but achieved 10 marks in the Music quiz. **1**
By creating a line of best fit or otherwise, explain why the student's Economics mark could not be estimated using the association between M and E for the other students.

- Attempting to estimate the score for $M=10$ requires extrapolation far beyond the given data range ($M=1$ to $M=6$)
- From the trend line, a mark of 10 for Music would give a negative mark for Economics which is not possible.

quite well done

Questions 31 (3 marks) **Marks**

A flu virus spreads in a little town on an island.
The number of people N infected D days after the virus started to spread can be modelled by the equation $N = Ka^D$, where K and a are constants.
The graph shows the number of people N infected after D days.



Using the information shown on the graph, find the number of people infected after 10 days. **3**

using (0, 4): $4 = ka^0$

$4 = k \times 1$

$\therefore k = 4$ ①

$N = 4a^D$

using (3, 32): $32 = 4a^3$

$a^3 = 8$

$a = 2$ ①

$\therefore N = 4 \cdot 2^D$

when $D = 10$:

$N = 4 \times 2^{10}$

$= 4096$ people infected after 10 days. ①

This proved difficult for many. 24

- Substituting (0,4) to find k proved a difficult first step for many
- worth revising before final exam.

Questions 32 (4 marks) **Marks**

The Australian income tax table for the 1999 – 2000 financial year is shown.

Taxable income	Tax on this income
0 –$5400	Nil
$5401–$20 700	20 cents for each $1 over $5400
$20 701–$38 000	$3060 plus 34 cents for each $1 over $20 700
$38 001–$50 000	$8942 plus 43 cents for each $1 over $38 000
$50 001 and over	$14 102 plus 47 cents for each $1 over $50 000

Australia uses a progressive tax system in which the amount of tax an individual pays depends on their taxable income.
Leanne pays $4216 in income tax under Australia's progressive tax system.

(a) Determine Leanne's total taxable income under the progressive tax system. **2**

let Leanne's taxable income = x

$4216 = 3060 + 0.34(x - 20\,700)$

$1156 = 0.34(x - 20\,700)$

$3400 = x - 20700$

$x = 3400 + 20700$

$\therefore$ Taxable income = $\$24\,100$

1 mark for significant progress

this proved difficult for some students... check solutions for suggested method

(b) If this system were replaced by a 15% flat rate tax system, individuals would be taxed at a rate of 15% regardless of their income. Calculate the amount of income tax Leanne would pay under the 15% flat rate system. **1**

Leanne's tax payable = 15% × $24 100

$\therefore$ Flat tax = $3615

(c) Hence, determine whether Leanne would save money under the flat rate system and by how much. **1**

$\therefore$ Leanne would save = $4216 − $3615

= $601

$3615 < $4216

$\therefore$ she saves $601 less than her progressive tax.

Questions 33 (4 marks) **Marks**

The table shows the number of hours that 12 students spent studying in the week leading up to a test and the score that each student achieved.

Hours spent studying x	1	2	2	3	3	4	4	5	5	6	7	8
Score y	52	55	58	61	63	67	65	72	70	78	82	88

(a) Find the equation of the least-squares regression line. Give answers to 2 decimal places. **2**

$y = Bx + A$

From calculator: $A = 46.20469799 = 46.20$ ½

$B = 5.130872483 = 5.13$ ½

$\therefore y = 5.13x + 46.20$ 1

(b) Interpret the y - intercept of the least-squares regression line found in part (a) in the context of the dataset and explain the limitations of using this value. **2**

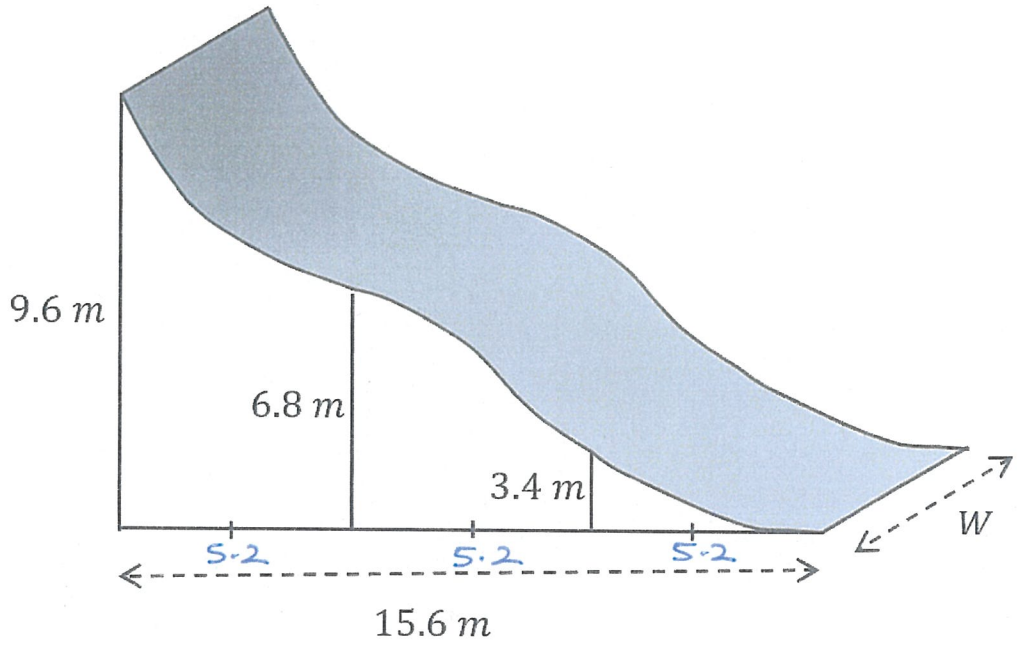
The y-intercept is 46.20, it indicates that if a student spent 0 hours studying in the week leading upto the test they would achieve a score of 46.20. 1

But, the table or dataset does not include $x = 0$, so this value is an extrapolation and so may not be accurate. 1

Students who new how to use the calculator generally well done

Questions 34 (4 marks) **Marks**

The diagram shows a slide in a fun park. The slide has a curved surface on the top and a uniform cross-sectional area in the front as shown.
Also, its left side and its base are rectangular faces.



(a) Use three applications of the trapezoidal rule to find an approximate area for the cross section. **2**

$A = \frac{5.2}{2}[9.6+6.8] + \frac{5.2}{2}[6.8+3.4] + \frac{5.2}{2}[3.4+0]$ (1)

$= 78 \text{ m}^2$

generally well done (1)

(b) If the curved area on the top is 169.68 m^2 and the total surface area of the slide (including the base) is 537.36 m^2, what is an approximate value of the width W? **2**

$SA = 169.68 + 2\times 78 + 9.6W + 15.6W$

$537.36 = 325.68 + 25.2W$ (1)

$211.68 = 25.2W$

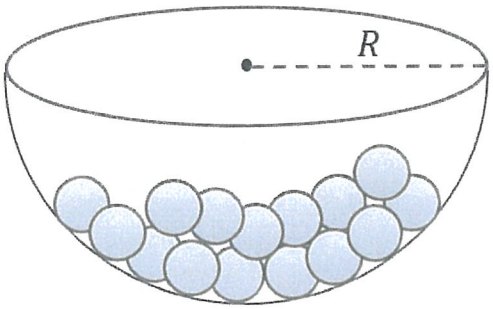
some students didn't consider every surface in the S.A.

$W = \frac{211.68}{25.2}$

$\therefore W = 8.4 \text{ m}$

Questions 35 (4 marks) **Marks**

Peter placed 15 identical small spherical marbles each of radius 2 cm in a large hemispherical bowl of radius R.



The volume of the empty space in the bowl is $992\pi\ cm^3$. **4**
What is the radius R of the hemispherical bowl?

V of 15 marbles $= 15 \times \frac{4}{3}\pi \times 2^3$

$= 160\pi\ cm^3$ (502.6...) — (1)

V of hemispherical bowl $= \frac{1}{2} \times \frac{4}{3}\pi \times R^3$

$= \frac{2}{3}\pi R^3$ — (1)

V of bowl = V of 15 marbles + the empty space

$\frac{2}{3}\pi R^3 = 160\pi + 992\pi$ — (1) (3619.11...)

$\frac{2}{3}\pi R^3 = 1152\pi$

$R^3 = \frac{1152 \times 3}{2}$

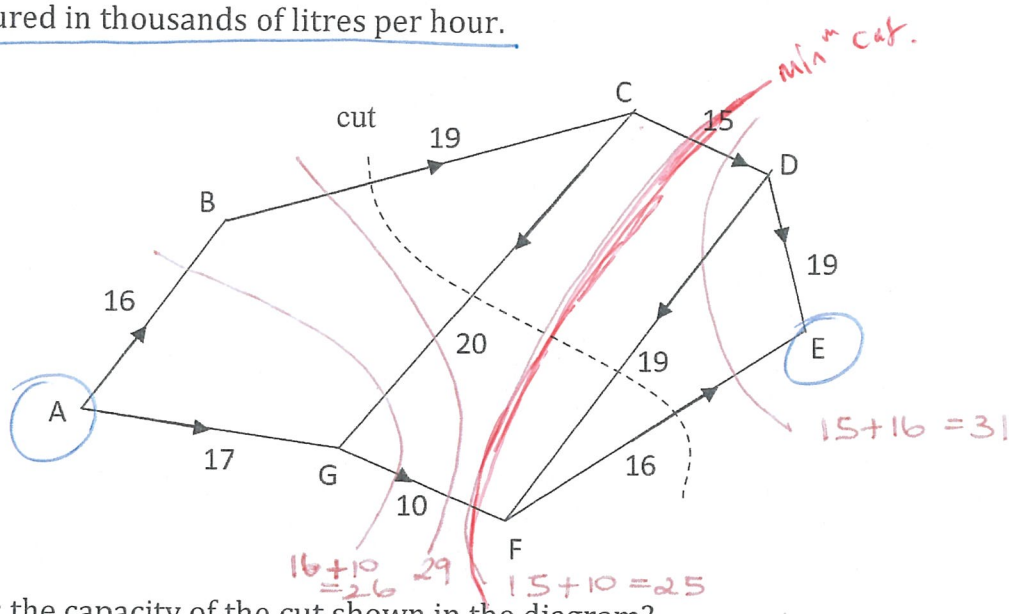
$R = \sqrt[3]{1728}$

$\therefore R = 12\ cm$ — (1)

* lots of students forgot it was a hemi-sphere - not a sphere.
* students who were confident working with π produced better working (easier to follow) were generally successful)

Questions 36 (5 marks) **Marks**

Water is to be pumped through a field, from the source at A to the sink at E, using a series of pipes from pumping station locations, labelled A to G.
The network diagram below shows the maximum flow rate through each of these pipes, measured in thousands of litres per hour.



(a) What is the capacity of the cut shown in the diagram? **1**

Capacity = 19 + 16
= 35

(b) Calculate the maximum flow of this network. **2**

Minimum cut passes through CD & GF.
Max. flow = min. cut = 15 + 10 = 25 ∴ Max. flow is 25 000 L

(c) The owners of this field want to increase the flow of water through one of the pipes in order to increase the maximum flow of this network. **2**
Which pipe should they choose, and what is the minimum amount by which its flow should be increased in order to maximise the amount of water flowing through this network?

• to increase the max. flow of the network we should change one of the pipes in the min. cut.

to increase the size of the minimum cut through CD & GF

GF is ~~seems~~ more suitable at 6 thousand litres per hour to GF as FE can only take 16 000 Litres!

this should increased the overall max^m flow in the network from (25 thousand to 31 thousand) litres/h.

5

Question 36

a) The capacity of the cut shown is $19 + 16 = 35$. The two pipes in the other direction are not included in the total.

b) The minimum cut for this network passes through CD and GF. The maximum flow is equal to the minimum cut, which is $15 + 10 = 25$.
So, the maximum flow is 25 000 litres per hour.

c) To increase the maximum flow of the network we should change one of the pipes in the minimum cut.
As AB is 16, the largest amount that could travel through CD is 16, an increase of just 1000 litres per hour.

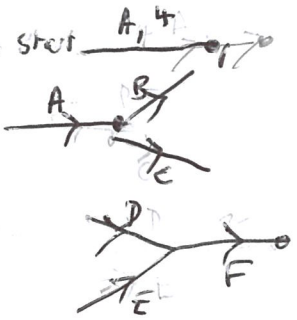
As AG is 17, GF could be increased from 10 to 17, and an additional 1 could be added to GF, which is the excess amount coming through CG.
However, as FE has a capacity of 16, there is no gain in increasing GF by any more than 6, from 10 to 16. This will increase the maximum flow of this network from 25 000 litres per hour to 31 000 litres per hour.

Questions 37 (5 marks) **Marks**

The activity table shows the tasks required to complete a construction project.

Since D and E have some, but NOT all the same predecessors, dummy needed from B to C

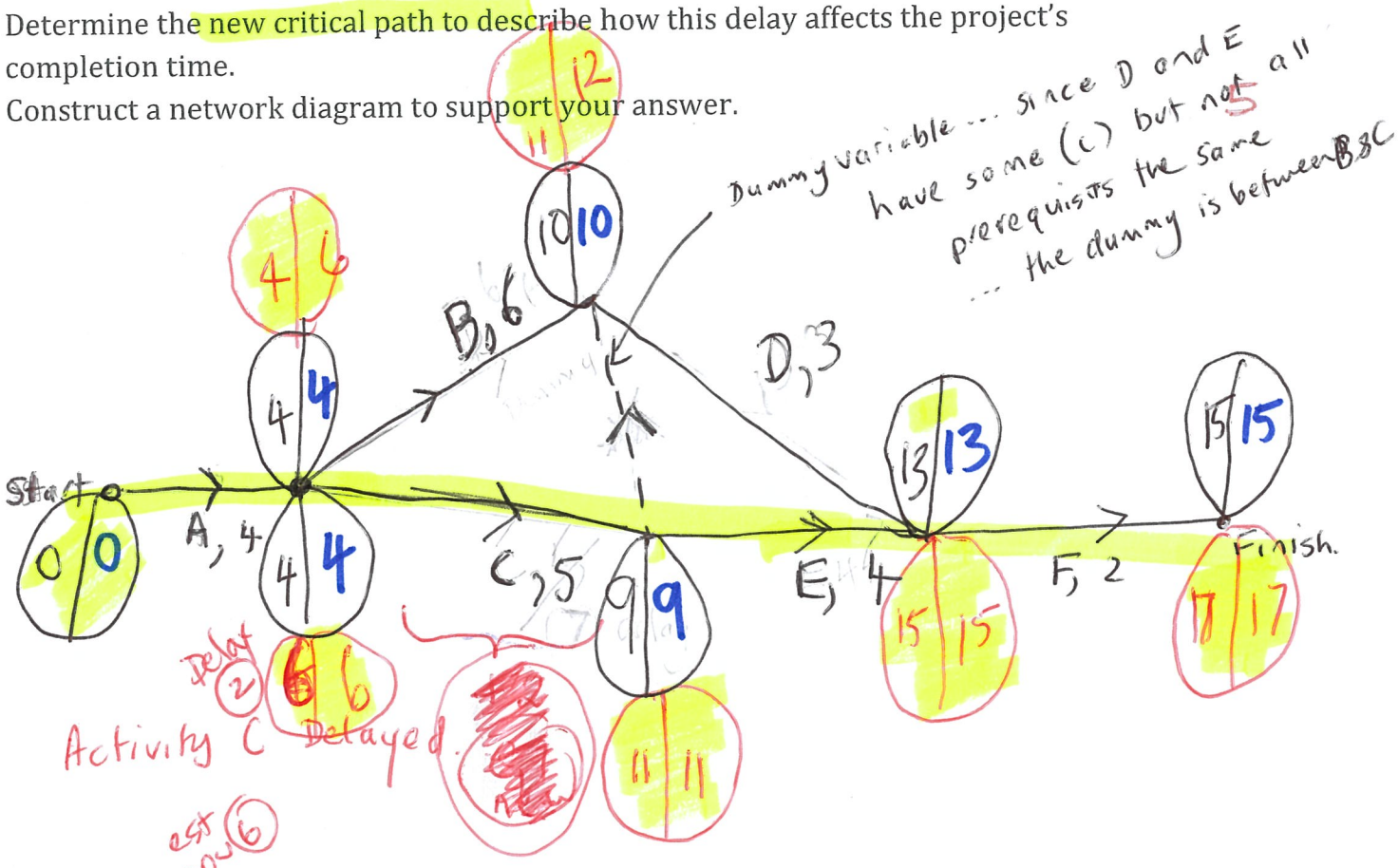
Activity	Prerequisite/s	Duration (days)
A	–	4
B	A	6
C	A	5
D	B, C	3
E	C	4
F	D, E	2



Activity C is delayed by two days.

Determine the new critical path to describe how this delay affects the project's completion time.

Construct a network diagram to support your answer.

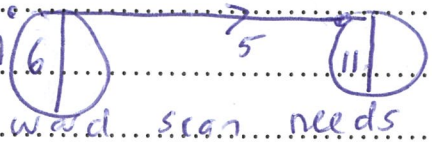


A - C - E - F New critical path.

Explanation:

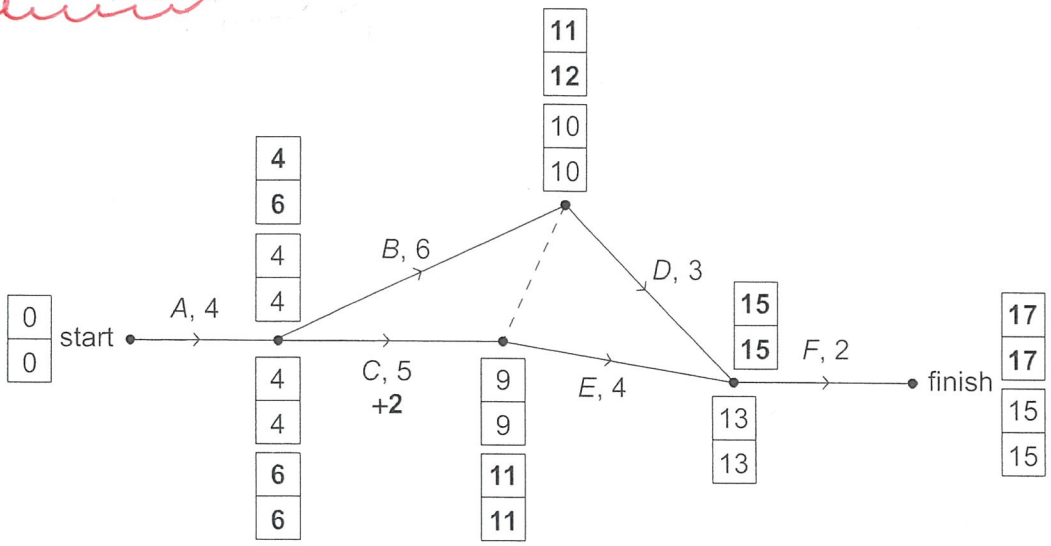
The critical path will be A C E F

A new forward and backward scan required at the rest of the forward and backward scan needs to be redone to create a diagram to calculate the critical path after the delay.



Previously, there were no float times for any activities but the delay extended the project from 15 to 17 days, the critical path A - C - E - F allowing some float times for activites B(2) & D.(1)

Question 37 continued



The network diagram shows that the original completion time is 15 days. Delaying activity C by two days means that the earliest starting time (EST) and latest starting time (LST) of the other activities are affected *(the new EST and LST for each activity are shown in bold)*. This means that the project's completion time is also delayed by two days and has a new completion time of 17 days. Therefore, the new critical path is $A - C - E - F$.

MS–N3 Critical Path Analysis (MS2–12–8) Bands 5–6

- Provides the correct solution 5

- Constructs a network diagram.
  AND
- Outlines the effect of the delay.
  AND/OR
- States the new critical path 4

- Constructs a network diagram.
  AND
- Finds the original completion time.
  AND
- Outlines the effect of the delay 3

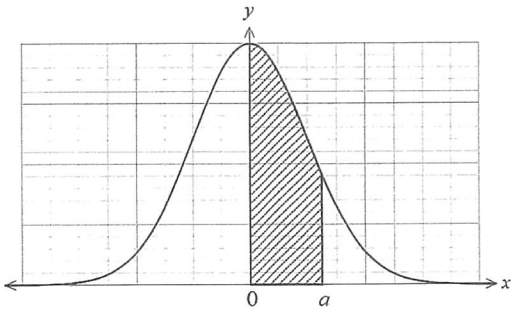
- Constructs a network diagram with minor errors.
  AND
- Uses critical path analysis to provide some relevant information 2

- Attempts to construct a network diagram 1

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Questions 38 (5 marks) **Marks**

The table below shows the percentage of scores which lie between $z = 0$ and $z = a$, where a is a positive value, for a normal distribution. Symmetry properties of the distribution can be used to determine other percentages.



z-score	Percentage	z-score	Percentage	z-score	Percentage
0.0	0.00	1.0	34.13	2.0	47.72
0.1	3.98	1.1	36.43	2.1	48.21
0.2	7.93	1.2	38.49	2.2	48.61
0.3	11.79	1.3	40.32	2.3	48.93
0.4	15.54	1.4	41.92	2.4	49.18
0.5	19.15	1.5	43.32	2.5	49.38
0.6	22.57	1.6	44.52	2.6	49.53
0.7	25.80	1.7	45.54	2.7	49.65
0.8	28.81	1.8	46.41	2.8	49.74
0.9	31.59	1.9	47.13	2.9	49.81

The ages (in years) of the members of the Martin Bay Tennis Club are normally distributed with a mean of 32 and a standard deviation of 16.0. $\bar{x} = 32$ $s = 16$

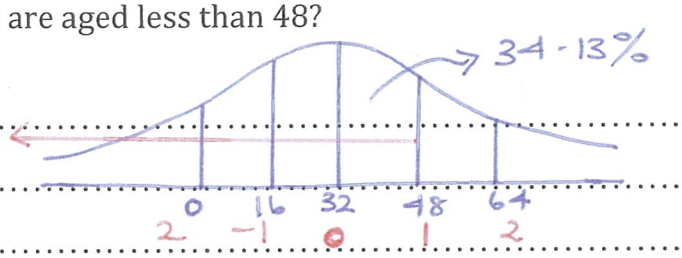
(a) Convert an age of 48 to a z-score. **1**

$Z = \frac{48 - 32}{16} = 1$

(b) What percentage of the members are aged less than 48? **1**
Answer as a whole percentage.

$Z = 1$

34·13%



50% + 34·13%

= 84·13%

= 84%

Questions 38 (continued) **Marks**

(c) If there are 60 members of the club, how many of them are aged between 8 and 40? **3**

$x = 8$: $x = 40$:

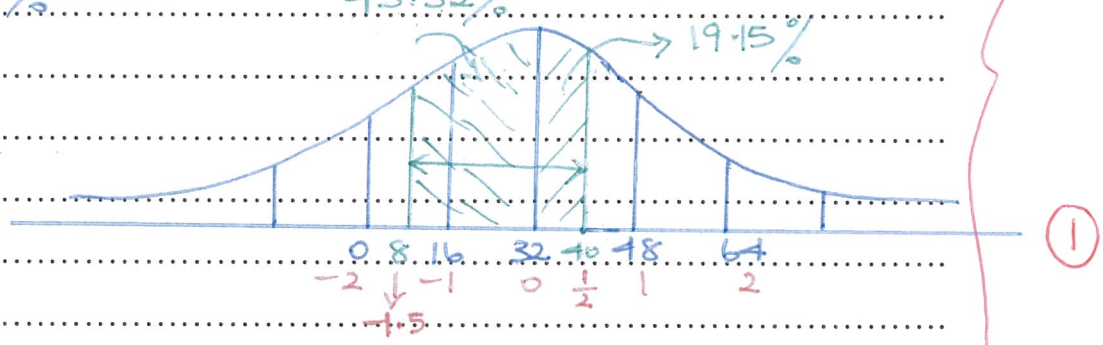
$Z = \frac{8-32}{16}$ $Z = \frac{40-32}{16}$ (1)

$= -1.5$ $= \frac{1}{2}$

From table: From table: 19.15%

$Z = 1.5$ (equivalent to $z = -1.5$)

43.32%



(1)

Between -1.5 and 0.5

$= 43.32\% + 19.15\%$

$= 62.47\%$

∴ No. of members between 8 and 40

$= 62.47\% \times 60$

$= 37.482$

$= 37$ (1)

(38 gave mk)

Questions 39 (4 marks) **Marks**

The tables below show the future values and present values of annuities of $1 for a variety of periods and interest rates. Contributions are made at the end of each period.

Future Value of an Annuity of $1.00

Years	Interest Rate Per Annum							
	5%	6%	7%	8%	9%	10%	11%	12%
6	6.802	6.975	7.153	7.336	7.523	7.716	7.913	8.115
7	8.142	8.394	8.654	8.923	9.200	9.487	9.783	10.089
8	9.549	9.897	10.260	10.637	11.028	11.436	11.859	12.300
9	11.027	11.491	11.978	12.488	13.021	13.579	14.164	14.776
10	12.578	13.181	13.816	14.487	15.193	15.937	16.722	17.549
11	14.207	14.972	15.784	16.645	17.560	18.531	19.561	20.655
12	15.917	16.870	17.888	18.977	20.141	21.384	22.713	24.133

First Investment

Present Value of an Annuity of $1.00

Months	Interest Rate Per Month							
	0.2%	0.3%	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%
8	7.928	7.893	7.858	7.823	7.788	7.754	7.720	7.685
9	8.911	8.866	8.823	8.779	8.736	8.693	8.650	8.608
10	9.891	9.837	9.783	9.730	9.678	9.626	9.574	9.522
11	10.869	10.805	10.741	10.677	10.614	10.552	10.490	10.428
12	11.845	11.769	11.694	11.619	11.545	11.471	11.399	11.327
13	12.820	12.731	12.643	12.556	12.470	12.385	12.300	12.217
14	13.792	13.690	13.589	13.489	13.390	13.292	13.195	13.099

Jane invested $3500 at the end of each year for 12 years into an annuity with an interest rate of 9% per annum. After 5 years, she decided to invest in an additional annuity at 6% per annum, making equal annual contributions at the end of each year for the next 7 years. She wants the total value of both annuities after 12 years to be $100 000.

To fund the annual contributions to the second annuity, Jane borrows each contribution amount at an interest rate of 6% per annum and repays it in 12 equal monthly instalments over the following year.

Calculate the amount Jane must pay back each month for the contributions to the additional annuity. **4**

Questions 39 (continued)

$r = 9\%$ pa Interest factor = 20.141

$n = 12$

∴ Future value of FIRST Annuity after 12 yrs = $20.141 \times \$3500$

$= \$70\,493.50$ (1)

Additional amount needed for 2ND Annuity

$= \$100\,000 - \$70\,493.50$

$= \$29\,506.50$ (1)

2ND Annuity has 7 yrs to run at 6% pa with annual contributions of $\$x$.

$r = 6\%$

$n = 7$ Interest factor = 8.394

$\$x \times 8.394 = \$29\,506.50$

$\$x = \frac{29506.50}{8.394}$

$= \$3515.189421$ (1)

$= \$3515.19$

$n = 12$ mths

$r = \frac{6\%}{12}$ Interest factor = 11.619

$= 0.5\%$ per month Let monthly repayment = $\$M$

$11.619 \times \$M = \$3515.19$

$\$M = \frac{\$3515.19}{11.619}$

$= 302.53808842$

$\$M = \$302.54$ per month (1)

End of Examination