Student Number:
Teacher: Mrs Moncrieff & Mrs Louskos

St George Girls High School

Mathematics Standard 2

2024 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 questions in the spaces provided.
  - **Show relevant mathematical reasoning** and/or calculations.
  - **Extra writing space** is provided at the back of this booklet on pages 32-34. 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 3 to 9)

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

Section II – 85 marks (pages 10 to 31)

- Attempt Questions 16 – 36
- 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 the most **expensive** sauce per mL?

(A) Ketchup at \$3.80 for 500 mL

(B) Honey Mustard Sauce at \$6.00 for 250 mL

(C) Barbeque Sauce at \$4.20 for 400 mL

(D) Chilli Sauce at \$2.70 for 285 mL

2. Which one of the following statements about the line $12x - 4y = 0$ is **not** true?

(A) The line passes through the origin

(B) The line has a slope of 12

(C) The line has the same slope as the line with the equation $12x - 4y = 12$

(D) For this line as x increases y increases

3. Part of Bhavni's partially completed payslip for a week is shown below.

Employee: Bhavni BALA			
	Rate	Hours	Pay owing
	Normal	35	$1470.00
	Time and a Half	6	
	Total	41	

What was her total pay owing for the week?

(A) $1722.00

(B) $1848.00

(C) $1974.00

(D) $2583.00

4. The table below shows the number of students in each year at a certain high school.

Year	*Number of students*
7	106
8	123
9	119
10	144
11	127
12	131
Total	750

A stratified sample of 75 students are to be surveyed. How many Year 9 students should be surveyed?

(A) 11

(B) 12

(C) 14

(D) 75

5. A 2400-Watt iron is used for 2 hours five times each fortnight. If electricity is charged at 26.5 c/kwh, what is the cost of ironing per fortnight?

(A) \$636

(B) \$127.20

(C) \$6.36

(D) \$1.27

6. Sixty tickets are sold in a raffle. There are two prizes. Farah buys 5 tickets. Which expression gives the probability that Farah wins both prizes?

(A) $\frac{5}{60} \times \frac{4}{59}$

(B) $\frac{5}{60} \times \frac{4}{60}$

(C) $\frac{5}{60} + \frac{4}{59}$

(D) $\frac{5}{60} + \frac{4}{60}$

7. A map has a scale of 1:5000. If Oak St is 800 m, what is the map distance of Oak St?

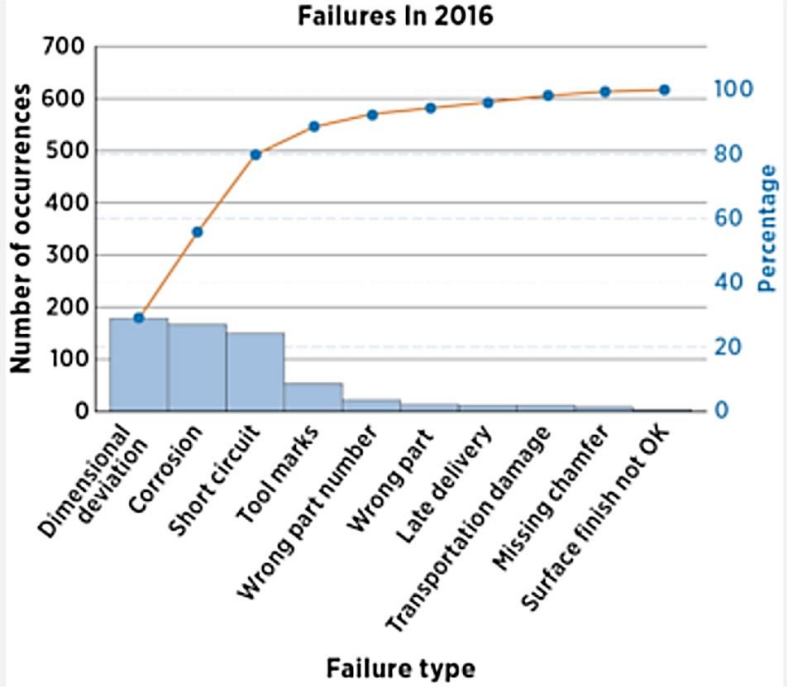
(A) 0.16 mm

(B) 16 mm

(C) 160 mm

(D) 1600 mm

8. According to the data in the Pareto chart below, which reason(s) account(s) for approximately 80% of failures in 2016?



(A) Short circuit

(B) Short circuit and Tool marks

(C) Dimensional deviation, Corrosion and Short circuit

(D) Tool marks

9. Mariam has shares with a current market value of \$7.35 each. She has received a cheque for the total dividend of \$512. If she owns 450 of these shares, calculate her current dividend yield on these shares.

(A) 0.15%

(B) 6.46%

(C) 8.36%

(D) 15.48%

10. Making x the subject of the formula $S = 2a^3 - 4ax$ gives the equation:

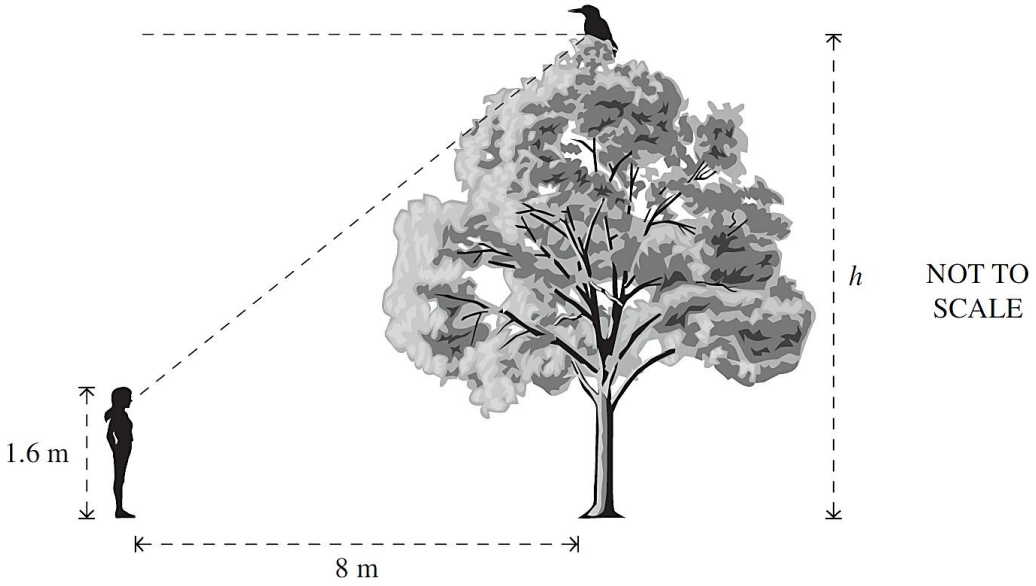
(A) $x = \dfrac{S - 2a^3}{4a}$

(B) $x = \dfrac{2a^2 - S}{4}$

(C) $x = \dfrac{S - 2a^2}{4}$

(D) $x = \dfrac{2a^3 - S}{4a}$

11. Kelly is watching a bird at the top of a tree. Kelly is 1.6 m tall and is standing 8 m away from the tree, as shown in the diagram.



If the angle of depression of Kelly from the bird is 73^o, what is the height of the tree?

(A) 2.45 m

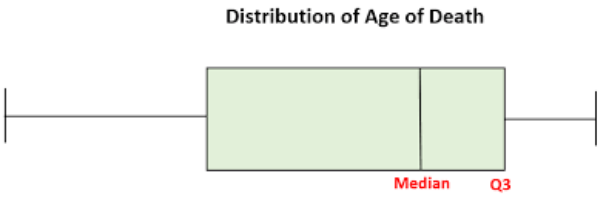
(B) 4.05 m

(C) 26.17 m

(D) 27.77 m

12. Which of the following data sets below is positively skewed?

(A)

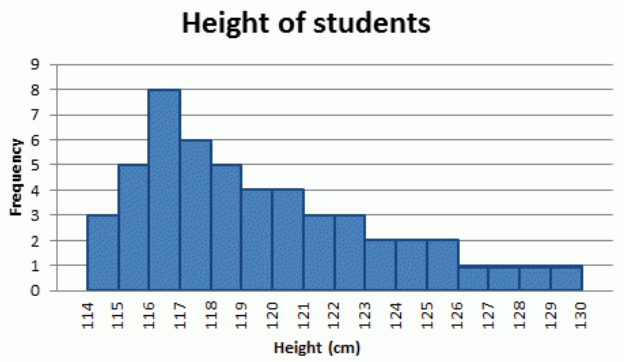


(B)

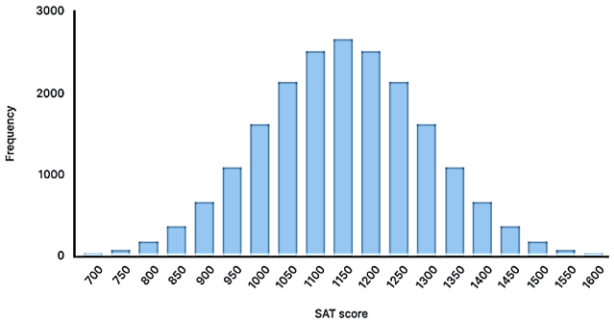
Weight in Kilograms of Children and Their Fathers

2	5 5 8 9
3	2 3 4 4 5 8 9
4	0 3 4 5 9
5	4
6	1 1 3 8
7	0 1 3 4 4 5 6 8 8
8	2 3 5
9	4

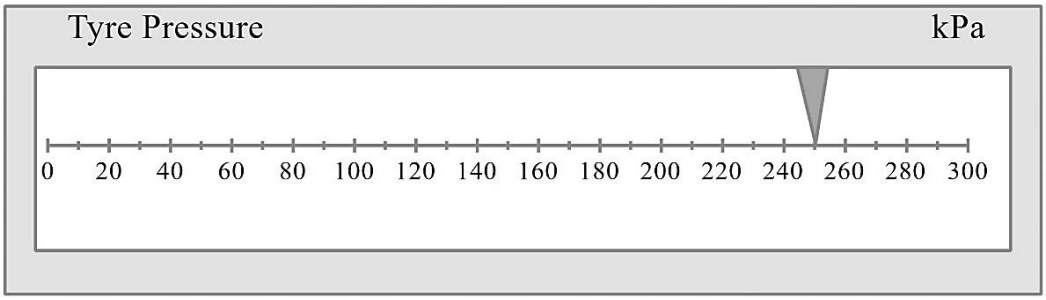
(C)



(D)



13. The tyre gauge below shows a pressure of 250 kilopascals.



What is the percentage error in this measurement?

(A) 2%

(B) 2.5%

(C) 4%

(D) 5%

14. The weights of 348 female players in a football competition are normally distributed with a mean of 76.6 kg and a standard deviation of 5.4 kg.

How many players are expected to weigh more than 65.8 kg?

(A) 8

(B) 16

(C) 332

(D) 339

15. Cities A and B are both located on the equator.
City A is at longitude $12^{o}E$ and city B is at longitude $74^{o}W$.
Irene is travelling from city B to city A. She chooses to take a flight that travels non-stop to city A along the shortest distance between the two cities A and B.
The flight departs from city B at 8:00 am on Monday.
Given the Earth's radius is 6371 km, and the average speed of the aeroplane is 835 km/h, what time and day would Irene expect to arrive in city A?

(A) 1:44 pm Monday

(B) 7:27 pm Monday

(C) 11:35 pm Monday

(D) 1:11 am Tuesday

END OF SECTION I

Section II

85 marks
Attempt questions 16 - 36
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 (3 marks) **Marks**

Solve the following equation $\frac{x}{3} + 2 = 3(x - 2)$. **3**

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Questions 17 (2 marks) **Marks**

Josephine is concerned about the lizard population in the local community. She collects 170 lizards and tags them. A couple of months later she collects 32 lizards and found 10 of them were tagged. What is her estimate of the lizard population using the capture-recapture method? **2**

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Questions 18 (4 marks)

A Year 12 class of 24 students were surveyed about the type of exercise they do. 12 said they go to the gym, 13 said they run and 4 said they neither go to the gym nor run.

(a) Complete the two-way table below to represent this data. **2**

	Gym	**Do Not Gym**	**Total**
Run			13
Do Not Run		4	
Total	12		

(b) Find the probability that a student who runs also goes to the gym. **1**

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(c) Find the percentage of runners who do not go to the gym. **1**
Leave your answer to the nearest percentage.

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Questions 19 (3 marks) **Marks**

The number of people (N) who attend a show varies inversely with the amount of floor space in cm^2 allowed per person (A).

A venue can hold 3200 people if each person is allowed 300 cm^2.

(a) How many people can the venue hold if a person is allowed 250 cm^2 ? **2**

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(b) What is the space allowed per person for 4000 to attend a show? **1**

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Questions 20 (4 marks) **Marks**

A bag contains blue, green and yellow marbles. The ratio of the number of blue marbles to the number of green marbles to the number of yellow marbles in the bag is 3: 8: 9.

(a) What is the total number of marbles in the bag if the number of green marbles is 112? **2**

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(b) A number of bags of these marbles are placed in a carton. The total number of marbles in the carton is 1960. What is the number of blue marbles in the carton? **2**

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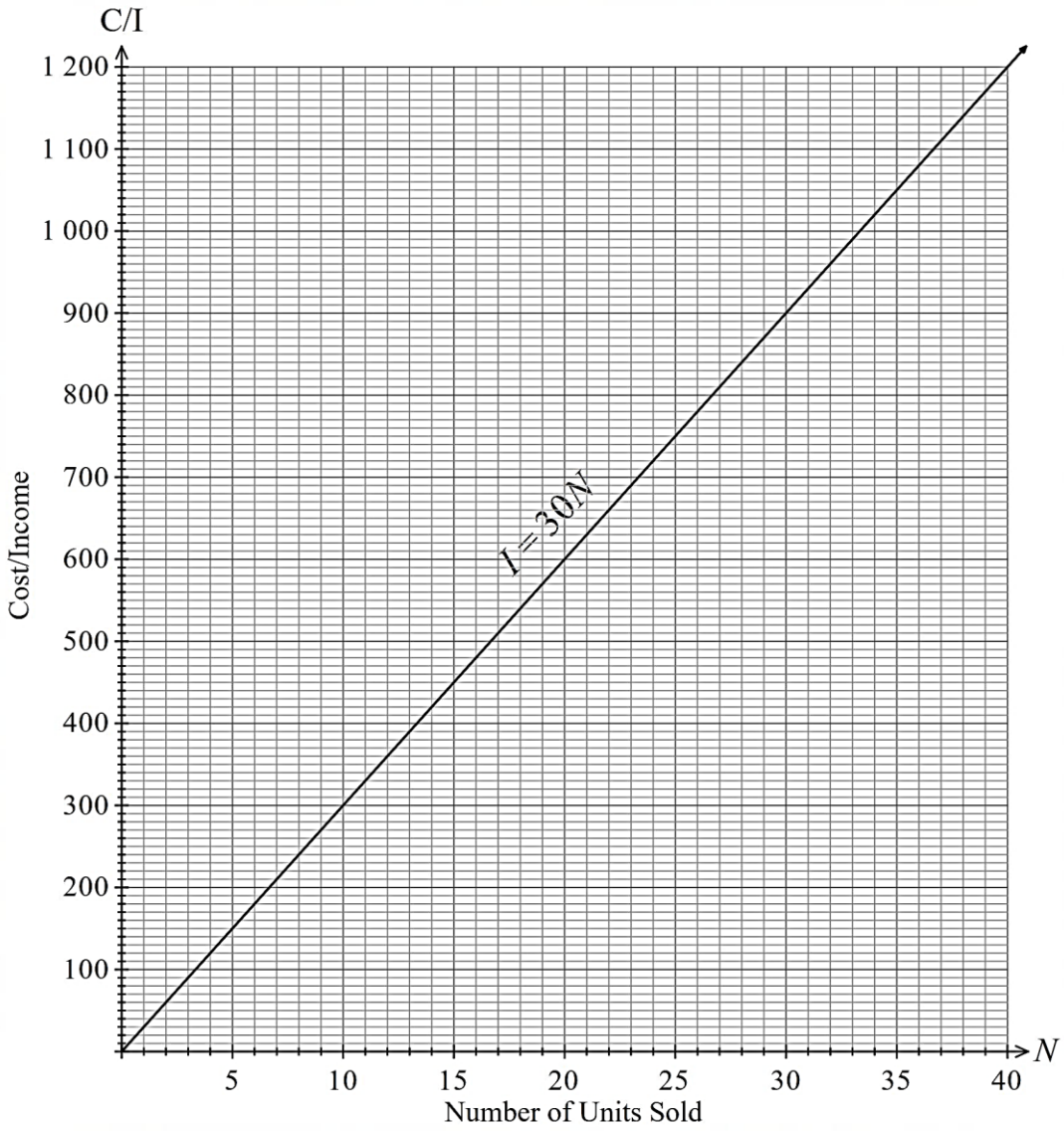
Questions 21 (5 marks) **Marks**

A wholesaler sells a device called a Midien for \$30 each. The income I from selling N devices is graphed below.



Each day their fixed costs (wages, rent etc) are \$300 and each Midien costs them \$10.

(a) The formula for the cost involved in selling N Midiens in a day is $C = 10N + 300$. **1**
What is the cost when 20 Midiens are sold in a day?

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(b) Draw the line representing the equation $C = 10N + 300$ on the graph above. **2**

Question 21 (continued) **Marks**

(c) How many Midiens would they need to sell in a day to break even? **1**

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(d) How much profit (or loss) would they make on a day where they sold 30 Midiens? **1**

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Questions 22 (3 marks)

Anna's yearly salary is $124 800. She decides to take her four weeks annual holiday. Find her holiday pay, which consists of her normal pay for four weeks plus 17.5% holiday loading. (Use 1 year = 52 weeks) **3**

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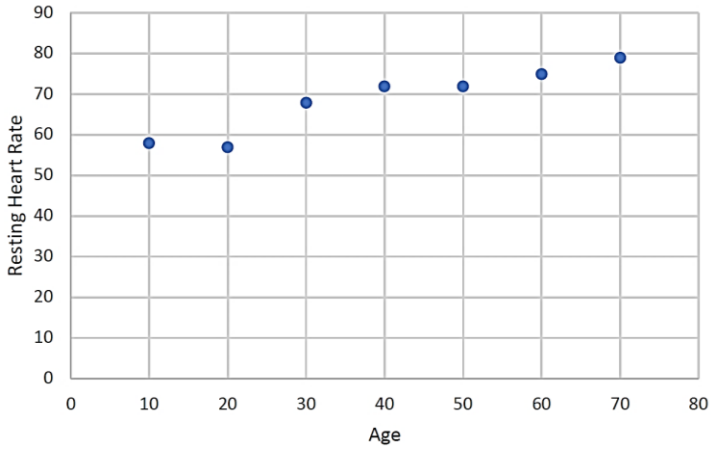
Questions 23 (7 marks) **Marks**

A set of bivariate data is collected by taking the resting heart rate and age of seven people. The following is a scatterplot of these measurements and a corresponding table of values.



Age	Resting Heart Rate
10	58
20	57
30	68
40	72
50	72
60	75
70	79

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

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(b) Comment on the direction and strength of the correlation between the two variables. **1**

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Questions 23 (continued) **Marks**

(c) Calculate the equation for the least-squares regression line, giving your answer in the following form: $Heart\ Rate = p \times Age + q$. **2**

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(d) Predict the heart rate of a 35 year old person using the least-squares regression line. **1**

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(e) Would your answer be an example of extrapolation or interpolation? Give a reason for your answer. **2**

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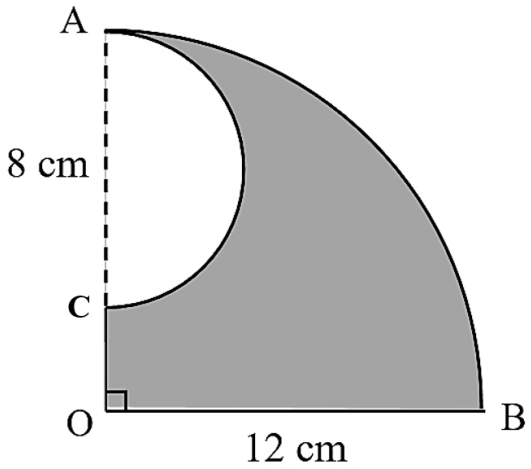
Questions 24 (3 marks) **Marks**

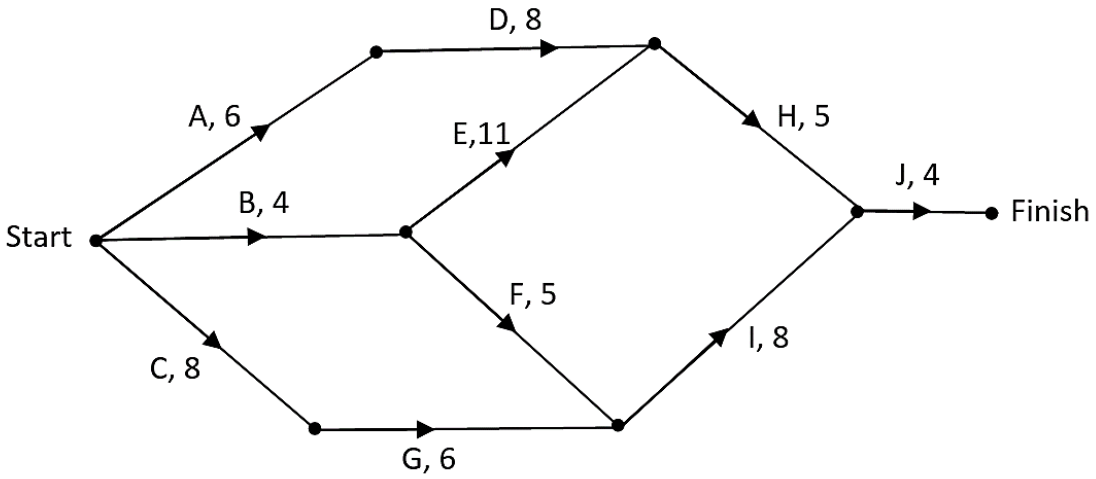
A shape is formed by removing a semi-circle with diameter 8 cm from a quarter of a circle with radius 12 cm as shown in the diagram.



What is the perimeter of the shaded shape correct to three decimal places? **3**

Questions 25 (4 marks) **Marks**

The network diagram below shows the activities for a project and their completion times in hours.



(a) Complete the table below, showing the earliest starting time (EST) and the latest starting time (LST) for each activity. **2**

Activity	EST	LST
A	0	3
B		
C		
D	6	9
E		
F		
G		
H		
I		
J		

(b) List the activities in order which make up the critical path for this network. **1**

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(c) Calculate the float time for activity D. **1**

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Questions 26 (4 marks) **Marks**

A company purchases a machine for \$50 000. The two methods of depreciation being considered are the declining-balance method and the straight-line method.

(a) For the declining-balance method, the salvage value of the machine after n years is given by the formula $S = V_0 \times (0.80)^n$, where S is the salvage value and V_0 is the initial value of the asset.

(i) What is the annual rate of depreciation used in this formula? **1**

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(ii) Calculate the salvage value of the machine after 3 years, based on the given formula. **1**

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(b) For the straight-line method, the value of the machine is depreciated at a rate of 12.2% of the purchase price each year. **2**
When will the value of the machine, using this method, be equal to the salvage value found in part (a)(ii)?

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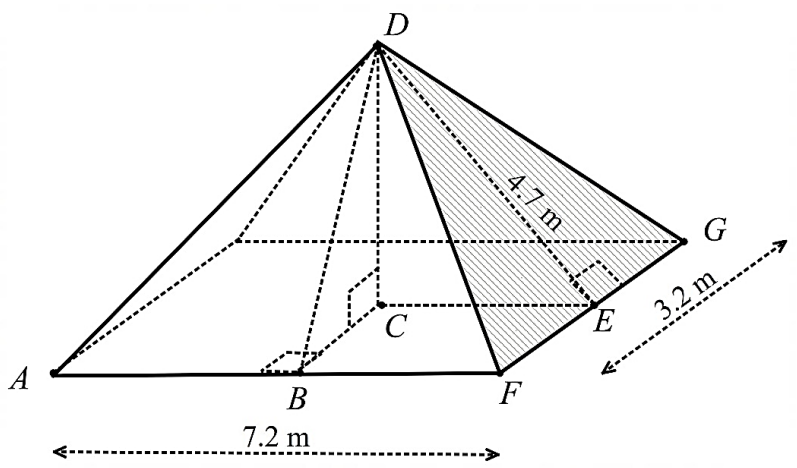
Questions 27 (3 marks) **Marks**

A cabin has a roof in the shape of a rectangular pyramid, as shown below.



$AF = 7.2$ m, $FG = 3.2$ m, $DE = 4.7$ m, and the vertical height $DC = 3.0$ m.

(a) Find the length of DB. **1**

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(b) Calculate the total surface area of the roof. **2**

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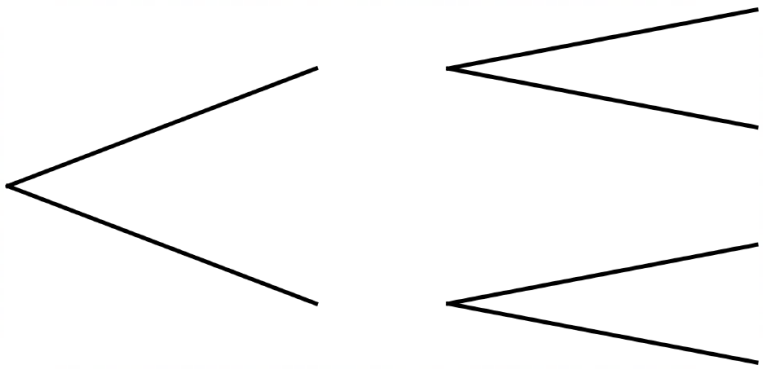
Questions 28 (5 marks) **Marks**

A packet of 20 lollypops contains only two colours. There are 7 red lollypops in the packet and the rest are green. Anastasia chooses a lollypop, eats it, and then chooses another.

(a) Complete the tree diagram representing this information. **2**
Include probabilities on all the branches.



(b) What is the probability Anastasia chose two red lollypops? **1**

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(c) What is the probability that the two lollypops Anastasia chose were different colours? **2**

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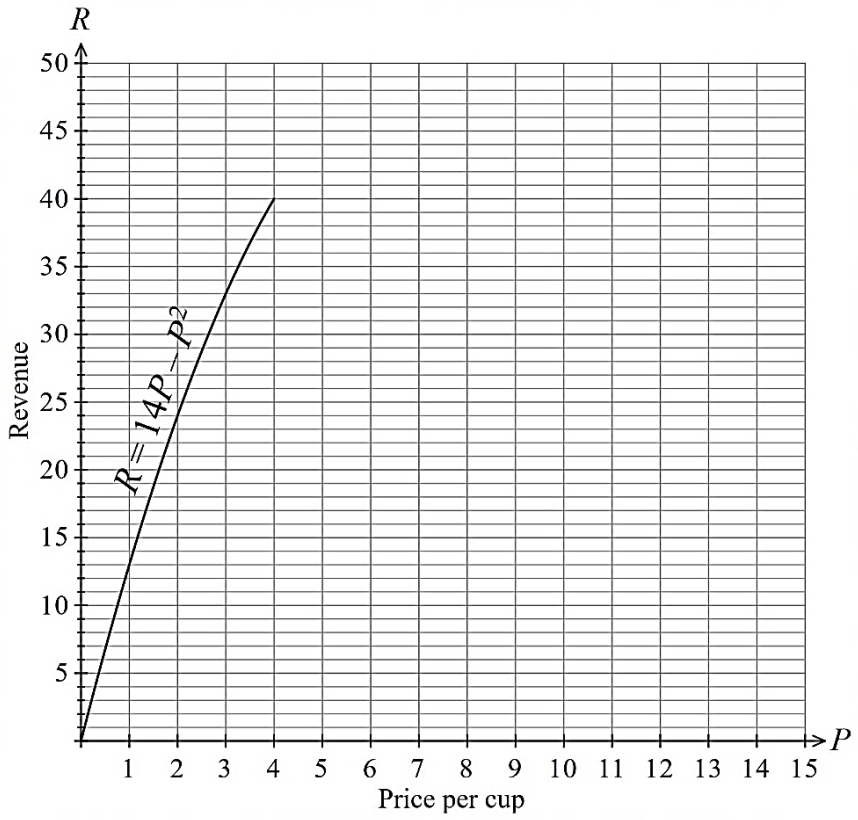
Questions 29 (5 marks) **Marks**

A coffee shop does some research to determine the best price to set for a cup of coffee. Their daily revenue depends on the price they charge per cup and the number of cups that they sell each day.
They find that the formula $R = 14P - P^2$ gives their daily revenue (R) from selling coffee at a price of $\$P$ per cup.
A graph of this formula for increasing values of P has been started below.



(a) Complete the graph on the axes above. **2**

(b) Determine the price per cup that produces the maximum revenue for a day. **1**

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(c) There is no revenue for a value $P = 0$ (i.e. giving the coffee away free earns no revenue). For what other value of P is there also no revenue? Explain what this implies about the pricing of the coffee. **2**

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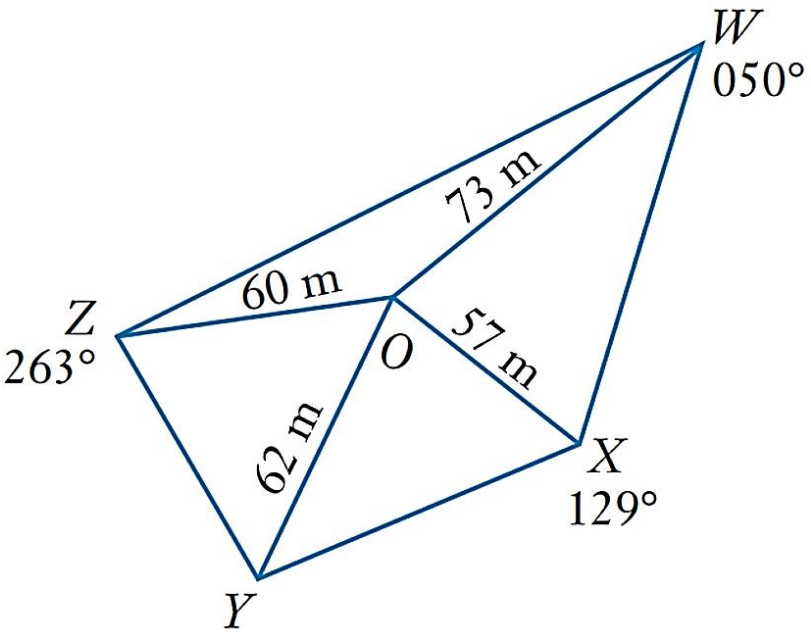
Questions 30 (3 marks) **Marks**

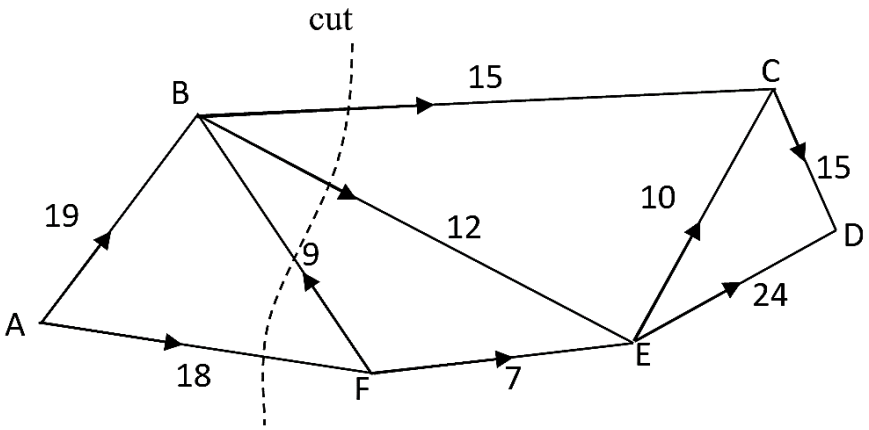
The following is a sketch of a radial survey.



If the area of triangle XOY is 1722 square metres, find the bearing of Y from point O. Give your answer to the nearest degree. **3**

Questions 31 (4 marks) **Marks**

The network diagram below shows the maximum flow rate through a series of pipes in litres per minute.
Water is flowing from the source at vertex A to the sink at vertex D.



(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. **1**

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(c) The owners of this network 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 by how much should its flow be increased, in order to increase the flow of water through this network by the maximum amount possible?

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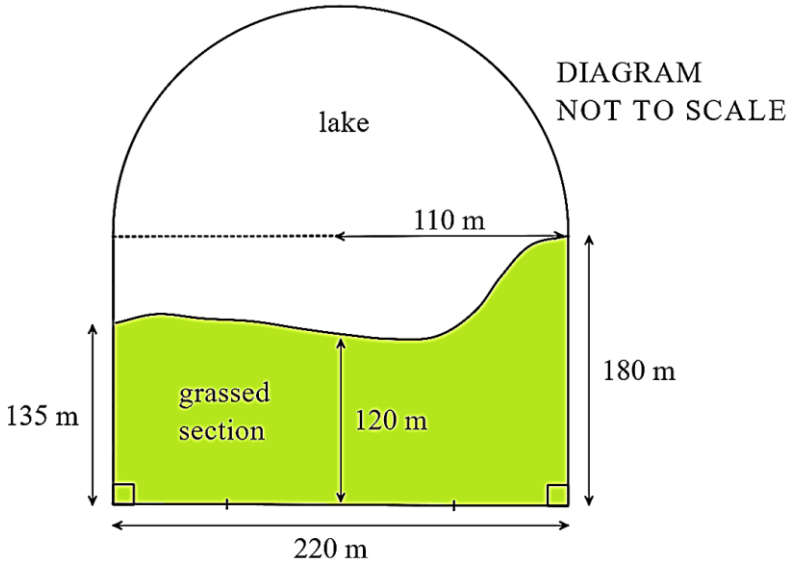
Questions 32 (4 marks) **Marks**

A landscaper, Annabel, wanted to ask the local council to renovate the park near her home. Her suggestion was to have a park partially occupied by a lake and the rest be a grassed section, as shown in the diagram below.



The park consists of a rectangle with dimensions, 220 m and 180 m, and a semi-circle with a radius of 110 m. Some measurements from the end of the grassed section to the edge of the lake are also shown.

(a) Using two applications of the Trapezoidal rule, calculate the approximate area of the grassed section. **2**

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(b) Hence calculate the approximate area of the lake, to the nearest square metre. **2**

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Questions 33 (3 marks) **Marks**

Tiffany has a credit card with the following conditions:

- There is no interest free period
- Interest is charged at the rate of 0.06% per day, compounded daily, at the end of each month
- Interest is calculated from the date of purchase to the last day of the month

Tiffany's credit card statement for January is shown, with some of the figures missing. The minimum payment is calculated as 6% of the closing balance on the 31st of January.

Statement Period: 1 January to 31 January

Date	**Details**	**Amount ($)**
1 January	Opening Balance	0
17 January	Laptop	2 900
31 January	Interest Charge	
31 January	Closing Balance	

Calculate the minimum payment. **3**

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Questions 34 (4 marks) **Marks**

Caryn is saving for a new car. She deposits $7500 at the end of each six-month period for three and a half years. She receives 6% per annum interest compounded twice a year. The table below shows the future values of an annuity of $1.

Future values of an annuity of $1

Number of Periods	Interest rate					
	1%	2%	3%	4%	5%	6%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938

(a) Using the table, find the amount of money Caryn will have in her account at the end of three and a half years. **2**

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(b) How much would Caryn need to invest as a one-off payment to achieve the same final amount under the same conditions? **2**

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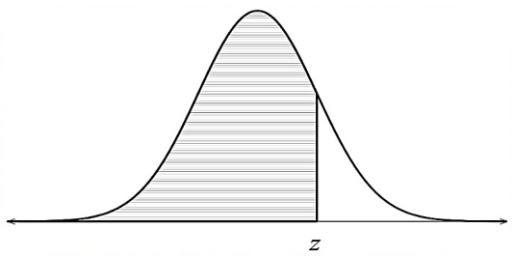
Questions 35 (5 marks) **Marks**

A random variable is normally distributed with a mean of 0 and a standard deviation of 1. The table gives the probability that this random variable lies below z for some positive values of z.

z	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Probability	0.6915	0.7258	0.7580	0.7881	0.8159	0.8413	0.8643	0.8849	0.9032	0.9192	0.9332

The probability values given in the table are represented by the shaded area in the following diagram.



The marks on the entrance test for a scholarship are normally distributed with mean $\mu = 125$ and standard deviation $\sigma = 15$.
All students who scored above 143 marks on the entrance test received a full scholarship and those who scored between 137 and 143 received a partial scholarship. There were 1250 students who sat the examination. How many students received a partial scholarship? **5**

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Questions 36 (7 marks) **Marks**

Isabella takes out a loan of \$150 000, which has an interest rate of 6.14% per annum. She makes regular monthly payments of \$1000. Isabella uses the table shown to calculate her interest.

n	P	I	$P+I$	$P+I-R$
1	\$150 000	\$767.50	\$150 767.50	\$149 767.50
2				A_2

From the table:

- n is the number of months
- P is the outstanding balance of the loan
- I is the monthly interest charged
- R is the monthly repayment

(a) Complete the table to find the value of A_2 . **2**

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(b) Let A_n be the value of Isabella's loan after n months. Complete the recurrence relation to model the value of this loan over time. Give your answers correct to three decimal places. **2**

$A_0 =$ _____

$A_{n+1} =$ _____ $\times A_n - 1000$

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Question 36 (continued)

(c) After the second month, Isabella realises that the interest she pays is very high. She decides to switch to a different bank, which offers an interest of 6% per annum. The table shows the present value for an annuity of $1.

Period	*Interest rate per period*						
	0.5%	1%	2%	3%	4%	5%	6%
90	72.331	59.161	41.587	31.002	24.267	19.752	16.579
100	78.543	63.029	43.098	31.599	24.505	19.848	16.618
120	90.073	69.701	45.355	32.373	24.774	19.943	16.651
132	96.460	73.111	46.338	32.660	24.859	19.968	16.659
142	101.497	75.658	46.996	32.832	24.905	19.98	16.665
144	102.475	76.137	47.112	32.861	24.912	19.982	16.663
165	112.173	80.637	48.095	33.079	24.961	19.994	16.666
168	113.477	81.206	48.205	33.101	24.966	19.994	16.666
180	118.504	83.322	48.584	33.170	24.979	19.997	16.666

Using the table, calculate the total interest that Isabella will pay if she repays the loan in full after 12 years. **3**

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End of Examination

Student Number: Answers
Teacher: Mrs Moncrieff & Mrs Louskos

- original....

St George Girls High School

Mathematics Standard 2

2024 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 questions in the spaces provided.
  - **Show relevant mathematical reasoning** and/or calculations.
  - **Extra writing space** is provided at the back of this booklet on pages 32-34. 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 3 to 9)

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

Section II – 85 marks (pages 10 to 31)

- Attempt Questions 16 – 36
- 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.

---

1. Which of the following is the most **expensive** sauce per mL?

76 ¢/mL (A) Ketchup at \$3.80 for 500 mL 100mL \$0.76

2.4¢/mL (B) Honey Mustard Sauce at \$6.00 for 250 mL 100mL = \$2.40

1.05¢/mL (C) Barbeque Sauce at \$4.20 for 400 mL 100mL = \$1.05

0.94¢/mL (D) Chilli Sauce at \$2.70 for 285 mL 100mL 0.95

2. Which one of the following statements about the line $12x - 4y = 0$ is **not** true?

(A) The line passes through the origin $12(0) - 4(0) = 0$ ✓

✗ (B) The line has a slope of 12

(C) The line has the same slope as the line with the equation $12x - 4y = 12$ gradient also 3.

(D) For this line as x increases y increases positive slope of 3 ∴ true.

✗ $12x - 4y = 0$

$4y = 12x$

$y = \frac{12x}{4}$ $y = mx + c$.

$y = 3x$

gradient = slope = 3

3. Part of Bhavni's partially completed payslip for a week is shown below.

Employee: Bhavni BALA			
	Rate	Hours	Pay owing
	Normal	35	$1470.00
	Time and a Half	6	$378
	Total	41	$1848

What was her total pay owing for the week?

(A) $1722.00

(B) $1848.00

(C) $1974.00

(D) $2583.00

$\frac{\$1470}{35} = \$42/h$

$(35 \times 42) + (6 \times 1.5 \times 42)$

4. The table below shows the number of students in each year at a certain high school.

Year	*Number of students*
7	106
8	123
9	119
10	144
11	127
12	131
Total	750

Fraction of students in year 9 $= \frac{119}{750}$

A stratified sample of 75 students are to be surveyed. How many Year 9 students should be surveyed?

(A) 11

(B) 12

(C) 14

(D) 75

$\therefore \frac{119}{750} \times 75 = 11.9$

5. A 2400-Watt iron is used for 2 hours five times each fortnight. If electricity is charged at 26.5 c/kwh, what is the cost of ironing per fortnight?

(A) $636

(B) $127.20

(C) $6.36

(D) $1.27

(M1) $2.4 \times 2 \times 5 \times 26.5 = 636$ c.

as

(M2) $2400W = 2.4kW$

$\text{Cost} = 2.4 \times 5 \times 2 \times \frac{26.5}{100}$.

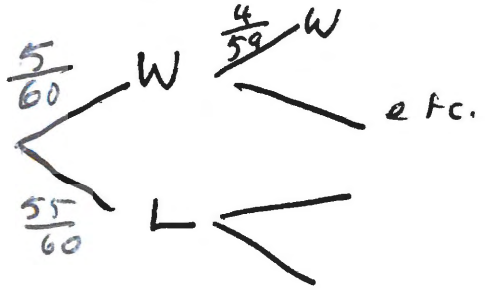
6. Sixty tickets are sold in a raffle. There are two prizes. Farah buys 5 tickets. Which expression gives the probability that Farah wins both prizes?

(A) $\frac{5}{60} \times \frac{4}{59}$

(B) $\frac{5}{60} \times \frac{4}{60}$

(C) $\frac{5}{60} + \frac{4}{59}$

(D) $\frac{5}{60} + \frac{4}{60}$



7. A map has a scale of 1:5000. If Oak St is 800 m, what is the map distance of Oak St?

(A) 0.16 mm

(B) 16 mm

(C) 160 mm

(D) 1600 mm

map length : real length

$1 : 5000$

$x : 800m$

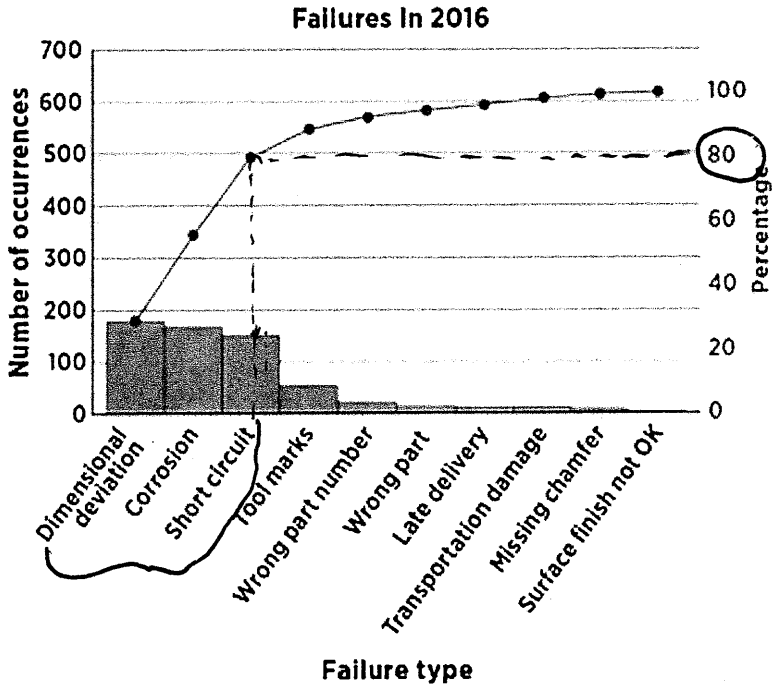
$\frac{x}{800} = \frac{1}{5000}$

$x = \frac{800}{5000}$ m

$= 0.16m$

$= 160mm$

8. According to the data in the Pareto chart below, which reason(s) account(s) for approximately 80% of failures in 2016?



(A) Short circuit

(B) Short circuit and Tool marks

(C) Dimensional deviation, Corrosion and Short circuit

(D) Tool marks

9. Mariam has shares with a current market value of $7.35 each. She has received a cheque for the total dividend of $512. If she owns 450 of these shares, calculate her current dividend yield on these shares.

(A) 0.15%

(B) 6.46%

(C) 8.36%

(D) 15.48%

Market value of shares
$= 450 \times \$7.35$
$= \$3307.50$

$\text{Dividend yield} = \frac{\text{Dividends}}{\text{Market value}} \times 100\%$

$= \frac{512}{3307.50} \times 100\%$

$= 15.48\%$ (2dp)

10. Making x the subject of the formula $S = 2a^3 - 4ax$ gives the equation:

(A) $x = \dfrac{S - 2a^3}{4a}$

(B) $x = \dfrac{2a^2 - S}{4}$

(C) $x = \dfrac{S - 2a^2}{4}$

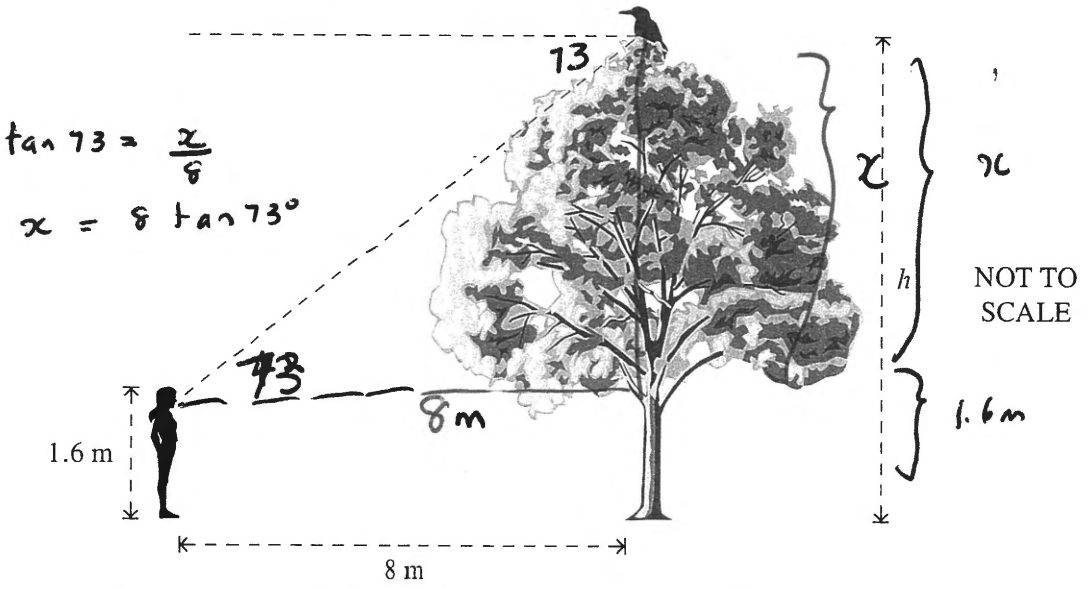
(D) $x = \dfrac{2a^3 - S}{4a}$

$4ax = 2a^3 - S$

$\dfrac{4ax}{4a} = \dfrac{2a^3 - S}{4a}$

$x = \dfrac{2a^3 - S}{4a}$

11. Kelly is watching a bird at the top of a tree. Kelly is 1.6 m tall and is standing 8 m away from the tree, as shown in the diagram.



$\tan 73 = \dfrac{x}{8}$

$x = 8 \tan 73°$

If the angle of depression of Kelly from the bird is 73°, what is the height of the tree?

(A) 2.45 m

(B) 4.05 m

(C) 26.17 m

(D) 27.77 m

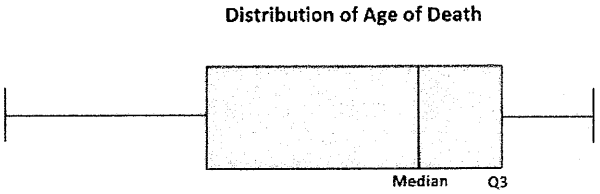
height $= x + 1.6\text{ m}$

$= 8 \tan 73° + 1.6\text{ m}$

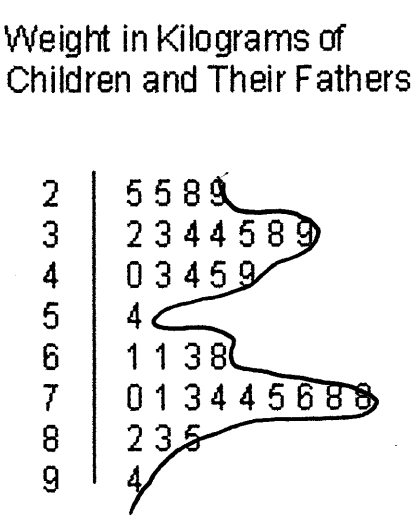
$= 27.77$ (2dp)

12. Which of the following data sets below is positively skewed?

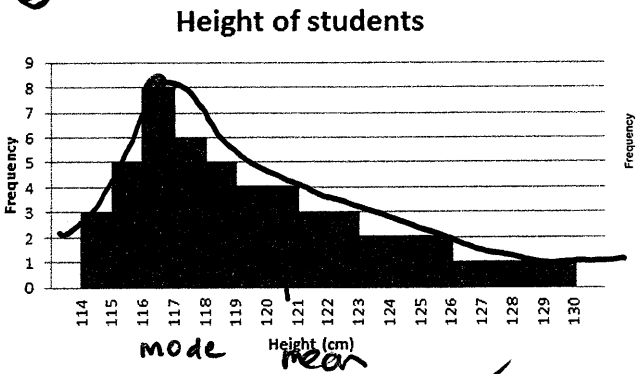
(A)



(B)



(C)

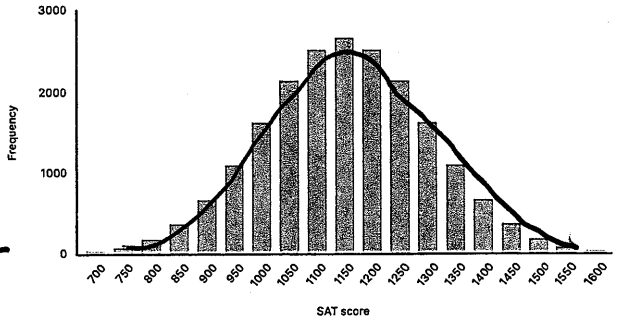


mode mean

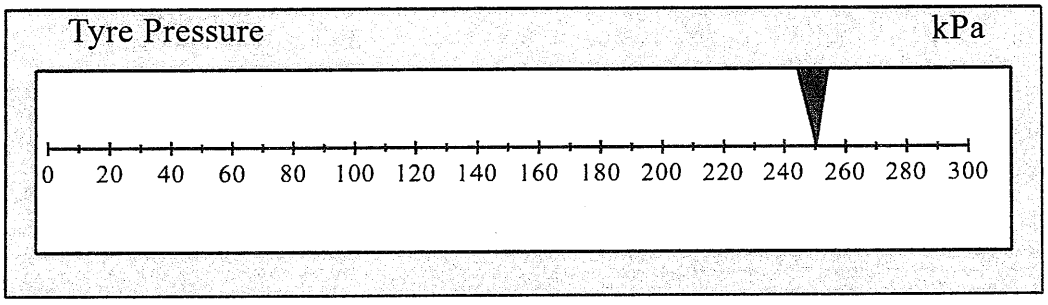
mean − mode positive ✓

tail points in positive direction ✓

(D)



13. The tyre gauge below shows a pressure of 250 kilopascals.



What is the percentage error in this measurement?

(A) 2%

(B) 2.5%

(C) 4%

(D) 5%

precision : 10 kPa

½ precision : 5 kPa.

$$\text{percent. error} = \frac{5}{250} \times 100\%$$

$$= 2\%$$

14. The weights of 348 female players in a football competition are normally distributed with a mean of 76.6 kg and a standard deviation of 5.4 kg.

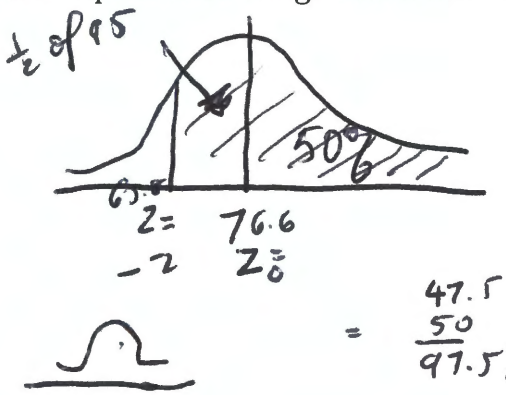
How many players are expected to weigh more than 65.8 kg?

(A) 8

(B) 16

(C) 332

(D) 339



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

$= \frac{65.8-76.6}{5.4}$

$= -2$

47.5 / 50 / 97.5%

Finally, $97.5\% \times 348 = 339$

15. Cities A and B are both located on the equator.

City A is at longitude $12°E$ and city B is at longitude $74°W$.

Irene is travelling from city B to city A. She chooses to take a flight that travels non-stop to city A along the shortest distance between the two cities A and B.

The flight departs from city B at 8:00 am on Monday.

Given the Earth's radius is 6371 km, and the average speed of the aeroplane is 835 km/h, what time and day would Irene expect to arrive in city A?

angular difference = 74 + 12 = 86

time difference = 86 × 4 minutes = 344 min = 5 h 44 min.

(A) 1:44 pm Monday

(B) 7:27 pm Monday

(C) 11:35 pm Monday

(D) 1:11 am Tuesday

l = shortest distance $= \frac{86}{360} \times 2 \times \pi \times 6371$ km

$= 9562.7636..$ km

8 am Mon +

time to travel $= \frac{D}{S} = \frac{9562.736 \text{ km}}{835 \text{ km/h}}$

= 11 hours 27 min.

Arrival Time 8 am Mon + 11 h 28 min + 5 hour 44 min

= 1:11 am Tuesday

END OF SECTION I

Section II

85 marks
Attempt questions 16 - 36
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 (3 marks) **Marks**

Solve the following equation $\frac{x}{3}+2=3(x-2)$. **3**

Method 1:
$\frac{x}{3}+2=3x-6$
$1x+6=9x-18$
$6+18=9x-1x$
$\frac{24}{8}=\frac{8x}{8}$
$x=3$

Method 2
$x+6=9(x-2)$
$x+6=9x-18$
$6+18=9x-1x$
$24=8x$
$x=3$

Method 3
$\frac{x}{3}+2=3x-6$
$\frac{x}{3}=3x-8$
$x=9x-24$
$24=9x-x$
$24=8x$
$x=3$

Questions 17 (2 marks) **Marks**

Josephine is concerned about the lizard population in the local community. She collects 170 lizards and tags them. A couple of months later she collects 32 lizards and found 10 of them were tagged. What is her estimate of the lizard population using the capture-recapture method? **2**

what fraction are tagged? let x = population of lizards.

$\frac{170}{x}=\frac{10}{32}$

$10x=170\times32$

$x=\frac{170\times32}{10}$

$=544$

∴ Her estimate will be 544 lizards in the population.

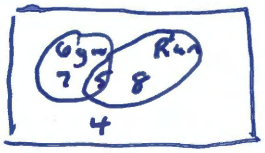
Questions 18 (4 marks)

A Year 12 class of 24 students were surveyed about the type of exercise they do. 12 said they go to the gym, 13 said they run and 4 said they neither go to the gym nor run.

(a) Complete the two-way table below to represent this data. **2**

	Gym	Do Not Gym	Total
Run	5	8	13
Do Not Run	7	4	11
Total	12	12	24

1 mark if 4 correct



(b) Find the probability that a student who runs also goes to the gym. **1**

$\frac{5}{13}$

(c) Find the percentage of runners who do not go to the gym. **1**
Leave your answer to the nearest percentage.

$\frac{8}{13} \times 100\%$

$= 62\%$ (nearest percent).

Questions 19 (3 marks) **Marks**

The number of people (N) who attend a show varies inversely with the amount of floor space in cm^2 allowed per person (A).

A venue can hold 3200 people if each person is allowed 300 cm^2.

(a) How many people can the venue hold if a person is allowed 250 cm^2 ? **2**

$N \propto \frac{1}{A}$

$N = \frac{k}{A}$ —— ①

substitute $N = 3200$ & $A = 300$ in ① to find k.

$3200 = \frac{k}{300}$

$\therefore k = 960000$ 1 mark to here.

$\therefore N = \frac{960000}{A}$ —— ②

when $A = 250 cm^2$,

$N = \frac{96000}{250} = 3840$ people.

(b) What is the space allowed per person for 4000 to attend a show? **1**

$N = \frac{960000}{A}$ $A = ?$ if $N = 4000$

$4000 = \frac{960000}{A}$

$4000A = 960000$

$\frac{4000A}{4000} = \frac{960000}{4000}$

$A = 240 cm^2$

Questions 20 (4 marks) **Marks**

A bag contains blue, green and yellow marbles. The ratio of the number of blue marbles to the number of green marbles to the number of yellow marbles in the bag is 3: 8: 9.

(a) What is the total number of marbles in the bag if the number of green marbles is 112? **2**

B : G : Y = 3 : 8 : 9

Total number of parts = 3 + 8 + 9 = 20 parts.

Method 1: Let x = total number of parts

112 Green $\Rightarrow \frac{8}{20} \times x = 112$

$x = 112 \times \frac{20}{8}$

$x = 280$ marbles

∴ there are 280 marbles altogether

Method 2: Using equivalent ratios.

B : G : Y

3 : 8 : 9

42 : 112 : 126

total = 42 + 112 + 126

= 280

(b) A number of bags of these marbles are placed in a carton. The total number of marbles in the carton is 1960. What is the number of blue marbles in the carton? **2**

Number of bags in the carton = 1960 ÷ 280

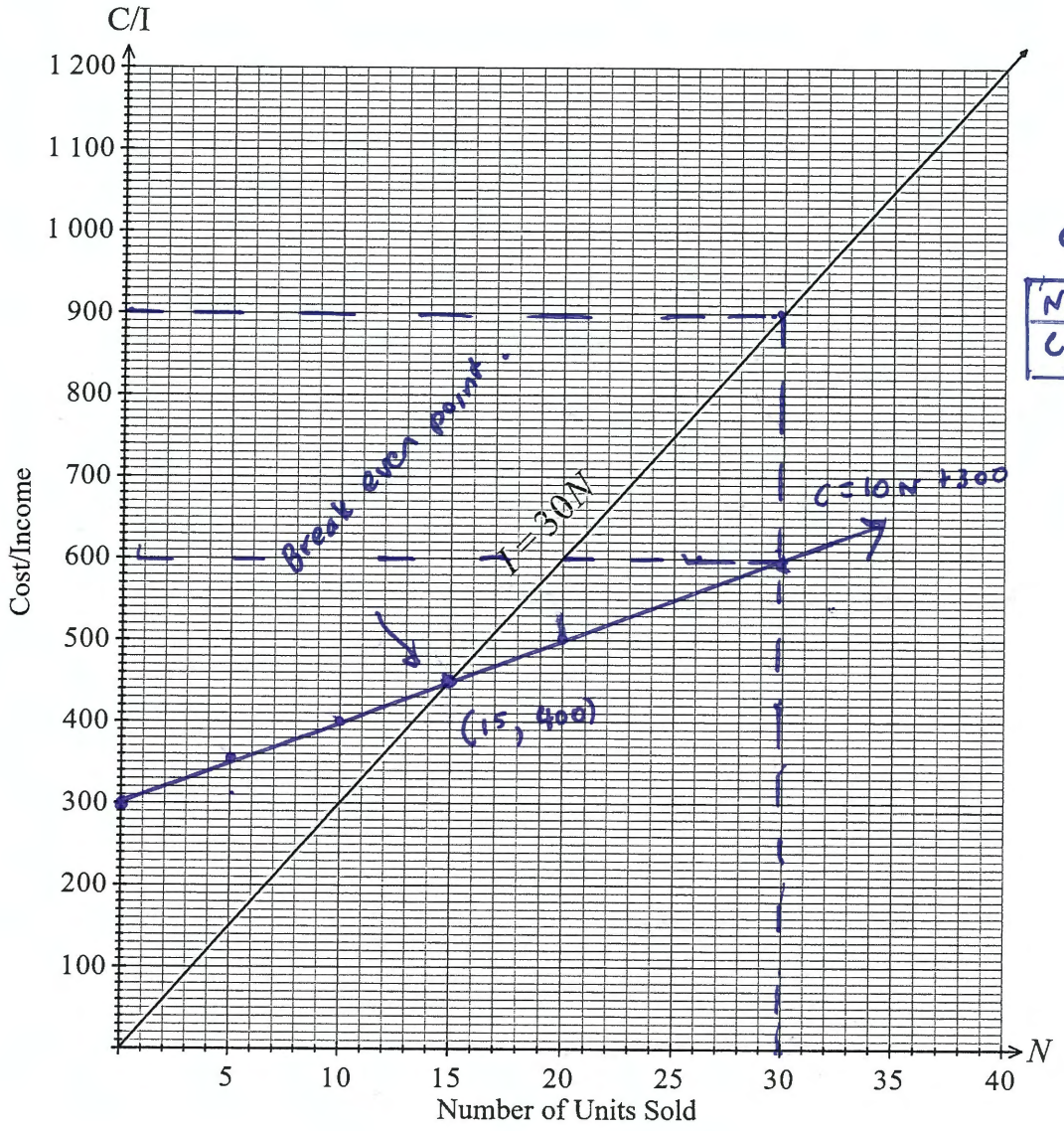
= 7 bags.

Number of blue marbles = $\frac{3}{20} \times 1960$

= 294 blue marbles in the carton.

Questions 21 (5 marks) **Marks**

A wholesaler sells a device called a Midien for \$30 each. The income I from selling N devices is graphed below.



$C = 10N + 300$

N	0	10	20	30	5	15
C	300	400	500	600	350	450

etc

Each day their fixed costs (wages, rent etc) are \$300 and each Midien costs them \$10.

(a) The formula for the cost involved in selling N Midiens in a day is $C = 10N + 300$. **1**

What is the cost when 20 Midiens are sold in a day?

when $N = 20$, $C = 10(20) + 300$ ∴ Cost = \$500

$= \$500.$

(b) Draw the line representing the equation $C = 10N + 300$ on the graph above. **2**

Question 21 (continued) **Marks**

(c) How many Midiens would they need to sell in a day to break even? **1**

15

(d) How much profit (or loss) would they make on a day where they sold 30 Midiens? **1**

Profit = 900 - 600

= 300

Questions 22 (3 marks)

Anna's yearly salary is $124 800. She decides to take her four weeks annual holiday. Find her holiday pay, which consists of her normal pay for four weeks plus 17.5% holiday loading. (Use 1 year = 52 weeks) **3**

normal pay for 4 weeks

$= \frac{\$124\,800}{52} \times 4$

$= 2400 \times 4$

$= \$9600$ 1 mark to here.

Holiday pay $= \$9600 + 17.5\% \times \$9600$

$= \$9600 + \$1680$

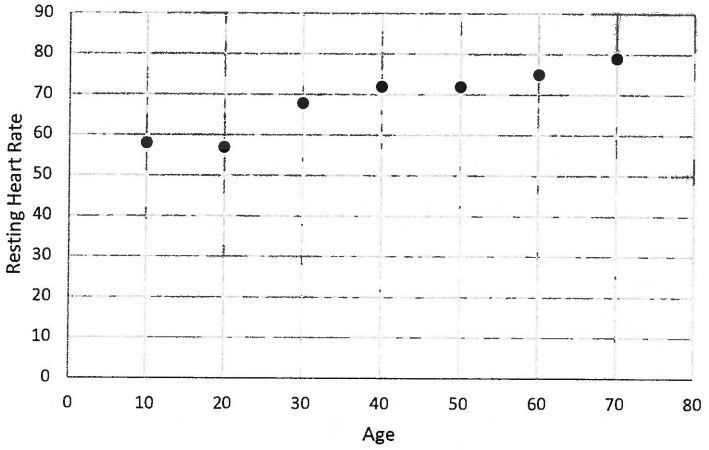
$= \$11\,280$

OR $117.5\% \times 9600$

$= \$11\,280$

Questions 23 (7 marks) **Marks**

A set of bivariate data is collected by taking the resting heart rate and age of seven people. The following is a scatterplot of these measurements and a corresponding table of values.



Age	Resting Heart Rate
10	58
20	57
30	68
40	72
50	72
60	75
70	79

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

r= 0.950449843

r= 0.95 (2 dp)

(b) Comment on the direction and strength of the correlation between the two variables. **1**

a positive, strong correlation

Questions 23 (continued) **Marks**

(c) Calculate the equation for the least-squares regression line, giving your answer in the following form: $Heart\ Rate = p \times Age + q$. **2**

B = p 0·367857 1429 = 0.368 — 1mk.

A = q = 54

Heart Rate = 0·368 x age + 54

(d) Predict the heart rate of a 35 year old person using the least-squares regression line. **1**

Heart Rate = 0.368 x 35 + 54

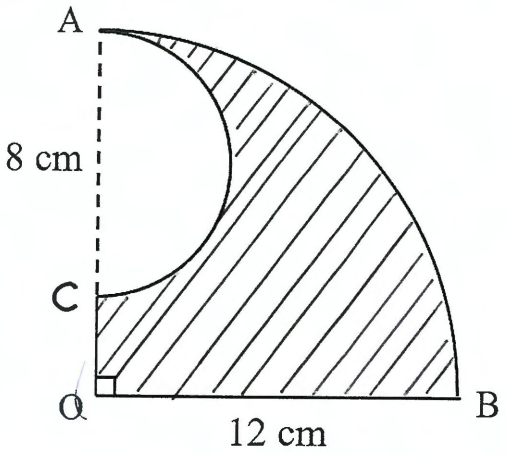
= 66.88 bpm.

(e) Would your answer be an example of extrapolation or interpolation? Give a reason for your answer. **2**

Interpolation as the age of 35 is within the range of the original data set

Questions 24 (3 marks) **Marks**

A shape is formed by removing a semi-circle with diameter 8 cm from a quarter of a circle with radius 12 cm as shown in the diagram.



What is the perimeter of the shaded shape correct to three decimal places? **3**

Perimeter = Arc$_{AC}$ + Arc$_{AB}$ + OB + OC

Arc$_{AC}$ = $\frac{1}{2} \times 2\pi \times 4$

semicircle = 4π } 1 mark.

Arc$_{AB}$ = $\frac{1}{4} \times 2\pi \times 12$

quadrant = 6π

$\therefore$ Perimeter = $4\pi + 6\pi + 12 + 4$ 1 mark.

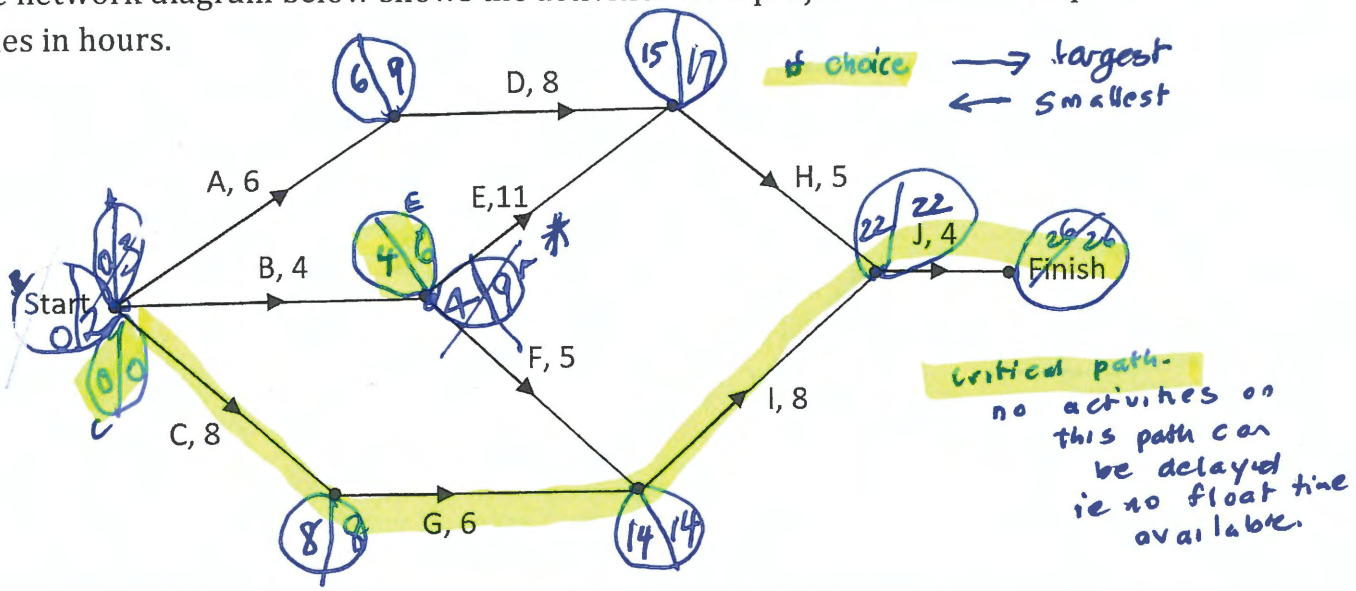
$= (10\pi + 16)$ cm

$= 47.415\,926\,5\ldots$

$= 47.416$ cm 1 mark

Questions 25 (4 marks) **Marks**

The network diagram below shows the activities for a project and their completion times in hours.



(a) Complete the table below, showing the earliest starting time (EST) and the latest starting time (LST) for each activity. **2**

Activity	EST	LST
A	0	3
B	0	2
C	0	0
D	6	9
E	4	6
F	4	9
G	8	8
H	15	17
I	14	14
J	22	22

given

given.

(b) List the activities in order which make up the critical path for this network. **1**

the critical path is C G I J

(c) Calculate the float time for activity D. **1**

Float time = (6|9) = 9 − 6 OR 17 − 6 − 8
= 3.

Questions 26 (4 marks) **Marks**

A company purchases a machine for \$50 000. The two methods of depreciation being considered are the declining-balance method and the straight-line method.

(a) For the declining-balance method, the salvage value of the machine after n years is given by the formula $S = V_0 \times (0.80)^n$, where S is the salvage value and V_0 is the initial value of the asset.

(i) What is the annual rate of depreciation used in this formula? **1**

$1 - r = 0.80$ formula sheet $\rightarrow S = V_0(1-r)^n$

$r = 1 - 0.8$ $S = V_0(0.80)^n$

$= 0.2$

$= 20\%$

(ii) Calculate the salvage value of the machine after 3 years, based on the given formula. **1**

$S = 50000(0.80)^3$ $n=3, V_0 = 50000, S = ?$

$= \$25\,600$

(b) For the straight-line method, the value of the machine is depreciated at a rate of 12.2% of the purchase price each year. **2**
When will the value of the machine, using this method, be equal to the salvage value found in part (a)(ii)?

SL depreciation $S = V_0 - Dn$. where $D = 12.2\% \times \$50000$

$= \$6100$

$S = 50000 - (12.2\% \times 50000) \times n$

$\boxed{S = 50000 - 6100n}$

if $S = 25600$, $25600 = 50000 - 6100n$

$6100n = 50000 - 25600$

$6100n = 24400$

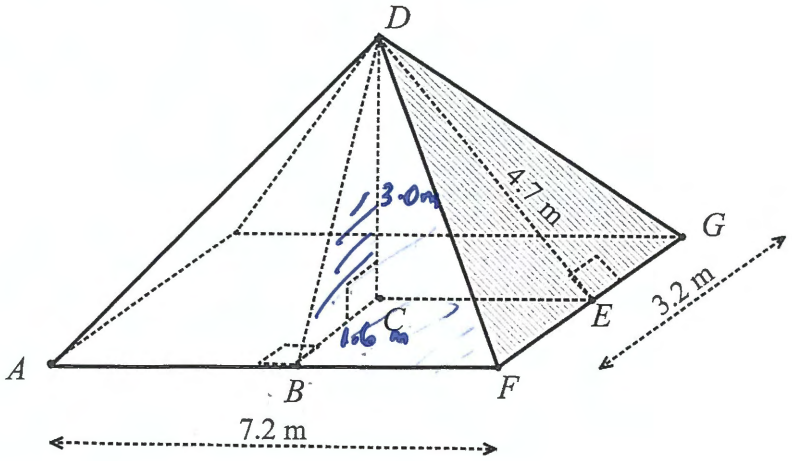
$n = \frac{24400}{6100}$

$n = 4$ years.

∴ at 4 years, the values will be the same.

Questions 27 (3 marks) **Marks**

A cabin has a roof in the shape of a rectangular pyramid, as shown below.



$AF = 7.2$ m, $FG = 3.2$ m, $DE = 4.7$ m, and the vertical height $DC = 3.0$ m.

(a) Find the length of DB. **1**

Using Pythagoras' theorem, in $\triangle DCB$, $DB^2 = (3.0)^2 + (1.6)^2$

$= 11.56$

$DB = \sqrt{11.56}$

$= 3.4$ m (1 dp)

(b) Calculate the total surface area of the roof. **2**

Surface Area = 4 triangles (Not the rectangular base)

$= 2 \times \left(\frac{1}{2} \times 3.2 \times 4.7\right) + 2 \times \left(\frac{1}{2} \times 7.2 \times 3.4\right)$ 1mk

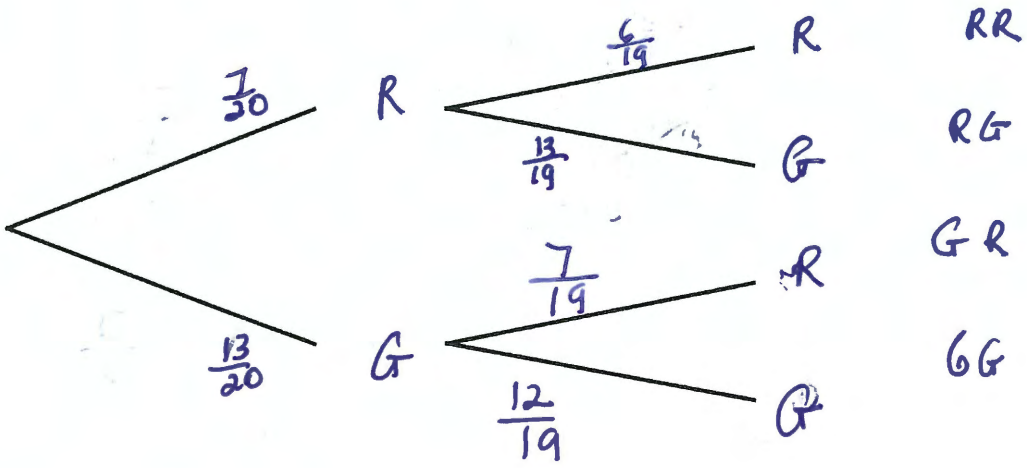
$= 15.04 + 24.48$

$= 39.52\ m^2$

Questions 28 (5 marks) **Marks**

A packet of 20 lollypops contains only two colours. There are 7 red lollypops in the packet and the rest are green. Anastasia chooses a lollypop, eats it, and then chooses another.

(a) Complete the tree diagram representing this information. **2**
Include probabilities on all the branches.



(b) What is the probability Anastasia chose two red lollypops? **1**

$P(RR) = \frac{7}{20} \times \frac{6}{19}$

$= \frac{21}{190}$

(c) What is the probability that the two lollypops Anastasia chose were different colours? **2**

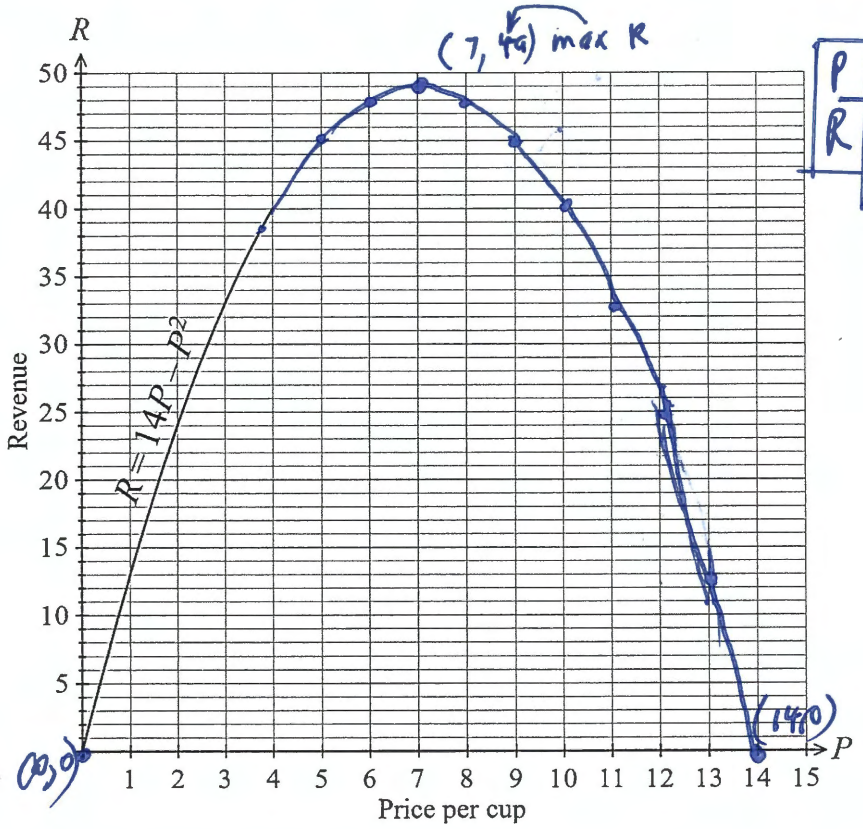
$= P(RG) + P(GR)$

$= \frac{7}{20} \times \frac{13}{19} + \frac{13}{20} \times \frac{7}{19}$

$= \frac{91}{190}$

Questions 29 (5 marks) **Marks**

A coffee shop does some research to determine the best price to set for a cup of coffee. Their daily revenue depends on the price they charge per cup and the number of cups that they sell each day.
They find that the formula $R = 14P - P^2$ gives their daily revenue (R) from selling coffee at a price of $\$P$ per cup.
A graph of this formula for increasing values of P has been started below.



parabola.

P	5	6	7	8	9	14
R	45	48	49	48	45	0

(10, 40)
(11, 33)
(12, 24)
(13, 13)

(a) Complete the graph on the axes above. **2**

(b) Determine the price per cup that produces the maximum revenue for a day. **1**

a price of $7 per cup maximises revenue for the day to be $49.
ie P = $7 R = $49.

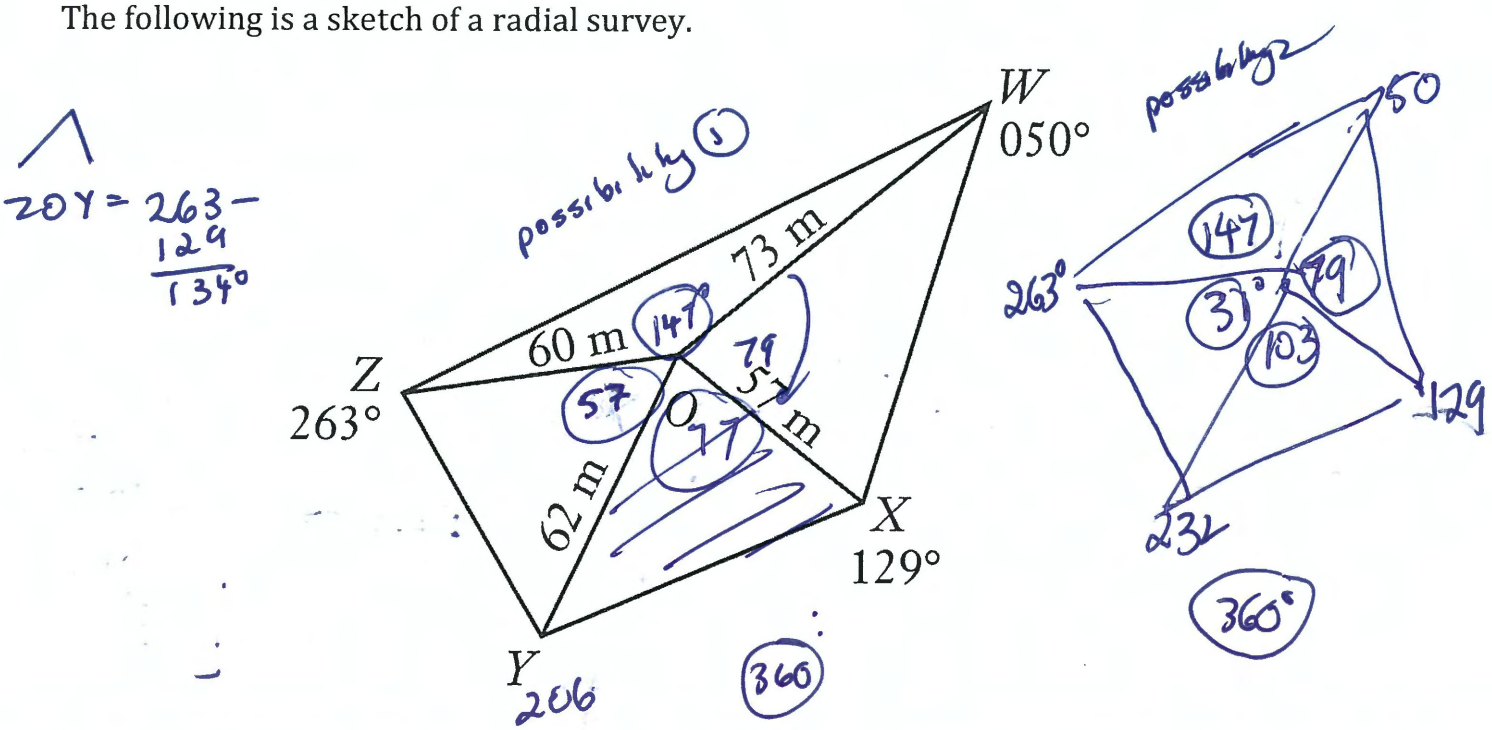
(c) There is no revenue for a value $P = 0$ (i.e. giving the coffee away free earns no revenue). For what other value of P is there also no revenue? Explain what this implies about the pricing of the coffee. **2**

P = $14 1 mark.

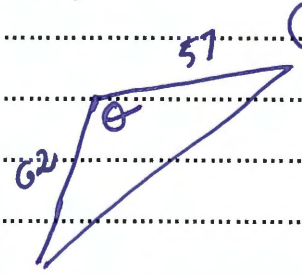
As the cost of coffee goes up, less people buy coffee
When the price reaches $14 no one will be prepared to buy coffee at this dearer price.

Questions 30 (3 marks) **Marks**

The following is a sketch of a radial survey.



If the area of triangle XOY is 1722 square metres, find the bearing of Y from point O. Give your answer to the nearest degree. **3**



① Finding angle XOY...

$\frac{1}{2}ab\sin C = 1722 \quad m^2$

$\frac{1}{2} \times 62 \times 57 \times \sin\theta = 1722$

$1767 \sin\theta = 1722$

$\sin\theta = \frac{1722}{1767}$

$\theta = \sin^{-1}\left(\frac{1722}{1767}\right)$

$\theta = 72°$, or $108°$

bearing of Y from O is $129 + 77$

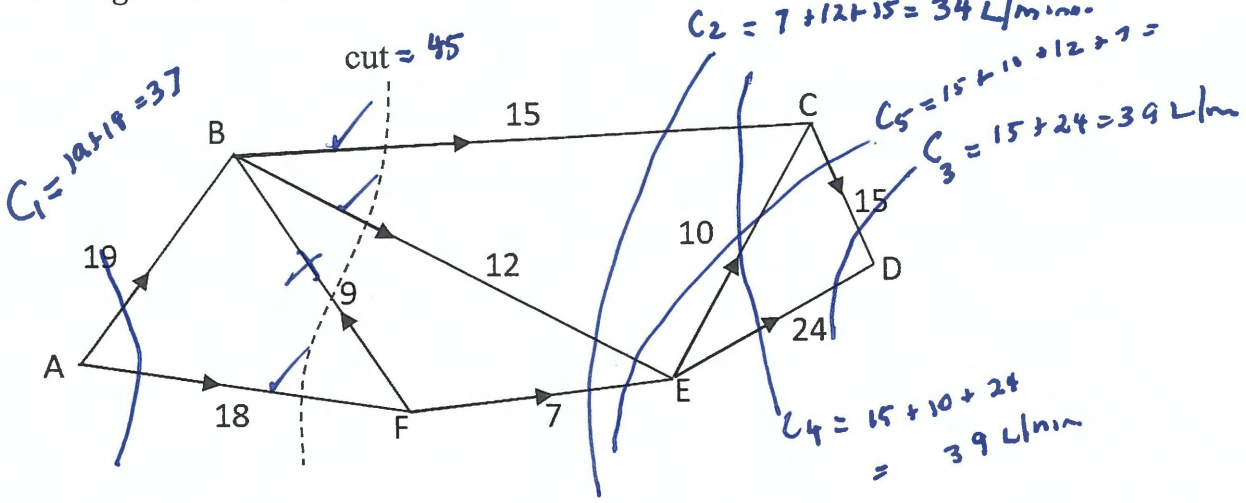
$= 206°$ T.

or $129 + 103 = 232°$ T

We will only consider the possible acute angle.

Questions 31 (4 marks) **Marks**

The network diagram below shows the maximum flow rate through a series of pipes in litres per minute.
Water is flowing from the source at vertex A to the sink at vertex D.



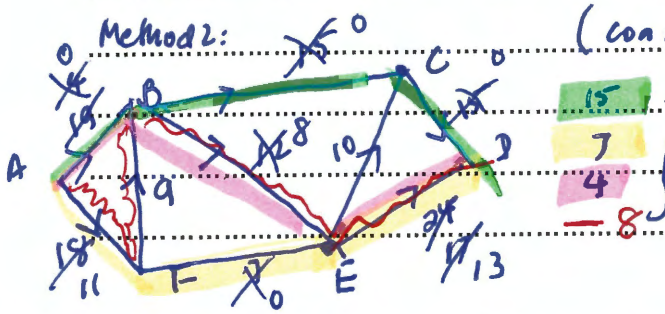
(a) What is the capacity of the cut shown in the diagram? **1**

= 15 + 12 + 18 (Not 9 wrong direction)
= 45 L/minute.

(b) Calculate the maximum flow of this network. **1**

Method 1: Max^m flow = minimum cut = Cut 2 = 7 + 12 + 15 = 34 L/min

Method 2: (consider all cuts find the smallest).



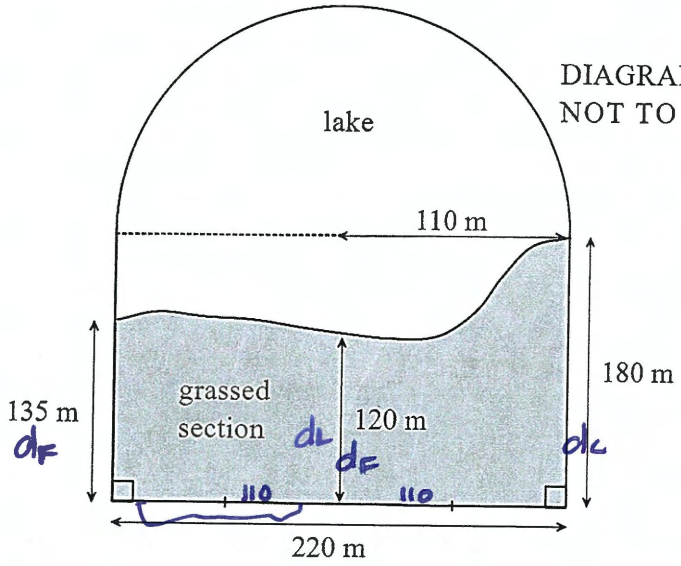
15 + 7 + 4 + 8 = 34 L/min
OR similar

(c) The owners of this network 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 by how much should its flow be increased, in order to increase the flow of water through this network by the maximum amount possible?

the minimum cut is Cut$_2$ 7 + 12 + 15 = 34 L/min
37 litres/min leaves A ... so can increase by 3 L/min.
if FE is increased from 7 to 10 ... (ie 3 L).
the extra 3 L can move through A-F-E-D as
there is excess room in these pipes.

Questions 32 (4 marks) **Marks**

A landscaper, Annabel, wanted to ask the local council to renovate the park near her home. Her suggestion was to have a park partially occupied by a lake and the rest be a grassed section, as shown in the diagram below.



The park consists of a rectangle with dimensions, 220 m and 180 m, and a semi-circle with a radius of 110 m. Some measurements from the end of the grassed section to the edge of the lake are also shown.

(a) Using two applications of the Trapezoidal rule, calculate the approximate area of the grassed section. **2**

$h = 110$.

$A = \frac{h}{2}[d_F + d_L] + \frac{h}{2}[d_L + d_L]$

$= \frac{110}{2}[135 + 120] + \frac{110}{2}[120 + 180]$ 1 mark

$= 30\,525\ m^2$ 1 mark.

(b) Hence calculate the approximate area of the lake, to the nearest square metre. **2**

Area of lake = overall area − grassed section area

$= \frac{1}{2} \times \pi \times 10^2 + (180 \times 220) - 30\,525$ ← part (a) (i)

$= 28.081.63555$

$= 28\,082\ m^2$. (i).

Questions 33 (3 marks) **Marks**

Tiffany has a credit card with the following conditions:

- There is no interest free period
- Interest is charged at the rate of 0.06% per day, compounded daily, at the end of each month
- Interest is calculated from the date of purchase to the last day of the month

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

Tiffany's credit card statement for January is shown, with some of the figures missing. The minimum payment is calculated as 6% of the closing balance on the 31st of January.

Statement Period: 1 January to 31 January

Date	Details	Amount ($)
1 January	Opening Balance	0
17 January	Laptop	2 900
31 January	Interest Charge	$26.21
31 January	Closing Balance	$2926.21.

- 31 days in January
- 16 days with $0 Balance

Calculate the minimum payment. **3**

Number of days interest charge = 31 − 16
= (15) days } (1)

Interest rate as a decimal = 0.06% = 0.06 ÷ 100 = (0.0006)

$FV = PV(1+r)^n$
$= 2900(1.0006)^{15}$
$= \$2926.209906$
$= \$2926.21$ } (1)

Minimum Payment = 6% of $2926.21
$= \$175.5726$
$= \$175.57$. (1)

Questions 34 (4 marks) **Marks**

Caryn is saving for a new car. She deposits \$7500 at the end of each six-month period for three and a half years. She receives 6% per annum interest compounded twice a year. The table below shows the future values of an annuity of \$1.

Future values of an annuity of \$1

Number of Periods	Interest rate					
	1%	2%	3%	4%	5%	6%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938

1 mk

(a) Using the table, find the amount of money Caryn will have in her account at the end of three and a half years. **2**

Amount = 7.6625 × \$7500 $r = \frac{6\%}{2} = 3\%$

= \$57468.75 3.5 yrs = 7 periods of 6 months

(b) How much would Caryn need to invest as a one-off payment to achieve the same final amount under the same conditions? **2**

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

$57468.75 = PV(1.03)^7$ } 1 mark.

$PV = \frac{57468.75}{(1.03)^7}$

= \$46727.35279

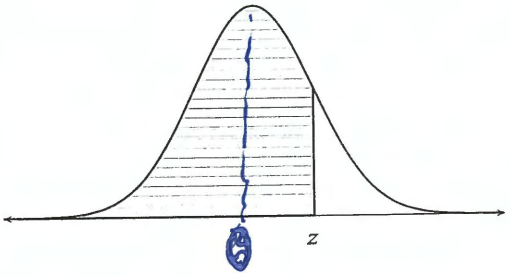
= \$46727.35 1 mk

Questions 35 (5 marks) **Marks**

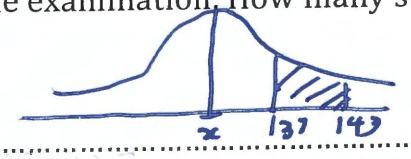
A random variable is normally distributed with a mean of 0 and a standard deviation of 1. The table gives the probability that this random variable lies below z for some positive values of z.

z	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Probability	0.6915	0.7258	0.7580	0.7881	0.8159	0.8413	0.8643	0.8849	0.9032	0.9192	0.9332

The probability values given in the table are represented by the shaded area in the following diagram.



The marks on the entrance test for a scholarship are normally distributed with mean $\mu = 125$ and standard deviation $\sigma = 15$.
All students who scored above 143 marks on the entrance test received a full scholarship and those who scored between 137 and 143 received a partial scholarship. There were 1250 students who sat the examination. How many students received a partial scholarship? **5**



step 1 find z scores

Z score of 143 $= \frac{143-125}{15}$ $= 1.2$ (1 mk)

Z score of 137 $= \frac{137-125}{15}$ $= 0.8$ (1 mk)

step 2 use table

$P(Z \leq 1.2) = 0.8849$

$P(Z \leq 137) = 0.7881$. (1 mk)

step 3 $P(0.8 \leq Z \leq 1.2) = 0.8849 - 0.7881$

$= 0.0968$ (1 mk)

step 4 Number of students with partial scholarship $=$

$= 0.0968 \times 1250$

$= 121$ students. (1 mark.)

Questions 36 (7 marks) **Marks**

Isabella takes out a loan of \$150 000, which has an interest rate of 6.14% per annum. She makes regular monthly payments of \$1000. Isabella uses the table shown to calculate her interest.

n	P	I	$P+I$	$P+I-R$
1	\$150 000	\$767.50	\$150 767.50	\$149 767.50
2	\$149 767.50	\$766.31	\$150 533.81	A_2

From the table:

- n is the number of months
- P is the outstanding balance of the loan
- I is the monthly interest charged
- R is the monthly repayment

= 149 533.8104
= 149 533.81

(a) Complete the table to find the value of A_2. **2**

$I = \frac{0.0614}{12} \times 149767.50$

$= \$766.31$ (1)

$P + I = \$150\ 533.81$

$A_2 = 150533.81 - 1000$

$= \$149\ 533.81$

(b) Let A_n be the value of Isabella's loan after n months. Complete the recurrence relation to model the value of this loan over time. Give your answers correct to three decimal places. **2**

$A_0 = \$150\,000$

$A_{n+1} = 1.005 \times A_n - 1000$

$A_1 = A_0\left(1 + \frac{0.0614}{12}\right) - 1000$

$= A_0(1.005\,11667) - 1000$

$A_2 = A_1(1.005) - 1000$

etc

Question 36 (continued)

(c) After the second month, Isabella realises that the interest she pays is very high. She decides to switch to a different bank, which offers an interest of 6% per annum. The table shows the present value for an annuity of $1.

Period	Interest rate per period						
	0.5% *	1%	2%	3%	4%	5%	6%
90	72.331	59.161	41.587	31.002	24.267	19.752	16.579
100	78.543	63.029	43.098	31.599	24.505	19.848	16.618
120	90.073	69.701	45.355	32.373	24.774	19.943	16.651
132	96.460	73.111	46.338	32.660	24.859	19.968	16.659
142	101.497	75.658	46.996	32.832	24.905	19.98	16.665
144	102.475	76.137	47.112	32.861	24.912	19.982	16.663
165	112.173	80.637	48.095	33.079	24.961	19.994	16.666
168	113.477	81.206	48.205	33.101	24.966	19.994	16.666
180	118.504	83.322	48.584	33.170	24.979	19.997	16.666

2 months paid already

Using the table, calculate the total interest that Isabella will pay if she repays the loan in full after 12 years. **3**

After transferring banks, she begins owing $149533.81.

12 years = 144 months. But she already has paid 2 months so $n = 142$

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

let A = Amount of repayment.

$A(101.497) = 149533.81$ 1mk for 101.497

$A = \frac{149533.81}{101.497}$ *

$= \$1473.28$ 1mk to here

Total to pay = 1000×2 + $\$1473.28 \times 142$

(first 2 months)

$= \$211\,205.76$ ← loan

Interest: $\$211\,205.76 - \$150\,000$

$= \$61\,205.76$ 1mk

End of Examination