Hills Grammar

Student Number: _____

Teacher Name: _____

Trial HSC Examinations 2023

Year 12

MATHEMATICS STANDARD 2

Time Allowed: 2 hours and 30 minutes (plus 10 minutes reading time)

Class Teachers: Mrs A Willson and Mr C O'Neill

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 paper
- For questions in Section II, show 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

Total marks: 100

Section I – 15 marks

- Attempt Questions 1 – 15
- Answer on Multiple Choice Answer Sheet provided
- Allow about 25 minutes for this section

Section II – 85 marks

- Attempt Questions 16 – 39
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Allow about 2 hours and 5 minutes for this section

Section I	**Your Mark:**	**15**
Section II	**Your Mark:**	**85**
Total	**Your Mark:**	**100**

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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 What is 0.003062 expressed in standard form with two significant figures?

A. 2.06×10^{-2}

B. 3.1×10^{-2}

C. 2.06×10^{-3}

D. 3.1×10^{-3}

2 Cornflour is sold in four different sized packets. Which is the best buy?

A. 1 kg for \$4.00

B. 2 kg for \$7.90

C. 100 g for \$0.45

D. 500 g for \$1.90

3 The formula $BAC_{Female} = \dfrac{10N - 7.5H}{5.5M}$ gives the Blood Alcohol Content for females, where N is the number of standard drinks consumed, H is the number of hours of drinking, and M is the person's weight in kilograms.

Calculate the *BAC* for Emma, whose weight is 70 kg, and who consumed 5 standard drinks over a period of 4 hours.

A. 0.026

B. 0.038

C. 0.052

D. 0.441

4 Which of the following measurements is the same as 2.25 m^2?

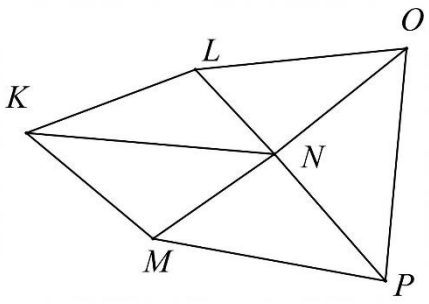
A. 22500 cm^2

B. 225000 cm^2

C. 225000 mm^2

D. 22500000 mm^2

5 A network diagram is shown below.



Which statement is true of the network?

A. All the vertices on this network are odd in degree.

B. There are 11 edges in this network.

C. The path *KMNO* forms a cycle.

D. This is a directed network.

6 On a business trip, Jacob plans to travel 2 500 km on highways and 250 km in city traffic.
His car has estimated fuel consumption rates of 6.24 L/100 km on highways and 9.36 L/100 km in city traffic.
Calculate the amount of fuel he could expect to use on the trip.

A. 156.0 litres

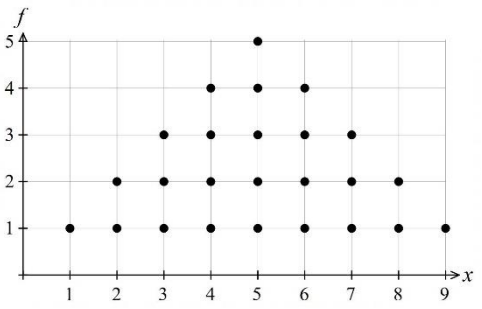
B. 179.4 litres

C. 183.9 litres

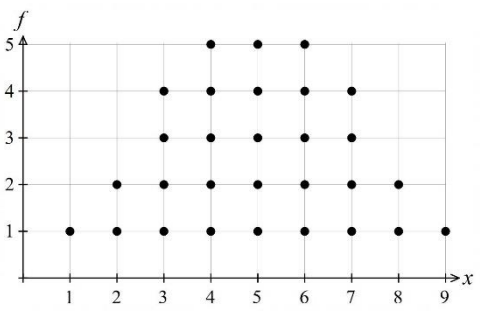
D. 390.0 litres

7 Which of the dot-plots below represents a symmetrical, bi-modal distribution?

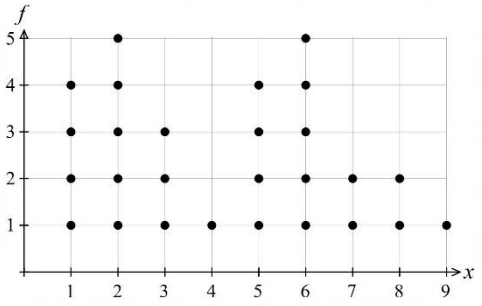
A.



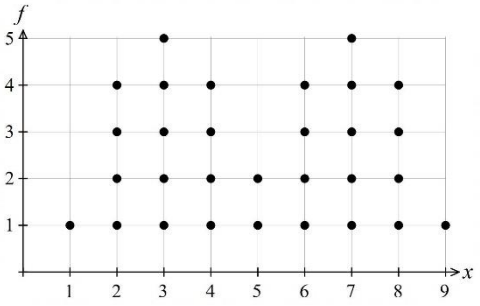
B.



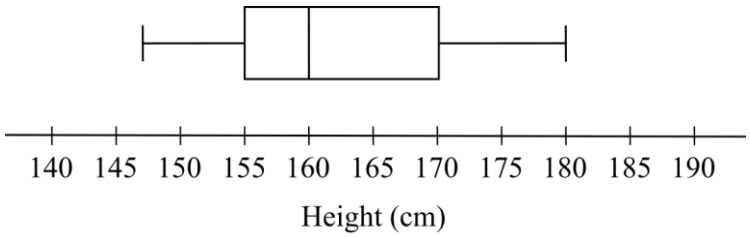
C.



D.



8 The heights of students in a class are represented in the boxplot below.



A new student, who will become the tallest member, is joining the class.

What is the maximum height the new student can be without being classified as an outlier?

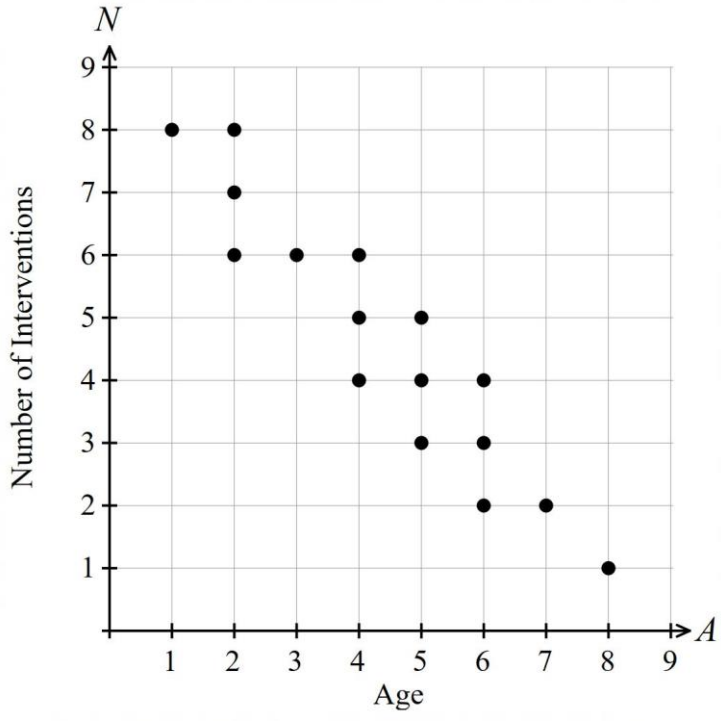
A. 187.5 cm

B. 192.5 cm

C. 197.5 cm

D. 202.5 cm

9 The scatterplot below compares the ages of rescued baby marsupials in months, with the number of veterinary interventions that were required.



Which description best fits the distribution of the bivariate data set?

A. A strong linear relationship with a Pearson's correlation co-efficient close to 1.

B. A strong linear relationship with a Pearson's correlation co-efficient close to –1.

C. A strong non-linear relationship with a Pearson's correlation co-efficient close to 1.

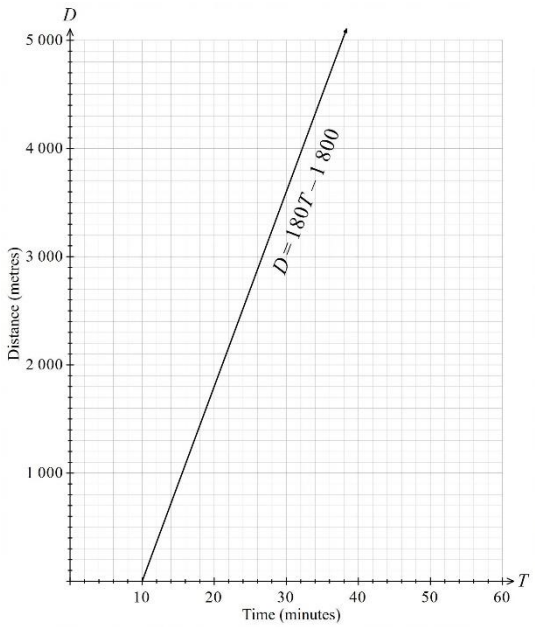
D. A strong non-linear relationship with a Pearson's correlation co-efficient close to –1.

10 The distance travelled by a person walking at a constant speed varies directly with the time that they have been walking.

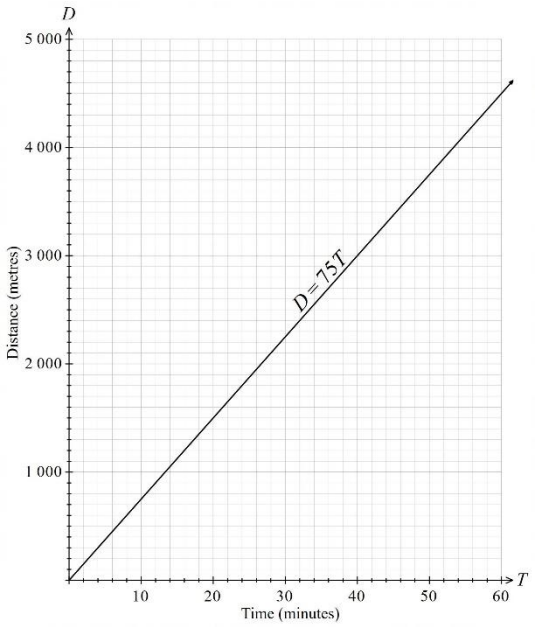
Jacob walked at a constant speed for 20 minutes and travelled a distance of 1 800 metres.

Which graph and equation below would represent this variation relationship?

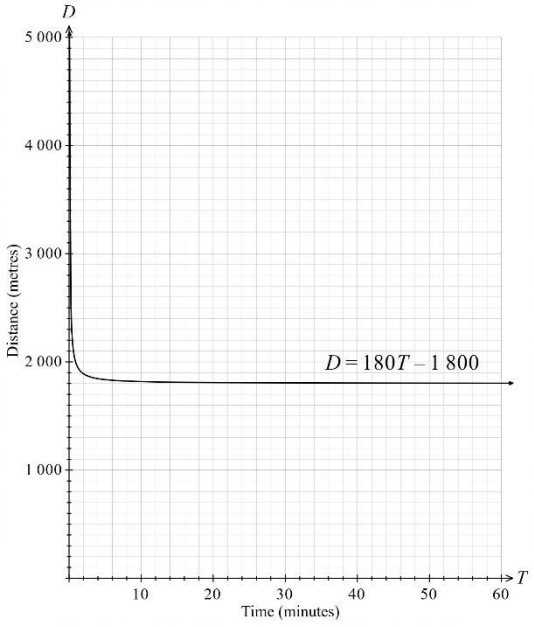
A.



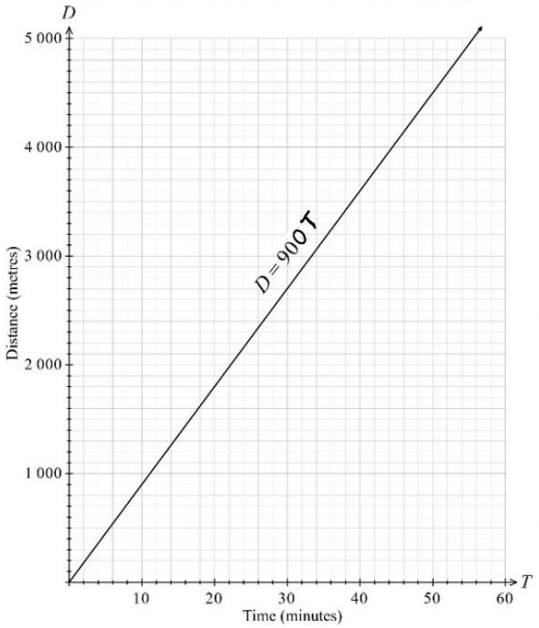
B.



C.

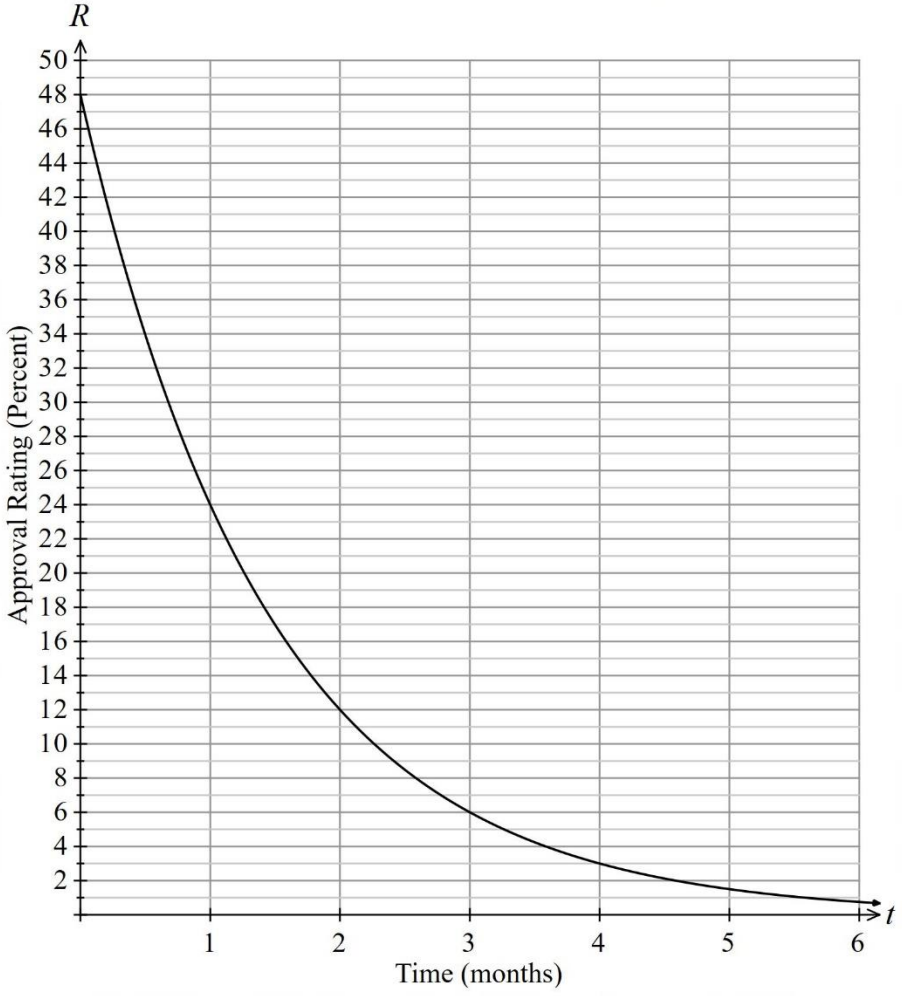


D.



11 The approval rating of a politician falls dramatically after an election. The rate of decrease can be modelled by the equation: $R = a \times b^{-t}$, where R is the percentage approval rating, t is the time in months since the election and a and b are positive constants.

The graph below shows the relationship.



Which equation could be used to model the graph shown?

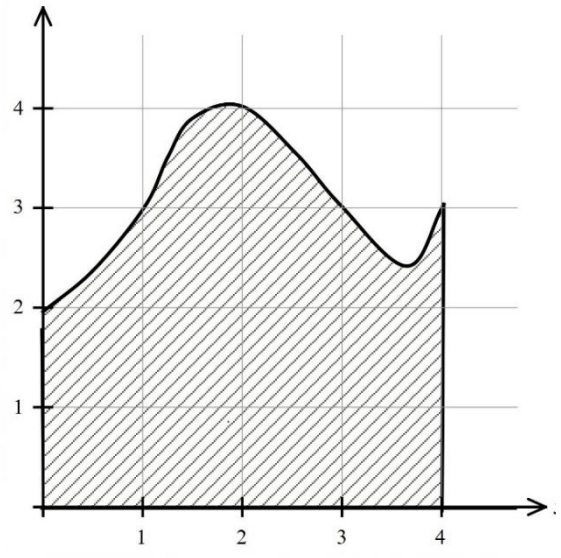
A. $R = 2 \times 48^{-t}$

B. $R = 24 \times 2^{-t}$

C. $R = 48 \times 2^{-t}$

D. $R = 48 \times 4^{-t}$

12 Using two applications of the Trapezoidal rule, find an estimate for the area of the irregular shape shown to the right. (Each square on the grid is one square unit.)



A. 12 square units

B. 12.5 square units

C. 13 square units

D. 13.5 square units

13 The table below shows the income tax rates for the 2022-2023 financial year.

Taxable income	*Tax on this income*
0 – $18 200	Nil
$18 201 – $45 000	19 cents for each $1 over $18 200
$45 001 – $120 000	$5 092 plus 32.5 cents for each $1 over $45 000
$120 001 – $180 000	$29 467 plus 37 cents for each $1 over $120 000
$180 001 and over	$51 667 plus 45 cents for each $1 over $180 000

For the 2022-2023 financial year, Janice had a taxable income of $120000, while her friend Yolanda had a taxable income of $140000.

What is the difference in the amount of tax payable by Janice and Yolanda, excluding the Medicare levy?

A. $5092

B. $7400

C. $22200

D. $29467

14 The table below shows the present value of an annuity of $1.

Table of present value interest factors

Number of periods	*Interest rate per period as a decimal*				
	0.001	0.00125	0.0015	0.00175	0.002
300	259.0707	250.0398	241.4379	233.2418	226.3477
330	280.9577	270.2690	260.1353	250.5239	240.7211
360	302.1982	289.7541	278.0106	266.9228	258.9154
390	325.2961	309.6290	297.0981	283.6291	261.9432

Thomas borrows $600 000 to purchase a home, with interest charged at 1.5% per annum, compounding monthly.

He agrees to repay the loan by making equal monthly payments over a 30-year period.

What is Thomas' monthly payment?

A. $2070.72

B. $2158.19

C. $2485.11

D. $173 852.46

15 The speeds (in km/h) which are recorded on a radar device approaching a section of road work are normally distributed, with a mean of 58 and a standard deviation of 4.

The speed limit for the section is 60 km/h and 2400 vehicles passed the radar in one day.

How many vehicles were travelling at 2 km/h above the speed limit or more?

A. 60 vehicles

B. 384 vehicles

C. 768 vehicles

D. 1 632 vehicles

Student Number: _____

Teacher Name: _____

TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Section II Answer Booklet

Section II

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

Attempt Questions 16–39 (85 marks)

Instructions

- Write your Name and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.

Please turn over

Question 16 (2 marks)

A rock is measured to be 8.0 cm in length, correct to one decimal place.

(a) Write the lower and upper bounds of this measurement. **1**

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(b) What is the percentage error in this measurement, to two decimal places? **1**

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Question 17 (2 marks)

Liam uses a 160 W refrigerator every hour of the day. What is the cost of using the refrigerator for a week if the electricity is \$0.41 per kWh? Answer correct to the nearest cent. **2**

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Question 18 (2 marks)

Jack owns 2400 shares in Ajaxian Pty Ltd, which had a share price of \$32.80 per share at the end of the financial year. **2**

Last financial year Jack was paid dividends by Ajaxian of \$2.05 per share.

Calculate Jack's dividend yield on his shares for the financial year, to two decimal places.

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Question 19 (2 marks)

A bank charges 0.0603% compound interest per day on the amount owing on a credit card. **2**

What is the interest charged in three weeks on a balance of $1500?

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Question 20 (3 marks)

Sandy is on holiday in San Francisco and wants to stream a Matilda's World Cup match which is played in Sydney on Monday 31st July and starts at 3:00 pm. **3**

San Francisco is located at UTC –8 and Sydney at UTC +10.

San Francisco is subject to daylight saving in July and August, but Sydney is not.

At what time and date in San Francisco should Sandy start streaming the match?

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Question 21 (4 marks)

Two teams of athletes were compared on their endurance, as measured by the number of repetitions that they could complete of a short, mixed-activity training circuit. The results are shown in the back-to-back stem-and-leaf-plot below.

Team A					Team B			
	8	6	5	0	2	6		
8	7	7	4	1	3	7	9	
	7	2	0	2	2	4	5	8
		3	1	3	4	6	7	
			0	4				

(a) What was the difference between the two teams in terms of the median number of repetitions? **2**

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(b) Given that Team B has an interquartile range of 16, show that Team A has a larger interquartile range, and explain what this means in terms of statistical comparison. **2**

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Question 22 (2 marks)

Change the subject of the formula $H = \frac{5p + k}{2}$ to p. **2**

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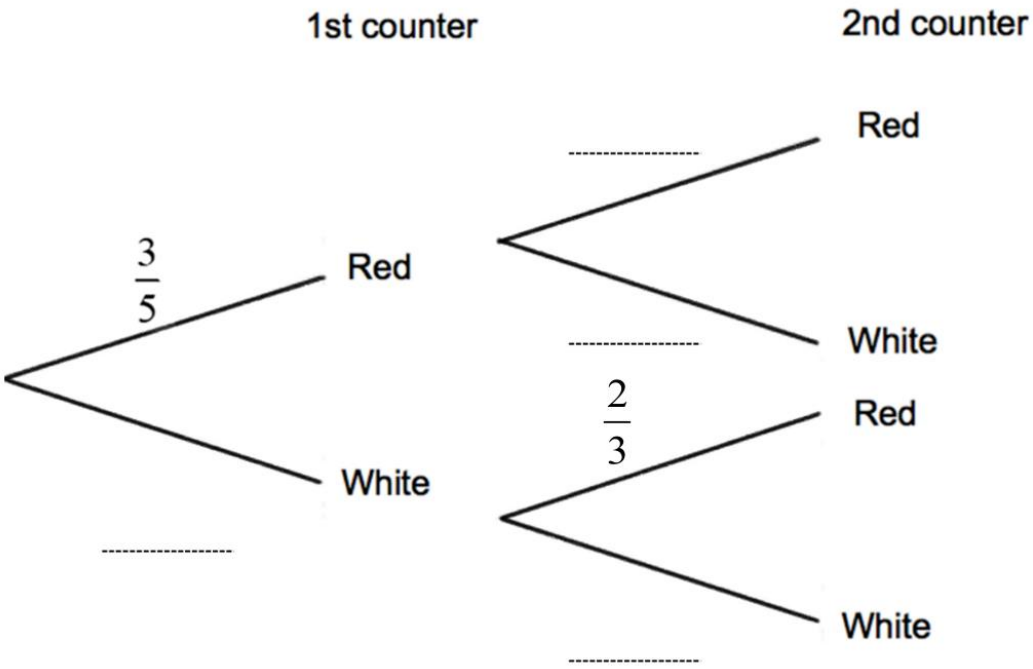
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Question 23 (4 marks)

Zoey has a bag of counters. There are 6 red and 4 white counters. She takes out a counter at random and records its colour. Without replacement, Zoey takes out another counter at random.



(a) Complete the probability tree diagram. **2**

(b) Find the probability that Zoey selects two counters that are the same colour. **2**

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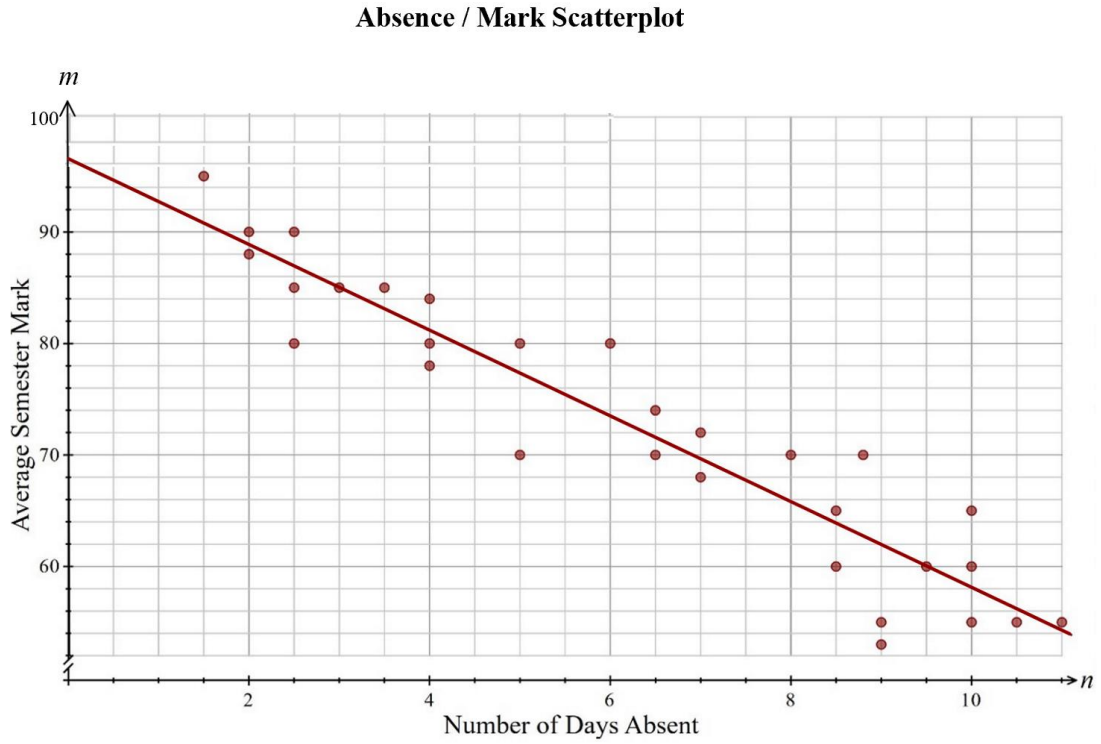
Question 24 (3 marks)

	A	***B***	***C***	***D***	***E***
A	–	3	–	4	6
B	3	–	1	–	–
C	–	1	–	2	5
D	4	–	2	–	7
E	6	–	5	7	–

Represent the table shown above as a weighted network. **3**

Question 25 (4 marks)

Mr Jensen records the number of days that each student in his Year 11 class is absent during Semester 1, and he also works out their average test mark as a percentage.



He draws the scatterplot below to help him in his discussions with his students in relation to their absences.

(a) Find the gradient of the line of best fit, correct to two decimal places. **2**

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(b) Hence, or otherwise, write the equation of the line of best fit in terms of the variables m and n. **1**

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(c) Mr Jensen calculated the correlation coefficient of the scatterplot to be -0.9419. Describe the strength and association between the number of days Mr Jensen's Year 11 students are absent and their average test mark in Semester 1. **1**

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Question 26 (5 marks)

A punch is made from orange juice, lemonade and mango juice in the ratio 8 : 5 : 1.

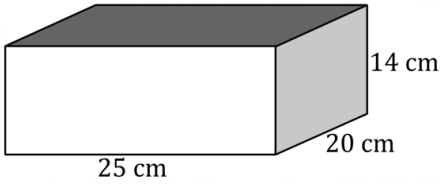
(a) How much lemonade is needed if the punch is to contain 2 litres of orange juice? **2**

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(b) The internal dimensions of a bowl, in the shape of a rectangular prism, are shown below. **3**



Not to scale

To completely fill the bowl with the punch, how many litres of orange juice are required?

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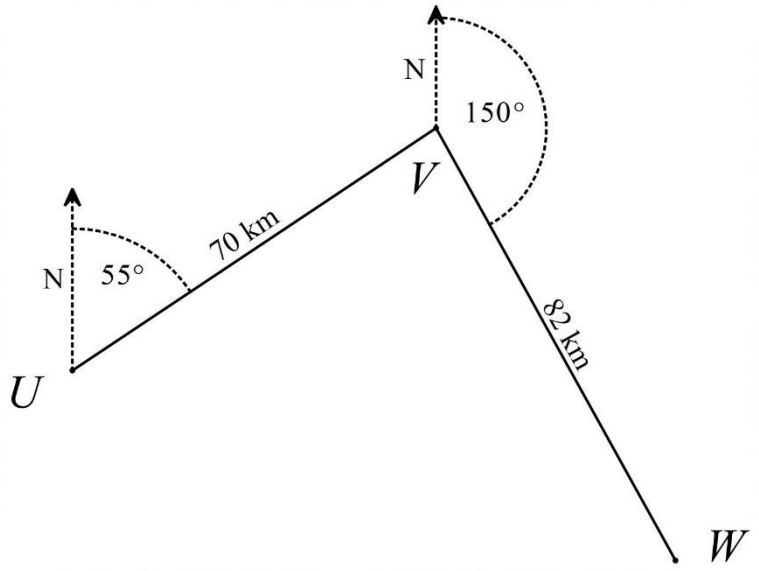
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Question 27 (5 marks)

A helicopter leaves Underwood and flies 70 km on a bearing of 055^o to Vanna Beach.
It then flies 82 km on a bearing of 150^o to Weston.

The diagram below illustrates the journey.



(a) Calculate, to the nearest kilometre, the distance that the helicopter will fly from Weston directly back to Underwood. **2**

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(b) Determine the bearing (from Weston) on which it should fly to return to Underwood, to the nearest degree. **3**

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Question 28 (5 marks)

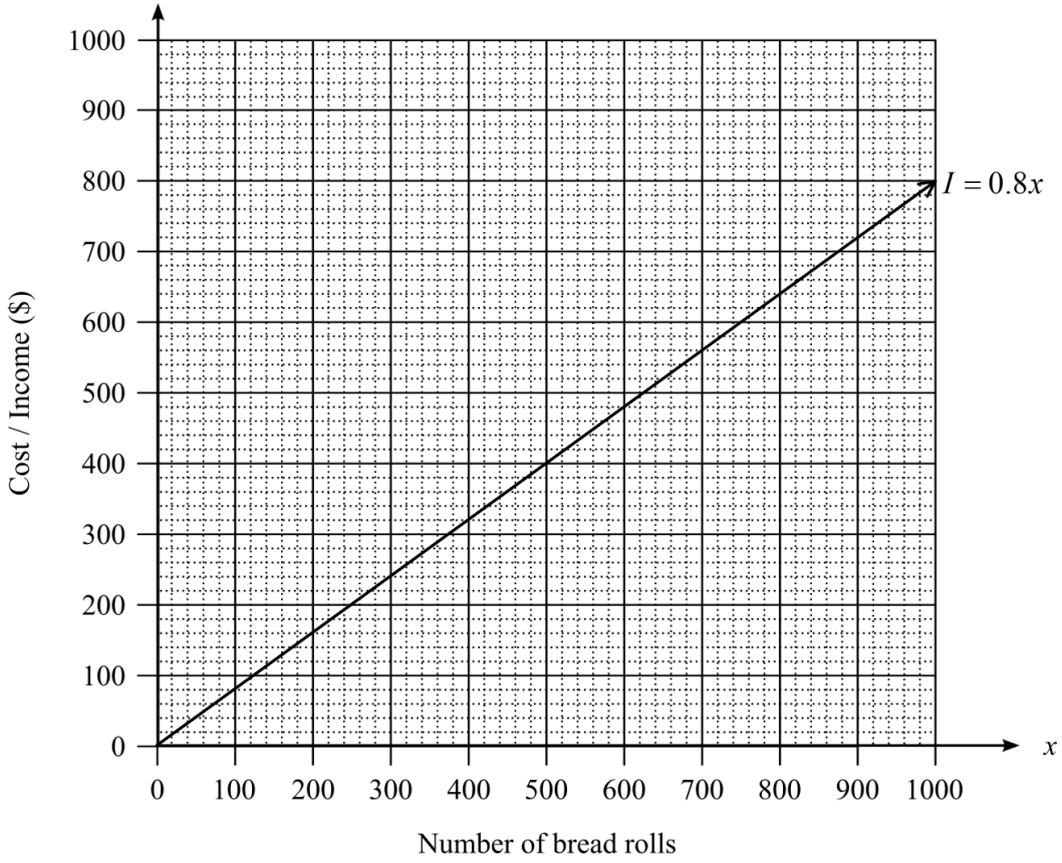
Buns & Roses sells bread rolls for \$0.80 each. The cost, C dollars, of making x bread rolls is given by $C = 300 + 0.2x$.

(a) What is the cost of making 1000 bread rolls? **1**

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(b) On the grid below, the income graph is shown. Draw the cost graph, $C = 300 + 0.2x$. **2**



Hence, find the number of bread rolls that must be sold to break-even.

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(c) Determine how many bread rolls must be sold to make a profit of \$240. **2**

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Questions 16 – 28 are worth 43 marks in total.

Question 29 (4 marks)

Tahnee bought a car for use with her small business for $24 000. For taxation purposes she needed to work out a depreciated value of the car each year.

She initially decided to do this using the declining balance method at a rate of 25%.

(a) What will be the car's value after 8 years? **2**

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(b) She decided to change to the straight-line method of depreciation, as calculations were easier, but wants the value after eight years to be the same as she calculated using the declining balance method. **2**

By what amount should she depreciate the car each year, and what percentage is this of the car's original value?

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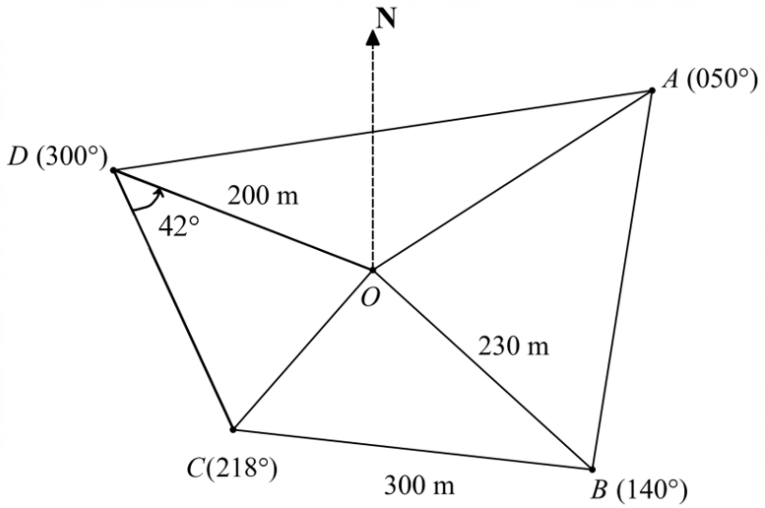
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Question 30 (7 marks)

Richie has inherited a large plot of land from a distant relative. The radial survey of the plot is shown below.



(a) Find the size of $\angle AOD$. **1**

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(b) Given that the area of triangle AOD is 28661 m^2, calculate the length of OA, correct to the nearest meter. **2**

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Question 30 is continued in the next page.

Question 30 Continued…

(c) In triangle *COD*, it is given that $\angle CDO = 42°$. Find the length of the boundary *CD*, correct to the nearest meter. **3**

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(d) A scale drawing of the field is completed with a scale of 1 : 500. **1**

What is the length (in millimetres) of the boundary *BC* on the drawing?

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Question 31 (4 marks)

The number of ants, (*n*), to break up a sandwich and carry it away, is inversely proportional to the time, (*t* in minutes), taken for the ants to perform the task.

If there are 20 ants, then it takes 42 minutes for the sandwich to be taken to the nest.

(a) Write an equation to describe the relationship and find the constant of proportionality. **2**

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(b) How many ants would it take to carry the sandwich in 1 hour and 10 minutes? **2**

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Question 32 (3 marks)

Jelena borrows \$24 000 through a reducing balance loan.

Interest is calculated monthly (with each month considered as $\frac{1}{12}$ of a year).

Repayments of \$800.00 are deducted each month after the interest is added.

Jelena uses the spreadsheet below, to show the progress of the loan.

	A	B	C	D	E
1	*N*	*P*	*I*	*P* + *I*	*P* + *I* - *R*
2	1	\$24,000.00	\$160.00	\$24,160.00	\$23,360.00
3	2	\$23,360.00	\$155.73	\$23,515.73	\$22,715.73
4	3	\$22,715.73	\$151.44	\$22,867.17	\$22,067.17
5	4	\$22,067.17	\$147.11	\$22,214.29	\$21,414.29
6	5				***X***

(a) Show that the monthly percentage interest rate is 0.6667%. **1**

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(b) Hence, or otherwise, calculate the amount that should appear in cell C6. **1**

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(c) Complete row 6 to find the amount ***X***, which would appear in cell E6. **1**

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Question 33 (3 marks)

Neil invests $3045 in an account that earns 3% p.a. compounded quarterly for 4 years. **3**
David wants to invest his money in another account that earns simple interest at 3% p.a. for 4 years.
If David is to earn the same amount of interest as Neil, how much must David invest in his chosen account?

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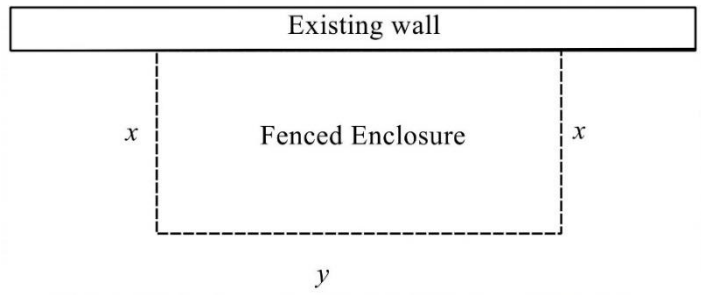
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Question 34 (4 marks)

Chloe plans to build a rectangular enclosure for her new chickens against an existing wall, using 16 metres of wire fencing as shown below. She calls the dimensions of the enclosure x and y.



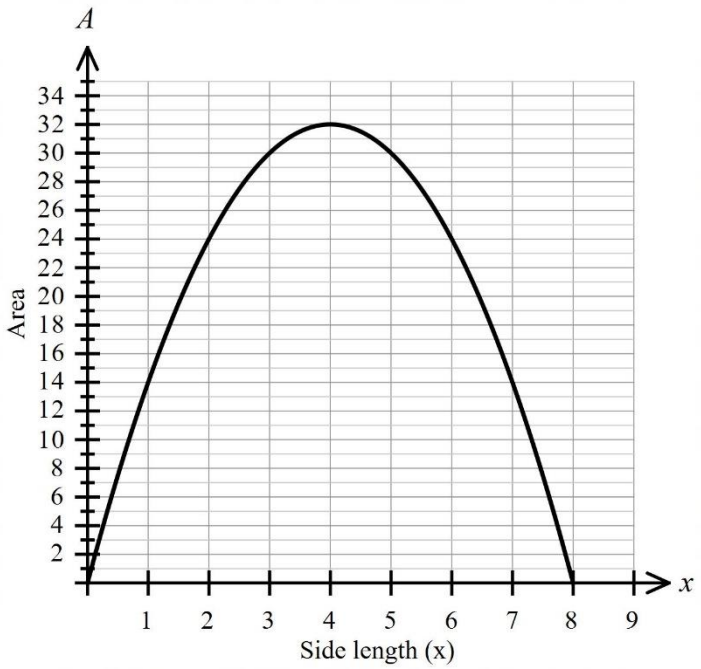
(a) She reasons that $2x + y = 16$. Write y in terms of x and hence, show that the area of the enclosure can be written as $A = 16x - 2x^2$. **1**

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(b) The graph of $A = 16x - 2x^2$ is shown below. **2**



Use the graph to determine the value(s) of x which would give the enclosure an area of 24 m^2 and give the dimensions of the enclosure in each case.

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Question 34 is continued in the next page.

Question 34 Continued …

(c) Determine the dimensions (both x and y) that will achieve the maximum possible area for the enclosure. **1**

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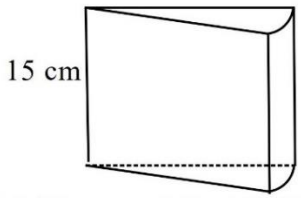
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Question 35 (3 marks)

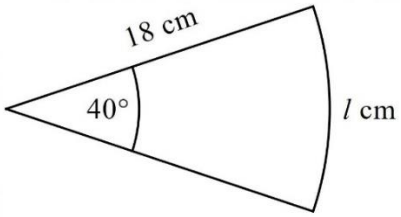
A cylindrical block of cheese is cut into nine identical wedges which are then wrapped for packaging for supermarkets.

One of the wedges is shown below.



NOT TO SCALE

The cross section of each wedge has the dimensions shown below.



NOT TO SCALE

(a) Calculate the value of l, correct to two decimal places. **1**

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(b) Hence or otherwise, find the surface area of the wedge, correct to two decimal places. **2**

……

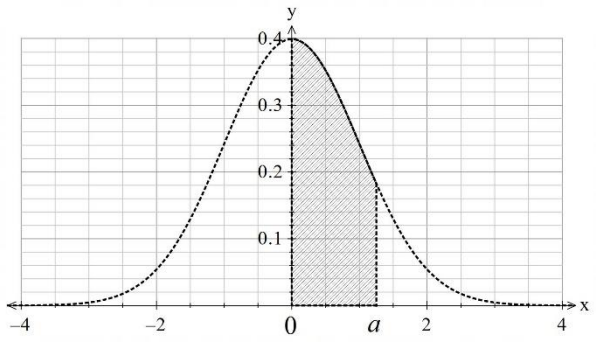
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Question 36 (4 marks)

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. The table can also be used for scores to the left of $z = 0$, as the distribution is symmetrical.



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

(a) A particular normal distribution has a mean of 40 and a standard deviation of 5. **1**

Convert a score of 47 from this distribution to a *z*-score.

……

……

……

(b) Calculate the percentage of scores in the distribution that will lie between 38 and 47. **3**

……

……

……

……

……

……

Question 37 (3 marks)

In a chess tournament, each player has a 'chess rating', which is a value from 1600 to 2000.

Danny wants to determine the relationship between the number of years a player has spent playing chess and their chess rating.

Danny randomly surveyed 10 players at the tournament. The results are shown in the table.

	Years spent playing chess (x)	*Chess rating (y)*
Player 1	1	1650
Player 2	2	1550
Player 3	2	1600
Player 4	3	1500
Player 5	4	1900
Player 6	4	1650
Player 7	6	1700
Player 8	8	1950
Player 9	10	1950
Player 10	15	2000

(a) Find the equation of the least-squares regression line for this data. **2**
Round your values to two decimal places.

……

……

(b) Beth, a competitor in the tournament, has spent 5 years playing chess. **1**

Use the equation to find Beth's predicted chess rating. Give your answer correct to the nearest whole number.

……

……

……

Question 38 (4 marks)

The population of rabbits in a town is estimated to be 1000 in the year 2000. The population increases by 80% each year. The population of the rabbits after n years is given by:

$$P = 1000 \times a^n$$

where P is the population of the rabbits and a is a constant.

(a) Show that the population of rabbits in the year 2009 is 198 359. **2**

……

……

……

……

……

(b) At the end of the year 2009, a disease enters the rabbits' ecosystem, decreasing the population by 80% each year. **2**

During which year will the rabbit population return to its initial population of 1000?

……

……

……

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……

……

Question 39 (3 marks)

The table shows the future value of a $1 annuity at different interest rates over different time periods. The contributions are made at the end of each period.

Future values of a $1 annuity

Time period	*Interest rate*			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1836	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8983
8	8.2857	8.5830	8.8923	9.2142

(a) An annuity account is opened and contributions of $5000 are made at the end of each year for 8 years. **1**

For the first 6 years, the interest rate is 4% per annum, compounding annually.

What is the amount in the account after 6 years?

……

……

……

(b) For the 7th and 8th year, the interest rate decreases to 3% per annum, compounding annually. **2**

Calculate the amount in the account immediately after the 8th contribution is made.

……

……

……

……

……

End of Assessment Task 4

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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.

Hills Grammar

Student Number: Solutions

Teacher Name: _____

2023 Higher School Certificate Trial

Year 12

MATHEMATICS STANDARD 2

Time Allowed: 2 hours and 30 minutes (plus 10 minutes reading time)

Class Teachers: Mrs A Willson and Mr C O'Neill

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 paper
- For questions in Section II, show 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

Total marks: 100

Section I – 15 marks

- Attempt Questions 1 – 15
- Answer on Multiple Choice Answer Sheet provided
- Allow about 25 minutes for this section

Section II – 85 marks

- Attempt Questions 16 – 39
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Allow about 2 hours and 5 minutes for this section

Section I	**Your Mark:**	**15**
Section II	**Your Mark:**	**85**
Total	**Your Mark:**	**100**

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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 What is 0.003062 expressed in standard form with two significant figures?

A. 2.06×10^{-2}

B. 3.1×10^{-2}

C. 2.06×10^{-3}

D. 3.1×10^{-3}

2 Cornflour is sold in four different sized packets. Which is the best buy?

A. 1 kg for \$4.00

B. 2 kg for \$7.90

C. 100 g for \$0.45

D. 500 g for \$1.90

3 The formula $BAC_{Female} = \dfrac{10N - 7.5H}{5.5M}$ gives the Blood Alcohol Content for females, where N is the number of standard drinks consumed, H is the number of hours of drinking, and M is the person's weight in kilograms.

Calculate the BAC for Emma, whose weight is 70 kg, and who consumed 5 standard drinks over a period of 4 hours.

$\dfrac{10\times5-7.5\times4}{5.5\times70}$

A. 0.026

B. 0.038

C. 0.052

D. 0.441

4 Which of the following measurements is the same as 2.25 m^2?

A. 22500 cm^2

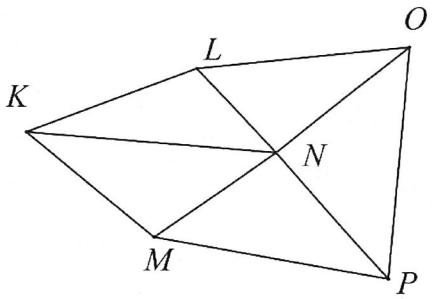
B. 225000 cm^2

C. 225000 mm^2

D. 22500000 mm^2

$m^2 \xrightarrow{\times 100^2} cm^2 \xrightarrow{\times 10^2} mm^2$

5 A network diagram is shown below.



Which statement is true of the network?

A. All the vertices on this network are odd in degree.

B. There are 11 edges in this network.

C. The path *KMNO* forms a cycle.

D. This is a directed network.

6 On a business trip, Jacob plans to travel 2 500 km on highways and 250 km in city traffic.
His car has estimated fuel consumption rates of 6.24 L/100 km on highways and 9.36 L/100 km in city traffic.
Calculate the amount of fuel he could expect to use on the trip.

A. 156.0 litres

B. 179.4 litres

C. 183.9 litres

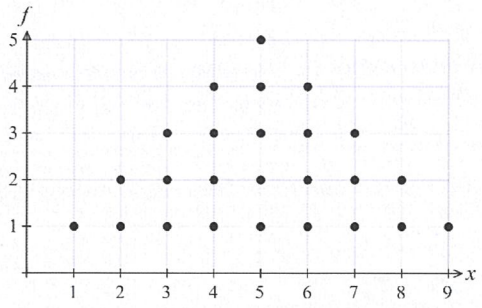
D. 390.0 litres

100 in 6.24 L → ×25 → 156 L; 2500

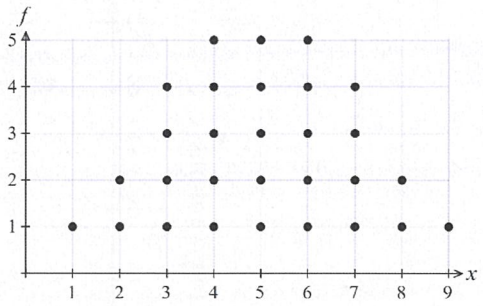
100 in 9.36 → ×2.5 → 23.4; 250

7 Which of the dot-plots below represents a symmetrical, bi-modal distribution?

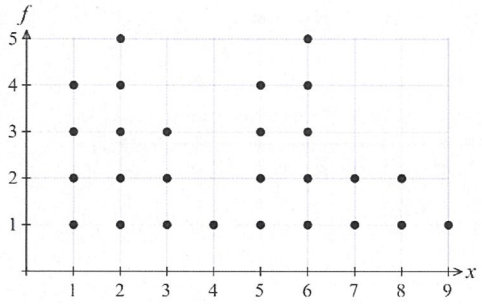
A.



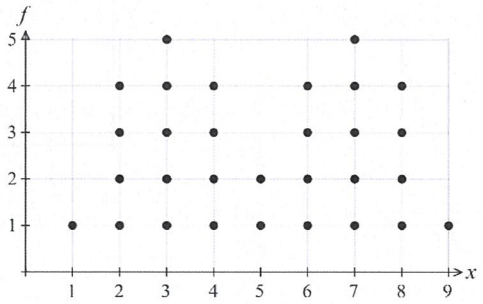
B.



C.

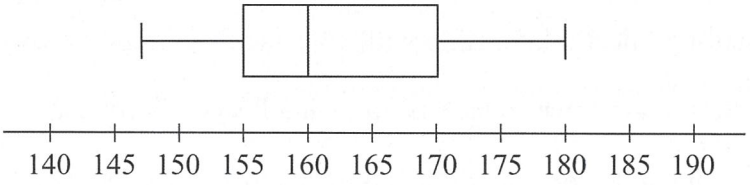


D.



ADV

8 The heights of students in a class are represented in the boxplot below.



A new student, who will become the tallest member, is joining the class.

What is the maximum height the new student can be without being classified as an outlier?

A. 187.5 cm

B. 192.5 cm

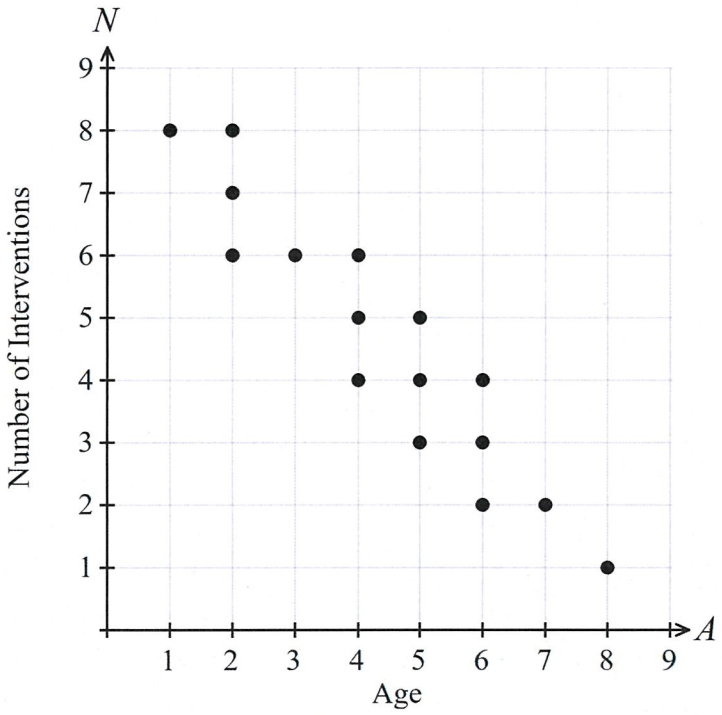
C. 197.5 cm

D. 202.5 cm

$Q_3 + 1.5 \times IQR$

$= 170 + 1.5(170 - 155)$

9 The scatterplot below compares the ages of rescued baby marsupials in months, with the number of veterinary interventions that were required.



Which description best fits the distribution of the bivariate data set?

A. A strong linear relationship with a Pearson's correlation co-efficient close to 1.

B. A strong linear relationship with a Pearson's correlation co-efficient close to –1.

C. A strong non-linear relationship with a Pearson's correlation co-efficient close to 1.

D. A strong non-linear relationship with a Pearson's correlation co-efficient close to –1.

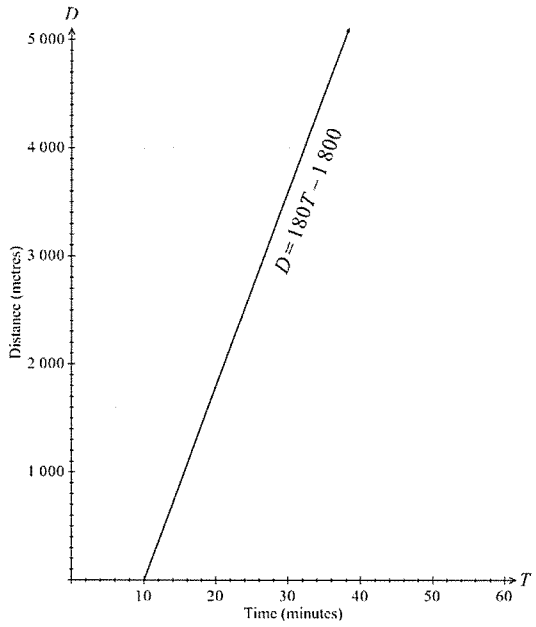
10 The distance travelled by a person walking at a constant speed varies directly with the time that they have been walking.

Jacob walked at a constant speed for 20 minutes and travelled a distance of 1 800 metres.

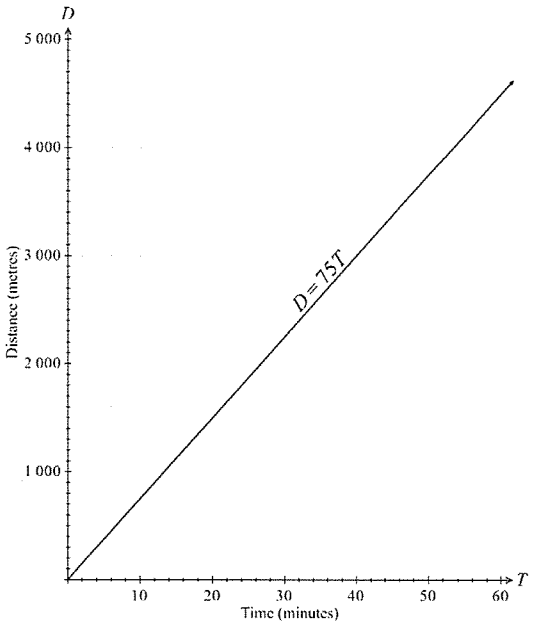
Which graph and equation below would represent this variation relationship?

$\frac{1800}{20} = 900$

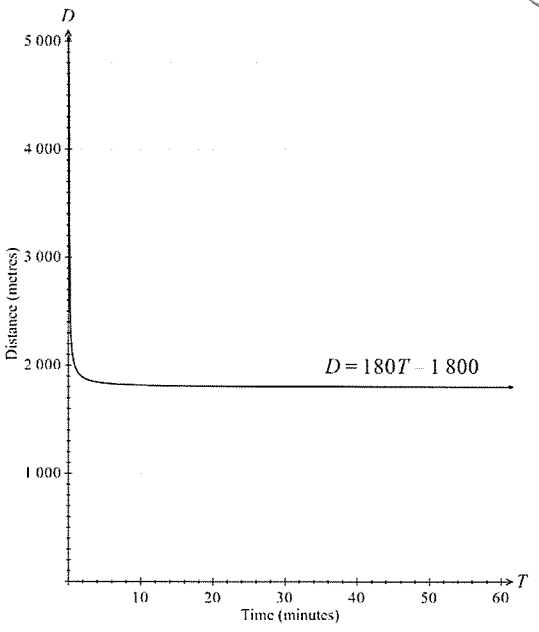
A.



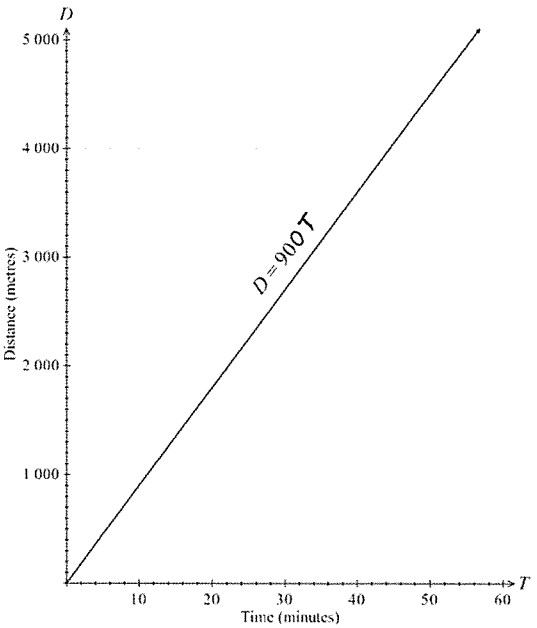
B.



C.

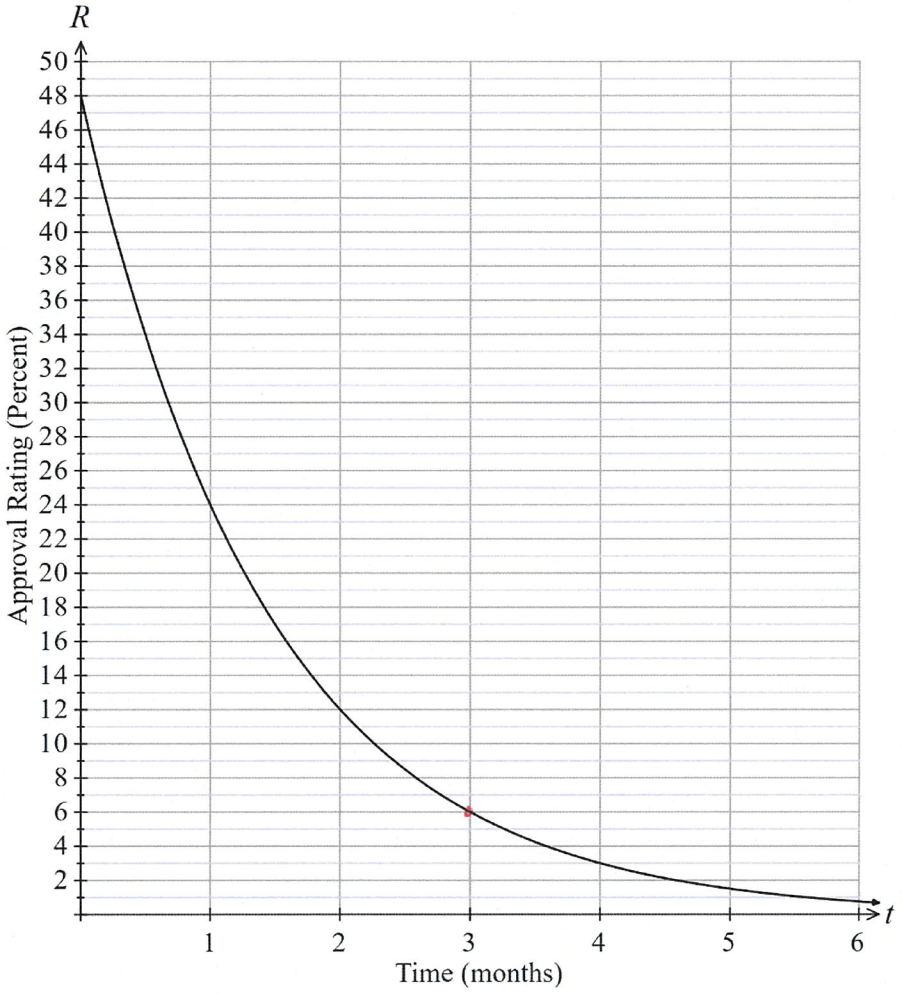


D.



11 The approval rating of a politician falls dramatically after an election. The rate of decrease can be modelled by the equation: $R = a \times b^{-t}$, where R is the percentage approval rating, t is the time in months since the election and a and b are positive constants.

The graph below shows the relationship.



Which equation could be used to model the graph shown?

A. $R = 2 \times 48^{-t}$

B. $R = 24 \times 2^{-t}$

C. $R = 48 \times 2^{-t}$

D. $R = 48 \times 4^{-t}$

$R = 48 \times b^{-t}$

Sub $t = 3$, $R = 6$.

$6 = 48 \times b^{-3}$

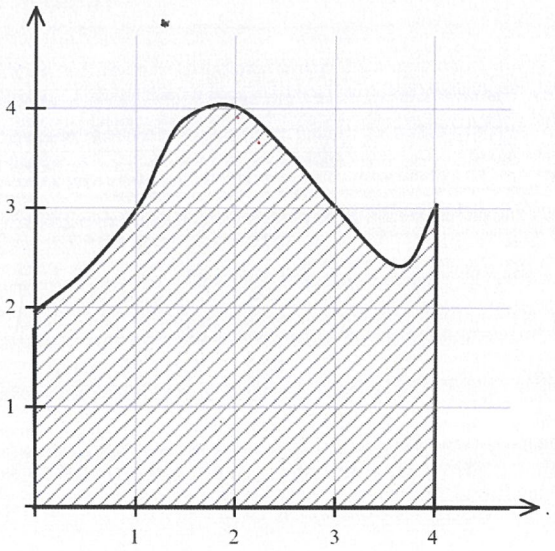
Try $b = 2$

$6 = 48 \times 2^{-3}$

$6 = \frac{48}{8}$ ✓

ADV

12 Using two applications of the Trapezoidal rule, find an estimate for the area of the irregular shape shown to the right. (Each square on the grid is one square unit.)



A. 12 square units

B. 12.5 square units

C. 13 square units

D. 13.5 square units

$\frac{2}{2}(2+4) + \frac{2}{2}(4+3)$

13 The table below shows the income tax rates for the 2022-2023 financial year.

Taxable income	*Tax on this income*
0 – $18 200	Nil
$18 201 – $45 000	19 cents for each $1 over $18 200
$45 001 – $120 000	$5 092 plus 32.5 cents for each $1 over $45 000
$120 001 – $180 000	$29 467 plus 37 cents for each $1 over $120 000
$180 001 and over	$51 667 plus 45 cents for each $1 over $180 000

For the 2022-2023 financial year, Janice had a taxable income of $120000, while her friend Yolanda had a taxable income of $140000.

What is the difference in the amount of tax payable by Janice and Yolanda, excluding the Medicare levy?

A. $5092

B. $7400

C. $22200

D. $29467

ADV

14 The table below shows the present value of an annuity of $1.

Table of present value interest factors

Number of periods	*Interest rate per period as a decimal*				
	0.001	0.00125	0.0015	0.00175	0.002
300	259.0707	250.0398	241.4379	233.2418	226.3477
330	280.9577	270.2690	260.1353	250.5239	240.7211
360	302.1982	289.7541	278.0106	266.9228	258.9154
390	325.2961	309.6290	297.0981	283.6291	261.9432

Thomas borrows $600 000 to purchase a home, with interest charged at 1.5% per annum, compounding monthly.

$r = 0.00125$

He agrees to repay the loan by making equal monthly payments over a 30-year period.

$n = 360$

What is Thomas' monthly payment?

600000

289.7541

A. $2070.72

B. $2158.19

C. $2485.11

D. $173 852.46

15 The speeds (in km/h) which are recorded on a radar device approaching a section of road work are normally distributed, with a mean of 58 and a standard deviation of 4.

The speed limit for the section is 60 km/h and 2400 vehicles passed the radar in one day.

How many vehicles were travelling at 2 km/h above the speed limit or more?



$1 - (50 + 34)$

$= 16\%$

A. 60 vehicles

B. 384 vehicles

C. 768 vehicles

D. 1 632 vehicles

2023 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Section II Answer Booklet

Section II

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

Booklet 1 — Attempt Questions 16–39 (85 marks)

Instructions

- Write your Name and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.

Please turn over

Question 16 (2 marks)

A rock is measured to be 8.0 cm in length, correct to one decimal place.

(a) Write the lower and upper bounds of this measurement. **1**

LB : $8.0 - \frac{0.1}{2} = 7.95$ cm

UB : $8.0 + \frac{0.1}{2} = 8.05$ cm

Poor response
→ common error 7.5 or 8.5
→ did not recognise absolute error

(b) What is the percentage error in this measurement, to two decimal places? **1**

$\frac{0.05}{8.0} \times 100 = 0.63\%$

poor response
→ did not remember formula
→ CE → $\frac{5}{8.0} \times 100$

Question 17 (2 marks)

Liam uses a 160 W refrigerator every hour of the day. What is the cost of using the refrigerator for a week if the electricity is \$0.41 per kWh? Answer correct to the nearest cent. **2**

0.16

$0.16 \times 24 \times 7 \times 0.41$

$= \$11.02$

CE
← forgot to convert 160w → kW
→ 1102c was accepted
→ rounding not punished

Question 18 (2 marks)

Jack owns 2400 shares in Ajaxian Pty Ltd, which had a share price of \$32.80 per share at the end of the financial year. **2**

Last financial year Jack was paid dividends by Ajaxian of \$2.05 per share.

Calculate Jack's dividend yield on his shares for the financial year, to two decimal places.

$\frac{2.05}{32.80} \times 100 = 6.25\%$

Poor response
→ most forget formula
→ a number of students were just multiplying numbers!

Question 19 (2 marks)

A bank charges 0.0603% compound interest per day on the amount owing on a credit card. **2**

What is the interest charged in three weeks on a balance of $1500?

$I = 1500(1+0.000603)^{21} - 1500$

$= \$19.11$

CE

→ use of simple interest formula

→ CE → 1500(1+0.000603)^21 - 1500

forgot %

→ CE 0.0603 ÷ 365

Question 20 (3 marks)

Sandy is on holiday in San Francisco and wants to stream a Matilda's World Cup match which is played in Sydney on Monday 31st July and starts at 3:00 pm. **3**

San Francisco is located at UTC –8 and Sydney at UTC +10.

San Francisco is subject to daylight saving in July and August, but Sydney is not.

At what time and date in San Francisco should Sandy start streaming the match?

S.F 18 - 1 = 17 Sydney

−17 ← Mon 3pm

10pm Sunday July 30

Mixed response

→ CE → 9pm Sunday July 30

→ did not factor in daylight saving.

Question 21 (4 marks)

Two teams of athletes were compared on their endurance, as measured by the number of repetitions that they could complete of a short, mixed-activity training circuit. The results are shown in the back-to-back stem-and-leaf-plot below.

Team A					Team B				
	8	6	5	0	2	6			
8	7	7	4	1	3	7	9		
	7	2	0	2	2 | 23	4	5	8	
		3	1	3	4	6	7		
			0	4					

(a) What was the difference between the two teams in terms of the median number of repetitions? **2**

$23 - 18 = 5$

CE → forgot to find the difference.

(b) Given that Team B has an interquartile range of 16, show that Team A has a larger interquartile range, and explain what this means in terms of statistical comparison. **2**

Team A: $Q_1 = \frac{8+14}{2} = 11$

$Q_3 = \frac{27+31}{2} = 29$

$IQR = 29 - 11$

$= 18$

∴ Team A's endurance values are more varied

CE → did not find IQR → greater range of values was accepted as a reason

Question 22 (2 marks)

Change the subject of the formula $H = \frac{5p+k}{2}$ to p. **2**

$2H = 5p + k$

$2H - k = 5p$

$p = \frac{2H-k}{5}$ ← done

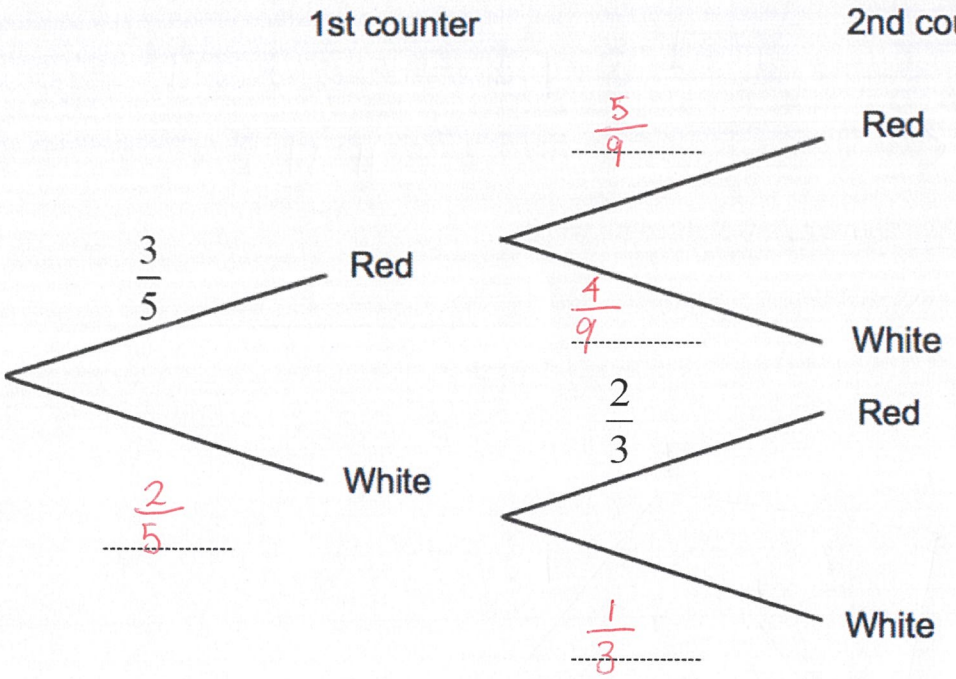
Generally well

→ CE $p = \frac{5H-k}{2}$

ADV

Question 23 (4 marks)

Zoey has a bag of counters. There are 6 red and 4 white counters. She takes out a counter at random and records its colour. Without replacement, Zoey takes out another counter at random.



CE → incorrect probabilities

(a) Complete the probability tree diagram. **2**

(b) Find the probability that Zoey selects two counters that are the same colour. **2**

$\frac{3}{5} \times \frac{5}{9} + \frac{2}{5} \times \frac{1}{3}$

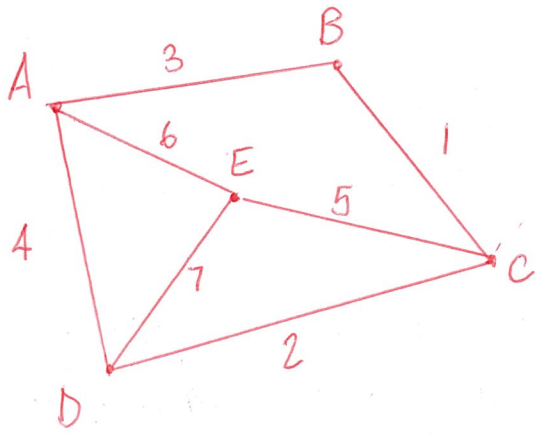
$= \frac{1}{3} + \frac{2}{15} = \frac{7}{15}$

CE → Prob more than 1!
→ adding branches instead of multiplying
→ MCF wdc common

Question 24 (3 marks)

	A	*B*	*C*	*D*	*E*
A	–	3	–	4	6
B	3	–	1	–	–
C	–	1	–	2	5
D	4	–	2	–	7
E	6	–	5	7	–

Represent the table shown above as a weighted network. **3**

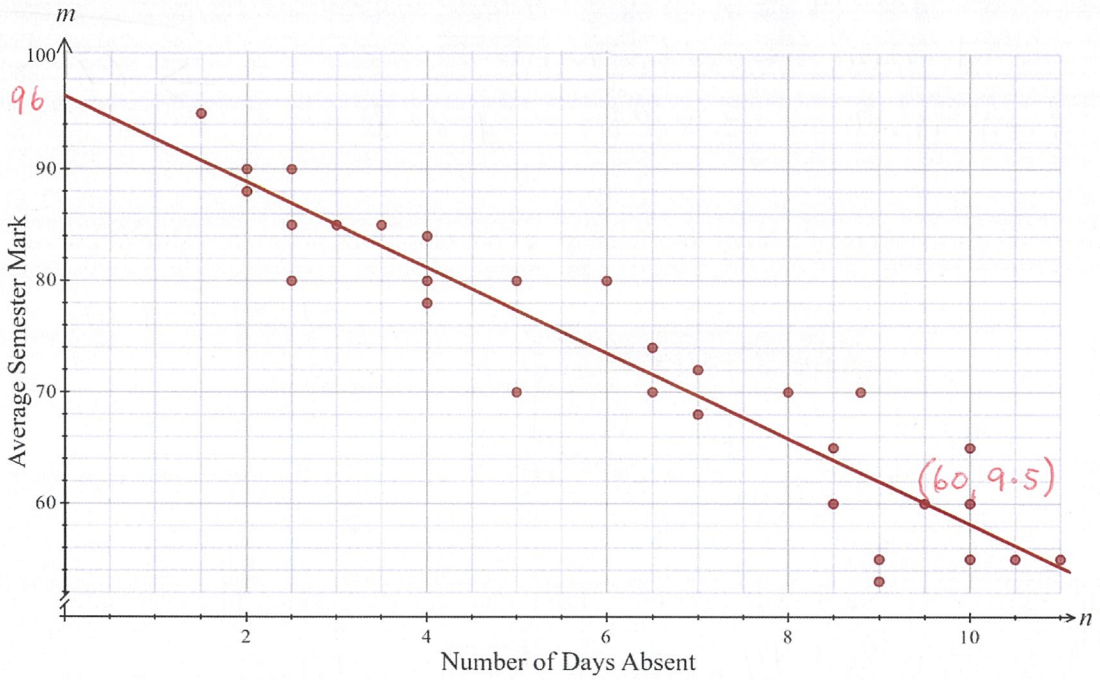


Well done

Question 25 (4 marks)

Mr Jensen records the number of days that each student in his Year 11 class is absent during Semester 1, and he also works out their average test mark as a percentage.

Absence / Mark Scatterplot



He draws the scatterplot below to help him in his discussions with his students in relation to their absences.

(a) Find the gradient of the line of best fit, correct to two decimal places. **2**

$m = \frac{96-60}{9.5-0} = -3.79$

CE → forget negative

→ Margin of error as well

(b) Hence, or otherwise, write the equation of the line of best fit in terms of the variables m and n. **1**

$m = -3.79n + 96$ ← Met based on (a)

→ ~~CE~~ $-y = -3.79x + 96$ accepted

(c) Mr Jensen calculated the correlation coefficient of the scatterplot to be -0.9419. Describe the strength and association between the number of days Mr Jensen's Year 11 students are absent and their average test mark in Semester 1. **1**

strong, negative linear association

needed both strong negative.

Question 26 (5 marks)

O L M

A punch is made from orange juice, lemonade and mango juice in the ratio 8 : 5 : 1.

(a) How much lemonade is needed if the punch is to contain 2 litres of orange juice? **2**

8 parts = 2000 mL

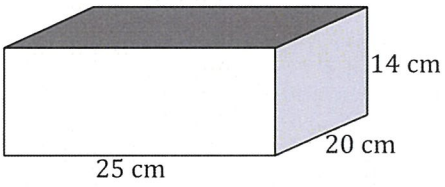
∴ 1 part = 250 mL

Lemonade : 5 x 250 = 1·25 L

Mixed response → CE → 2÷5

(b) The internal dimensions of a bowl, in the shape of a rectangular prism, are shown below. **3**

1 mL = 1cm^3



Not to scale

To completely fill the bowl with the punch, how many litres of orange juice are required?

V = 25 x 20 x 14

= 7000 cm^3

= 7000mL

= 7L

Orange juice : $\frac{8}{14}$ x 7

= 4L

most students get this, some poor conversions

CE → did not work out rate of orange juice

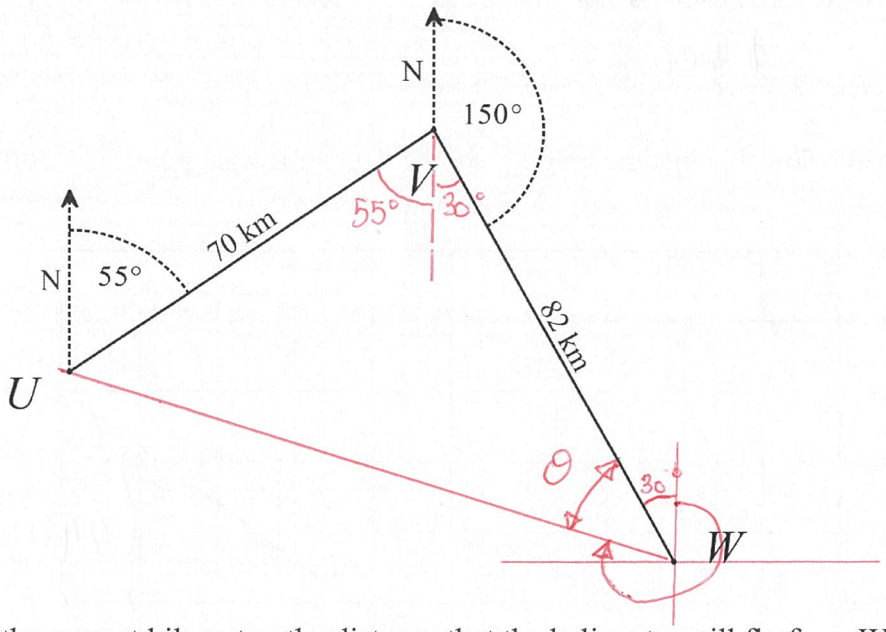
ADV

Question 27 (5 marks)

A helicopter leaves Underwood and flies 70 km on a bearing of 055° to Vanna Beach.

It then flies 82 km on a bearing of 150° to Weston.

The diagram below illustrates the journey.



(a) Calculate, to the nearest kilometre, the distance that the helicopter will fly from Weston directly back to Underwood. **2**

$UW^2 = 70^2 + 82^2 - 2 \times 70 \times 82 \cos 85°$

$UW = 103$ km

Mixed response

→ CE → wrong angle

→ SOHCAHTOA

(b) Determine the bearing (from Weston) on which it should fly to return to Underwood, to the nearest degree. **3**

$\frac{\sin\theta}{70} = \frac{\sin 85}{103}$

$\sin\theta = \frac{70 \sin 85}{103}$

$\theta = 43°$

Bearing $= 360 - 43 - 30 = \boxed{287°}$

Poor response

→ N/A was common

→ some tried to use cosine rule

→ some found 43° but did not know how to find bearing

Question 28 (5 marks) ADV

Buns & Roses sells bread rolls for \$0.80 each. The cost, C dollars, of making x bread rolls is given by $C = 300 + 0.2x$.

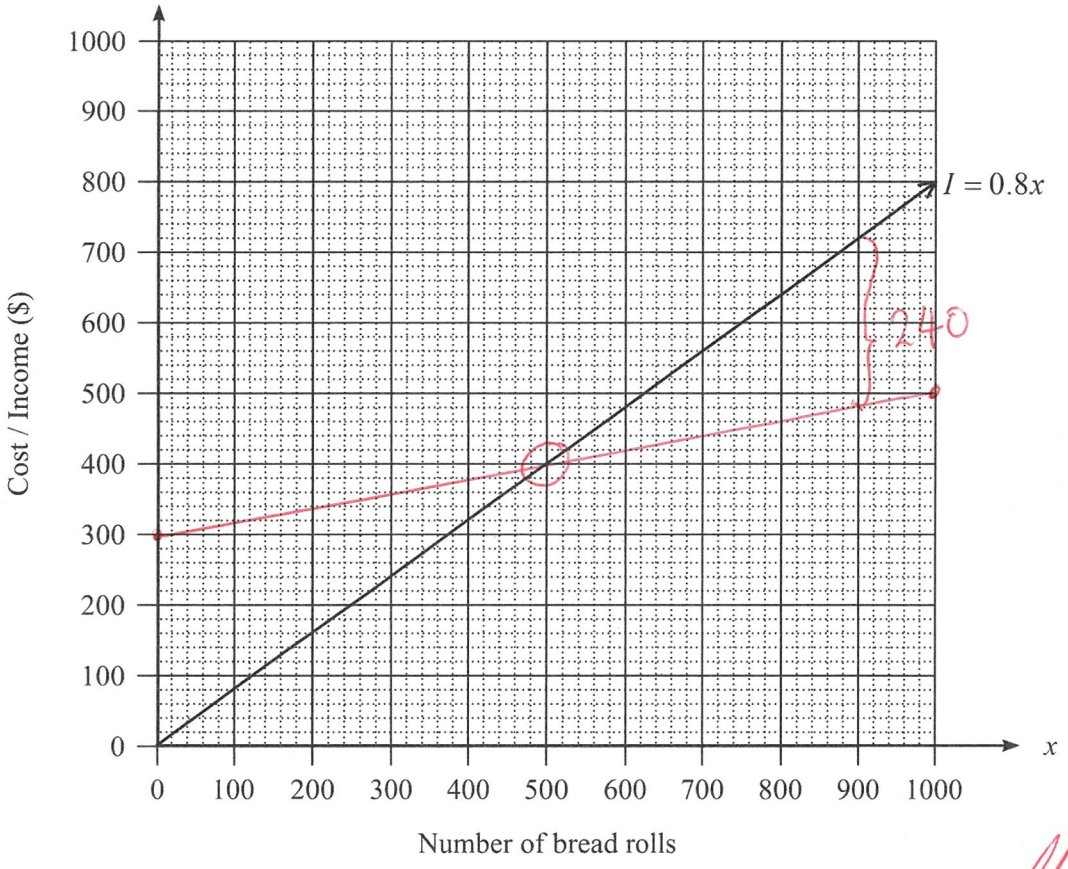
(a) What is the cost of making 1000 bread rolls? **1**

well done

$C = 300 + 0.2 \times 1000$

$= \$500$

(b) On the grid below, the income graph is shown. Draw the cost graph, $C = 300 + 0.2x$. **2**



Hence, find the number of bread rolls that must be sold to break-even.

well done

$x = 500$

(c) Determine how many bread rolls must be sold to make a profit of \$240. **2**

$240 = I - C$

$= 0.8x - (300 + 0.2x)$ poor response

$0.6x = 540 \Rightarrow x = 900$ → CE → \$240

Questions 16 – 28 are worth 43 marks in total.

Question 29 (4 marks)

Tahnee bought a car for use with her small business for $24 000. For taxation purposes she needed to work out a depreciated value of the car each year.

She initially decided to do this using the declining balance method at a rate of 25%.

(a) How much will the car's value after 8 years? **2**

$S = 24000(1-0.25)^8$ ①

$= \$2402.71$ ①

well done.

(b) She decided to change to the straight-line method of depreciation, as calculations were easier, but wants the value after eight years to be the same as she calculated using the declining balance method. **2**

By what amount should she depreciate the car each year, and what percentage is this of the car's original value?

$2402.71 = 24000 - D \times 8$

$8D = 21597.29$ ①

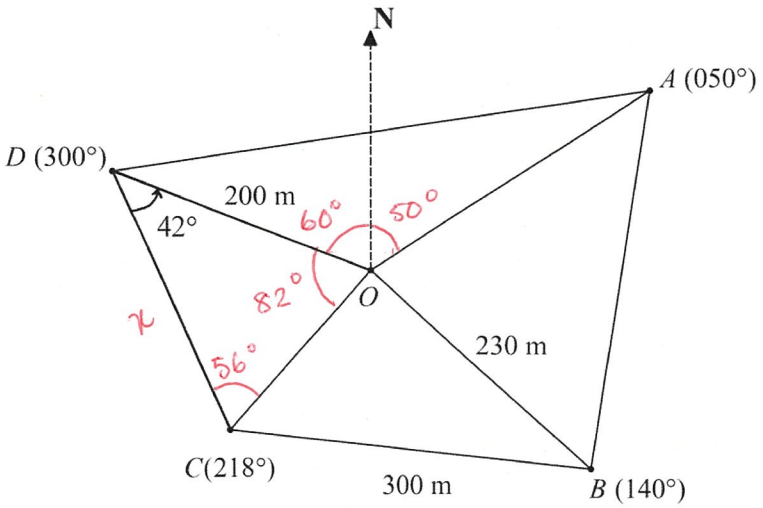
$D = \$2699.66$

mixed response.

$\frac{2699.66}{24000} \times 100 = 11.25\%$ ①

Question 30 (7 marks)

Richie has inherited a large plot of land from a distant relative. The radial survey of the plot is shown below.



(a) Find the size of $\angle AOD$. **1**

mostly well done.

$\angle AOD = 60 + 50$

$= 110°$

(b) Given that the area of triangle AOD is 28661 m^2, calculate the length of OA, correct to the nearest meter. **2**

$28661 = \frac{1}{2} \times 200 \times OA \times \sin 110$

$OA = \frac{28661}{100 \sin 110}$

$OA = 305$ m

- Some tried to use the Aine rule.
- mixed response.

Question 30 is continued in the next page.

Question 30 Continued…

(c) In triangle COD, it is given that $\angle CDO = 42°$. Find the length of the boundary CD, correct to the nearest meter. **3**

$\frac{CD}{\sin 82°} = \frac{200}{\sin 56°}$ mixed response.

$CD = \frac{200 \sin 82°}{\sin 56°}$

$CD = 239m$

(d) A scale drawing of the field is completed with a scale of 1 : 500. **1**

What is the length (in millimetres) of the boundary BC on the drawing?

$BC = 300m$ $\frac{300000}{500} = 600mm$ common error

$BC = 300 \times 1000$

$= 300000mm$ practice needed.

Question 31 (4 marks) ADV

The number of ants, (n), to break up a sandwich and carry it away, is inversely proportional to the time, (t in minutes), taken for the ants to perform the task.

If there are 20 ants, then it takes 42 minutes for the sandwich to be taken to the nest.

(a) Write an equation to describe the relationship and find the constant of proportionality. **2**

$n = \frac{k}{t}$ $n = \frac{840}{t}$

$20 = \frac{k}{42}$ practice needed with forming equation

$K = 840$

(b) How many ants would it take to carry the sandwich in 1 hour and 10 minutes? **2**

$n = \frac{840}{70}$

mixed response

$= 12$

Question 32 (3 marks)

Jelena borrows $24 000 through a reducing balance loan.

Interest is calculated monthly (with each month considered as $\frac{1}{12}$ of a year).

Repayments of $800.00 are deducted each month after the interest is added.

Jelena uses the spreadsheet below, to show the progress of the loan.

	A	B	C	D	E
1	N	P	I	$P + I$	$P + I - R$
2	1	$24,000.00	$160.00	$24,160.00	$23,360.00
3	2	$23,360.00	$155.73	$23,515.73	$22,715.73
4	3	$22,715.73	$151.44	$22,867.17	$22,067.17
5	4	$22,067.17	$147.11	$22,214.29	$21,414.29
6	5	21414.29	142.77	21557.06	X

(a) Show that the monthly percentage interest rate is 0.6667%. **1**

$\frac{160}{24000} \times 100 = 0.6667\%$

some careless errors CE - not multip. by 100

(b) Hence, or otherwise, calculate the amount that should appear in cell C6. **1**

$21414.29 \times 0.6667\% = \$142.77$

rounding errors

(c) Complete row 6 to find the amount X, which would appear in cell E6. **1**

$21557.06 - 800 = \$20757.06$

some students did not know how to use table values.

Question 33 (3 marks)

Neil invests $3045 in an account that earns 3% p.a. compounded quarterly for 4 years. **3**

David wants to invest his money in another account that earns simple interest at 3% p.a. for 4 years.

If David is to earn the same amount of interest as Neil, how much must David invest in his chosen account?

CE

Neil:

$A = 3045\left(1 + \frac{0.03}{4}\right)^{4\times4}$

$= 3431.69$ (1)

$I = 3431.69 - 3045$

$= \$386.69$ (1)

David:

$386.69 = P \times 0.03 \times 4$

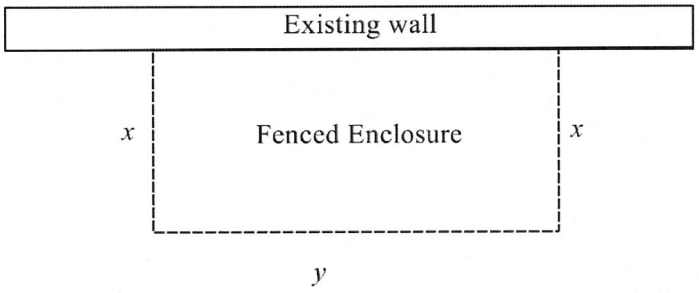
$P = \frac{386.69}{0.03 \times 4}$ (1)

$= \$3222.42$

- some calculator errors: practice needed.
- some students didn't use the correct formulas
- algebraic errors

Question 34 (4 marks)

Chloe plans to build a rectangular enclosure for her new chickens against an existing wall, using 16 metres of wire fencing as shown below. She calls the dimensions of the enclosure x and y.



(a) She reasons that $2x + y = 16$. Write y in terms of x and hence, show that the area of the enclosure can be written as $A = 16x - 2x^2$. **1**

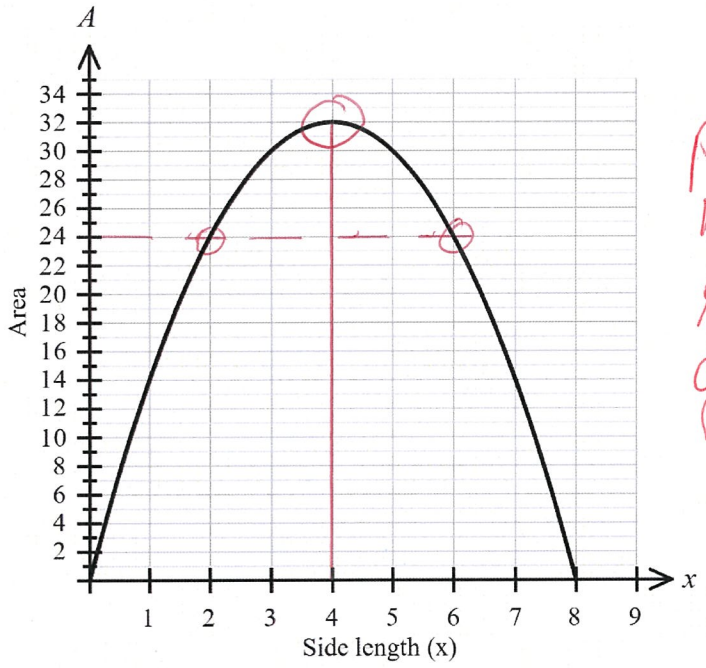
poorly done.

$y = 16 - 2x$ $A = xy$

$= x(16 - 2x)$

$= 16x - 2x^2$

(b) The graph of $A = 16x - 2x^2$ is shown below. **2**



practice needed with reading graphs.

Use the graph to determine the value(s) of x which would give the enclosure an area of 24 m^2 and give the dimensions of the enclosure in each case.

$x = 2$ m, $x = 6$ m

Question 34 is continued in the next page.

Question 34 Continued …

(c) Determine the dimensions (both x and y) that will achieve the maximum possible area for the enclosure. **1**

max area = $32\ m^2$ $x = 4m$

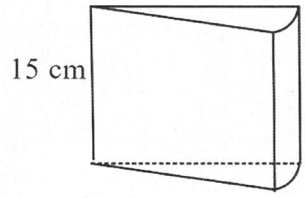
$32 \div 4 = 8$ $y = 8m$

- mixed response
- practice needed

Question 35 (3 marks)

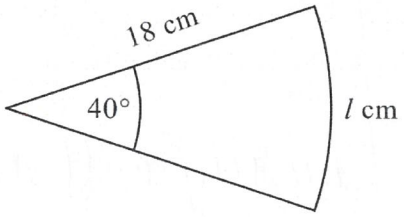
A cylindrical block of cheese is cut into nine identical wedges which are then wrapped for packaging for supermarkets.

One of the wedges is shown below.



NOT TO SCALE

The cross section of each wedge has the dimensions shown below.



NOT TO SCALE

(a) Calculate the value of l, correct to two decimal places. **1**

$l = \frac{40}{360} \times 2\pi \times 18$

$= 12.57\ cm$

- common error 'r = 9'
- some calc. errors

(b) Hence or otherwise, find the surface area of the wedge, correct to two decimal places. **2**

S.A. = $2 \times 15 \times 18 + \frac{40}{360} \times 2\pi \times 18^2 + 12.57 \times 15$ (1)

curved side

$= 954.74\ cm^2$ (1)

top and bottom

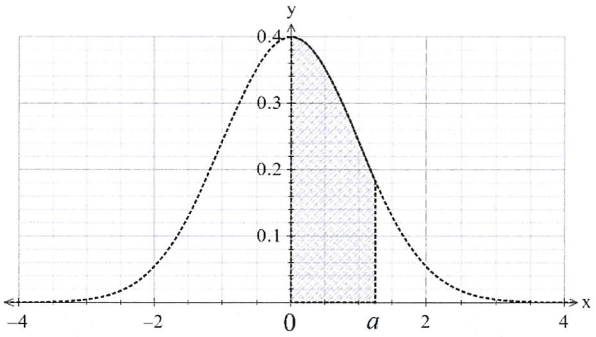
side faces

Common error.

- Students should count the number of surfaces!

Question 36 (4 marks) Common with Advanced.

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. The table can also be used for scores to the left of $z = 0$, as the distribution is symmetrical.



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

(a) A particular normal distribution has a mean of 40 and a standard deviation of 5. **1**

Convert a score of 47 from this distribution to a z-score.

$z_{47} = \frac{47-40}{5}$ mostly well done

$= 1.4$

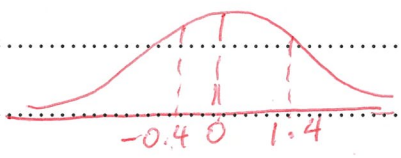
(b) Calculate the percentage of scores in the distribution that will lie between 38 and 47. **3**

$z_{38} = \frac{38-40}{5}$ ①

$= -0.4$ ①

$15.54 + 41.92$ ①

$= 57.46\%$ ①



- many students did not know how to use the table.
- practice needed.

Question 38 (4 marks)

The population of rabbits in a town is estimated to be 1000 in the year 2000. The population increases by 80% each year. The population of the rabbits after n years is given by:

$$P = 1000 \times a^n$$

$P = 1000(1+0.8)^n$

where P is the population of the rabbits and a is a constant.

(a) Show that the population of rabbits in the year 2009 is 198 359. **2**

$n = 9$ $P = 1000(1.8)^9$ (1)

$= 198359$ (1)

- mixed response.

common error.

(b) At the end of the year 2009, a disease enters the rabbits' ecosystem, decreasing the population by 80% each year. **2**

$P = 198359(1-0.8)^n$ common error.

During which year will the rabbit population return to its initial population of 1000?

$1000 = 198359 \times 0.2^n$

$0.2^n = \frac{1000}{198359}$ (1)

$0.2^n = 0.005$

$0.2^2 = 0.04$

$0.2^3 = 0.008$

$0.2^4 = 0.0016$ (1)

$\therefore$ about 3 years later $\Rightarrow$ 2012

- poorly done.
- practice needed.

ADV

Question 37 (3 marks)

In a chess tournament, each player has a 'chess rating', which is a value from 1600 to 2000.

Danny wants to determine the relationship between the number of years a player has spent playing chess and their chess rating.

Danny randomly surveyed 10 players at the tournament. The results are shown in the table.

	Years spent playing chess (x)	*Chess rating (y)*
Player 1	1	1650
Player 2	2	1550
Player 3	2	1600
Player 4	3	1500
Player 5	4	1900
Player 6	4	1650
Player 7	6	1700
Player 8	8	1950
Player 9	10	1950
Player 10	15	2000

(a) Find the equation of the least-squares regression line for this data. Round your values to two decimal places. **2**

$y = 1554.49 + 34.64x$ (1) (1) - calculator errors

(b) Beth, a competitor in the tournament, has spent 5 years playing chess. **1**

Use the equation to find Beth's predicted chess rating. Give your answer correct to the nearest whole number.

$y = 1554.5 + 34.6 \times 5$ many ECF

$= 1728$

ADV

Question 39 (3 marks)

The table shows the future value of a $1 annuity at different interest rates over different time periods. The contributions are made at the end of each period.

Future values of a $1 annuity

Time period	*Interest rate*			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1836	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8983
8	8.2857	8.5830	8.8923	9.2142

(a) An annuity account is opened and contributions of $5000 are made at the end of each year for 8 years. **1**

For the first 6 years, the interest rate is 4% per annum, compounding annually.

What is the amount in the account after 6 years?

5000×6.633 well done

$= \$33165$

(b) For the 7th and 8th year, the interest rate decreases to 3% per annum, compounding annually. **2**

Calculate the amount in the account immediately after the 8th contribution is made.

$33165 \times 1.03^2 + 5000(1.03) + 5000$

$= \$45334.75$ 7th year poorly done.

End of Assessment Task 4

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