Student Name: _____

KNOX GRAMMAR SCHOOL

2024

TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

General Instructions

- Reading Time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- NESA approved calculators may be used
- A reference sheet is provided
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total Marks

Section I – 15 marks (pages 3 - 11)

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

Section II – 85 marks (pages 8 – 25)
- Attempt questions 16 – 41
- Allow about 2 hours and 5 minutes for this section

Please **circle** your teacher's name :

D-Line   E-Line

Ms Rodrigues   Ms Coughlan
Mr Singh   Ms Rodrigues
Ms Padayachee   Mrs Knight/Dr Melville
Ms McFarlane   Mr Afeaki
                      Mr Naidoo
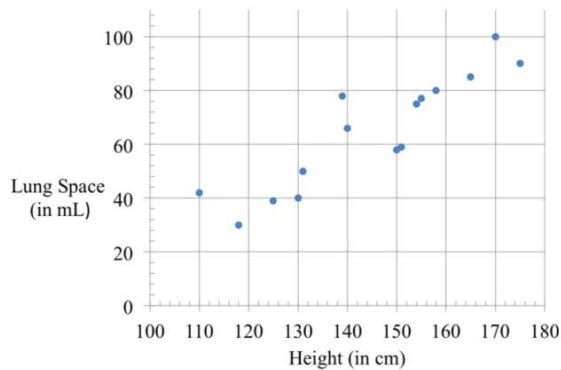
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Section I

15 marks

Attempt Questions 1 – 15

Allow about 25 minutes for this section

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

1.   The data in the scatterplot below compares the heights of some children with the space in their lungs.

This relationship is best described as

(A)   perfect positive correlation

(B)   weak negative correlation

(C)   strong positive correlation

(D)   no correlation

2.   Which of the following is an exponential function?

(A) $y = \dfrac{x^2}{2}$ (B) $y = \dfrac{2}{x}$ (C) $y = \dfrac{x}{2}$ (D) $y = 2^x$

3.   Patrick bought a car for $80 000. The car depreciates at a rate of 15% p.a.

Correct to the nearest thousand, what is the value of the car after 4 years?

(A) $68 000   (B) $48 000

(C) $42 000   (D) $41 000

4. Which network has an Eulerian Trail?
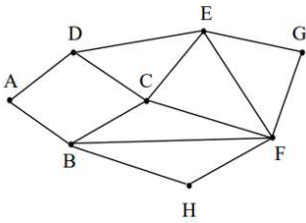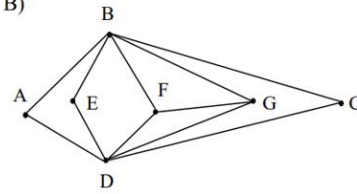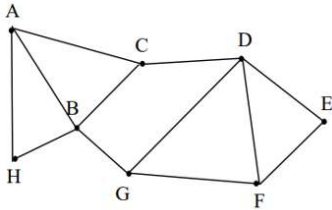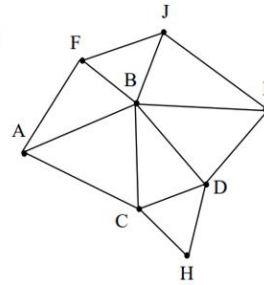
5. Madeleine invested $1250 over 3 years at 6% p.a. compounded quarterly.

    What is the compound **interest** earned correct to the nearest cent?

    (A) $238.77   (B) $244.52   (C) $1488.77   (D) $1494.52

6. What is the area of this triangle?

    8.5 m

    9.5 m

    52°

    NOT TO SCALE

    50°
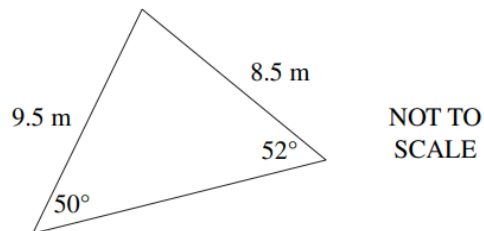
    (A)   31 m²   (B)   32 m²   (C)   35 m²   (D)   39 m²

7. 3000 flathead were caught, tagged and released in Sydney Harbour. Three months later, a sample of 2000 flathead were taken. In this sample, 720 tagged flathead were found.

    Which of the following is the best estimate for the number of flathead in Sydney Harbour?

    (A)   1080   (B)   2280   (C)   5000   (D)   8300

8. The table shows the present value of an annuity with a contribution of $1 for various interest rates and durations.

End of year	Present value of $1			
	3%	4%	5%	6%
5	4.5797	4.4518	4.3295	4.2124
6	5.4172	5.2421	5.0757	4.9173
7	6.2303	6.0021	5.7864	5.5824
8	7.0197	6.7327	6.4632	6.2098

    What is the present value of an annuity where $16 000 is contributed every year for six years at 5% pa?

    (A) $16 800.00   (B) $67 398.40

    (C) $81 211.20   (D) $96000.00

9. Which of the following is the graph of $y = 3x - 3$?

    (A)

    (B)

    (C)

    (D)
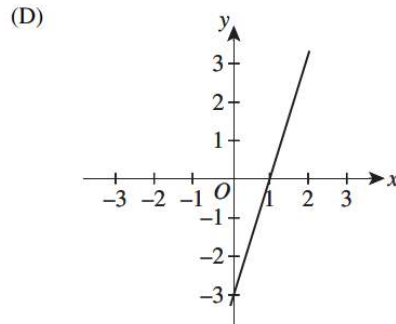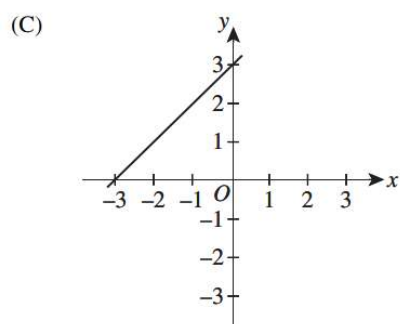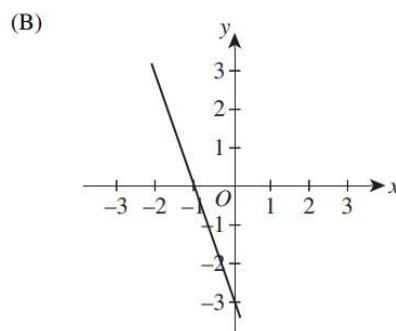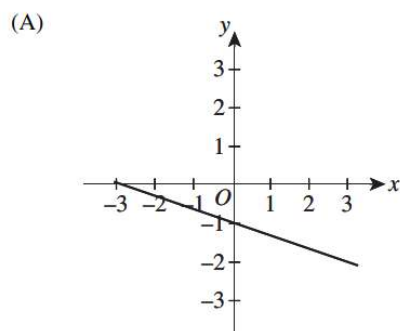
10. If $8x^3 = -64$, what is the value of $8x^2$?

(A) 2   (B) 16   (C) 32   (D) 128

11. The careers advisor of a high school conducted a survey of last year's HSC students regarding their path after school.

Gender	Workforce	Study
female	27	76
male	31	69

A female student is selected at random. What is the probability that this student joined the workforce?

(A) $\dfrac{27}{203}$ (B) $\dfrac{27}{103}$ (C) $\dfrac{27}{100}$ (D) $\dfrac{27}{58}$

12. Andreas' car consumes an average of 11 L of fuel per 100 km of city driving and 8 L per 100 km of country driving.

If Andreas takes a trip where he travels 62 km in the city and 230 km in the country, what is his expected fuel consumption?

(A) 28.66 L   (B) 25.22 L   (C) 32.16 L   (D) 27.74 L

13. The balance of an annuity investment after n monthly payments can be modelled by the recurrence relation : $V_{n+1} = V_n \times 1.015 - 1300$ and $V_0 = 120\,000$

This investment has

(A) monthly interest rate 1.5% and monthly payments of $1300

(B) monthly interest rate 12.6% and monthly payments of $1300

(C) annual interest rate 10.5% and monthly payments of $1300

(D) annual interest rate 12.6% and annual payment of $120 000

14. Latoya has a credit card with interest compounded daily at 0.034%.

    The card has an interest free period of 60 days. Seventy-five days ago, Latoya made a purchase for $3500 and did not make any further purchases nor payments on the card.

    Correct to the nearest cent, what is the minimum amount of interest Latoya owes on the card?

    (A) $17.85

    (B) $17.89

    (C) $90.38

    (D) $3517.89

15. For the network shown below, find the capacity of the identified cut.
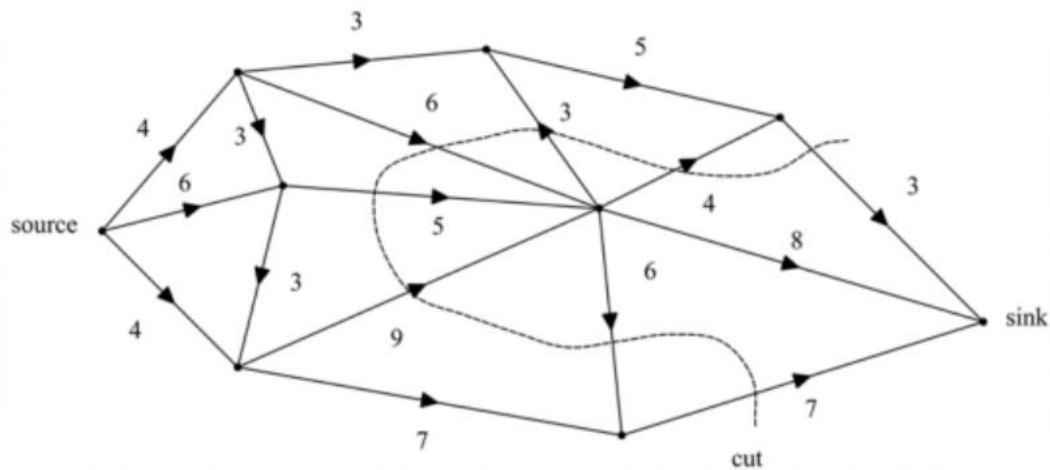
    (A)   23   (B)   30   (C)   34   (D)   41

End of Section I

Mathematics Standard 2

Section II Answer Booklet

85 marks

Attempt Questions 16 -

Allow about 2 hours and 5 minutes for this section

Instructions

- Answer the questions in the spaces provided.
  These spaces provide rough guidance for the expected length of response.

- Think about your responses before putting pen to paper.
  They should include relevant mathematical reasoning and/or calculations.

- Extra writing space is provided at the back of this booklet.
  If you use the extra writing space, **clearly indicate which question** you are answering.

Question 16 (2 marks)

The scale on a map is given as 1 mm = 250 m. If the distance between two points is 1.25 km, what is the map distance between these points?

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Question 17 (2 marks)

The three angles in a triangle are in the ratio 2 : 6 : 7. What is the size of the largest angle?

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Question 18 (3 marks)

Luisa lives in New York City (UTC -5) and her sister, Anita lives in Sydney (UTC +10).

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Anita makes a call to Luisa at 12:30 pm on Monday, February 24th.

Noting that, in February, daylight saving is operating in Sydney but not in New York City, what is the date and time in New York City when Luisa takes the call?

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Question 19 (4 marks)

The cost, C, in dollars, of manufacturing n shirts, is shown by the line in the graph below.
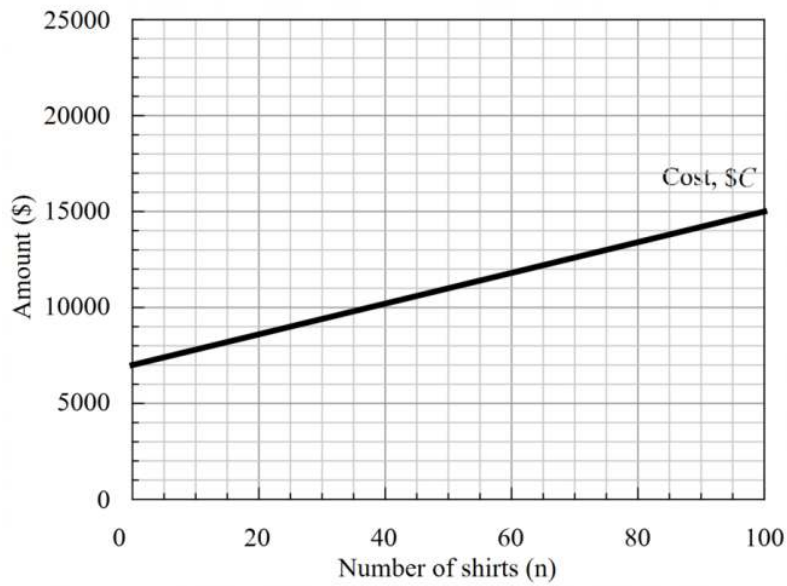
(a)   Write an equation for the cost, C, of manufacturing n shirts.   **2**

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The revenue earned, in dollars, when n shirts are sold is given by $R = 220n$.

(b)   Add the revenue function to the graph above.   **1**

(c)   Determine the number of shirts that need to be sold before a profit is made.   **1**

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Question 20 (2 marks)

In 1903, the fastest recorded speed on a motor bike was 103 kilometres per hour.   **2**

Express this speed in metres per second, correct to one decimal place.

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Question 21 (2 marks)

Aran conducted a study to examine the relationship between students' English and Mathematics results at a particular school.

His spreadsheet software enabled him to make the scatterplot below, recording the Pearson's correlation coefficient, r, to be -0.75.

The equation of the least-squares regression line to be $y = 84 - 0.2x$, and is graphed on the scatterplot.
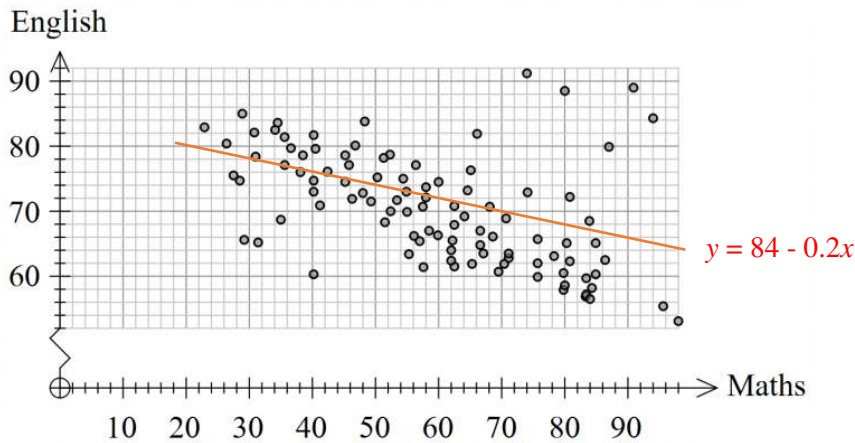
Based on this data and using the graph **or** the given equation, determine the likely Mathematics score for a student who scores 75 for English.   **2**

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Question 22 (3 marks)

A university IT department is installing a new high-speed fibre optic circuit on campus.

The cost in thousands of dollars to connect the cables between the five main buildings is shown in the table below. Buildings that cannot feasibly be connected are indicated with a '-' symbol.

	A	B	C	D	E
A		10	-	12	7
B	10		4	11	12
C	-	4		6	-
D	12	11	6		9
E	7	12	-	9	

(a)   Use the table to complete the weighted network below.   **1**
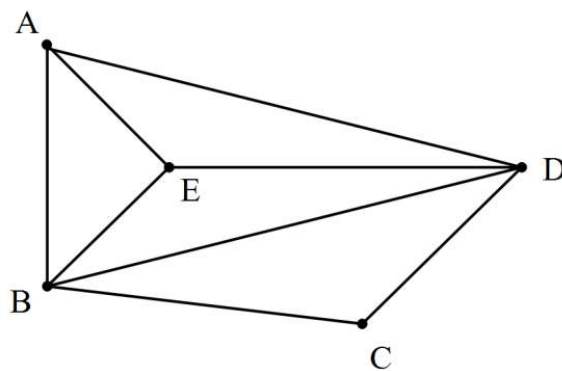
(b)   Use your network diagram in part (a) to draw a minimum spanning tree for the campus in the space below.

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(c)   What is the minimum cost to the university to connect the buildings with cabling?   **1**

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Question 23 (2 marks)

Andy is planning to take an overseas trip in 3 years' time. He wishes to save $25 000 for the trip by investing in an annuity. He has chosen an account that pays 12% p.a. compounded **monthly**.

Use the table below to determine the amount, correct to the nearest cent, that he needs to invest each month in order to achieve his goal.

2

Future values of annuity of $1					
	Interest Rate				
Period	1%	2%	3%	4%	8%
3	3.0301	3.0604	3.0909	3.1216	3.2464
6	6.1520	6.3081	6.4684	6.6330	7.3359
9	9.3685	9.7546	10.1591	10.5828	12.4876
12	12.6825	13.4121	14.1920	15.0258	18.9771
18	19.6147	21.4123	23.4144	25.6454	37.4502
24	26.9735	30.4219	34.4265	39.0826	66.7648
30	34.7849	40.5681	47.5754	56.0849	113.2832
36	43.0769	51.9944	63.2759	77.5983	187.1021

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Question 24 (2 marks)

A full water tank with a 4 kilolitre capacity is emptied at a rate of 5 litres per minute.

Giving your answer in hours and minutes, how long will it take to empty the tank?

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Question 25 (3 marks)

Scores on a particular nation-wide aptitude test are normally distributed with a mean score of 120 and a standard deviation of 12.

(a)   Maria's report showed that she received a z-score of 1.5. What was her actual mark on the test?   **1**

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(b)   If a person who took the test was chosen at random, what is the probability their mark on the test was between 132 and 144?   **2**

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Question 26 (3 marks)

Sydney is located at $(34°S, 151°E)$ and Johannesburg is at $(26°S, 28°E)$.

The Wallabies fly out of Johannesburg at 9:30 am local time on Sunday on a non-stop flight and arrive in Sydney at 5:28 am on Monday, Sydney time.   **3**

Ignoring time zones and noting that 15º longitude = 1 hour time difference, determine the length of the flight.

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Question 27 (5 marks)

(a)   Nick bought 2000 MNRA shares with his retrenchment payout at $12.50 per share.   **2**
Shortly after buying the shares, the company paid a dividend of $0.75 per share.

What was the dividend yield?

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(b)   A year later, Nick sold the shares for $13.00 per share.   **3**

Given that he paid brokerage fees of 1.5% on the purchase of the shares and 1.8% on the sale of the shares, what profit did Nick make?

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Question 28 (2 marks)

The network diagram below shows the flow of water in litres per second through a series of pipes.
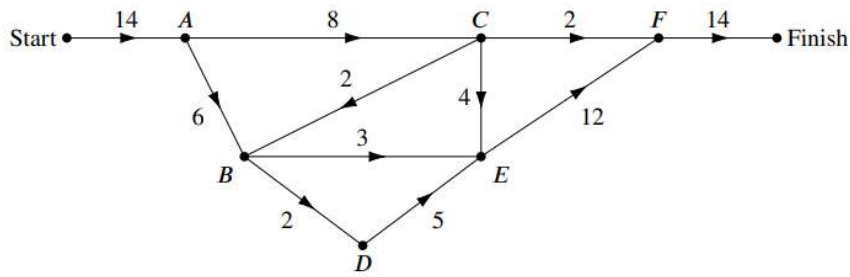
(a)   Determine the maximum flow for this network.   **1**

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(b)   Indicate the minimum cut on the network.   **1**

Question 29 (2 marks)

The diagram shown represents an irregularly shaped paddock between a river
and a road.
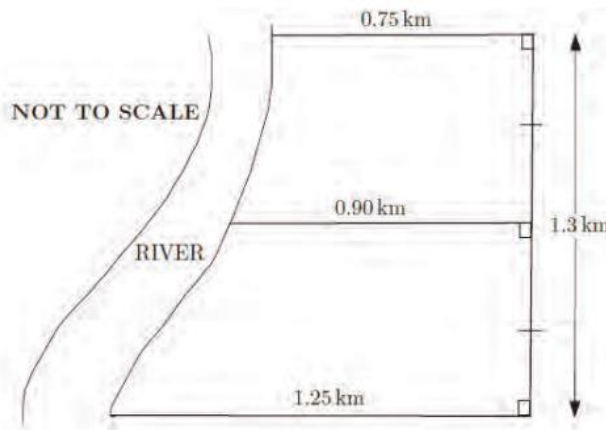
Use two applications of the Trapezoidal Rule to find, to one decimal place, the area of the paddock.   **2**

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Question 30 (4 marks)

The table shows a $490 000 loan borrowed at a reducible interest rate of 5.6% p.a.

Loan period in years	15	20	25	30
Monthly repayments	$3831	$3318	$3034	$2864

(a) Find the total amount to be repaid if the loan were taken over 20 years. **1**

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(b) Determine the **equivalent simple interest rate** over those 20 years. Give your final answers as a percentage, correct to one decimal place. **3**

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Question 31 (3 marks)

A ship travels 58 nautical miles west from Port A then 93 nautical miles south.

What is the ship's bearing from Port A? **3**

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Question 32 (5 marks)

A class of students is assigned a project that requires them to complete Activities A to G.

The activity chart below shows the immediate prerequisite(s) and duration (in hours) for each activity.

Activity	Immediate prerequisite(s)	Duration (hours)
A	–	13
B	–	9
C	A	10
D	B	14
E	D	11
F	C, E	2
G	D	5

(a)   Construct a network diagram using the activity chart.   **2**

(b)   By performing a forwards and backwards scan on your network diagram, determine the minimum
time required for the students to complete the project.   **2**

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(c)   Determine the float time for Activity G.   **1**

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Question 33 (6 marks)

A backyard swimming pool is to be constructed according to the plans below. Its shape consists of a rectangle 17 metres long and 6.3 metres wide with semi-circular ends.
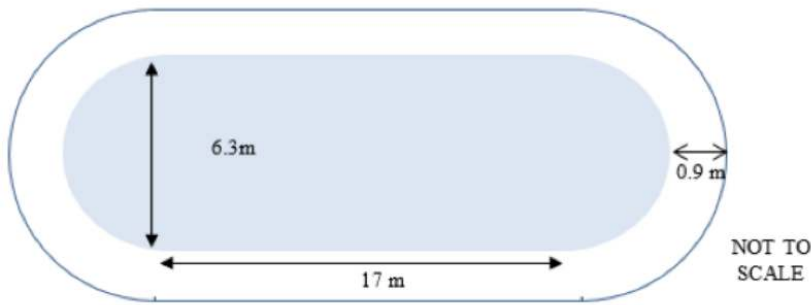
(a) Show that, correct to two decimal places, the area, A of the top of the swimming pool is 138.27 m^2 .   **2**

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(b) A 0.9 metre path is to be paved around the pool, as shown. Calculate the area to be paved,   **3**
giving your final answer correct to 1 decimal place.

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(c) The pool is to be filled to a uniform depth of 1.2 metres. Using the expression from part (a),   **1**
determine the volume of water, correct to the nearest kilolitre, that is required to fill the pool.

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Question 34 (3 marks)

The volume, V, of a gas varies indirectly with the pressure, P, being applied to it.
When the pressure is 32 kg/cm², the volume is 400 cm³.

3

What will be the volume of the gas if the pressure is increased to 40 kg/cm²?

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Question 35 (3 marks)

In the triangle shown, θ is **obtuse**.

Find the value of θ, correct to the nearest minute.

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23°37'

54.1 cm

θ

25 cm

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Question 36 (4 marks)

Farmer Bert is building a **rectangular** pigpen. He has 500 m of fencing to use, but can use an existing fence as one boundary, as shown in the diagram below.

Existing fence

x m
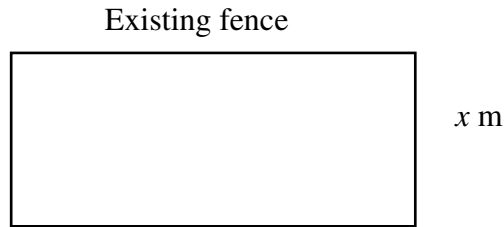
(a)   If the breadth of the paddock is to be x metres, show that the area can be found using the rule   **2**

$$A = 500x - 2x^2.$$

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(b)   The graph of the function in part (a) is shown below.

Find the dimensions of the paddock so that its area is a maximum.   **2**

A
(m^2)

x

(metres)

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Question 37 (7 marks)

The scatterplot below shows the respective heights of a sample of 10 fathers and their oldest sons.
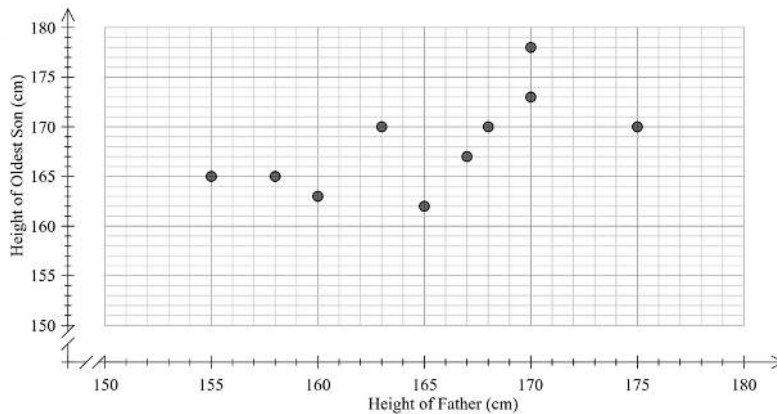
(a)   Complete the table of pairs below from the scatterplot.   **1**

Height of father, x	155	158	160	163	165	167	168	170	170	175
Height of oldest son, y	165		163	170		167	170	173	178	

(b)   Use the appropriate statistics function on your calculator to find the equation of the least-squares regression line, giving values correct to three significant figures.   **2**

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(c)   (i)   Determine, correct to four decimal places, the Pearson's correlation coefficient for the data above.   **1**

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(ii)   Using the following values and the formulae provided for calculating the gradient, m and y-intercept, c, confirm your equation from part (b).   **3**

	Mean	Standard deviation
Height of father, x	$\bar{x} = 165.1$	$s_x = 6.154$
Height of oldest son, y	$\bar{y} = 168.3$	$s_y = 4.900$

$$m = r\frac{s_y}{s_x} \qquad\qquad c = \bar{y} - m\bar{x}$$

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Question 38 (3 marks)

Dustin is sorting his sheep (S) from his goats (G). In a pen he has 13 sheep and 9 goats.

He selects **two** animals at random.

(a) Complete the tree diagram below, adding probabilities to the remaining branches. **1**
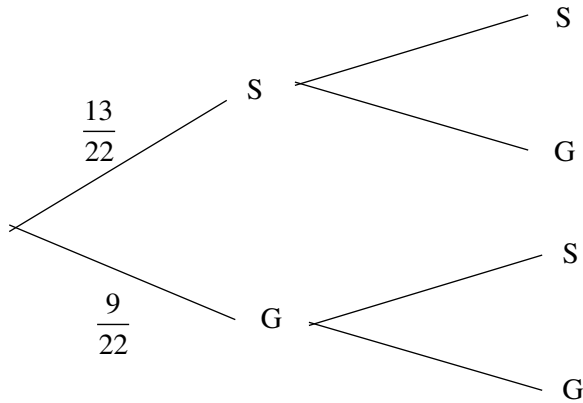
(b) Determine the probability that Dustin ends up with two of the same type of animal. **2**

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Question 39 (3 marks)

The table below shows a school mean and standard deviation for four HSC subjects. **3**

Subject	Mean	Standard Deviation
English	65	10
Mathematics Standard	59	12
Society and Culture	55	8

Mo achieved the following marks :

English 70, Mathematics Standard 66, Society and Culture 60,

By determining the z-score for each result, determine the subject in which Mo achieved his best result.

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Question 40 (3 marks)

Use the cosine rule to find the length, *PQ* of the pond in the following diagram. Give your final answer **3**
correct to one decimal place

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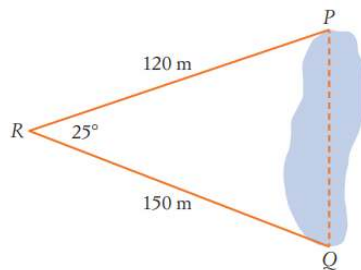
Question 41 (4 marks)

A random variable is normally distributed with mean 0 and standard deviation 1.

The table below gives the probability that this random variable lies between -z and z for different values of z.

The probability values given in the table for different values of z are represented by the shaded area in the diagram of the normal distribution bell curve to the right of the table.

z	Probability
0.00	0.0000
0.25	0.1974
0.50	0.3829
0.75	0.5467
1.00	0.6827
1.25	0.7887
1.50	0.8664
1.75	0.9199
2.00	0.9545
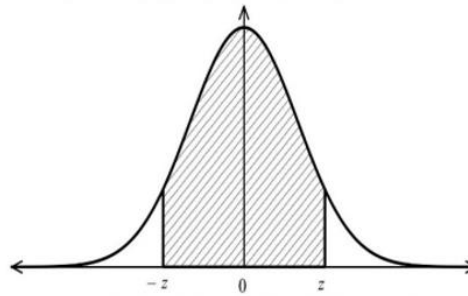
(a) Using the table, determine the probability that this random variable, z will be greater than -0.75. **2**

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(b) The arm span in metres for a group of 1200 residents of a town are normally distributed with a mean of 1.68 metres and a standard deviation of 0.24 metres. **2**

By first calculating the z-score, use the table above to determine the number of residents with an arm span of greater than 1.5 metres.

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End of Examination

Extra Space if required

Please label questions clearly.

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