

Carlingford High School



TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

2019

Student Number: _____

Mathematics Standard 2

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours and 30 minutes
- Write using black/blue pen
- Approved calculators may be used
- A reference sheet is provided at the back of this paper
- In Questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks : **Section I – 15 marks** (pages 3 – 8)
100

- Attempt Questions 1 – 15
- Use the Multiple Choice Answer sheet on page 29
- Allow about 25 minutes for this section

Section II – 85 marks (pages 9 – 26)

- Attempt Questions 16 – 46
- Allow about 2 hours and 5 minutes for this section

	Linear and Non-Linear Relationships	Applications of Measurement	Financial Mathematics	Statistical Analysis	Network Concepts	
1	/1					
2			/1			
3				/1		
4		/1				
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39		/2				
40		/3				
41		/2				
42				/1		
43				/4		
44					/3	
45			/4			
46		/4				
Total	/20	/29	/23	/24	/4	/100

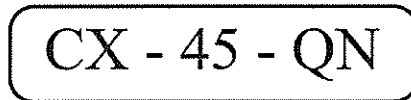
Section I: 15 marks

Attempt Questions 1–15.

Allow 25 minutes for this section

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

1. Simplify: $2x(7 - x) - 3x$
(A) $11x - x^2$
(B) $11x - 2x^2$
(C) $14x - 2x^2 - 3x$
(D) $17x - 2$
2. Cameron earns \$14.50 per hour normal rate. How much does he earn if he works 38 hours at normal rate and 5 hours at time-and-a-half?
(A) \$587.25
(B) \$630.75
(C) \$659.75
(D) \$935.25
3. A type of car number plate has two letters, followed by two numerals, followed by two more letters. For example:

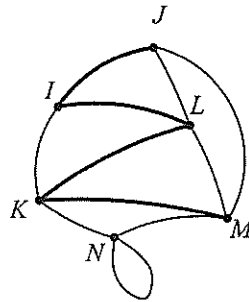


Which calculation would give the total number of number plates of this type?

- (A) $26 \times 26 \times 10 \times 10 \times 26 \times 26$
- (B) $26 \times 10 \times 10 \times 26 \times 26$
- (C) $26 \times 25 \times 10 \times 9 \times 26 \times 25$
- (D) $25 \times 10 \times 9 \times 24 \times 23$

4. John measured his height to be 182cm, correct to the nearest centimetre. What is the percentage error in his measurement?
- (A) $\pm 0.0027 \%$
- (B) $\pm 0.0055 \%$
- (C) $\pm 0.27 \%$
- (D) $\pm 27 \%$

5. An undirected network with vertices I, J, K, L, M and N is shown below.



Which term could **not** be used to describe the highlighted section $J I L K M$?

- (A) a cycle
- (B) a path
- (C) a tree
- (D) a walk
6. An estimate of a person's maximum heart rate, R (in beats per minute) is given by the formula:

$$R = 220 - A \quad \text{where } A \text{ is the person's age in years.}$$

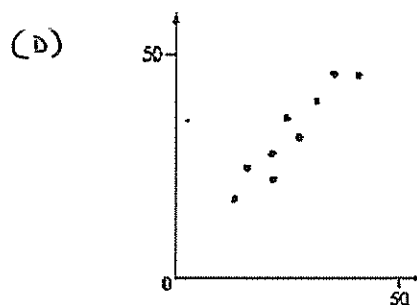
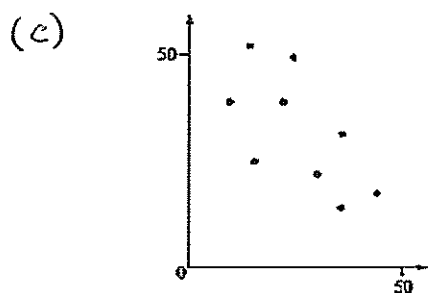
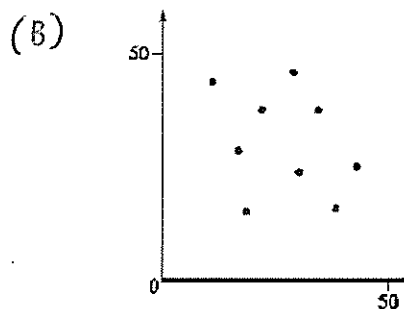
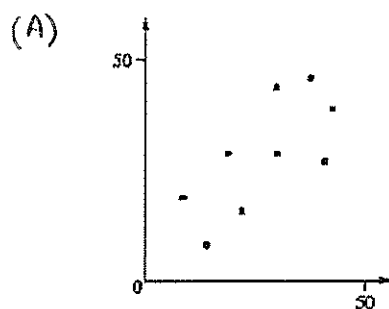
It is estimated that a healthy person should have a target heart rate of 55% of their maximum rate when beginning to exercise.

Hanna is a healthy 17 years, 6 months old girl.

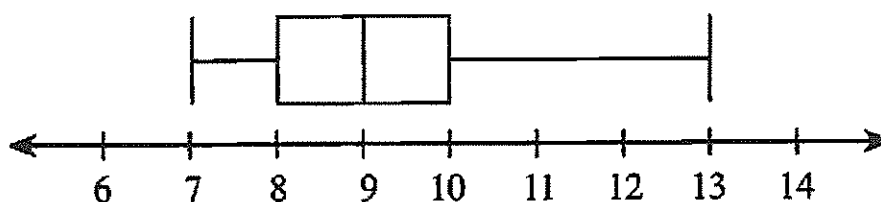
What is an estimate of her target heart rate, in beats per minute, when she begins exercising?

- (A) 202.5
- (B) 91.1
- (C) 210.4
- (D) 111.4

7. Which graph below best shows data with a correlation closest to -0.3 ?



8. The box-and-whisker plot below represents the number of calls made to find a casual person for the day.



Which of the following must be correct?

- (A) The median is 9
- (B) The mode is 9
- (C) The mean is 9
- (D) The interquartile range is 9

9. A house was purchased in 1984 for \$65 000. Assume that the rate of inflation in Australia has averaged at 3% per annum..

Which expression gives the value of the house in 2009?

- (A) $65000(1 + 0.03)^{25}$
 (B) $65000(1 + 3)^{25}$
 (C) $65000 \times 25 \times 0.03$
 (D) $65000 \times 25 \times 3$

10. Darren borrowed \$18 000 from the Credit Union for 3 years, at 8% per annum monthly reducible interest, to buy a car. His monthly repayments are \$564.

The table below shows the calculations for the first two months of his loan.

	<i>Principal (P)</i>	<i>Interest (I)</i>	<i>P + I</i>	<i>P + I - R</i>
First month	\$18 000	\$120	\$18 120	\$17 556
Second month	\$17 556	\$117.04	\$17 673.04	\$17 109.04
Third month				

How much will Darren owe the Credit Union at the end of the three months?

- (A) \$16 545.04
 (B) \$16 659.10
 (C) \$17 787.10
 (D) \$17 913.73

11. Which of the following correctly expresses n as the subject of $v = \frac{3mn^2}{r}$?

- (A) $n = \pm \frac{\sqrt{rv}}{3m}$
 (B) $n = \pm r\sqrt{\frac{v}{3m}}$
 (C) $n = \pm \frac{r\sqrt{v}}{3m}$
 (D) $n = \pm \sqrt{\frac{rv}{3m}}$

12. Ridges High decide to survey their students using a stratified random sample which will be based on year level and gender. The following table shows the number of students in each level and their gender.

Year level	Males	Females
7	110	105
8	110	110
9	105	100
10	100	102
11	98	101
12	84	75

Based on this table, how many Year 12 girls should be surveyed in a sample of 80 students?

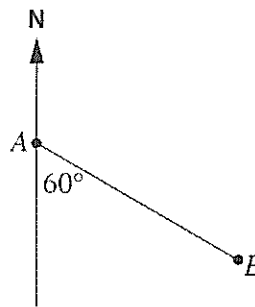
- (A) 4
- (B) 5
- (C) 6
- (D) 7
13. Jihwan lists the costs of running his car:
- Registration - \$378.00 annually
 - CTP insurance - \$546.00 annually
 - Comprehensive insurance - \$460.00 annually
 - Mechanical service and repairs - \$450.00 every three months
 - Petrol and consumables - \$40.00 per week

He wants to put money into an account each week to cover these costs and allow an extra 10% contingency in case of unforeseen expenses.

How much (to the nearest dollar) should he deposit each week?

- (A) \$89.00
- (B) \$101.00
- (C) \$102.00
- (D) \$111.00

14. What is the bearing of A from B ?



- (A) 060°
 (B) 120°
 (C) 300°
 (D) 150°
15. The table below is used to calculate monthly loan repayments.

Monthly loan repayments (in dollars) per \$1000 borrowed				
<i>Interest rate % pa</i>	<i>5 years</i>	<i>10 years</i>	<i>15 years</i>	<i>20 years</i>
5%	18.87	10.61	7.91	6.60
6%	19.33	11.10	8.44	7.16
7%	19.80	11.61	8.99	7.75
8%	20.28	12.13	9.56	8.36
9%	20.76	12.67	10.14	9.00

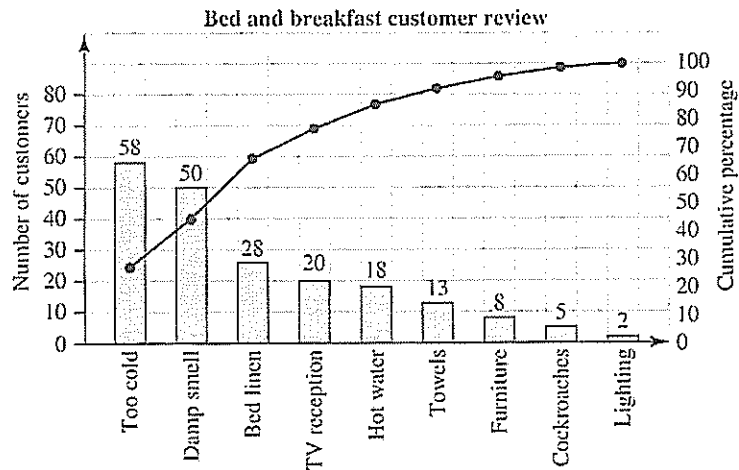
Daniel has borrowed \$70 000 at 8% per annum for 15 years.
 What is his monthly loan repayment?

- (A) \$143.40
 (B) \$669.20
 (C) \$8 030.40
 (D) \$10 038.00

End of Section 1

Question 16 (3 marks)

The Pareto chart below shows the complaints of customers staying at a particular bed-and-breakfast located in an alpine resort area.



a) How many customers reviewed the bed-and-breakfast resort?

1

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b) What area(s) should the resort concentrate on improving?

2

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Question 17 (3 marks)

The masses of the adult female koalas in a colony are normally distributed with a mean of 9.5 kg and a standard deviation of 0.8 kg.

By calculating the z-scores, what percentage of these females would you expect to have masses between 7.9 kg and 10.3 kg?

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Question 18 (7 marks)

The ordered back-to-back stem-and-leaf plot below shows the distribution of maximum temperatures in Sydney and Melbourne over the last fortnight of January this year.

Sydney		Melbourne
	1	8 9
9 9 8 8 7 7 6 5 4 3	2	3 6 9
4 2 1	3	1 2 6 6 6
1	4	1 3 4 5

- a) What was the highest recorded temperature? 1

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- b) What was Sydney's median temperature in the last fortnight of January? 1

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- c) Sydney has a lower quartile (Q_L) of 26 and an upper quartile (Q_U) of 31. 2
Is the temperature of 41 an outlier? Justify your answer with mathematical working.

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- d) Compare and contrast the two data sets by examining the shape and skewness of the distributions and the measures of location and spread. 3

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Question 19 (2 marks)

Rosa compared her examination results in Chemistry and Biology.

	Mean	Standard Deviation	Mark
Chemistry	80	12	92
Biology	58	10.5	89

- a) Rosa's z-score for Biology is 2.95. What does this mean?

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- c) If Rosa's z-score for Chemistry is 1, in which subject did she perform better in?
Explain your answer.

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Question 20 (2 marks)

The average rate for domestic electricity is \$0.18/kWh.

Calculate the cost of running an 800-watt air conditioner for 6 hours per day for 90 days.

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Question 21 (3 marks)

Margaret lives in Dubbo, NSW, which is in the Eastern Standard Time zone of UTC + 10.
Areej lives in Denver, Colorado which has longitude of UTC -7.

- a) What is the time difference between Dubbo and Denver? 1

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- b) If Margaret makes a call to Areej at 7:30 am on Friday 5th July (Dubbo time), what 2
will be the local time and date in Denver when Areej receives the call?

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Question 22 (1 mark)

Simplify fully: $\frac{3t^2}{d} \times \frac{5dt}{6}$

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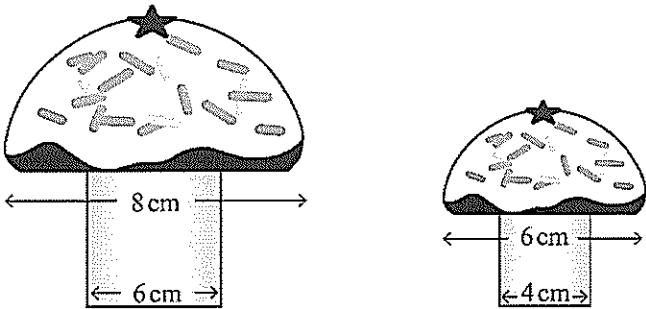
Question 23 (2 marks)

Solve the equation: $\frac{2x-2}{3} - 4 = 6$

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Question 24 (4 marks)

A café sells two sizes of muffins. The bottom section of the larger size muffin is shaped as a cube with side length 6 cm. When cooked, a hemisphere is formed on the top with a diameter of 8cm. The bottom section of the smaller size muffin is shaped as a cube with side length 4 cm. When cooked, a hemisphere is formed on the top with a diameter of 6 cm.



The price is based on the volume of cake mixture used in the muffin.
The large muffin costs \$5.40.

- a) Find the volume of the small muffin, correct to two decimal places.2

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- b) If the volume of the large muffin is 350.04 cm^3 , find the cost charged per cm^3 .1
Answer correct to two decimal places.

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- c) Hence, or otherwise, find the cost of each small muffin.1

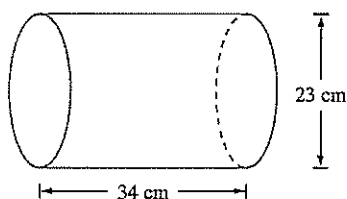
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Question 25 (2 marks)

Calculate the surface area of the closed cylinder drawn below, correct to 3 significant figures.



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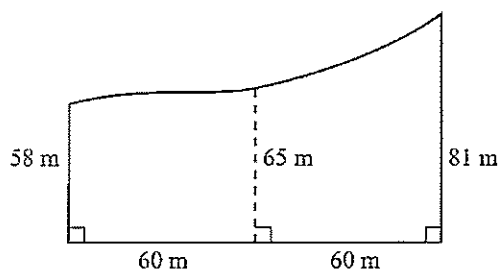
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Question 26 (4 marks)

A lake has a cross-section as shown below.



- a) Calculate the area of this cross-section using two applications of the Trapezoidal rule. 2

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- b) The lake is 60 cm deep. Marc thinks he can empty the lake using an eight-litre bucket. How many times would he have to fill the bucket from the lake in order to empty the lake? ($1\text{m}^3 = 1000\text{ L}$) 2

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Question 27 (3 marks)

On 15th March, James bought a camera costing \$1600 using a credit card. Compound interest was charged at a rate of 21.3% per annum for purchases. There is no interest-free period. The period for which interest was charged included the date of purchase and the date of payment.

James made no other purchases on his card.

- a) What is the daily percentage interest rate, correct to 3 decimal places? 1

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- b) What amount was paid when the account was paid in full on 31st March? 2

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Question 28 (3 marks)

Patrick is considering purchasing a television at a price of \$3990. He has a deposit of \$500 but needs to borrow the rest of the money. A finance company offers him the money at a flat rate of 21% p.a. to be repaid monthly over 4 years.

- a) What is the total amount that Patrick must borrow to purchase the television? 1

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- b) Calculate the interest paid on the balance over the four years. 1

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- c) Calculate the monthly repayment on the loan. 1

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Question 29 (3 marks)

Bonita buys 500 shares in a company at \$4.50 per share.

- a) If there are fixed brokerage fees of \$25.60 and stamp duty of 15 cents per \$100 or part thereof, calculate the total cost for Bonita to buy the shares. 2

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- b) The company pays a dividend of 90 cents per share. Calculate the dividend yield on the shares, correct to one decimal place. 1

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Question 30 (3 marks)

Mark wants to take out a home loan to buy a unit. He has saved \$45 000 as a deposit and he can only afford to pay back \$3600 per month. The bank interest rate is 6.8% per annum over 25 years.

Using the Present Value formula, calculate the most expensive unit that Mark can afford to buy?

$$A = a \left\{ \frac{(1 + r)^n - 1}{r(1 + r)^n} \right\}$$

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Question 31 (2 marks)

Tabitha purchased a machine for \$60 000. This machine depreciates in value over time. Two methods of depreciation were considered by the company.

- Method 1 — Straight line: The machine is depreciated by \$6 000 per year.
Method 2 — Declining-balance: The machine is depreciated by 15% per year.

a) Find the value of the machine after 3 years using the declining-balance method. 1

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b) Using the straight-line method, how many years will it take for the machine to reach a value of \$12 000? 1

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Question 32 (2 marks)

The formula to provide an estimate for blood alcohol content for females is :

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

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.

Florence, who weighs 64 kg, has her BAC measured at 0.08 after drinking for three hours. How many drinks did she have according to the formula?

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Question 33 (3 marks)

Joey's car uses 6.3L/100 km.

- a) How much petrol does she use to travel 1375 km from Sydney to Adelaide? 1
Answer correct to one decimal place.

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- b) Petrol cost \$1.20/L. How far, to the nearest kilometre, can Joey travel on \$75? 2

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Question 34 (1 mark)

Clark's formula, shown below, is used to calculate the dosage of medication for children aged between 2 and 12, based on the child's build.

$$\text{Dosage} = \frac{\text{weight in kg} \times \text{adult dosage}}{70}$$

A drug has an adult dosage of 45 ml. Calculate the dosage given for a child who is 11 years of age and who weighs 67 kg.

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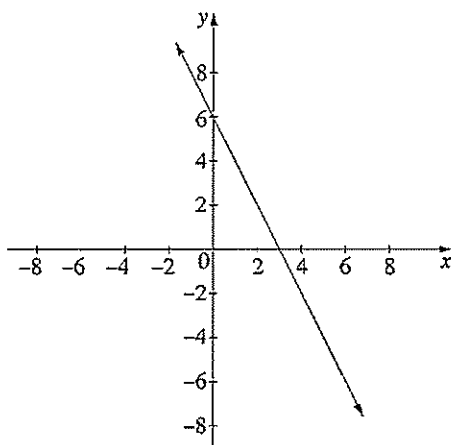
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Question 35 (2 marks)

The graph of a line is shown below.



- a) Write the equation of the line in the form $y = mx + b$.

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- b) When the line with equation $y = x + 3$ is drawn on the same number plane, these two lines will intersect.

What is the point of intersection of these two lines?

1

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Question 36 (2 marks)

The table below compares age (in years) and pulse rate (in beats per minute).

a	5	10	15	20	25	30
p	62.6	64.1	65.9	67.6	69.0	70.4

- a) Calculate the value of the correlation coefficient, correct to three decimal places.

1

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- b) Find the equation of the line of best fit, giving your values correct to two decimal places.

1

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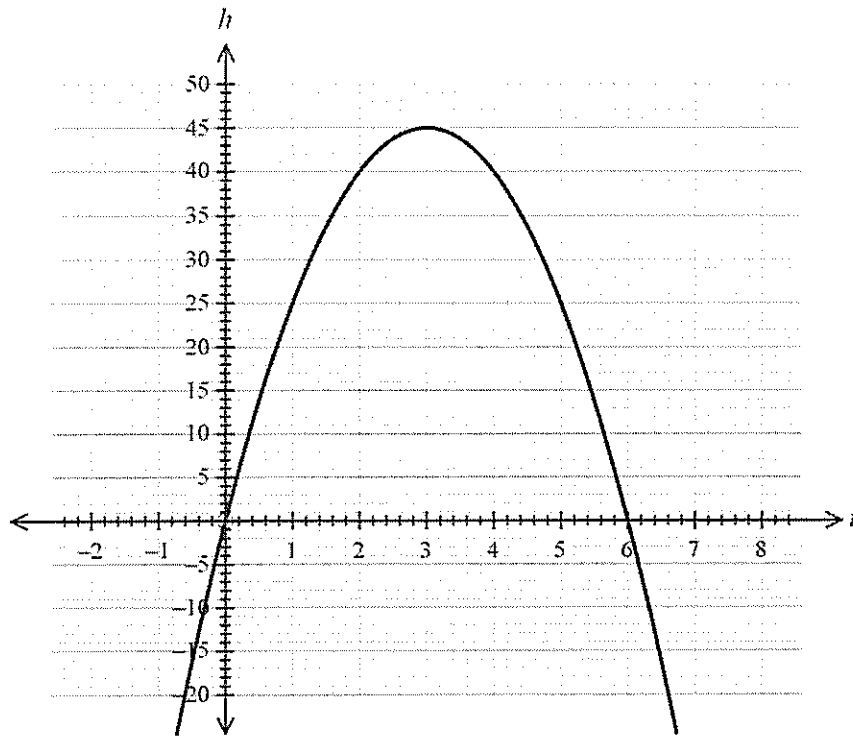
Question 37 (3 marks)

Ethan uses the equation below to model the height of a ball tossed into the air from ground level and allowed to fall under gravity (with air resistance ignored).

$$h = 30t - 5t^2$$

where h is the height of the ball in metres and t is the time elapsed in seconds

Ethan uses graphing software to draw the following graph of the equation.



Ethan knows that only part of this curve applies to his model for the height of the ball.

- a) Between what values of t does the graph model the height of the ball? 1

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- b) What is the maximum height that the ball reaches, AND when did this occur? 1

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- c) For how many seconds is the ball more than 25 metres from the ground? 1

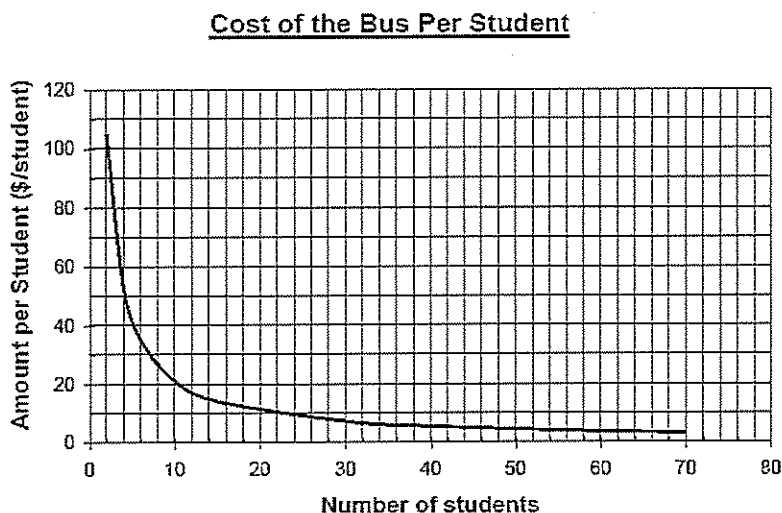
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Question 38 (2 marks)

A preschool centre pays \$270 to hire a bus for an excursion. Selina is organising the excursion and has worked out an equation that will determine, depending on the number of students, the amount each student will need to pay to cover the cost of the bus.

The graph below also shows the amount to be paid per student based on the number of students.



The formula used to draw this graph was $A = \frac{270}{N}$

where A = amount per student

N = number of students attending the excursion

- a) Use the graph to find the approximate cost per student if 22 students go on the excursion. 1

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- b) How many students will need to go on the excursion to cover all costs if they each pay \$2.30? 1

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Question 39 (2 marks)

The weight of an object on the moon varies directly with its weight on Earth. An astronaut who weighs 84 kg on Earth weighs only 14 kg on the moon. A lunar landing craft weighs 2449 kg when on the moon. Calculate the weight of this landing craft when on Earth.

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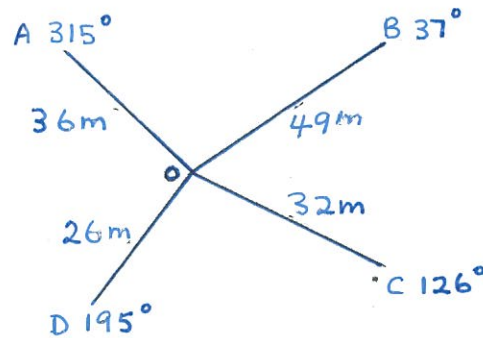
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Question 40 (3 marks)

The following notebook entry was made during a compass radial survey of a field.



- a) Show that the size of angle AOB is 82° .

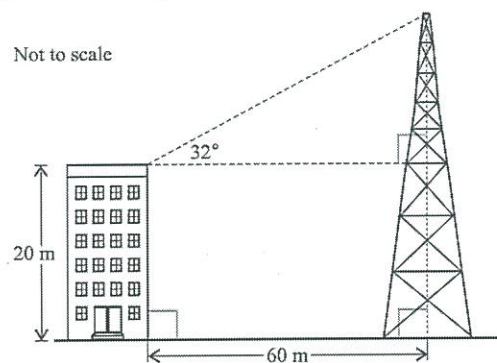
1

- b) Find the area of the triangle AOB, correct to one decimal place.

2

Question 41 (2 marks)

The diagram below shows a building and a communications tower. From the top of the building, the angle of elevation of the top of the tower is 32° .



Determine the height of the tower, correct to the nearest metre.

Question 42 (1 mark)

Angela recorded the number of births at a hospital over the period of a week.

Outcome	Frequency
Number of girls born	144
Number of boys born	156

What is the relative frequency of a girl being born?

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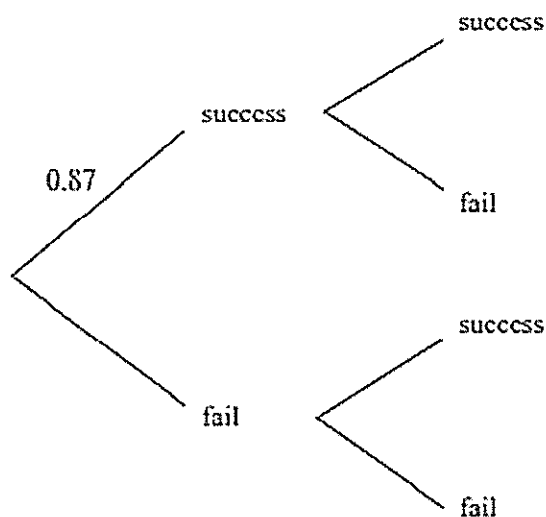
Question 43 (4 marks)

A new vaccine has a probability of 0.87 of being successful in preventing the spread of a virus.

Two people are selected at random to test the vaccine.

a) Complete the probability tree below.

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b) What is the probability of the vaccine being successful on at least one persons?

2

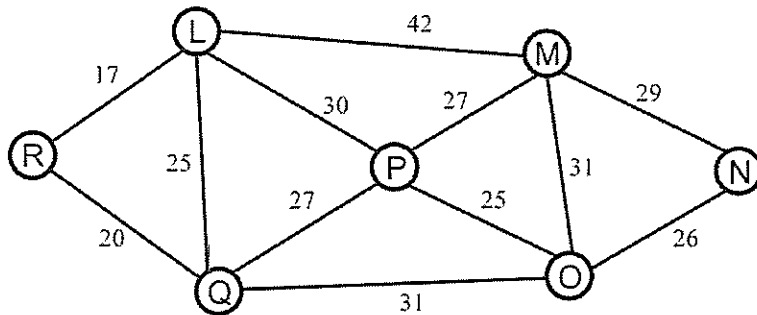
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Question 44 (3 marks)

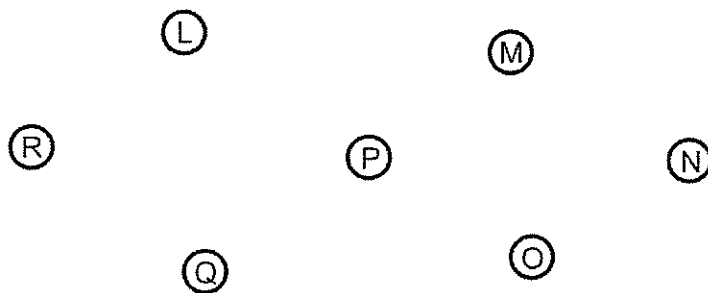
A network of pipes connects nodes labelled L to R. The length of each pipe in kilometres is shown in the diagram below.



The owner of the network wants to reduce the number of pipes but still connect all the nodes.

- a) Draw the minimum spanning tree that will achieve the owner's requirement on the set of nodes below.

2



- b) What is the minimum length of pipe needed to connect the seven nodes?

1

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Question 45 (4 marks)

The table below shows the tax payable to the Australian Taxation Office for different taxable incomes.

<i>Taxable income</i>	<i>Tax on this income</i>
\$0 – \$18 200	Nil
\$18 201 – \$37 000	19c for each \$1 over \$18 200
\$37 001 – \$80 000	\$3572 plus 32.5c for each \$1 over \$37 000
\$80 001 – \$180 000	\$17 547 plus 37c for each \$1 over \$80 000
\$180 001 and over	\$54 547 plus 45c for each \$1 over \$180 000

Santiago has a gross salary of \$65 000. He has tax deductions of \$800 for work related expenses. The Medicare levy that he pays is calculated at 2% of his taxable income.

Santiago has already paid \$14 200 in tax.

Will Santiago receive a tax refund or will he owe money to the Australian Taxation Office?

Justify your answer with appropriate calculations.

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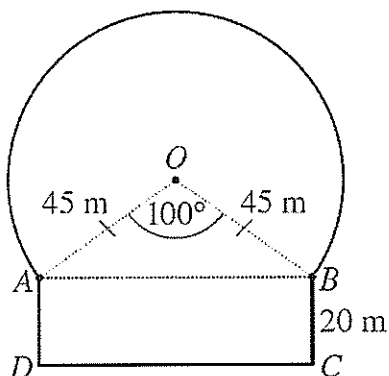
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A school playground consists of part of a circle, with centre O , and a rectangle as shown in the diagram below. The radius OB of the circle is 45 m, the width BC of the rectangle is 20 m and $\angle AOB$ is 100° .



What is the perimeter of the whole playground, correct to one decimal place?

This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Section II Extra writing space

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

[illegible]

Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

$$\text{Absolute error} = \frac{1}{2} \times \text{precision}$$

$$\text{Upper bound} = \text{measurement} + \text{absolute error}$$

$$\text{Lower bound} = \text{measurement} - \text{absolute error}$$

Length

$$l = \frac{\theta}{360} \times 2\pi r$$

Area

$$A = \frac{\theta}{360} \times \pi r^2$$

$$A = \frac{h}{2}(a + b)$$

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

Surface area

$$A = 2\pi r^2 + 2\pi rh$$

$$A = 4\pi r^2$$

Volume

$$V = \frac{1}{3}Ah$$

$$V = \frac{4}{3}\pi r^3$$

Trigonometry

$$\sin A = \frac{\text{opp}}{\text{hyp}}, \quad \cos A = \frac{\text{adj}}{\text{hyp}}, \quad \tan A = \frac{\text{opp}}{\text{adj}}$$

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

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Financial Mathematics

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

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

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

Statistical Analysis

An outlier is a score

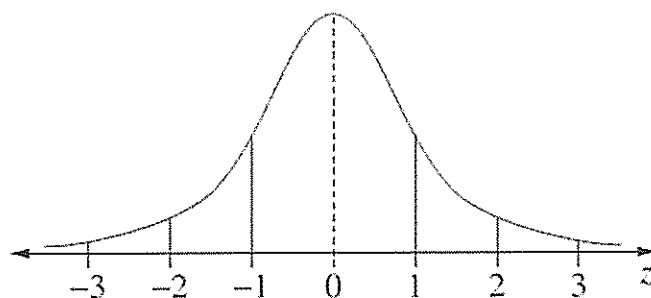
$$\text{less than } Q_1 - 1.5 \times IQR$$

or

$$\text{more than } Q_3 + 1.5 \times IQR$$

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

Normal distribution



- approximately 68% of scores have z -scores between -1 and 1
- approximately 95% of scores have z -scores between -2 and 2
- approximately 99.7% of scores have z -scores between -3 and 3

**2019 Trial Higher School Certificate Examination
Mathematics Standard 2**

Student Number : _____

Section I – Multiple Choice Answer Sheet

Allow about 25 minutes for this section

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

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

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

A ☒ B ☒ C ☐ D ☐

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

A ☒ B ☒ ^{correct} C ☐ D ☐

- | | | | | | | | | |
|-----|---|-----------------------|---|-----------------------|---|-----------------------|---|-----------------------|
| 1. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 2. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 3. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 4. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 5. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 6. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 7. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 8. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 9. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 10. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 11. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 12. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 13. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 14. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |
| 15. | A | <input type="radio"/> | B | <input type="radio"/> | C | <input type="radio"/> | D | <input type="radio"/> |

