MEREWETHER
HIGH SCHOOL

2020 YEAR 12 TRIAL HSC

Mathematics Standard 2

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
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks : 100

Section I – 15 marks (pages 2 – 8)

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

Section II – 85 marks (pages 9 – 30)

- Attempt Questions 16 – 46
- 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 Grahame is driving a car at a constant speed and takes 1.4 seconds to react to a situation and then applies the brakes. His reaction distance was 27 metres.

At what speed, in kilometres per hour, was Grahame travelling?

A. 19 km/h

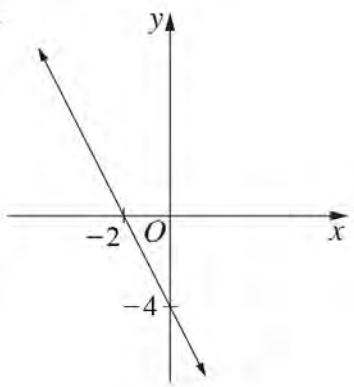
B. 38 km/h

C. 69 km/h

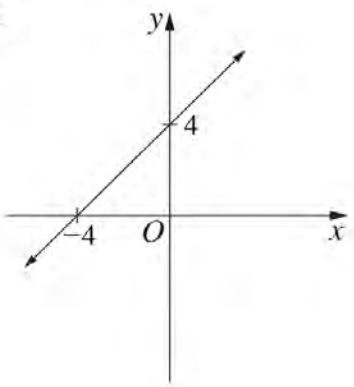
D. 85 km/h

2 Which of the following is the graph of $y = 2x - 4$.

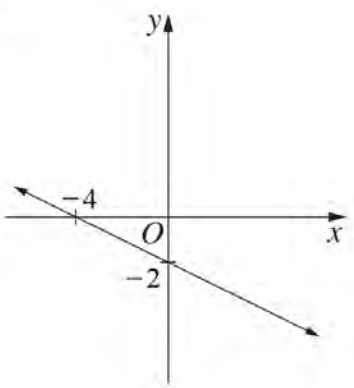
A.



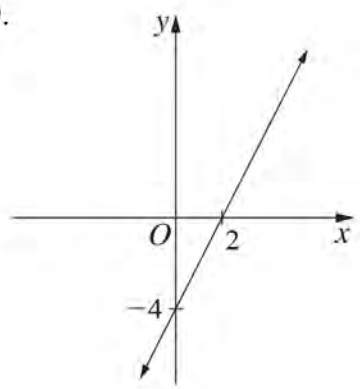
B.



C.



D.



3 A salesperson is paid a retainer and 4% commission on any sales made during a fortnight. During a fortnight, the salesperson sells $3000 worth of goods and is paid $730.
The value of the retainer is

A. $120

B. $610

C. $850

D. $930

4 A password for an internet portal login is to be made up of two letters followed by two digits, for example AB89. Letters and digits may be repeated.

How many unique passwords exists?

A. 256

B. 10 000

C. 54 756

D. 67 600

5 Four towns *L*, *M*, *P* and *Q* are linked by roads. The table below represents the weighted network of roads between the towns. The units in the table are kilometres.

	L	*M*	*P*	*Q*
L	0	3	6	0
M	3	0	5	0
P	6	5	0	4
Q	0	0	4	0

How many edges are in the network?

A. 4

B. 6

C. 18

D. 36

6 A table of future value interest factors is shown.

Table of future value interest factors

Period	*Interest rate per period*				
	1%	*2%*	*3%*	*4%*	*5%*
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101

A certain annuity involves making equal contributions of $2400 into an account every 6 months for two years at an interest rate of 4% per annum.

Based on the information provided, what is the future value of this annuity?

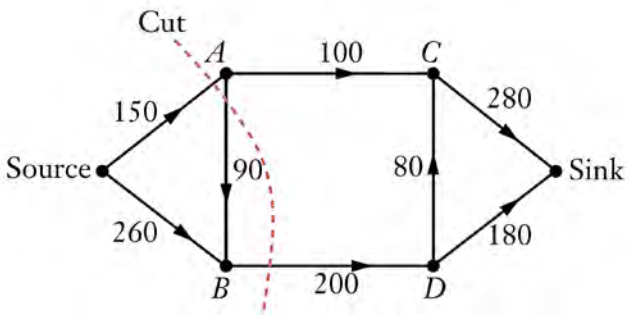
A. $4896.00

B. $7344.96

C. $9891.84

D. $10 191.60

7 A cut has been drawn on a network.



The capacity of the cut shown is

A. 350

B. 440

C. 500

D. 700

8 An audience leaving a cinema is surveyed on whether they enjoyed the film they viewed. Every 5th person that exits the cinema is surveyed.

Which type of sampling technique is being used?

A. Random

B. Systematic

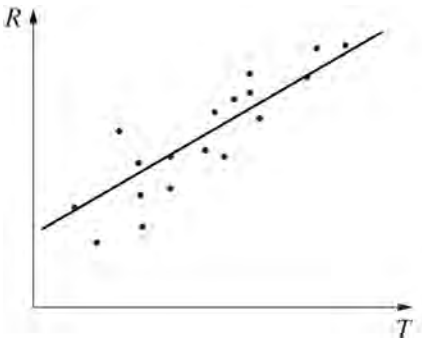
C. Stratified

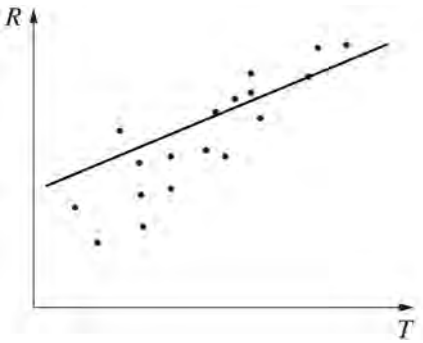
D. Self-selected

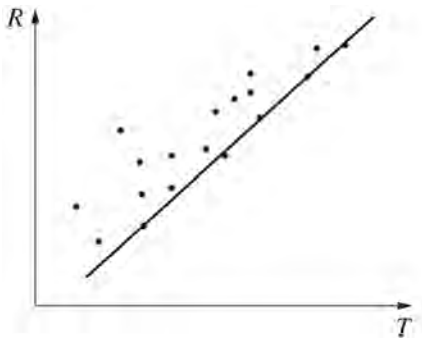
9 A scatterplot is drawn to compare two variables, *R* and *T*.

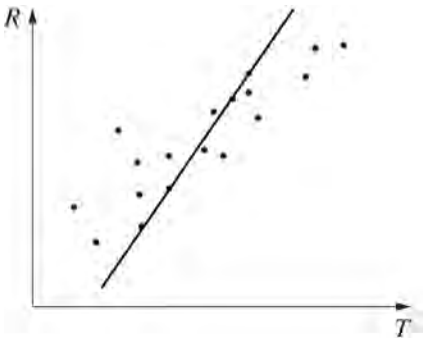


Which ONE of the following graphs shows an appropriate line of best fit for the data?

A.


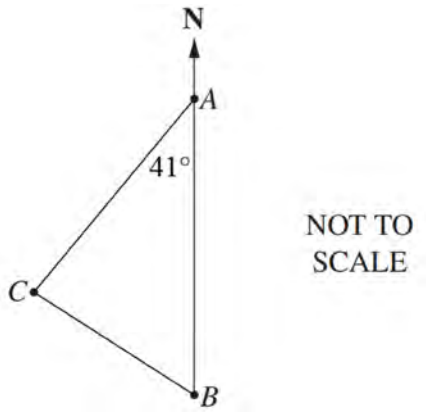
B.


C.


D.


10 The diagram shows the positions of towns *A*, *B* and *C*.

Town *B* is due south of town *A* and $\angle CAB = 41°$.



What is the bearing of town *A* from town *C*?

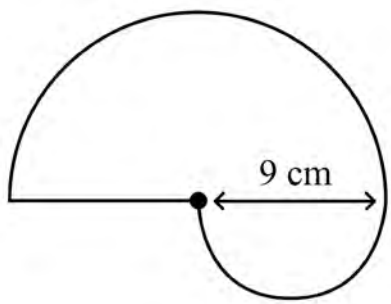
A. 041°

B. 049°

C. 151°

D. 221°

11 A shape consists of two semi-circles. The smallest semi-circle has a diameter of 9 cm.



To the nearest centimetre, what is the perimeter of the shape?

A. 42 cm

B. 51 cm

C. 60 cm

D. 85 cm

12 Aaron purchased a car for $45 000. It depreciated by 10% in the first year and then $2500 each year after. He intends to list it for sale when its salvage value reaches $26 750.

How many years and months after he purchased the car will Aaron list it for sale?

A. 5 years and 5 months

B. 5 years and 6 months

C. 6 years and 5 months

D. 6 years and 6 months

13 A bag contains red, green and black coloured tokens. One token is to be drawn at random. The probability, as a decimal, of selecting a red token is 0.52 and it is twice as likely to draw a green token than a black token.

What is the chance of selecting a red or a green token?

A. 0.84

B. 0.86

C. 0.88

D. 0.90

14 A network has a minimum spanning tree consisting of n edges, for $n \geq 1$.

How many vertices are there on the minimum spanning tree?

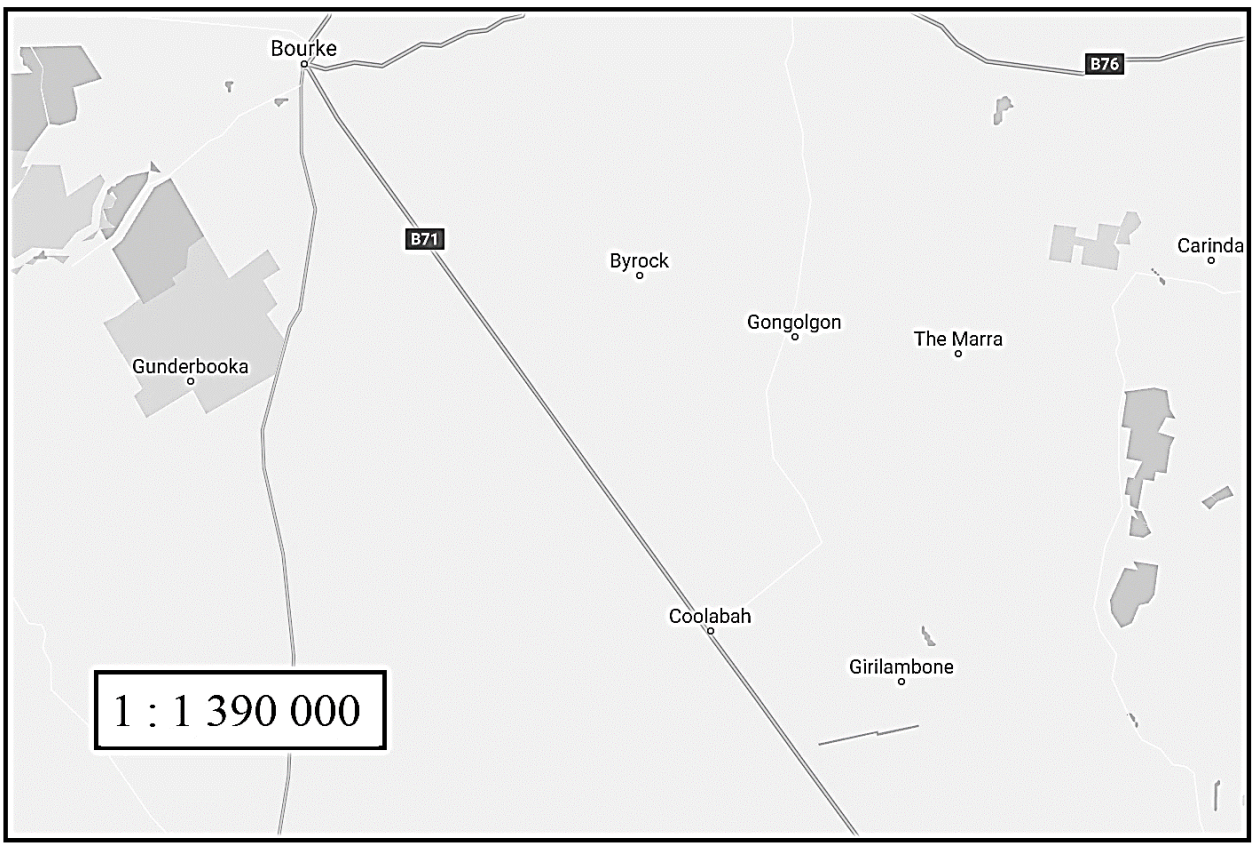
A. n

B. $n+1$

C. $n-1$

D. $\frac{n}{2}$

15 Simon is driving from Coolabah to Bourke on the B71. A scale map of the area is provided.



His car has a fuel consumption of 6.7 L/100 km. When he fills his car with fuel in Coolabah, the petrol price was $1.68 per litre.

Which ONE of the following is the approximate cost, to the nearest dollar, of fuel for his trip from Coolabah to Bourke?

A. $10

B. $14

C. $18

D. $22

MEREWETHER
HIGH SCHOOL

2020 Trial HSC Examination

Mathematics Standard 2

Section II – Answer Booklet

Student Name: _____

85 marks
Attempt Question 16 – 46
Allow about 2 hours and 5 minutes for this section.

Instructions

- Write your name in the space above.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (2 marks)

A person owns 315 shares with a market value of $4.55 per share.
The percentage dividend yield from these shares is 7.25%.

Calculate, to the nearest cent, the total value of the dividends received. **2**

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Question 17 (2 marks)

A set of digital scales read 68.7 kg.



Show that, to three decimal places, the percentage error of the reading is 0.073% **2**

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Question 18 (2 marks)

Solve the equation $4y - 2(4 + y) = y - 13$ **2**

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Question 19 (3 marks)

The ages of 10 members of a group fitness class are as shown.

39 41 42 44 47 48 51 53 57 69

(a) What is the range of the data? **1**

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(b) Is the age of the oldest member of the class considered an outlier?
Justify your answer with calculations. **2**

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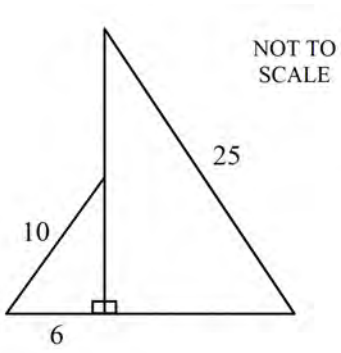
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Question 20 (2 marks)

An art piece is made of two similar triangles. Some dimensions of the triangles, in centimetres, are shown on the diagram.



Calculate the total area of both triangles. **2**

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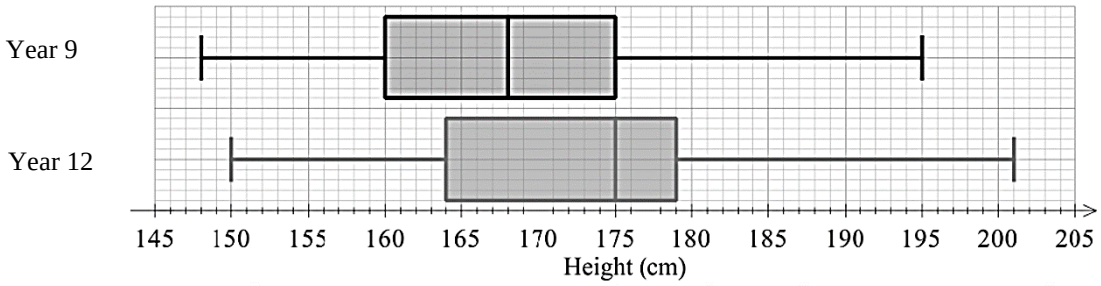
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Question 21 (3 marks)

The box-plot below shows the heights of students in Year 9 and Year 12 at Fig Tree HS.



(a) What percentage of students in Year 9 have a height below 160 cm? **1**

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(b) There are the same number of students with heights above 175 cm in Year 9 as there are students with heights above 175 cm in Year 12.
If there are 140 students in total in Year 9, how many students are in Year 12? **2**

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Question 22 (2 marks)

Isabelle was studying the number of frogs living in a swamp.
She caught, tagged and released 45 frogs. Later she caught 20 frogs at random, six of which had been tagged.
Calculate the estimated number of frogs living in the swamp. **2**

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Question 23 (2 marks)

Hugo is considering purchasing a new freezer and has narrowed down his choice to two options:

The Freezmax	*3 star energy rating*	*335 kWh/year*
The IceCold	*3½ star energy rating*	*251 kWh/year*

If electricity is charged at a constant 22.4c/kWh, how much would Hugo save per year by running the more energy efficient freezer? **2**

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Question 24 (2 marks)

A seven year-old child requires the correct dosage of a particular medicine. The dosage for a child is given by Young's formula:

$$\text{Dosage for children } 1-12 \text{ years} = \frac{\text{age of child (in years)} \times \text{adult dosage}}{\text{age of child (in years)} + 12}$$

Calculate the dosage for a seven year-old child if the adult dosage is 120 mg. **2**

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Question 25 (2 marks)

The volume of bottles filled with spring water is checked as part of a quality control check. The results are normally distributed with a mean of 355 mL and a standard deviation of 5 mL.

Bottles with a volume of less than 350 mL are rejected. How many from a random sample of 300 bottles would not pass the quality control check? **2**

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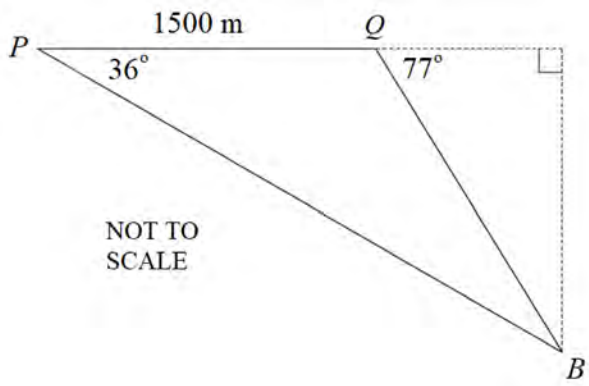
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Question 26 (3 marks)

A small aircraft is flying across the ocean at a constant altitude. At the point *P* the angle of depression to a boat, *B*, is 36º. After the small aircraft flies another 1500 m towards the boat the angle of depression, at the point *Q*, is 77 º.



Use the Sine rule to find the distance *QB*, to the nearest metre. **3**

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Question 27 (2 marks)

A set of scores is displayed in a stem-and-leaf plot.

Stem	Leaf
1	1
2	9
3	4 6 7
4	5 5 6 7

Calculate the population standard deviation of the data and comment on the skewness of the distribution. **2**

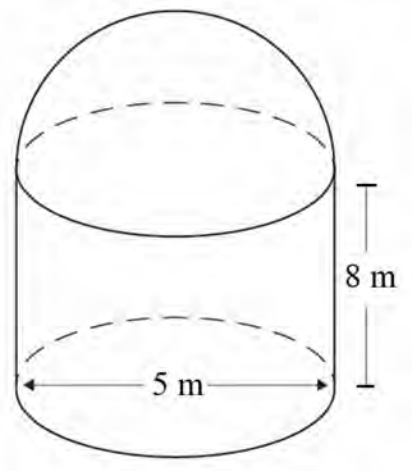
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Question 28 (3 marks)

The diagram shows a water tank made from a cylinder and a hemisphere.



Calculate the volume of the water tank, to two decimals places. **3**

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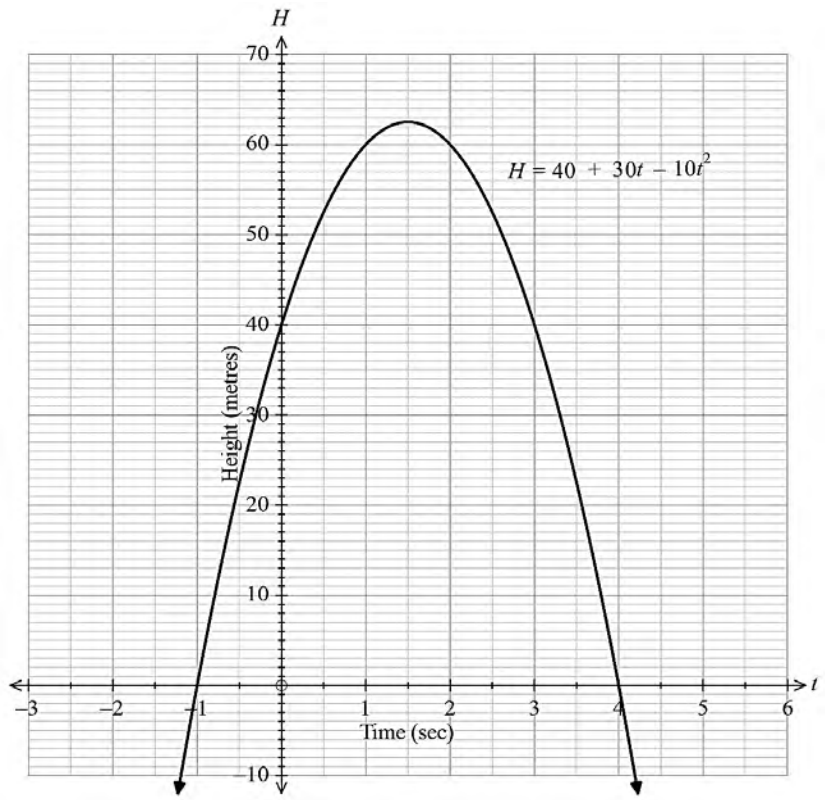
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Question 29 (3 marks)

Molly uses the equation $H = 40 + 30t - 10t^2$ to model the height above the ground of a ball thrown upward from a raised platform.



(a) From what height above the ground was the ball thrown? **1**

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(b) What is the maximum height above the ground that the ball reaches? **1**

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(c) What are the limitations of this model? **1**

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Question 30 (3 marks)

The table below shows the income tax rates for the 2019 – 2020 financial year.

Taxable income	*Tax payable on this income*
$0 to $18 200	Nil
$18 201 to $37 000	19c for each $1 over $18 200
$37 001 to $90 000	$3 572 plus 32.5c for each $1 over $37 000
$90 001 to $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

The Medicare levy is calculated as 2% of taxable income.

Rylan has a gross annual income of $90 740 and is eligible for tax deductions of $3970. He is required to pay the Medicare levy. He has already paid $20 412 in Pay As You Go (PAYG) tax. Should Rylan receive a tax refund or will he have a tax debt? **3**

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Question 31 (4 marks)

Laura has a credit card with the following conditions:

No interest free period.
Interest charged on the last day of the month.
Interest rate is 21.5% p.a., compounded daily.
Interest is charged from day of purchase until the end of the month, inclusive.
Minimum payment is 5% of the closing balance.

Laura made several purchases in the month of June, as given below.

Statement Period: 1 June to 30 June

Date	**Details**	**Amount**
1 June	Opening balance	$0
14 June	Concert tickets	$600
21 June	Bike	$250
30 June	Interest charged	……
30 June	Closing balance	……

(a) Calculate, to the nearest cent, the amount of interest charged for the month of June. **3**

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(b) Calculate the minimum payment required. **1**

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Question 32 (2 marks)

A monitor purchased for $940 for a software business depreciates by 20% per annum.

Use the declining balance method of depreciation to determine the salvage value (S) of the monitor after 4 years? **2**

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Question 33 (2 marks)

Elizabeth lives in New York, USA (UTC –5) and Margaret lives in Sydney, NSW (UTC +10). Margaret makes a call to Elizabeth at 12:30 pm on Monday 24th February, Sydney time.

February is a month when NSW has daylight saving time and New York does not.

What is the time and day in New York when Elizabeth receives the call? **2**

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Questions 16 – 33 are worth 44 marks in total

Question 34 (3 marks)

The variable T varies inversely with the variable S. If $T = 0.72$ when $S = 11.5$, find the value of T when $S = 42$, to two significant figures. **3**

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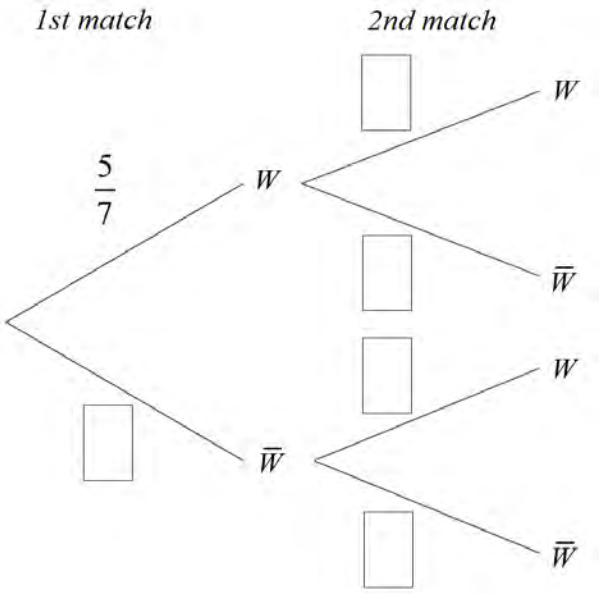
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Question 35 (3 marks)

Emily's basketball team is close to making the finals for the season. They are required to win at least one of their remaining two games. The probability of them winning any given game is $\frac{5}{7}$.

A probability tree of Emily's team winning (W) and not winning ($\overline{W}$) is being constructed.



Complete the tree diagram and calculate the probability of Emily's team making the finals. **3**

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Question 36 (2 marks)

The table shows the present values of an annuity of $1 for periods between 58 and 62 months, for different interest rates.

Table of present value interest factors

Months	Interest Rate Per Month				
	0.4%	0.5%	0.6%	0.7%	0.8%
58	51.67171	50.23911	48.86109	47.53525	46.25932
59	52.46186	50.98419	49.56370	48.19786	46.88425
60	53.24887	51.72556	50.26213	48.85587	47.50421
61	54.03274	52.46324	50.95639	49.50931	48.11926
62	54.81348	53.19726	51.64651	50.15820	48.72942

Calculate the contribution per period of an annuity with a present value of $25 700 at 6% per annum compounded monthly for 5 years. **2**

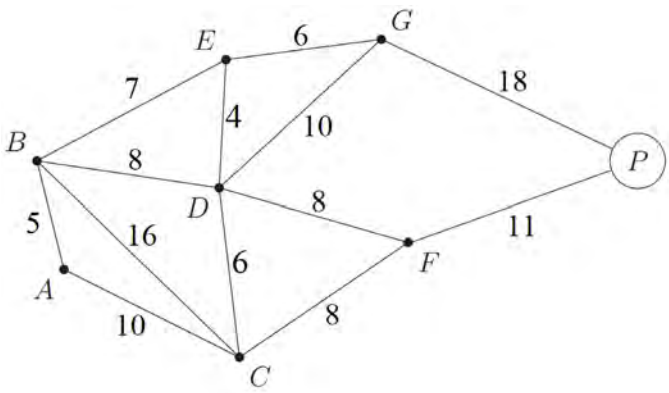
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Question 37 (2 marks)

A series of cabins in a caravan park are to be connected to the power source at *P*. The weighted graph below shows the distances in metres between certain cabins and the power source.



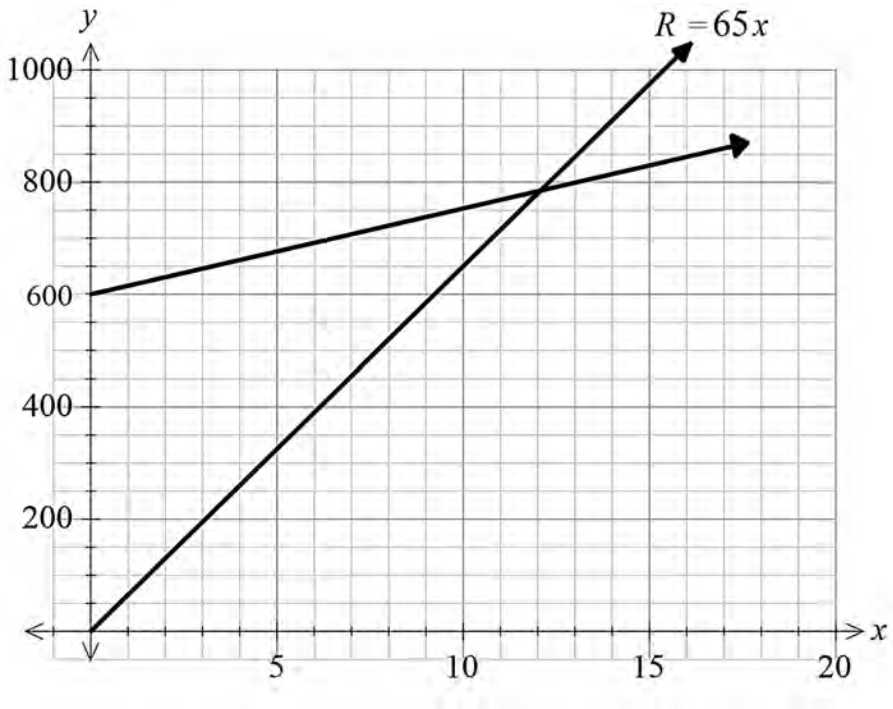
Draw the minimum spanning tree of the network. **2**

Question 38 (4 marks)

A personal trainer sets up her own gym at home to train clients.

Graphing software was used to draw the two straight line graphs which represent the cost (C) of setting up the home gym and the revenue (R) from the personal training sessions. The x-axis represents the number of clients and the y-axis the cost/revenue in dollar ($).

The function for revenue is $R = 65x$.



(a) State the coordinates of the break-even point and interpret its meaning. **2**

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(b) Find the equation to represent the cost of setting up the home gym. **2**

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Question 39 (4 marks)

The table below shows all activities required to complete a project and their immediate prerequisites. The time taken for each activity is also given.

Activity	Immediate prerequisites	Time taken (days)
A	-	1
B	*A*	0.5
C	*B*	2
D	*A*	3
E	*D*	2
F	*C, E*	3
G	*F*	4

(a) Draw a network diagram to determine the minimum time to complete the project. **3**

Minimum time =……

(b) What is the float time of the non-critical activities? **1**

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Question 40 (4 marks)

The formula below can be used to estimate the blood alcohol content (BAC) for males.

$$BAC_{Male} = \frac{10N - 7.5H}{6.8M}$$

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.

The number of hours required for a person to reach a zero BAC after they stop drinking alcohol is given by the formula:

$$\text{Time} = \frac{BAC}{0.015}$$

The number of standard drinks is as shown in the table:

	No. of Standard Drinks
Glass of wine	1.2
Bottle of beer	1.3
Shot of a spirit	1

Elijah was out Saturday night celebrating his team's win. The celebrations started at 8 p.m. and continued until the team's 12:30 a.m. curfew. During this time he consumed 6 bottles of beer and 3 shots of spirits. He then stopped drinking alcohol.

Given that Elijah weights 76 kg, use the information and formulas provided above to determine what time on Sunday his BAC should reach zero. **4**

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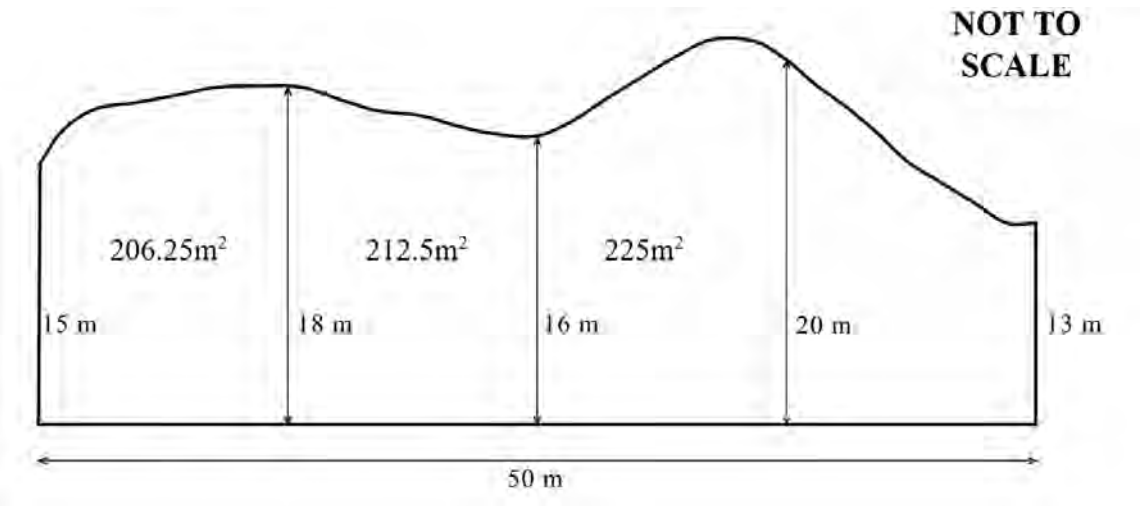
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Question 41 (3 marks)

A landscaper is creating a new native garden. The Trapezoidal Rule was used to approximate the area of the first 3 sections. These areas are shown on the bird's eye view sketch of the garden below.



To complete the garden, soil to the depth of 0.15 metres is to be added uniformly across the garden.

Find the total volume of soil needed for the garden. **3**

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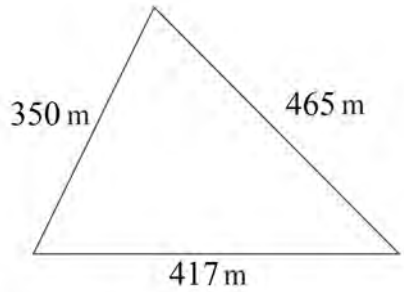
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Question 42 (4 marks)

The diagram represents a triangular paddock.



NOT TO SCALE

By first finding an angle, calculate the area of the paddock. **4**

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Question 43 (5 marks)

A colony of bacteria grows exponentially and is modelled by the function $P = 100(1.43)^x$ where P is the population of bacteria after x hours.

(a) What was the size of the colony initially? **1**

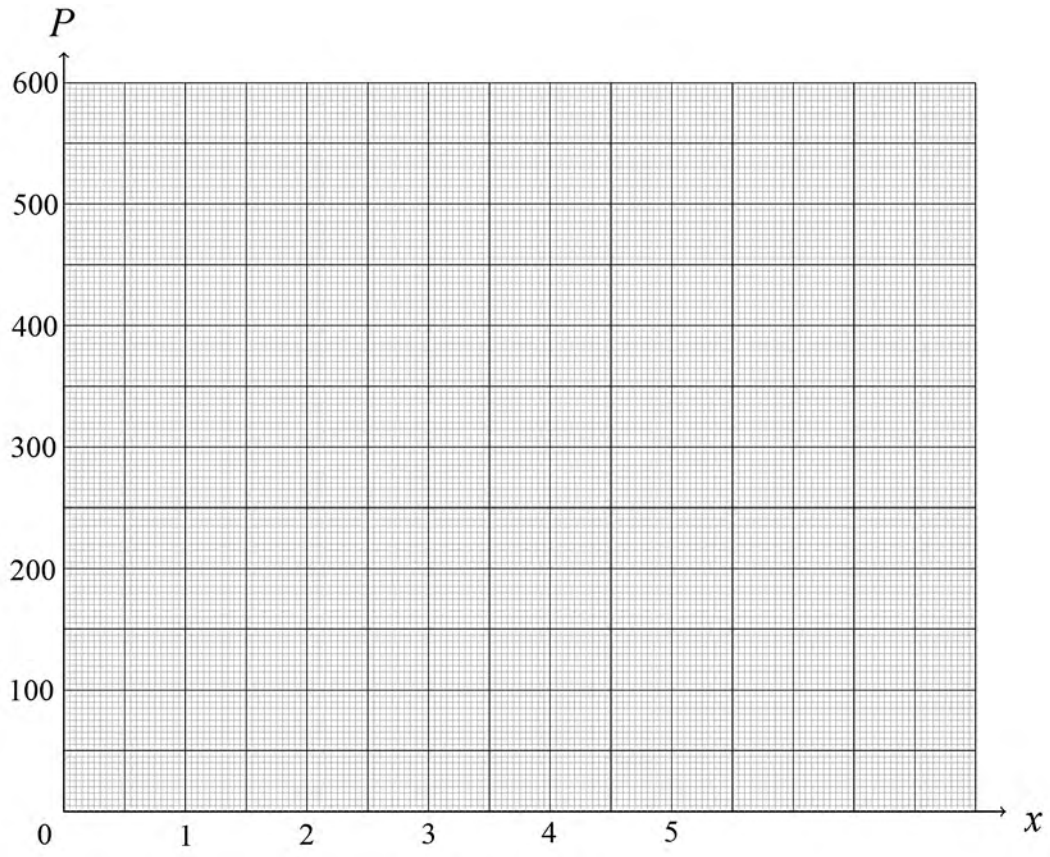
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(b) Complete, to the nearest whole number, the following table of values. **1**

Time in hours (x)	0	1	2	3	4	5
Population (P)						

(c) Sketch the exponential function for values $0 \le x \le 5$ on the graph below. **2**



(d) Estimate how long it will take for the colony to reach 350 bacteria. **1**

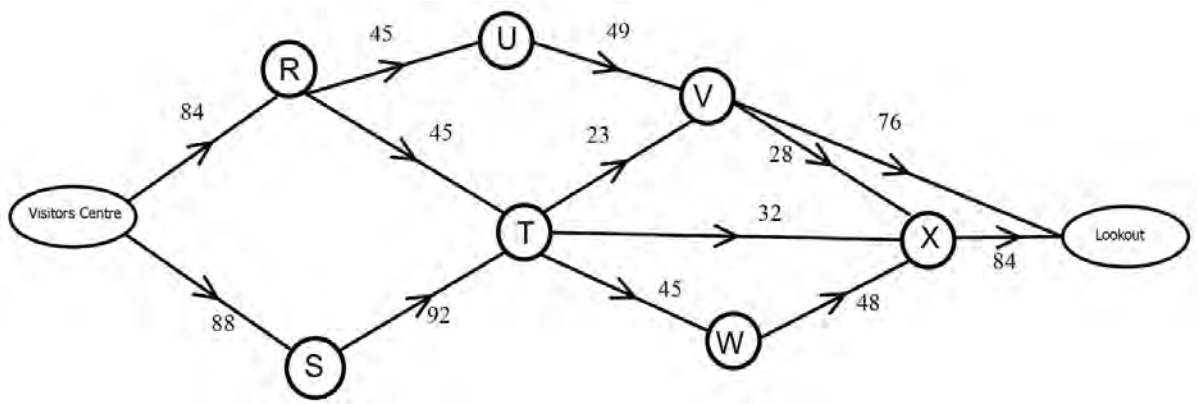
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Question 44 (3 marks)

To reduce congestion at Tao National Park, one-way trails are used to direct visitors from the Visitors Centre to the Lookout.

The network flow diagram below shows the layout of the trails.



The trails pass through picnic areas which are labelled R through to X as shown above.

The capacity of each trail, in visitors per hour, is shown beside the trail.

All visitors return to the Visitors Centre along a single one-way trail which has a capacity of 160 visitors per hour. (This trail is not shown.)

(a) What is the maximum flow of visitors from the Visitors Centre to the Lookout? **2**

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(b) What increase to the capacity of a single trail would allow the return trail to operate at its full capacity of 160? **1**

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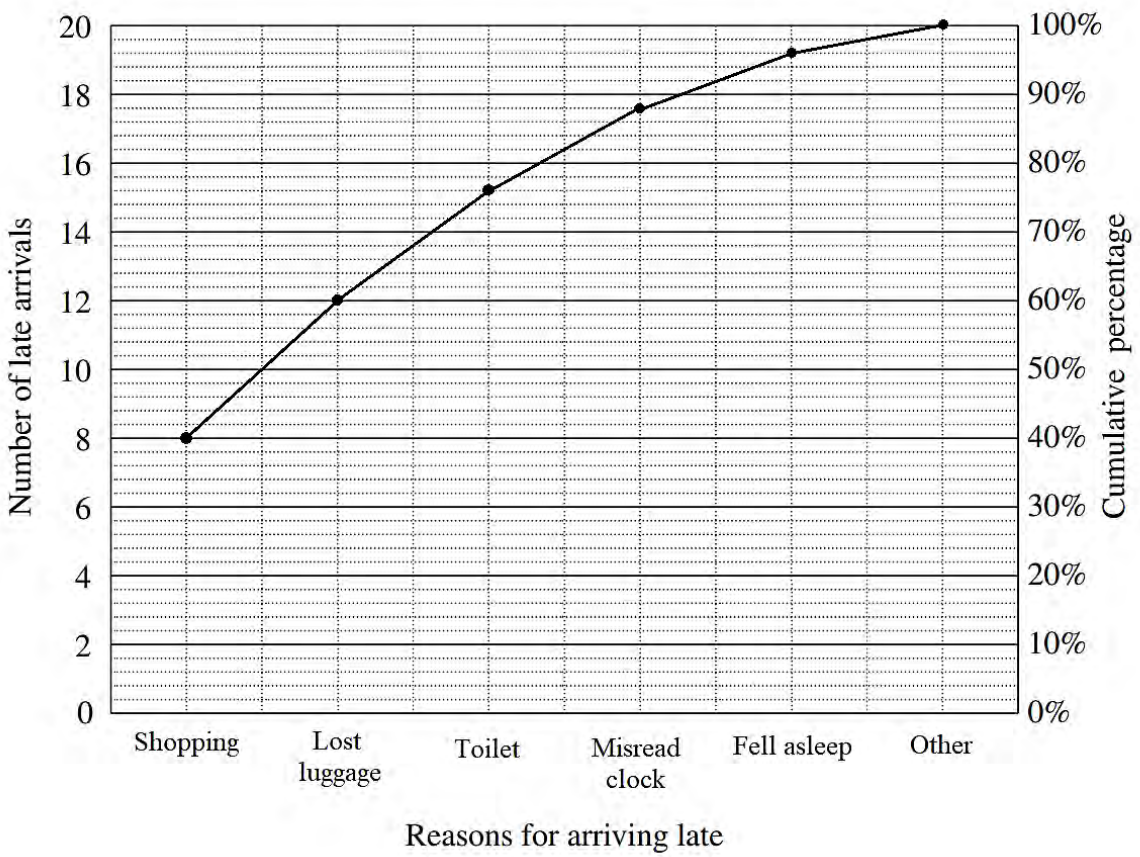
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Question 45 (2 marks)

An airport check-in gate collected data from 50 different passengers on reasons why passengers arrived late to the gate.

The data was to be displayed on the Pareto chart. The cumulative percentage has been provided.

Complete the Pareto chart by drawing the frequency histogram on the chart below. **2**



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Please turn over

Question 46 (2 marks)

Bobby opens a savings bank account and deposits $5000 into it. Interest is paid at r % per annum, compounded monthly.

What interest rate, r, correct to two decimal places, should Bobby require for his savings account if he intends to have doubled his money after 10 years? **2**

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End of paper

Section II extra writing space

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

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STUDENT NAME: Solutions

MEREWETHER
HIGH SCHOOL

2020

YEAR 12
TRIAL HSC

Mathematics Standard 2

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
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks : 100

Section I – 15 marks (pages 2 – 8)

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

Section II – 85 marks (pages 9 – 30)

- Attempt Questions 16 – 46
- 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 Grahame is driving a car at a constant speed and takes 1.4 seconds to react to a situation and then applies the brakes. His reaction distance was 27 metres.

At what speed, kilometres per hour, was Grahame travelling?

A. 19 km/h

B. 38 km/h

C. 69 km/h

D. 85 km/h

$D = S \times T$

$27 = S \times 1.4$

$\therefore S = 19.29 \text{ m/s}$

$= 69 \text{ km/h}$

2 Which of the following is the graph of $y = 2x - 4$.

$m = 2$

$b = -4$

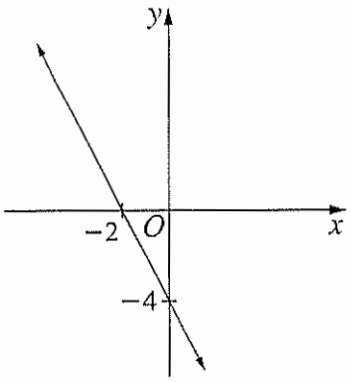
x intercept:

$2x - 4 = 0$

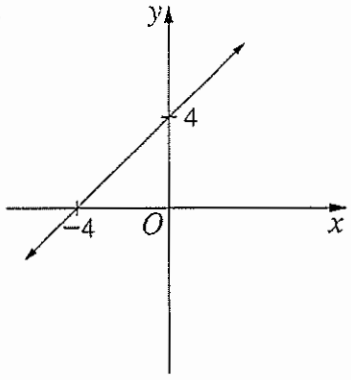
$2x = 4$

$x = 2$

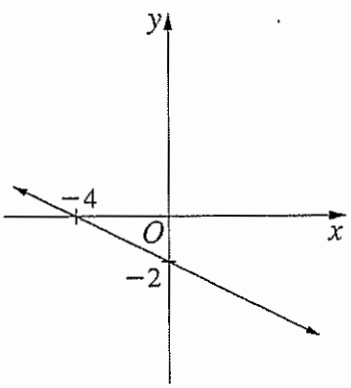
A.



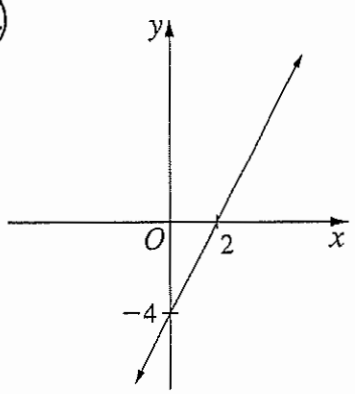
B.



C.



D.



3 A salesperson is paid a retainer and 4% commission on any sales made during a fortnight. During a fortnight, the salesperson sells $3000 worth of goods and is paid $730. The value of the retainer is

A. $120

B. $610

C. $850

D. $930

$730 = R + 0.04 \times 3000$

$730 = R + 120$

$\therefore R = 610$

4 A password for an internet portal login is to be made up of two letters followed by two digits, for example AB89. Letters and digits may be repeated.

How many unique passwords exists?

A. 256

B. 10 000

C. 54 756

D. 67 600

$26 \times 26 \times 10 \times 10$

5 Four towns L, M, P and Q are linked by roads. The table below represents the weighted network of roads between the towns. The units in the table are kilometres.

	L	M	P	Q
L	0	3	6	0
M	3	0	5	0
P	6	5	0	4
Q	0	0	4	0

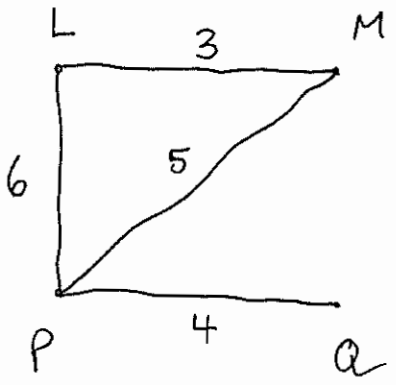
How many edges are in the network?

A. 4

B. 6

C. 18

D. 36



6 A table of future value interest factors is shown.

Table of future value interest factors

Period	*Interest rate per period*				
	1%	*2%*	*3%*	*4%*	*5%*
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500
3	3.0301	3.0604	3.0909	3.1216	3.1525
4	4.0604	4.1216	4.1836	4.2465	4.3101

A certain annuity involves making equal contributions of $2400 into an account every 6 months for two years at an interest rate of 4% per annum.

Based on the information provided, what is the future value of this annuity?

A. $4896.00

B. $7344.96

(C.) $9891.84

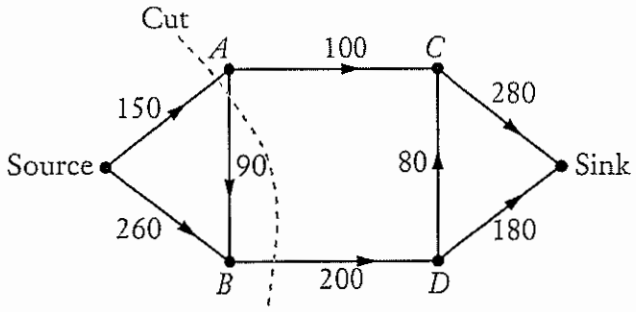
D. $10 191.60

Every 6 months for 2 years → n = 4

4% per annum → 2% per 6 months

∴ 4.1216 × 2400

7 A cut has been drawn on a network.



The capacity of the cut shown is

150 + 200

(A.) 350

B. 440

C. 500

D. 700

8 An audience leaving a cinema is surveyed on whether they enjoyed the film they viewed. Every 5th person that exits the cinema are surveyed.

Which type of sampling technique is being used?

A. Random

B. Systematic

C. Stratified

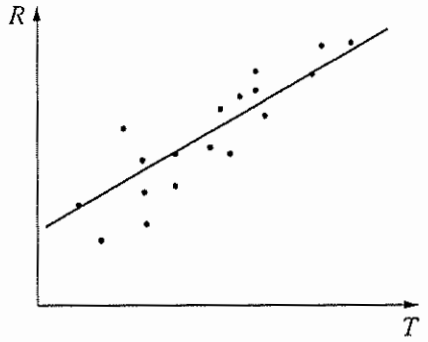
D. Self-selected

9 A scatterplot is drawn to compare two variables, R and T.

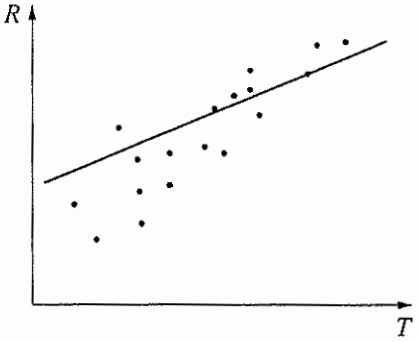


Which ONE of the following graphs shows the line of best fit for the data?

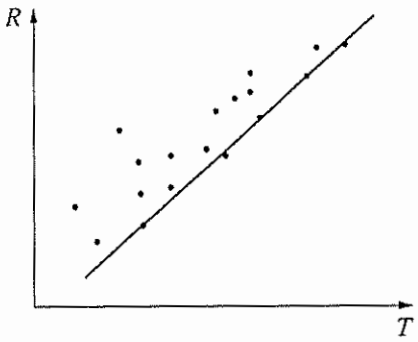
A.



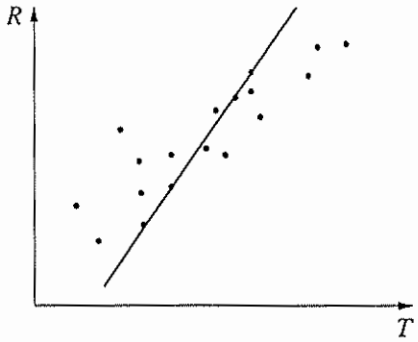
B.



C.

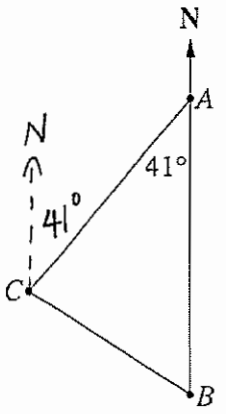


D.



10 The diagram shows the positions of towns A, B and C.

Town B is due south of town A and $\angle CAB = 41°$.



NOT TO SCALE

What is the bearing of town A from town C?

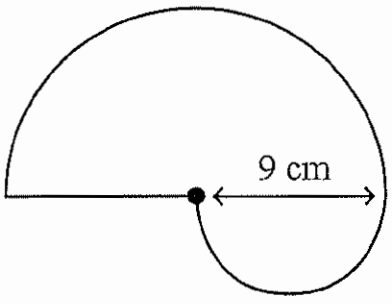
(A.) 041°

B. 049°

C. 151°

D. 221°

11 A shape consists of two semi-circles. The smallest semi-circle has a diameter of 9 cm.



$P = \frac{1}{2}\pi d_1 + \frac{1}{2}\pi d_2 + 9$

$= \frac{1}{2}\pi \times 9 + \frac{1}{2}\pi \times 18 + 9$

$\therefore P = 51.4$

$\therefore P = 51$

To the nearest centimetre, what is the perimeter of the shape?

A. 42 cm

(B.) 51 cm

C. 60 cm

D. 85 cm

12 Aaron purchased a car for \$45 000. It depreciated by 10% in the first year and then \$2500 each year after. He intends to list it for sale when its salvage value reaches \$26 750.

How many years and months after he purchased the car will Aaron list it for sale?

A. 5 years and 5 months

B. 5 years and 6 months

C. 6 years and 5 months

(D.) 6 years and 6 months

$\$45000 \times 0.9 = \$40\,500$

$S = V_0 - Dn$

$26\,750 = 40\,500 - 2500 \times n$

$-13\,750 = -2500n$

$n = 5.5$

$\therefore$ After purchase, Aaron will sell $6\frac{1}{2}$ years later

13 A bag contains red, green and black coloured tokens. One token is to be drawn at random. The probability, as a decimal, of selecting a red token is 0.52 and it is twice as likely to draw a green token than a black token.

What is the chance of selecting a red or a green token?

(A.) 0.84

B. 0.86

C. 0.88

D. 0.90

$P(R) = 0.52$

$P(B) = 0.16$

$P(G) = 0.32$

$\therefore P(R \text{ or } G) = 0.52 + 0.32$

$= 0.84$

14 A network has a minimum spanning tree consisting of n edges, for $n \geq 1$.

How many vertices are there on the minimum spanning tree?

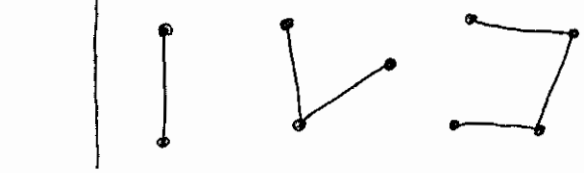
A. n

(B.) $n+1$

C. $n-1$

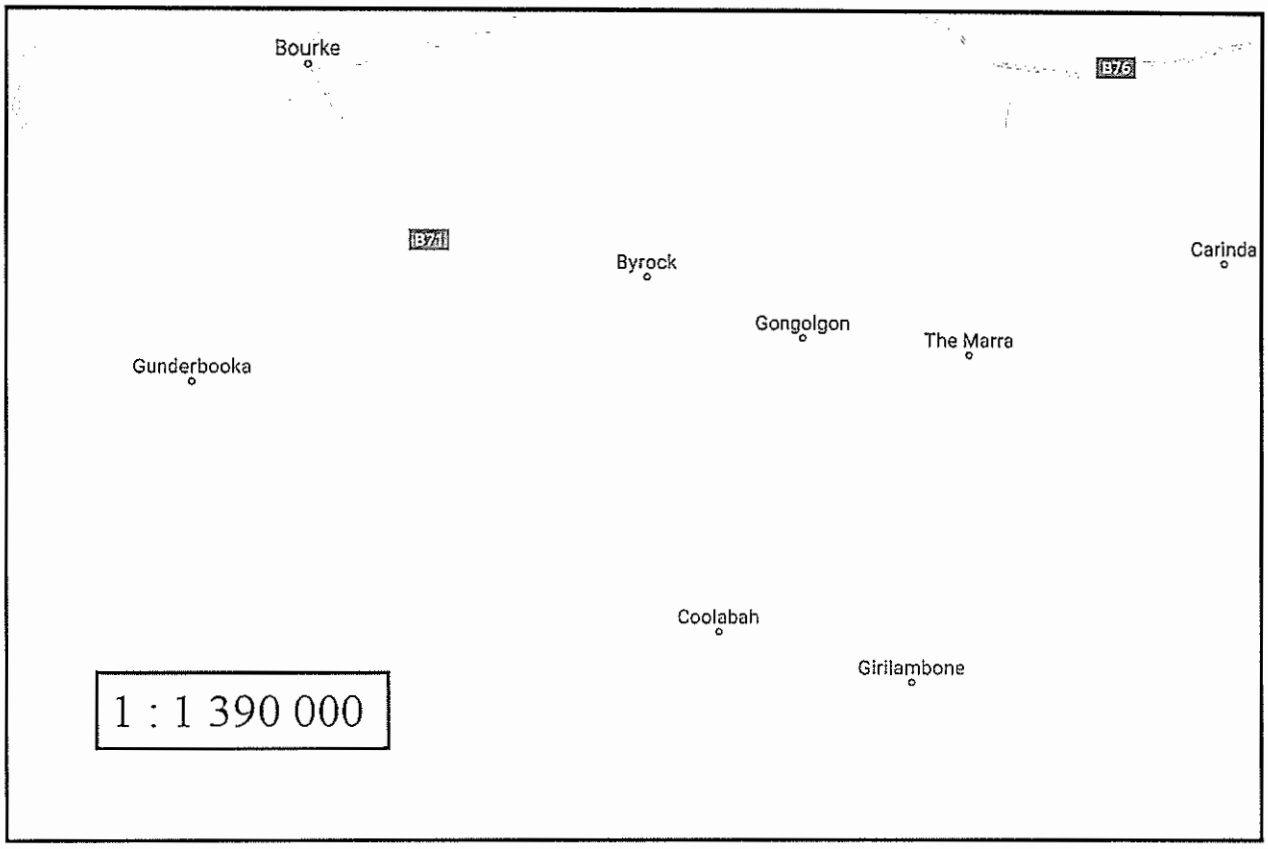
D. $\frac{n}{2}$

n	1	2	3
V	2	3	4



$V = n + 1$

15 Simon is driving from Coolabah to Bourke on the B71. A scale map of the area is provided.



His car has a fuel consumption of 6.7 L/100 km. When he fills his car with fuel in Coolabah, the petrol price was $1.64 per litre.

Which ONE of the following is the approximate cost, to the nearest dollar, of fuel for his trip from Coolabah to Bourke?

A. $10

B. $12

C. $14

D. $16

1 : 1 390 000

9·2 : 12 788 000

∴ 127·88 km

6·7 L / 100 km

$\frac{6·7}{100}$ L / 1 km

∴ 8·56796 L × $1·64

= $14.05

MEREWETHER
HIGH SCHOOL

2020 Trial HSC Examination

Mathematics Standard 2

Section II – Answer Booklet

Student Name: _____

85 marks
Attempt Question 16 – 46
Allow about 2 hours and 5 minutes for this section.

Instructions

- Write your name in the space above.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

Question 16 (2 marks)

A person owns 315 shares with a market value of $4.55 per share.
The percentage dividend yield from these shares is 7.25%.

Calculate, to the nearest cent, the total value of the dividends received. **2**

$\text{Dividend Yield} = \frac{\text{Dividend}}{\text{Price}}$

$0.0725 = \frac{\text{Dividend}}{4.55}$ — (1)

$\therefore \text{Dividend} = 0.329875 \times 315$

$= \$103.91$ — (1)

Question 17 (2 marks)

A set of digital scales read 68.7 kg.



Show that, to three decimal places, the percentage error of the reading is 0.073% **2**

$\text{Absolute error} = \frac{1}{2} \times 0.1$

$= 0.05$ — (1)

$\text{Percentage error} = \frac{0.05}{68.7} \times 100$ —

$= 0.073\%$ — (1)

Question 18 (2 marks)

Solve the equation $4y - 2(4 + y) = y - 13$ **2**

$4y - 8 - 2y = y - 13$ (1)

$2y - 8 = y - 13$

$y = -5$ (1)

Question 19 (3 marks)

The ages of 10 members of a group fitness class are as shown.

39 41 42 44 47 48 51 53 57 69

(a) What is the range of the data? **1**

$69 - 39 = 30$

(b) Is the age of the oldest member of the class considered an outlier?
Justify your answer with calculations. **2**

Q_2

39 41 (42) 44 47 | 48 51 (53) 57 69

Q_1 Q_3

$IQR = Q_3 - Q_1$

$= 53 - 42$

$= 11$

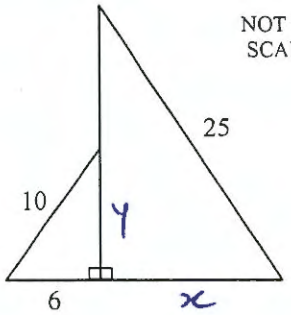
Is $69 > 11 \times 1.5 + 53$

$69 > 69.5$

∴ No, not an outlier.

Question 20 (2 marks)

An art piece is made of two similar triangles. Some dimensions of the triangles, in centimetres, are shown on the diagram.



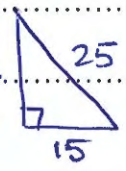
$y = \sqrt{10^2 - 6^2}$

$= 8$

Calculate the total area of both triangles. **2**

$\frac{x}{25} = \frac{6}{10}$

$x = 15$ — (1)



$z = \sqrt{25^2 - 15^2}$

$z = 20$

$A_1 = \frac{1}{2} \times 6 \times 8$

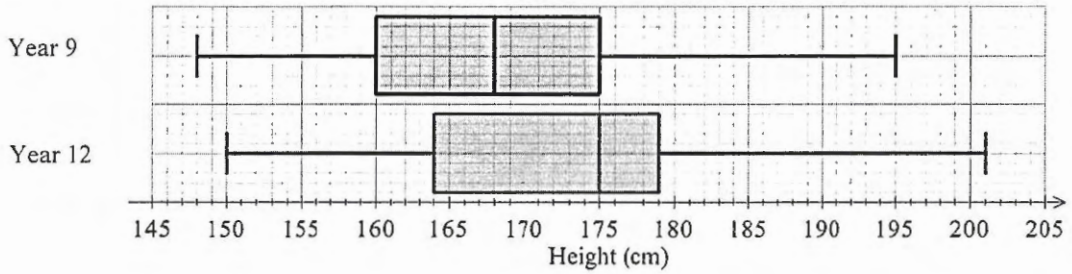
$A_2 = \frac{1}{2} \times 20 \times 15$

$\therefore A = 24 + 150$

$A = 174 cm^2$ — (1)

Question 21 (3 marks)

The box-plot below shows the heights of students in Year 9 and Year 12 at Fig Tree HS.



(a) What percentage of students in Year 9 have a height below 160 cm? **1**

25%

(b) There are the same number of students with heights above 175 cm in Year 9 as there are students with heights above 175 cm in Year 12.
If there are 140 students in total in Year 9, how many students are in Year 12? **2**

$140 \times 25\% = 35$ — (1)

$\therefore 35 \times 2 = 70$ students in Year 12 — (1)

Question 22 (2 marks)

Isabelle was studying the number of frogs living in a swamp.
She caught, tagged and released 45 frogs. Later she caught 20 frogs at random, six of which had been tagged.
Calculate the estimated number of frogs living in the swamp. **2**

$\frac{45}{F} = \frac{6}{20}$ — (1)

$6F = 900 \quad \therefore F = 150$ — (1)

$\therefore$ 150 frogs in the swamp.

Question 23 (2 marks)

Hugo is considering purchasing a new freezer and has narrowed down his choice to two options:

The Freezmax	*3 star energy rating*	*335 kWh/year*
The IceCold	*3½ star energy rating*	*251 kWh/year*

If electricity is charged at a constant 22.4c/kWh, how much would Hugo save per year by running the more energy efficient freezer? **2**

Difference = 335 − 251

= 84 kWh / year — (1)

Saving = 84 × 0.224

= $18.816 — (1)

Question 24 (2 marks)

A seven year-old child requires the correct dosage of a particular medicine. The dosage for a child is given by Young's formula:

$$\text{Dosage for children } 1-12 \text{ years} = \frac{\text{age of child (in years)} \times \text{adult dosage}}{\text{age of child (in years)} + 12}$$

Calculate the dosage for a seven year-old child if the adult dosage is 120 mg. **2**

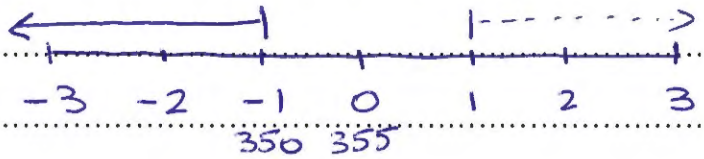
Dosage = $\frac{7 \times 120}{7 + 12}$ — (1)

Dosage = 44.21 mg — (1)

Question 25 (2 marks)

The volume of bottles filled with spring water is checked as part of a quality control check. The results are normally distributed with a mean of 355 mL and a standard deviation of 5 mL.

Bottles with a volume of less than 350 mL are rejected. How many from a random sample of 300 bottles would not pass the quality control check? **2**



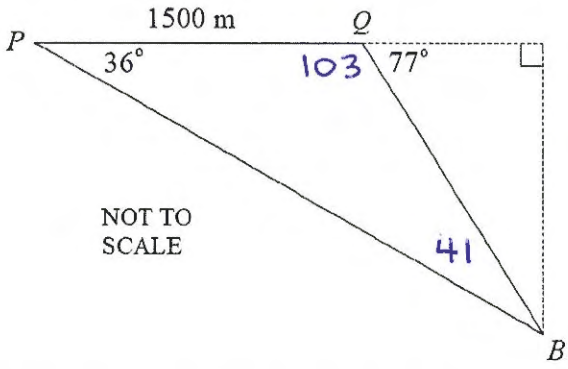
$\frac{100\% - 68\%}{2} = 16\%$ below 350mL – (1)

$\therefore 16\% \times 300 = 48$ – (1)

$\therefore$ 48 bottles not pass quality control check.

Question 26 (3 marks)

A small aircraft is flying across the ocean at a constant altitude. At the point P the angle of depression to a boat, B, is 36°. After the small aircraft flies another 1500 m towards the boat the angle of depression, at the point Q, is 77 °.



Angle sum (1)

Use the Sine rule to find the distance QB, to the nearest metre. **3**

$\frac{QB}{\sin 36} = \frac{1500}{\sin 41}$ – (1)

$QB = \frac{1500 \times \sin 36}{\sin 41}$

$QB = 1343.9$

$\therefore QB = 1344\text{m}$ (nearest m) – (1)

Question 27 (2 marks)

A set of scores is displayed in a stem-and-leaf plot.

Stem	Leaf
1	1
2	9
3	4 6 7
4	5 5 6 7

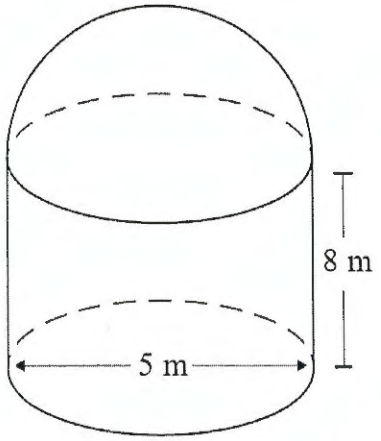
Calculate the population standard deviation of the data and comment on the skewness of the distribution. **2**

$\sigma_x = 10.8$ (1 d.p.) – (1)

The distribution is negatively skewed. – (1)

Question 28 (3 marks)

The diagram shows a water tank made from a cylinder and a hemisphere.



$r = 2.5$

Calculate the volume of the water tank, to two decimals places. **3**

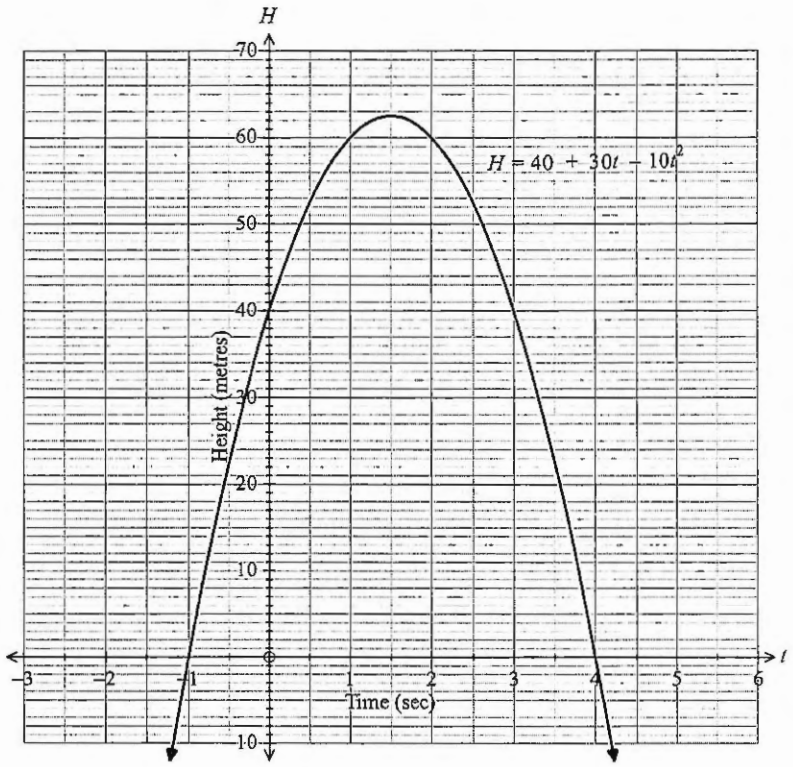
$V = \pi r^2 h + \frac{1}{2} \times \frac{4}{3} \pi r^3$ – (1)

$= \pi \times 2.5^2 \times 8 + \frac{1}{2} \times \frac{4}{3} \pi \times 2.5^3$ – (1)

$\therefore V = 189.80\ m^3$ (2 dp.) – (1)

Question 29 (3 marks)

Molly uses the equation $H = 40 + 30t - 10t^2$ to model the height above the ground of a ball thrown upward from a raised platform.



(a) From what height above the ground was the ball thrown? **1**

40m

(b) What is the maximum height above the ground that the ball reaches? **1**

Max height at $t = 1.5$

$\therefore H = 40 + 30(1.5) - 10(1.5)^2$

$= 62.5$ (1)

(c) What are the limitations of this model? **1**

t values cannot be negative.

Question 30 (3 marks)

The table below shows the income tax rates for the 2019 – 2020 financial year.

Taxable income	*Tax payable on this income*
\$0 to \$18 200	Nil
\$18 201 to \$37 000	19c for each \$1 over \$18 200
\$37 001 to \$90 000	\$3 572 plus 32.5c for each \$1 over \$37 000
\$90 001 to \$180 000	\$20 797 plus 37c for each \$1 over \$90 000
\$180 001 and over	\$54 097 plus 45c for each \$1 over \$180 000

The Medicare levy is calculated as 2% of taxable income.

Rylan has a gross annual income of \$90 740 and is eligible for tax deductions of \$3970. He is required to pay the Medicare levy. He has already paid \$20 412 in Pay As You Go (PAYG) tax. Should Rylan receive a tax refund or will he have a tax debt? **3**

Taxable income = 90 740 − 3970
= 86 770

∴ Tax payable = 3572 + 0.325 × 49770
= \$19 747.25 – (1)

Medicare levy = 2% × 86 770
= \$1735.40 – (1)

∴ Total tax = \$21 482.65

PAYG = \$20 412

∴ Rylan will have tax debt of \$1070.65 (1)

Question 31 (4 marks)

Laura has a credit card with the following conditions:

> *No interest free period.*
> *Interest charged on the last day of the month.*
> *Interest rate is 21.5% p.a., compounded daily.*
> *Interest is charged from day of purchase until the end of the month, inclusive.*
> *Minimum payment is 5% of the closing balance.*

Laura made several purchases in the month of June, as given below.

Statement Period: 1 June to 30 June

Date	**Details**	**Amount**
1 June	Opening balance	$0
14 June	Concert tickets	$600
21 June	Bike	$250
30 June	Interest charged	.....
30 June	Closing balance	.....

(a) Calculate, to the nearest cent, the amount of interest charged for the month of June. **3**

14th → 30th is 17 days 17

$\therefore A = 600\left(1 + \frac{0.215}{365}\right) = 606.036615$ (1)

21st → 30th is 10 days 10

$\therefore A = 250\left(1 + \frac{0.215}{365}\right) = 251.476512$ (1)

∴ Total interest is $7.51 (1)

(b) Calculate the minimum payment required. **1**

5% × $857.51 = $42.88

Question 32 (2 marks)

A monitor purchased for $940 for a software business depreciates by 20% per annum.

Use the declining balance method of depreciation to determine the salvage value (S) of the monitor after 4 years? **2**

$S = V_0(1-r)^n$ 4

$S = 940(1-0.2)$ -(1)

$\therefore S = \$385.02$ -(1)

Question 33 (2 marks)

Elizabeth lives in New York, USA (UTC –5) and Margaret lives in Sydney, NSW (UTC +10). Margaret makes a call to Elizabeth at 12:30 pm on Monday 24th February, Sydney time.

February is a month when NSW has daylight saving time and New York does not.

What is the time and day in New York when Elizabeth receives the call? **2**

NYC SYD

-5 0 +10 15 hrs +1 -(1)

$\therefore$ 12:30pm – 16 hours

= 8:30pm on Sunday in NY -(1)

Questions 16 – 33 are worth 44 marks in total

Question 34 (3 marks)

The variable T varies inversely with the variable S. If $T = 0.72$ when $S = 11.5$, find the value of T when $S = 42$, to two significant figures. **3**

$T = \frac{k}{S} \rightarrow 0.72 = \frac{k}{11.5}$

$\therefore k = 8.28$ – (1)

$\therefore T = \frac{8.28}{S} \rightarrow T = \frac{8.28}{42}$

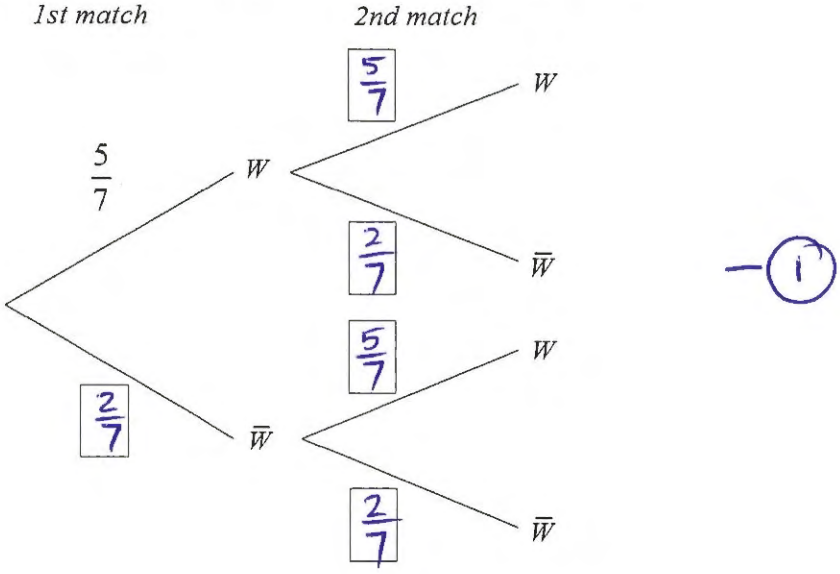
$= 0.1971$ – (1)

$= 0.20$ – (1)

Question 35 (3 marks)

Emily's basketball team is close to making the finals for the season. They are required to win at least one of their remaining two games. The probability of them winning any given game is $\frac{5}{7}$.

A probability tree of Emily's team winning (W) and not winning ($\overline{W}$) is being constructed.



– (1)

Complete the tree diagram and calculate the probability of Emily's team making the finals. **3**

P(at least one W) = 1 − P(no wins) – (1)

$= 1 - \frac{2}{7} \times \frac{2}{7}$

$= \frac{45}{49}$ – (1)

Question 36 (2 marks)

The table shows the present values of an annuity of \$1 for periods between 58 and 62 months, for different interest rates.

Table of present value interest factors

Months	Interest Rate Per Month				
	0.4%	0.5%	0.6%	0.7%	0.8%
58	51.67171	50.23911	48.86109	47.53525	46.25932
59	52.46186	50.98419	49.56370	48.19786	46.88425
60	53.24887	51.72556	50.26213	48.85587	47.50421
61	54.03274	52.46324	50.95639	49.50931	48.11926
62	54.81348	53.19726	51.64651	50.15820	48.72942

Calculate the contribution per period of an annuity with a present value of \$25 700 at 6% per annum compounded monthly for 5 years. **2**

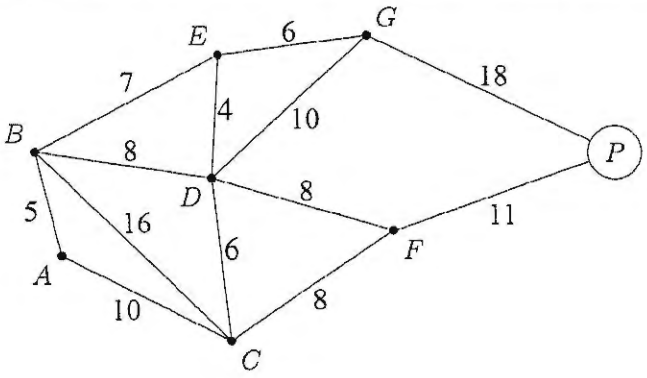
Factor is 51.72556 ✓

$\therefore P \times 51.72556 = 25700$ ✓

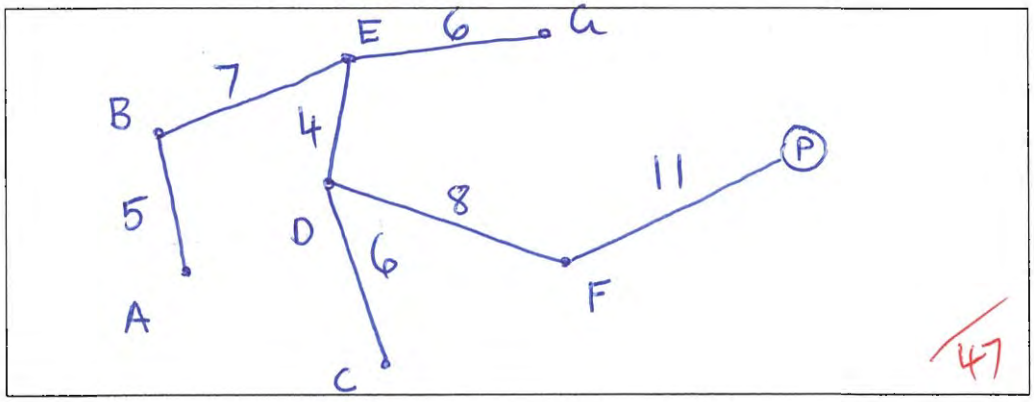
$\therefore P = \$496.85$ ✓

Question 37 (2 marks)

A series of cabins in a caravan park are to be connected to the power source at P. The weighted graph below shows the distances in metres between certain cabins and the power source.



Draw the minimum spanning tree of the network. **2**

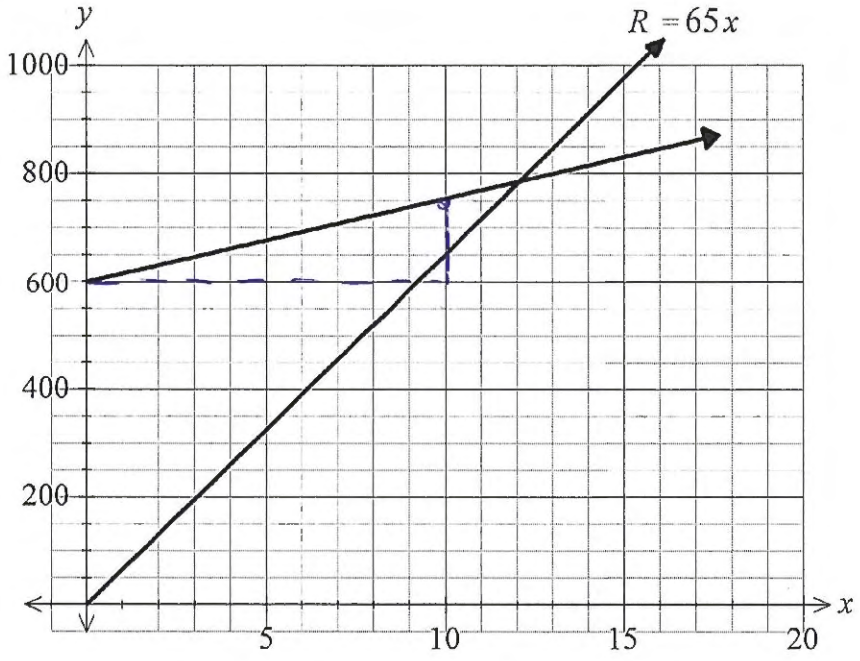


Question 38 (4 marks)

A personal trainer sets up her own gym at home to train clients.

Graphing software was used to draw the two straight line graphs which represent the cost (C) of setting up the home gym and the revenue (R) from the personal training sessions. The x-axis represents the number of clients and the y-axis the cost/revenue in dollar ($).

The function for revenue is $R = 65x$.



(a) State the coordinates of the break-even point and interpret its meaning. **2**

Break even point is (12, 780) —(1)

After $x = 12$, the gym begins making a profit. —(1)

(b) Find the equation to represent the cost of setting up the home gym. **2**

$m = \frac{750 - 600}{10}$

$\therefore m = 15$ —(1)

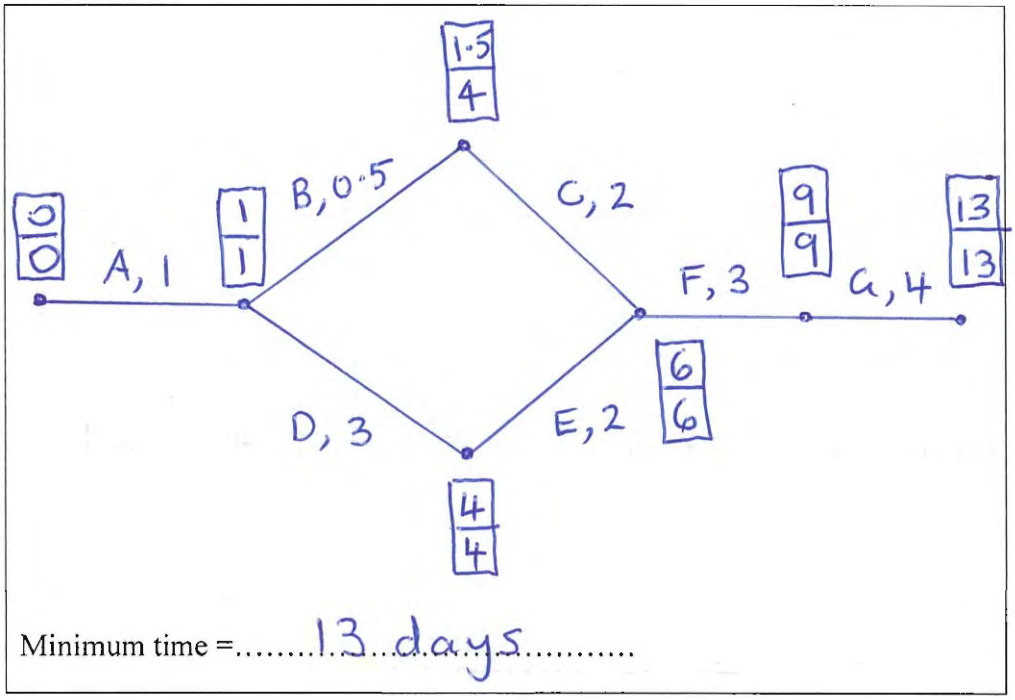
$\therefore C = 15x + 600$ —(1)

Question 39 (4 marks)

The table below shows all activities required to complete a project and their immediate prerequisites. The time taken for each activity is also given.

Activity	Immediate prerequisites	Time taken (days)
A	-	1
B	*A*	0.5
C	*B*	2
D	*A*	3
E	*D*	2
F	*C, E*	3
G	*F*	4

(a) Draw a network diagram to determine the minimum time to complete the project. **3**



Minimum time =.....13 days.....

(b) What is the float time of the non-critical activities? **1**

.....4 - 1·5 = 2·5 days.....

.....

.....

Question 40 (4 marks)

The formula below can be used to estimate the blood alcohol content (BAC) for males.

$$BAC_{Male} = \frac{10N - 7.5H}{6.8M}$$

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.

The number of hours required for a person to reach a zero BAC after they stop drinking alcohol is given by the formula:

$$\text{Time} = \frac{BAC}{0.015}$$

The number of standard drinks is as shown in the table:

	No. of Standard Drinks
Glass of wine	1.2
Bottle of beer	1.3
Shot of a spirit	1

Elijah was out Saturday night celebrating his team's win. The celebrations started at 8 p.m. and continued until the team's 12:30 a.m. curfew. During this time he consumed 6 bottles of beer and 3 shots of spirits. He then stopped drinking alcohol.

Given that Elijah weights 76 kg, use the information and formulas provided above to determine what time on Sunday his BAC should reach zero. **4**

Standard drinks = $6 \times 1.3 + 3 \times 1$

$= 10.8$

$\therefore BAC = \frac{10 \times 10.8 - 7.5 \times 4.5}{6.8 \times 76}$

$BAC = 0.1436726006$

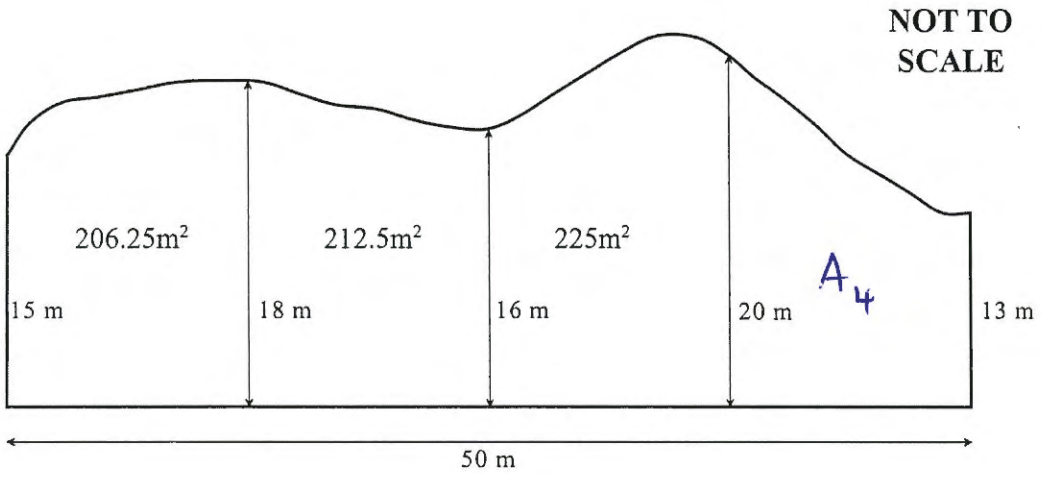
$\therefore$ Hours $= \frac{0.1436726}{0.015} = 9.578$

$= 9$ hours, 35 min

$\therefore$ Will reach zero at 10.05 am.

Question 41 (3 marks)

A landscaper is creating a new native garden. The Trapezoidal Rule was used to approximate the area of the first 3 sections. These areas are shown on the bird's eye view sketch of the garden below.



To complete the garden, soil to the depth of 0.15 metres is to be added uniformly across the garden.

Find the total volume of soil needed for the garden. **3**

$A_4 = \frac{12.5}{2}(20+13)$

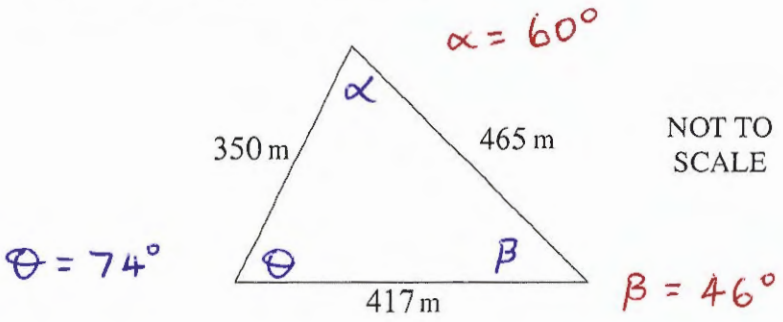
$A_4 = 206.25\ m^2$ – (1)

$\therefore A = 850 m^2 \times 0.15$ – (1)

$\therefore V = 127.5\ m^3$ – (1)

Question 42 (4 marks)

The diagram represents a triangular paddock.



By first finding an angle, calculate the area of the paddock. **4**

$\cos\theta = \dfrac{350^2 + 417^2 - 465^2}{2 \times 350 \times 417}$ (1)

$\cos\theta = 0.2746\ldots$

$\therefore \theta = 74°$ (nearest degree) (1)

$\therefore A = \frac{1}{2} \times 417 \times 350 \times \sin 74°$ (1)

$\therefore A = 70169\ m^2$ (1)

Question 43 (5 marks)

A colony of bacteria grows exponentially and is modelled by the function $P = 100(1.43)^x$ where P is the population of bacteria after x hours.

(a) What was the size of the colony initially? **1**

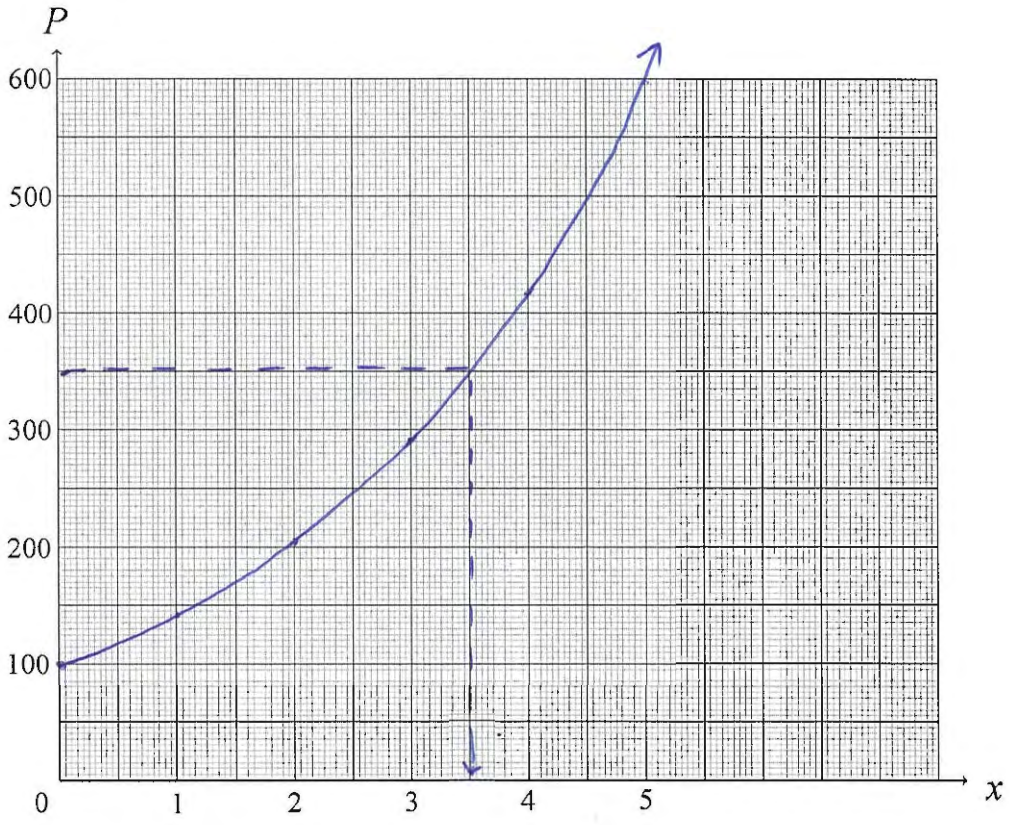
$P = 100(1.43)^0$

$\therefore P = 100$

(b) Complete, to the nearest whole number, the following table of values. **1**

Time in hours (x)	0	1	2	3	4	5
Population (P)	100	143	204	292	418	598

(c) Sketch the exponential function for values $0 \leq x \leq 5$ on the graph below. **2**



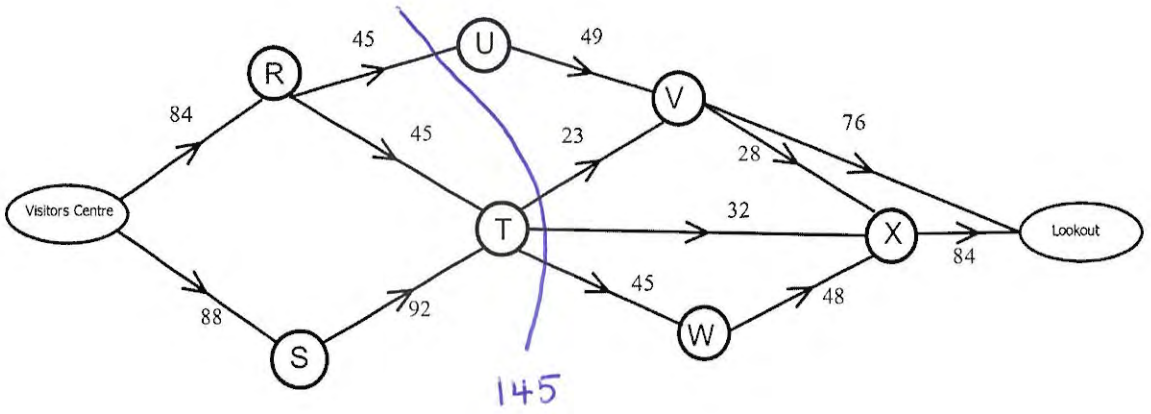
(d) Estimate how long it will take for the colony to reach 350 bacteria. **1**

$\approx$ 3.5 hours (3hrs 30min)

Question 44 (3 marks)

To reduce congestion at Tao National Park, one-way trails are used to direct visitors from the Visitors Centre to the Lookout.

The network flow diagram below shows the layout of the trails.



The trails pass through picnic areas which are labelled R through to X as shown above.

The capacity of each trail, in visitors per hour, is shown beside the trail.

All visitors return to the Visitors Centre along a single one-way trail which has a capacity of 160 visitors per hour. (This trail is not shown.)

(a) What is the maximum flow of visitors from the Visitors Centre to the Lookout? **2**

(1) Mark for correct cut (on diagram)

(1) Mark for max flow of 145

(b) What increase to the capacity of a single trail would allow the return trail to operate at its full capacity of 160? **1**

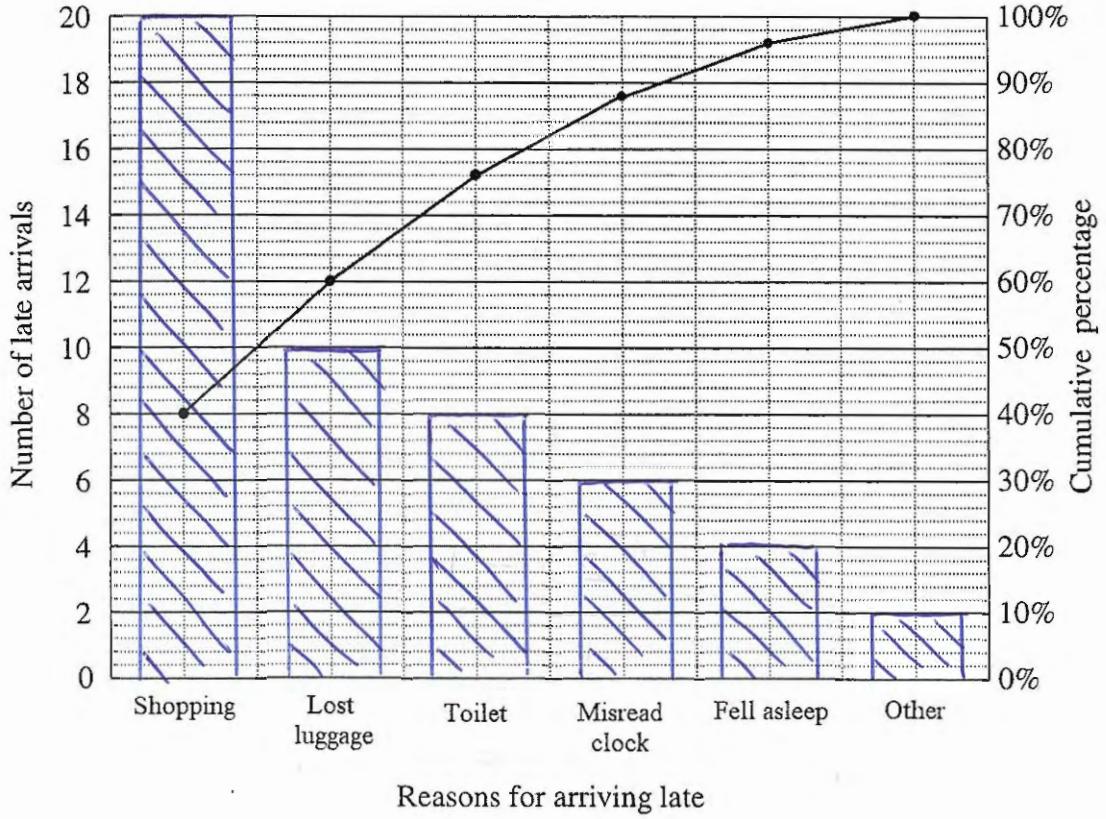
Increase TV by 15

Question 45 (2 marks)

An airport check-in gate collected data from 50 different passengers on reasons why passengers arrived late to the gate.

The data was to be displayed on the Pareto chart. The cumulative percentage has been provided.

Complete the Pareto chart by drawing the frequency histogram on the chart below. **2**



Reason	f	c.f	c.f%
Shopping	20	20	40%
Luggage	10	30	60%
Toilet	8	38	76%
Clock	6	44	88%
Asleep	4	48	96%
Other	2	50	100%

Please turn over

Question 46 (2 marks)

Bobby opens a savings bank account and deposits \$5000 into it. Interest is paid at r% per annum, compounded monthly.

What interest rate, r, correct to two decimal places, should Bobby require for his savings account if he intends to have doubled his money after 10 years? **2**

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

$10000 = 5000\left(1+\frac{r}{12}\right)^{10\times 12}$ – (1)

$2 = \left(1+\frac{r}{12}\right)^{120}$

$\sqrt[120]{2} = 1+\frac{r}{12}$

$\sqrt[120]{2}-1 = \frac{r}{12}$

$\therefore r = \left(\sqrt[120]{2}-1\right)\times 12$ – (1)

$\therefore r = 0.0695 \times 100$

$\therefore r = 6.95\%$

End of paper