Name: _____

MEREWETHER
HIGH SCHOOL

2022 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 – 10)

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

Section II – 85 marks (pages 11 – 36)

- Attempt Questions 16 – 40
- Allow about 2 hours and 5 minutes for this section

Section I

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

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

---

1 Which data about a virus could be classified as "categorical nominal"?

A. The number of people who contracted the virus

B. The place of origin of the virus

C. The rate at which the virus spread throughout the population

D. The length of time taken to control the spread of the virus

2 The stopping distance (S) in metres of a motor vehicle travelling at V km/h can be modelled by the equation: $S = B + R$ where B is the braking distance in metres and R is the drivers reaction distance in metres.

If $B = 0.01V^2$ and $R = 0.7V$ what is the stopping distance (metres) of a motor vehicle travelling with a speed of 60 km/h?

A. 38

B. 42.36

C. 54

D. 78

3 Matt travels in his car at a constant speed of 75 km/h from 8:00 am until 9:30 am.

If Matt's car has an average fuel consumption of 9.25 L/100 km, how many litres of fuel did the car use?

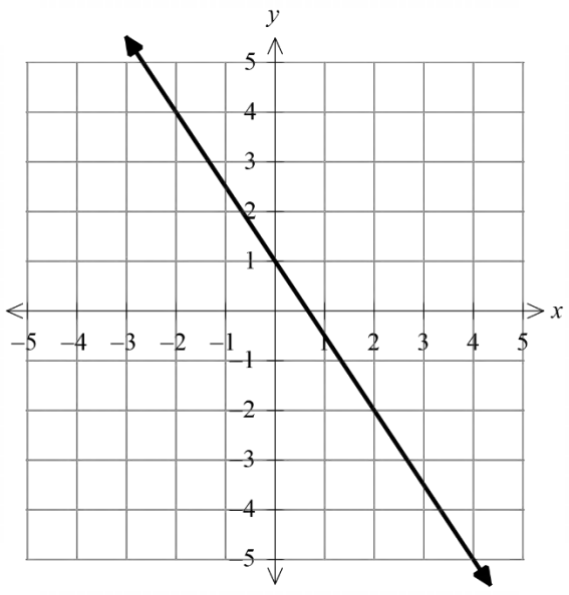
A. 9.8

B. 10.4

C. 10.8

D. 11.2

4 Which of the following equations would represent the linear relationship shown below



A. $y = x + 1$

B. $y = -x + 2$

C. $y = -\frac{3x}{2} + 1$

D. $y = \frac{3}{2}x + 1$

5 There are five more green marbles in a bag than there are yellow marbles.
All marbles in the bag are either green or yellow.

The probability of randomly selecting a green marble from the bag is $\frac{3}{5}$.

How many yellow marbles are in the bag?

A. 10

B. 15

C. 20

D. 25

6 Lisa borrows $450 000 from her bank, agreeing to pay the loan in equal monthly repayments.

The bank has an annual interest rate of 3.5% p.a. added monthly to the balance owing.

After her repayment, Lisa owes the bank $448 512.50

What is Lisa's monthly repayment?

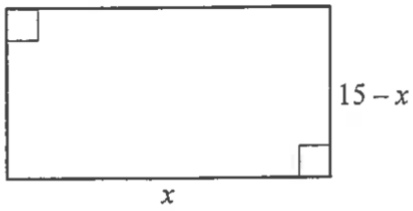
A. $2800

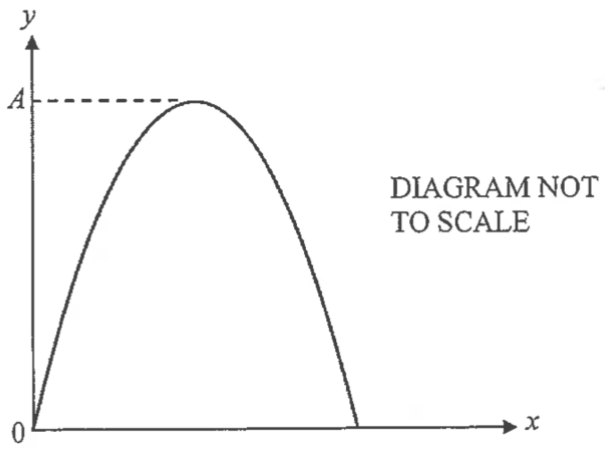
B. $2900

C. $2950

D. $3125

7 To determine the maximum area (A) of a rectangle with a perimeter of 30 metres, Lara sketched the following diagrams in her notebook.





The point A is at the turning point on the parabolic graph.

Lara correctly determined the maximum area of the rectangle (in square metres) by finding the value of A.

What is the value of the maximum area of the rectangle?

A. 48 m^2

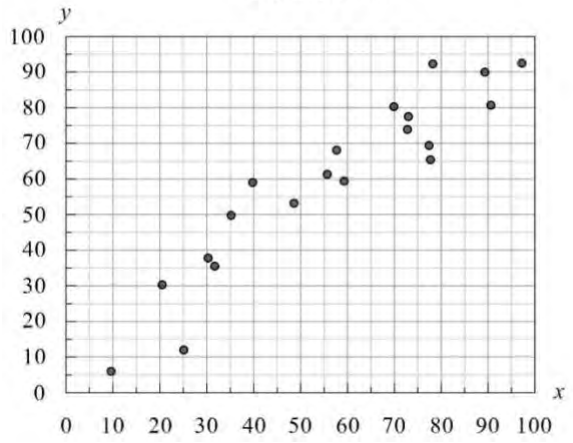
B. 50 m^2

C. 56.25 m^2

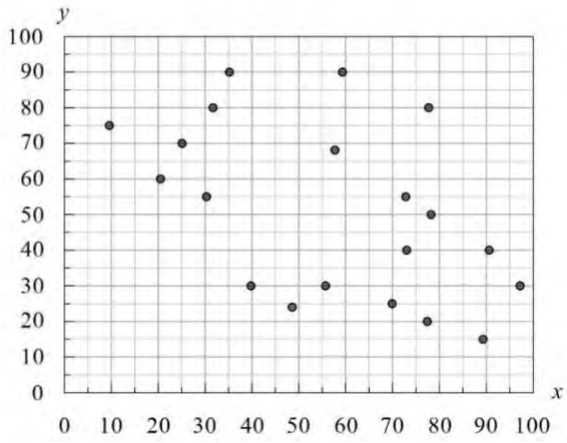
D. 100 m^2

8 Scatterplots for two sets of bivariate data are shown below.

Data Set M



Data Set N



Which of the following is the best estimate for the values of the two correlation coefficients?

A. Set M $r = -0.9$ Set N $r = 0.9$

B. Set M $r = -0.5$ Set N $r = 0.5$

C. Set M $r = 0.5$ Set N $r = -0.9$

D. Set M $r = 0.9$ Set N $r = -0.5$

9 Which of the following expresses V as the subject of the formula $u = \dfrac{\sqrt{mV}}{0.5r}$?

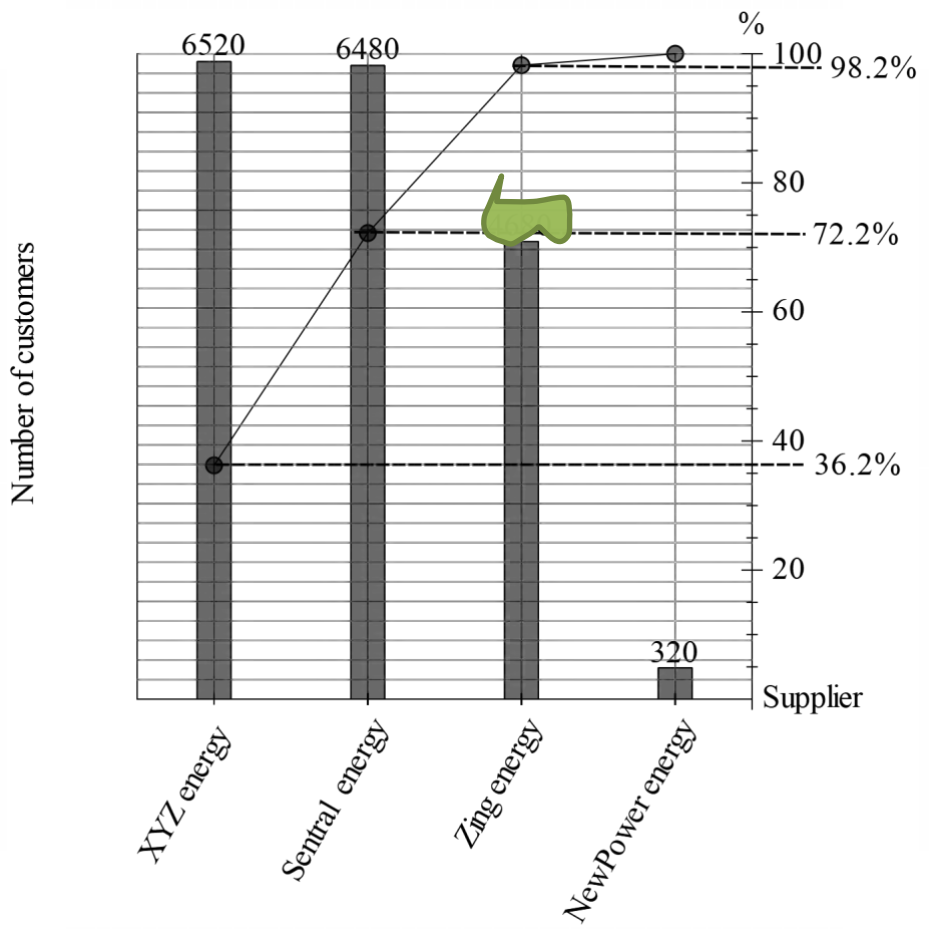
A. $V = \dfrac{5ru}{m}$

B. $V = \sqrt{\dfrac{5ru}{m}}$

C. $V = \dfrac{u^2r^2}{4m}$

D. $V = 4u^2r^2m$

10 The Pareto chart below shows data indicating the number of customers using various energy supply companies.



The number at the top of the Zing energy column has become smudged. Use the information in the graph to work out to which of the following values it is closest.

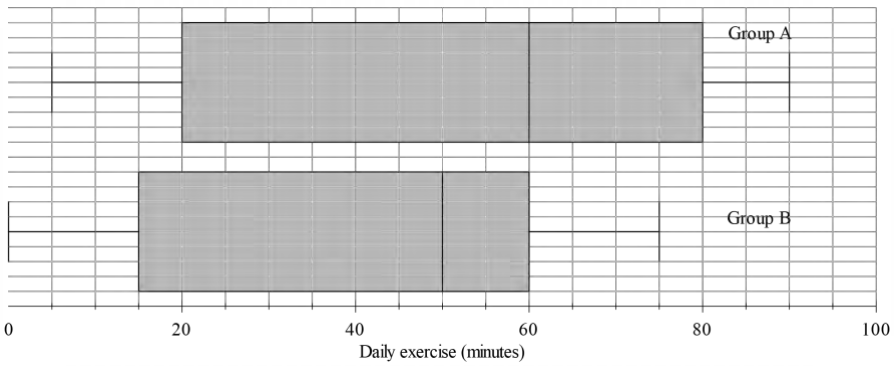
A. 4680

B. 4860

C. 5000

D. 5240

11 Employees in a workplace were divided into two groups for a fitness challenge over a week. Each employee tracked the number of minutes of exercise they completed each day and reported their daily average.



The parallel box-plots above show the data collected for the two groups.

There were 72 employees in Group A.

The same number of employees in each group recorded an average daily exercise time of more than 60 minutes.

How many employees in Group B recorded less than 15 minutes of average daily exercise time?

A. 15

B. 18

C. 36

D. 72

12 Which of the following expresses the number 2 871 501 in standard form correct to two significant figures?

A. 2.87×10^6

B. 2.9×10^6

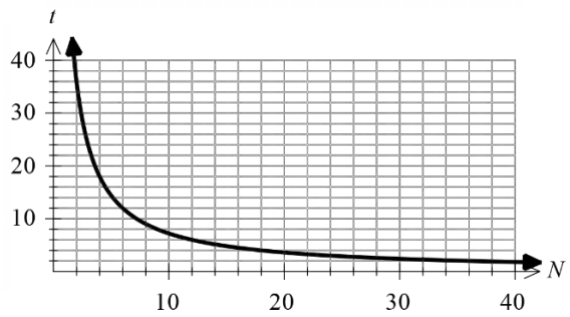
C. 28.7×10^5

D. 2.9×10^7

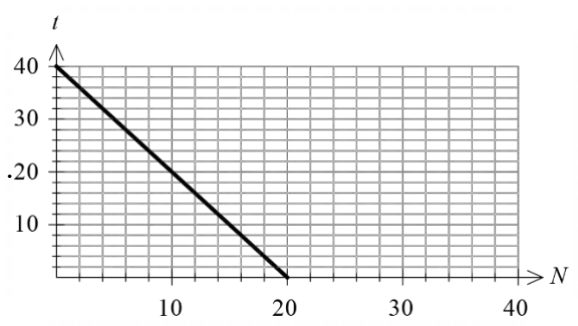
13 The time taken (t days) to paint a house varies inversely with the number of painters (N) on the job.

Which of the following best represents the relationship between number of painters and the time taken to paint a house, given that it takes 4 painters 18 days to paint the same house?

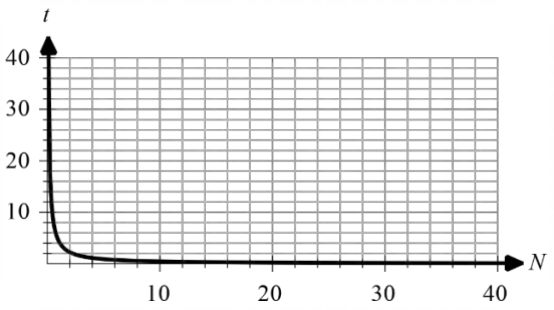
A.



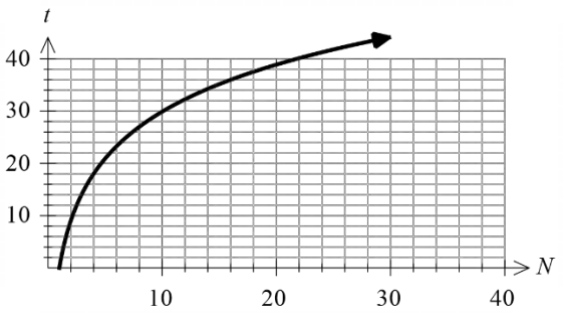
B



C.



D.



14 When it is 9:20 am local time in City M it is 2:20 pm local time in City N the same day.
Which of the following Universal Coordinated Times (UTC) could represent the cities?

	City M	*City N*
A.	+ 2	+ 7
B.	- 4	+ 9
C.	+ 2	- 3
D.	- 2	- 7

15 Hannah's mark in a test was 79%. The average mark for the test was 70%.
What might the z-score be for Hannah's mark?

A. -0.9

B. -0.2

C. 0

D. 0.9

MEREWETHER
HIGH SCHOOL

2022 Trial HSC Examination

Mathematics Standard 2

Section II – Answer Booklet

Student Name: _____

85 marks
Attempt Question 16 – 40
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 (3 marks)

3

At a rail station, a train is scheduled to arrive at 9:00 am each morning.

The following data shows times the train arrived on seven consecutive days.

9:03 am, 9:04 am. 9:02 am, 9:11 am, 9:02 am, 9:03 am, 9:01 am

With the aid of calculations, determine whether the arrival time of 9:11 am could be considered an outlier for the presented data.

……

……

……

……

……

……

……

Question 17 (2 marks)

The width of a driveway was recorded as 4.75 m.

(a) What is the absolute error of this measurement? **1**

……

……

(b) What is the upper limit of this measurement? **1**

……

……

Question 18 (4 marks)

The table shows the income tax rates for the 2021 – 2022 financial year.

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

Michelle earned a gross annual salary of $92 500. She has allowable tax deductions of $1200 for home office expenses. Michelle must also pay a Medicare Levy of 2% of her taxable income. Michelle's employer has deducted $1850 per month from Michelle's pay in Pay As You Go (PAYG) tax.

Determine if Michelle will receive a tax refund or will have to pay a tax bill.

Show calculations, including the amount of the refund or bill. **4**

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Question 19 (2 marks)

A person owns 286 shares with a market value of $11.05 per share. The total dividend received for these shares is $640.90.

Calculate the percentage dividend yield, correct to 1 decimal place. **2**

……

……

……

……

……

……

……

……

Question 20 (2 marks)

Solve the equation $4x - \frac{2x+1}{3} = 5$ **2**

……

……

……

……

……

……

……

……

……

Question 21 (2 marks)

A researcher used the capture-recapture technique to estimate the number of fish in a lake. He captured, tagged and released 36 fish. Later he caught 25 at random and found that 4 had been tagged. What is the estimate for the total fish in the lake? **2**

……

……

……

……

……

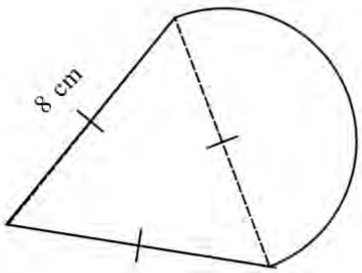
……

……

Question 22 (2 marks)

Calculate the perimeter of this shape consisting of a semicircle and an equilateral triangle, correct to 1 decimal place.

2



NOT TO SCALE

……

……

……

……

……

……

Question 23 (3 marks)

The diagram below shows the cross-section PQRS of a piece of foam (of thickness 4 cm) to be cut from a rectangular piece and used for packing.

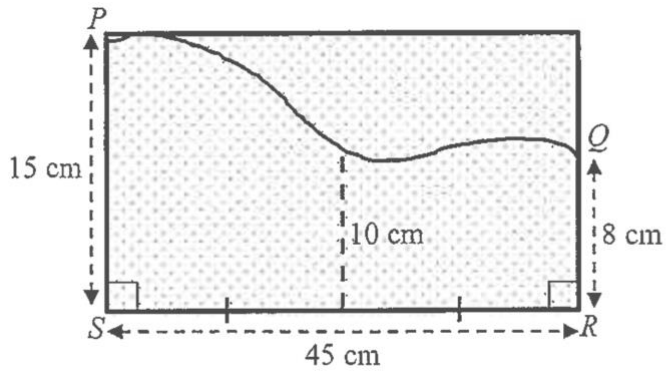


DIAGRAM NOT TO SCALE

By using two applications of the Trapezoidal Rule in your working, calculate the volume, in cubic centimetres, of the piece of foam to be used for packing. **3**

……

……

……

……

……

……

……

……

……

Question 24 (4 marks)

A square based pyramid with base edges of length L cm and perpendicular height h cm, is shown.

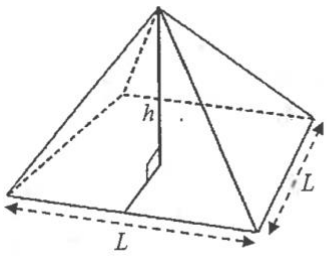


DIAGRAM NOT TO SCALE

The formulas for the volume (V) and surface area (A) of the pyramid in terms of L and h can be given by:

$$V = \frac{L^2 h}{3} \quad \text{and} \quad A = L^2 + L\sqrt{L^2 + 4h^2}$$

(a) The pyramid has a surface area of 5184 cm^2 and its base area is 2304 cm^2. **3**

Show that the perpendicular height of the pyramid is 18 cm.

……

……

……

……

……

……

……

(b) What is the volume of this pyramid? **1**

……

……

……

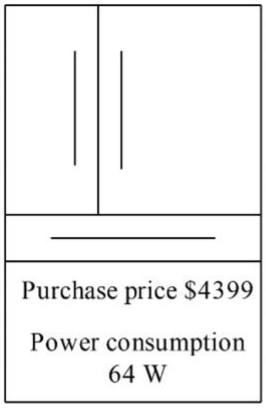
……

……

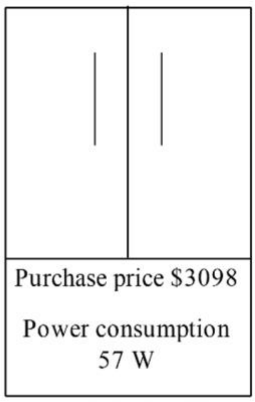
Question 25 (4 marks)

Annika needs to buy a new refrigerator. She has found two brands with all the features she requires. Their prices and power consumption are shown in the following diagrams.

Option A



Option B



The average cost of electricity is 26c/kWh.

Annika's refrigerator will be switched on 24 hours per day, every day.

(a) If Annika chooses Option A, her annual electricity cost for the refrigerator will be $145.77. **1**

Calculate Annika's annual electricity costs if she chooses Option B.

……

……

……

……

……

……

Question 25 continues on page 19

Question 25 (continued)

(b) Annika has been offered the following finance deals for the two refrigerators:

Option A	**Option B**
Monthly repayment = $102.27	Monthly repayment = $78.59
Term = 4 years	Term = 5 years

Assuming electricity costs remain the same, the total cost to purchase Option A over the 4 year finance term, including electricity costs is $5492.04. **1**

Calculate the total costs to purchase and run the refrigerator on Option B.

……

……

……

……

……

……

(c) The cost of Option A over a 5 year period (to allow comparison), would include one more year of electricity costs as shown here: **2**

$$\$5492.04 + \$145.77 = \$5637.81$$

By how much would the monthly repayments for Option A need to decrease so that its total 5 year cost is the same as for Option B?

……

……

……

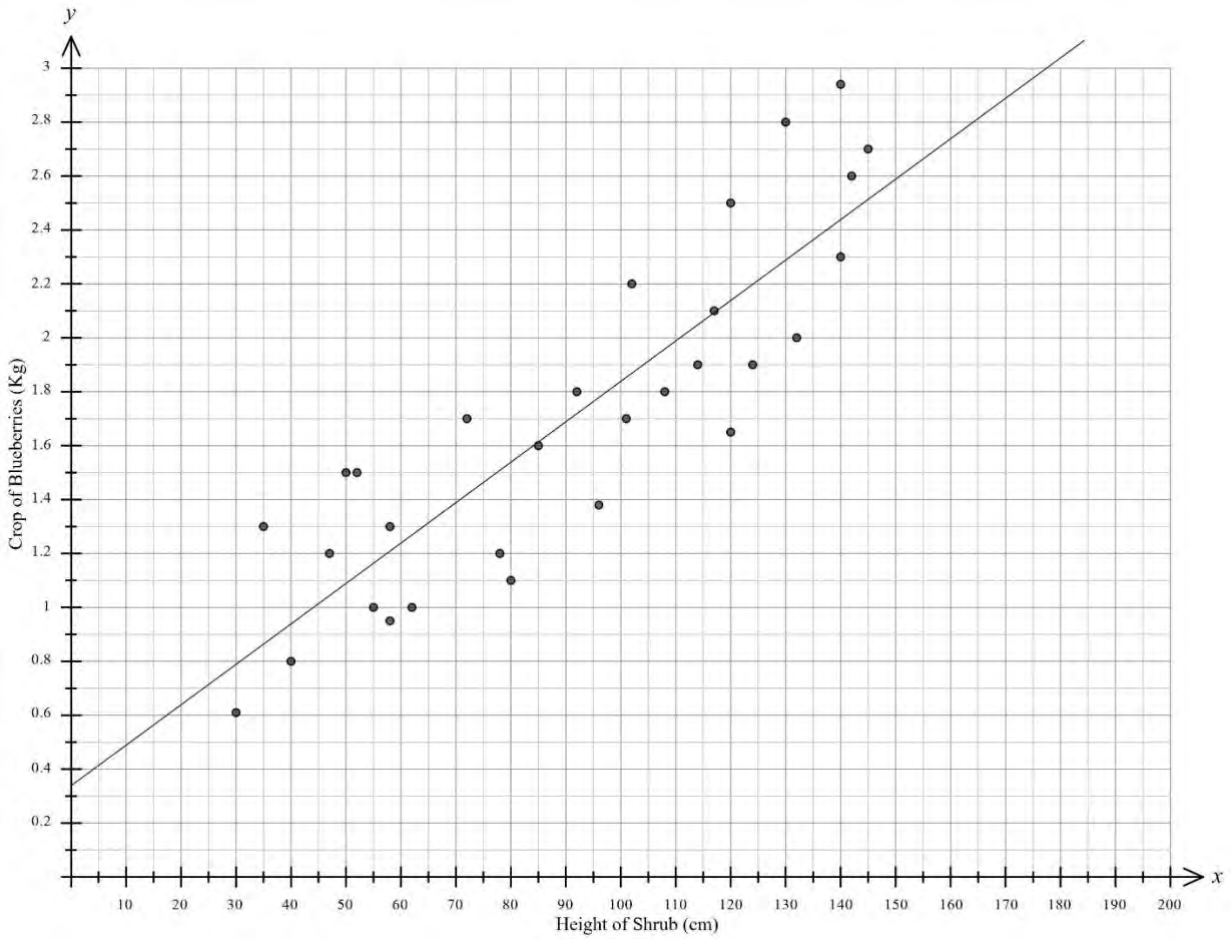
……

……

……

Question 26 (2 marks)

A blueberry farmer records the crop size in kilograms from a range of blueberry shrubs on his trial patch. The data includes shrubs which have just begun to produce berries right through to fully mature plants.



Some statistical measures for the data in the Scatterplot are shown below.

Correlation Coefficient (r)= 0.874

Statistical Measure	Height of Shrub (x)	Crop Size (y)
Mean	90.83	1.70
Standard Deviation	35.42	0.61

Question 26 continues on page 21

Question 26 (continued)

An estimate to the gradient of the least-squares regression line can be found using the formula:

$$\text{gradient } = r \times \frac{\text{standard deviation of y scores}}{\text{standard deviation of x scores}} = r\,\frac{\sigma_y}{\sigma_x}.$$

Given that the least-squares regression line crosses the vertical axis at 0.339, find the equation of the regression line and hence predict the crop (in kg) from a 100 cm high shrub. **2**

……

……

……

……

……

……

……

……

……

……

Question 27 (4 marks)

At Mike's Milkshakes, the ratio of milk to ice cream to chocolate syrup in a chocolate milkshake is 35:10:3.

There is 525 millilitres of milk in Mike's regular sized milkshake.

(a) How many millilitres of chocolate syrup are needed to make one of Mike's regular chocolate milkshakes? **1**

……

……

……

……

……

(b) Mike has 8 litres of milk, 2 litres of ice cream and 1 litre of chocolate syrup in stock.

What is the maximum number of regular sized milkshakes he can sell before more supplies arrive? **3**

……

……

……

……

……

……

……

……

……

Question 28 (5 marks)

After 5 years, the value of a piece of machinery has reduced to $25 000.

The original value of the machinery when purchased new was $80 000.

(a) If the straight-line method was used to depreciate the value of the machinery, what was the annual loss in value as a percentage of the purchase price. **2**

……

……

……

……

(b) Show that if the declining balance method was used to depreciate the machinery, the annual loss in value as a percentage of the purchase price was 20.76%. **3**

……

……

……

……

……

……

……

……

……

Question 29 (4 marks)

In a particular game of chance, two dice are thrown. If both dice show a number greater than 4 then the person wins $2.50. If only one die shows a number greater than 4 the person wins $1.00. If both dice show numbers of 4 or less then the person loses $2.50.
If the person played the game 10 times, calculate their expected winnings or loss.

With the aid of a probability tree describe this scenario and use appropriate calculations to find the person's expected winnings or loss. **4**

……

……

……

……

……

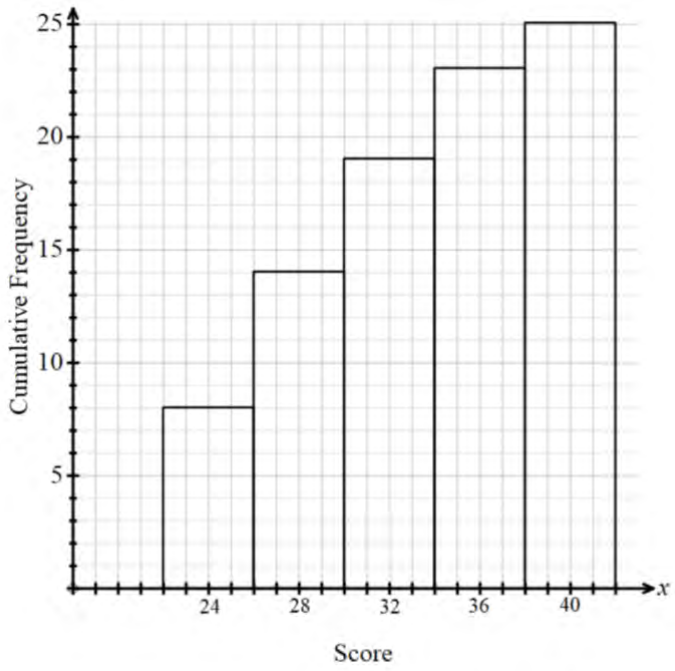
……

……

Questions 16 – 29 (43 marks

Question 30 (4 marks)

Sam recorded the scores of 25 footballers who each took 50 shots at goal.
The cumulative frequency graph displays the results.



(a) Use the graph to estimate the median number of goals scored. **2**

……

(b) Calculate the mean number of goals scored. (Answer to 1 decimal place.) **1**

……

……

(c) Estimate the percentage of players that scored 37 goals or more? **1**

……

……

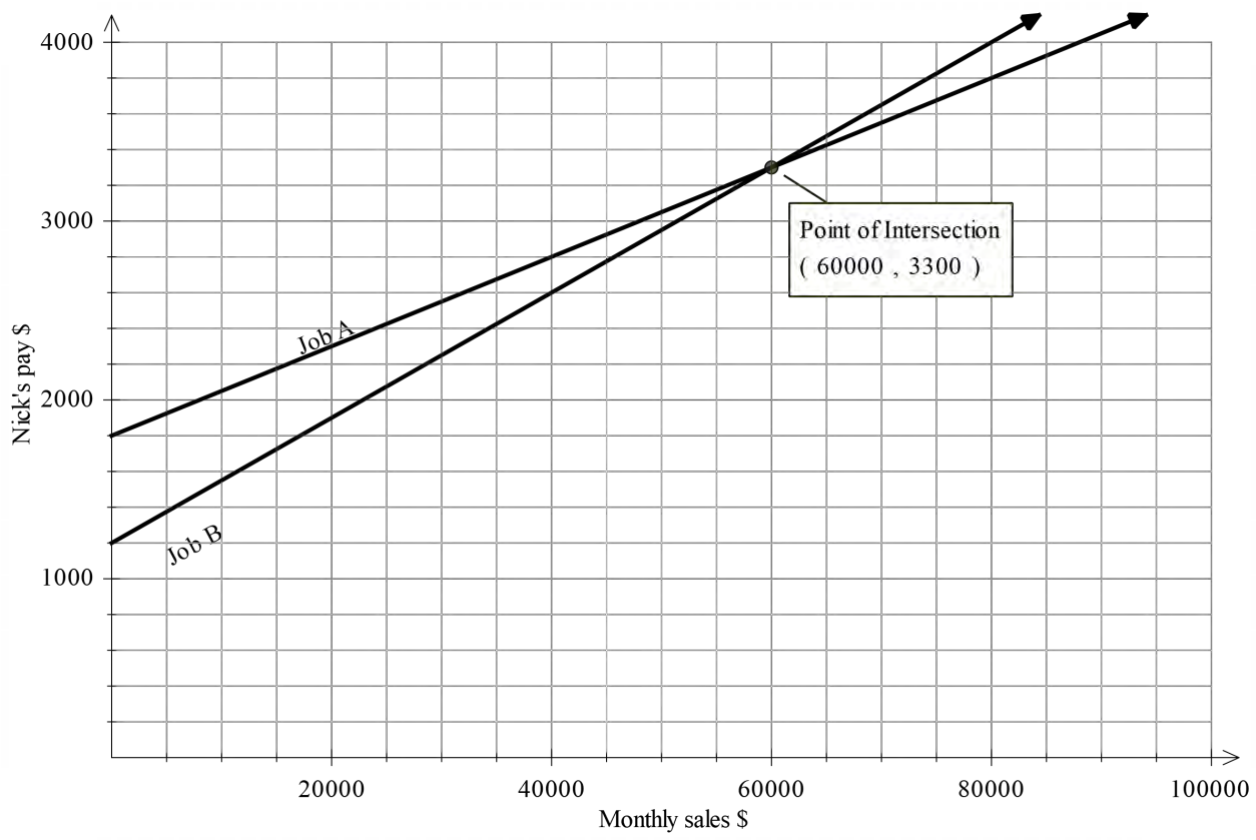
……

Question 31 (3 marks)

Nick was offered two full-time sales positions. Both employers offered:

- a monthly retainer
- a commission on sales

The graph below shows the different pay rates for Job A and Job B.



(a) Calculate the difference in retainers between Job A and Job B. **1**

……

……

……

……

……

Question 31 continues on page 27

Question 31 (continued)

(b) Calculate the percentage commission Nick would receive if he selected Job B. **2**

……

……

……

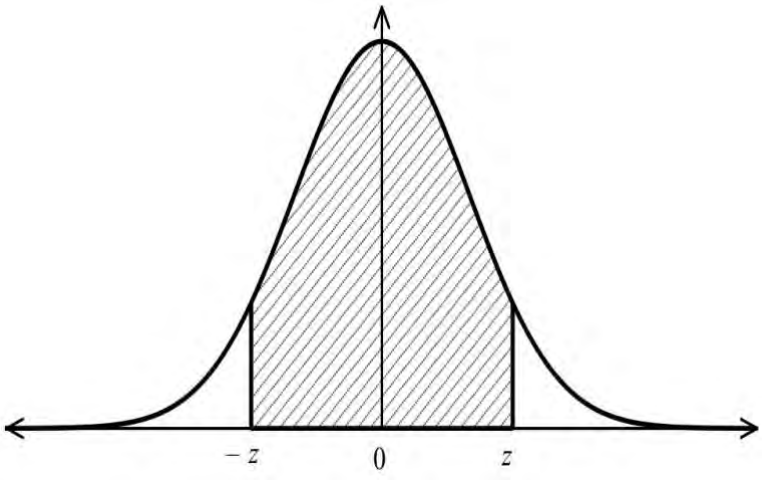
……

……

……

Question 32 (4 marks)

A random variable is normally distributed with mean 0 and standard deviation 1.
The table gives the probability that this random variable lies between -z and z for different values of z.



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

The probability values given in the table for different values of z are represented by the shaded area in the diagram beside the table.

(a) Using the table, determine the probability that this random variable will lie between $z = -0.50$ and $z = 1.25$. **2**

……

……

……

……

(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. By first calculating z-scores, use the table above to determine how many of the residents have an arm span greater than 1.5 metres. **2**

……

……

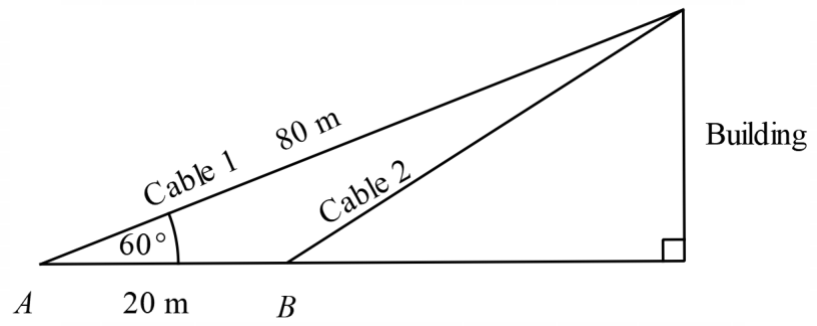
……

……

……

Question 33 (4 marks)

A support cable, 80 metres long, has been secured at an angle of elevation of 60° from point *A* to the top of a building. A second support cable will be secured from point *B*, 20 metres closer to the base of the building than point *A*. This information is shown in the diagram.



(a) Show that the length of the second cable is approximately 72 metres. **2**

……

……

……

……

(b) Given that the height of the building is 69.2 metres, calculate the distance between point *A* and the base of the building. **2**

……

……

……

……

……

……

……

Question 34 (4 marks)

Cases of a new strain of a virus have been tracked over the past few months. Data analysts determined that they could forecast the number of cases for a particular day using the formula:

$$N = 560 \times 1.1^{d}$$

where N is the number of cases and d is the number of days since the day this formula was developed.

(a) Complete the table of values using the formula. **1**

d	5	10	15	20
N	902	1452		3767

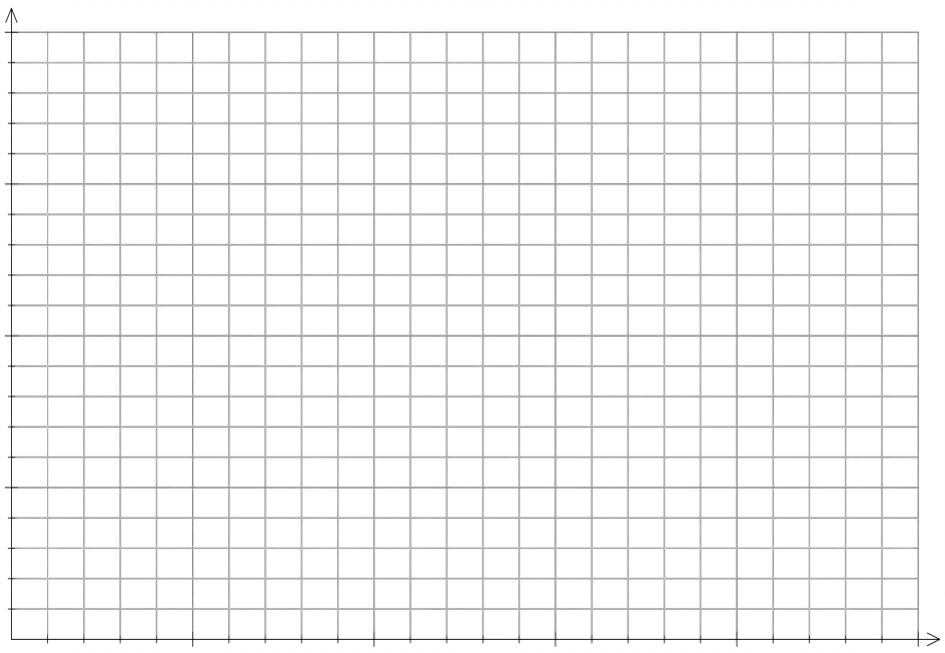
……

……

(b) What will the vertical intercept be when the relationship between d and N is graphed? **1**

……

(c) Graph the relationship on the grid provided. **2**



Question 35 (3 marks)

Harrison received a lump sum from his superannuation fund when he retired. He deposited some of this into a new bank account, earning 2% p.a. compounded annually.

The table below shows present value interest factors for an annuity of \$1 for various interest rates (r) and numbers of periods (N).

Number of interest periods (N)	Interest rate per period as a decimal r			
	0.01	0.015	0.02	0.025
5	4.8534	4.7826	4.7135	4.6458
10	9.4713	9.2222	8.9826	8.7521
15	13.8651	13.3432	12.8493	12.3814
20	18.0456	17.1686	16.3514	15.5892

(a) For the first 5 years following retirement, Harrison was able to withdraw \$36 000 at the end of each year to pay his remaining mortgage and living expenses. **1**

Show that the present value of a \$36 000 annuity for 5 years is \$169 686.

……

……

……

……

(b) Harrison wants to be able to withdraw \$20 000 per year for ten years, starting 6 years after his retirement. **2**

If the amount he deposited when he opened the account was \$340 000, would he be able to make these planned withdrawals over the ten years? Justify your answer with calculations.

……

……

……

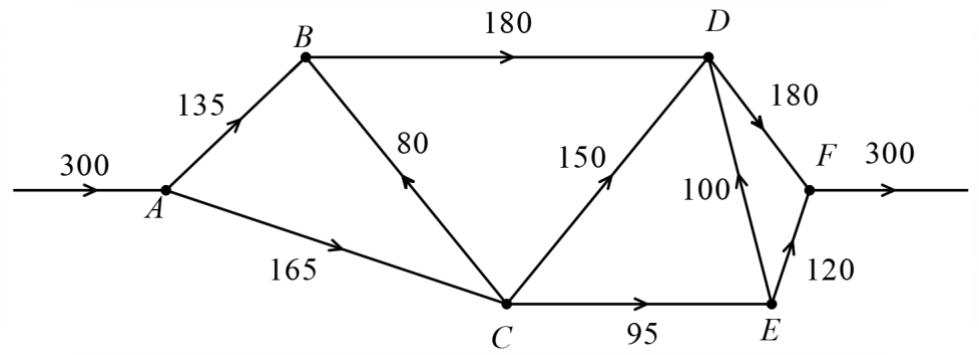
……

……

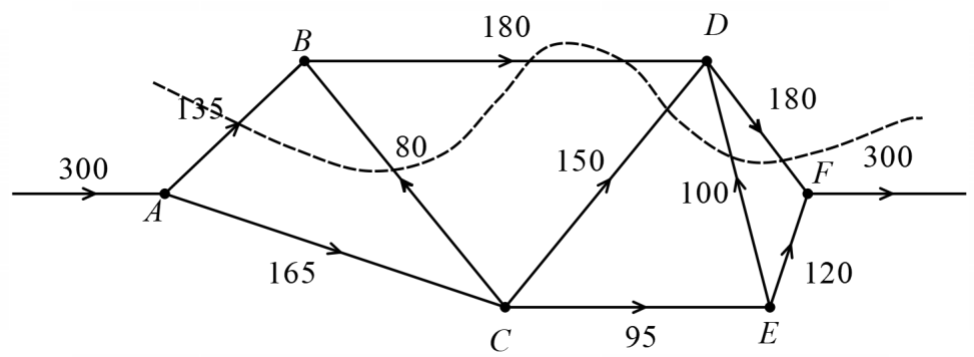
……

Question 36 (3 marks)

The network diagram below shows a series of water pipes and sprinklers in a section of an underground lawn watering system. The vertices *A, B, C, D, E* and *F* represent the sprinklers. The edges represent the underground water pipes which connect the sprinklers. The numbers on the edges represent the maximum capacity (in litres per hour) of the water pipes.



(a) In the diagram below, a non-valid cut has been marked on the network. Explain why it is not a valid cut. **1**



……

……

……

(b) Determine the maximum flow of the network. **2**

……

……

……

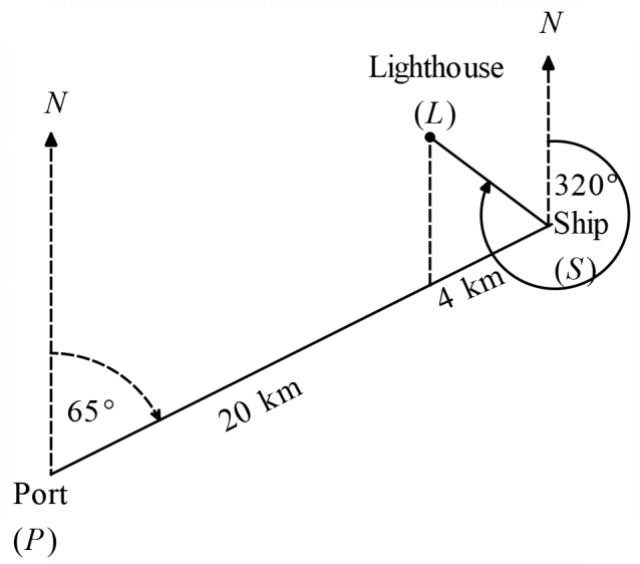
……

……

Question 37 (4 marks)

A ship leaves port travelling on a bearing of 065°. After travelling 20 kilometres the ship is due south of a lighthouse.

The ship continues on this bearing for a further 4 kilometres, then measures the bearing to the lighthouse to be 320°.



(a) Show that $\angle PSL$ is 75°. **2**

……

……

……

……

(b) Calculate the distance from the ship to the lighthouse at this time. **2**

……

……

……

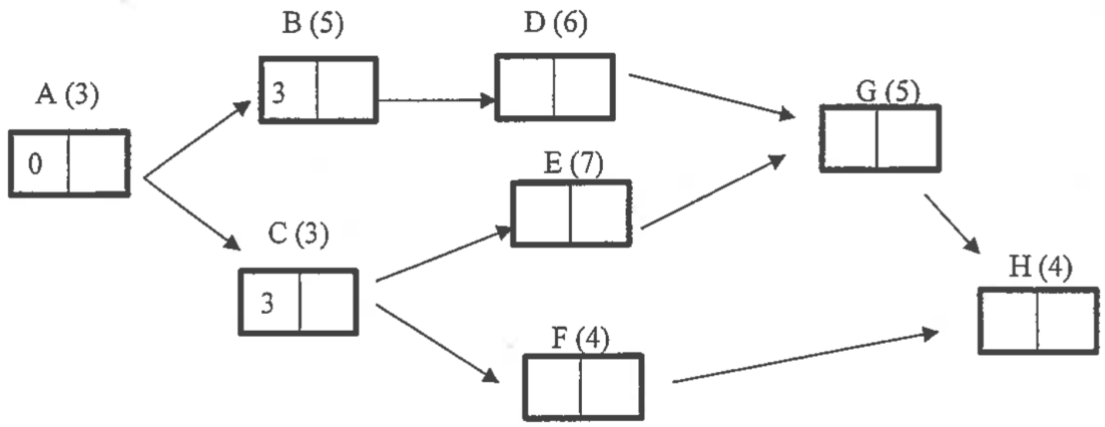
……

Question 38 (5 marks)

There are 8 stages (*A – H*) in the production of heavy-duty machines at a manufacturing plant which operates 7 days a week.

The times in days needed for the completion of each stage are indicated on the partly completed network diagram below, with their respective earliest start times (*EST*) and latest start times (*LST*) shown as :

EST	LST



(a) Complete the above network diagram by inserting the missing EST and LST for each stage. **2**

……

(b) List the critical path in the production of the machines to be completed. **1**

……

(c) What is the minimum time required to complete the production of these machines? **1**

……

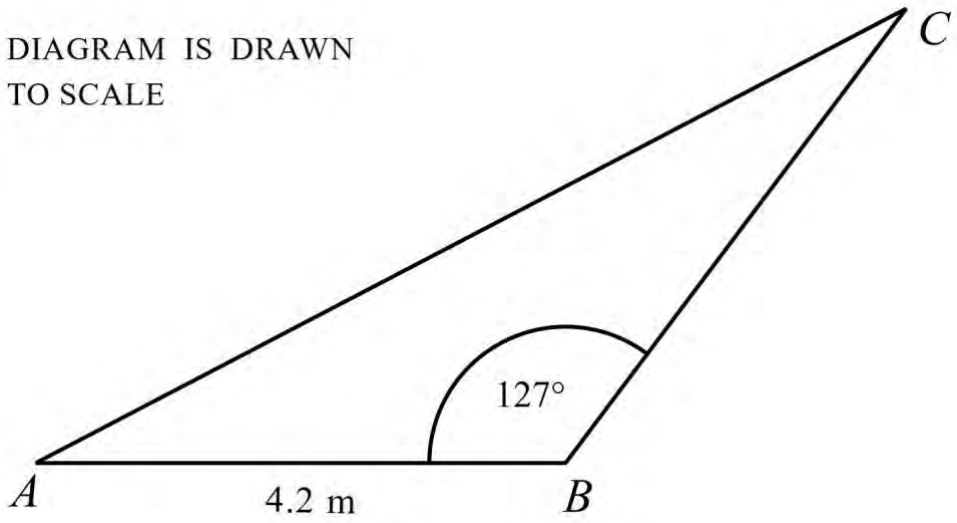
……

(d) Which activity has the greatest float time? **1**

……

Question 39 (4 marks)

This scale drawing represents a triangular section of a garden.



(a) Measure the length of AB in the diagram and use this to show that the scale factor is 1:60. **1**

……

……

……

……

(b) Calculate the area of the actual triangular garden bed.

Give your answer correct to the nearest tenth of a square metre. **3**

……

……

……

……

……

……

……

Question 40 (4 marks)

Connor weighs 72 kilograms. He consumed 4 full-strength beers and 2 cans of pre-mixed spirits between 8:00 pm Tuesday and 12:30 am Wednesday. He then stopped drinking alcohol.

	
Full strength beer 375 ml 4.8% 1.4 standard drinks	Pre-mixed spirits 375 ml 5.0% 1.5 standard drinks

Using the formulas below, calculate the time on Wednesday when Connor's blood alcohol content (BAC) should return to zero.

$$\text{BAC}_{\text{MALE}} = \frac{10N - 7.5H}{6.8M}$$

Time for BAC to return to zero $= \frac{BAC}{0.015}$ hours, **4**

where N is the number of standard drinks and H is the number of hours drinking.

……

……

……

……

……

……

……

……

……

……

……

End of paper.

Section II extra writing space

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

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Name: Anne Sivs

MEREWETHER
HIGH SCHOOL

2022 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 – 10)

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

Section II – 85 marks (pages 11 – 36)

- Attempt Questions 16 – 40
- Allow about 2 hours and 5 minutes for this section

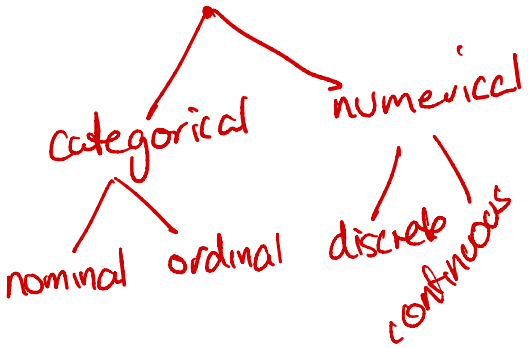
Section I

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

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

---

1 Which data about a virus could be classified as "categorical nominal"?



A. The number of people who contracted the virus

B. The place of origin of the virus

C. The rate at which the virus spread throughout the population

D. The length of time taken to control the spread of the virus

2 The stopping distance (S) in metres of a motor vehicle travelling at V km/h can be modelled by the equation: $S = B + R$ where B is the braking distance in metres and R is the drivers reaction distance in metres.

If $B = 0.01V^2$ and $R = 0.7V$ what is the stopping distance (metres) of a motor vehicle travelling with a speed of 60 km/h?

$S = 0.01 \times 60^2 + 0.7 \times 60$
$= 78$

A. 38

B. 42.36

C. 54

D. 78

3 Matt travels in his car at a constant speed of 75 km/h from 8:00 am until 9:30 am.

If Matt's car has an average fuel consumption of 9.25 L/100 km, how many litres of fuel did the car use?

A. 9.8

B. 10.4

C. 10.8

D. 11.2

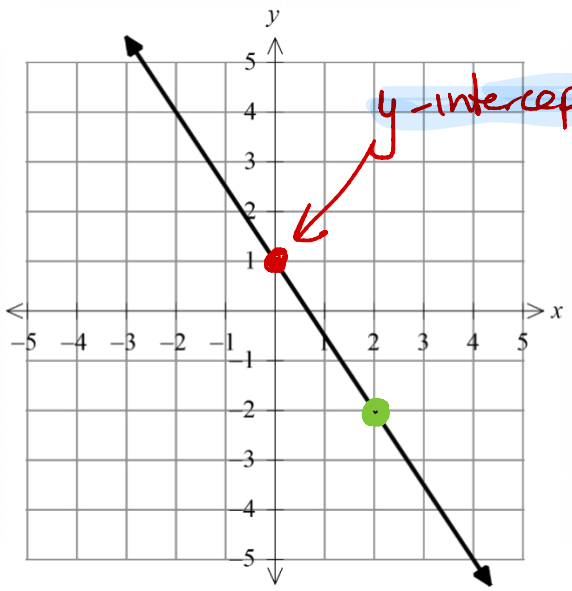
75km/hr for $1\frac{1}{2}$ hrs

Distance travelled $= 75 \times 1.5$
$= 112.5$

1 km = 0.0925 L

$112.5 \text{ km} = 0.0925 \times 112.5$
$= 10.41$

4 Which of the following equations would represent the linear relationship shown below



y-intercept $(x=0)$

$y = mx + b$
$b = 1$

$m = \frac{\text{rise}}{\text{run}}$
$= -\frac{3}{2}$

A. $y = x + 1$

B. $y = -x + 2$

C. $y = -\frac{3x}{2} + 1$

D. $y = \frac{3}{2}x + 1$

$x+5$ x

5 There are five more green marbles in a bag than there are yellow marbles.

All marbles in the bag are either green or yellow.

The probability of randomly selecting a green marble from the bag is $\frac{3}{5}$.

How many yellow marbles are in the bag?

Total marbles $= x+5+x$
$= 2x+5$

$\frac{x+5}{2x+5} = \frac{3}{5}$

$5(x+5) = 3(2x+5)$
$5x+25 = 6x+15$
$25 = x+15$
$x = 10$

A. 10

B. 15

C. 20

D. 25

6 Lisa borrows $450 000 from her bank, agreeing to pay the loan in equal monthly repayments.

The bank has an annual interest rate of 3.5% p.a. added monthly to the balance owing.

After her repayment, Lisa owes the bank $448 512.50

What is Lisa's monthly repayment?

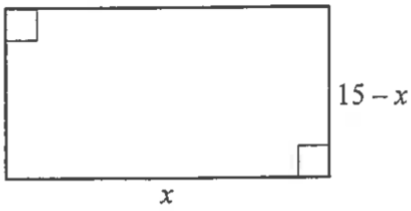
A. $2800

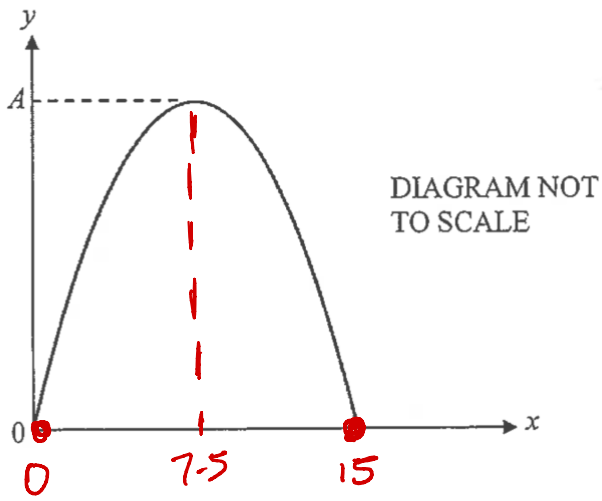
B. $2900

C. $2950

D. $3125

7 To determine the maximum area (A) of a rectangle with a perimeter of 30 metres, Lara sketched the following diagrams in her notebook.





$y = x(15 - x)$

roots when $y = 0$

$x = 0$

$x = 15$

axis of symmetry

$x = \frac{0 + 15}{2}$

$= 7.5$

The point A is at the turning point on the parabolic graph.

Lara correctly determined the maximum area of the rectangle (in square metres) by finding the value of A.

What is the value of the maximum area of the rectangle?

$y = 7.5(15 - 7.5)$

$= 56.25$

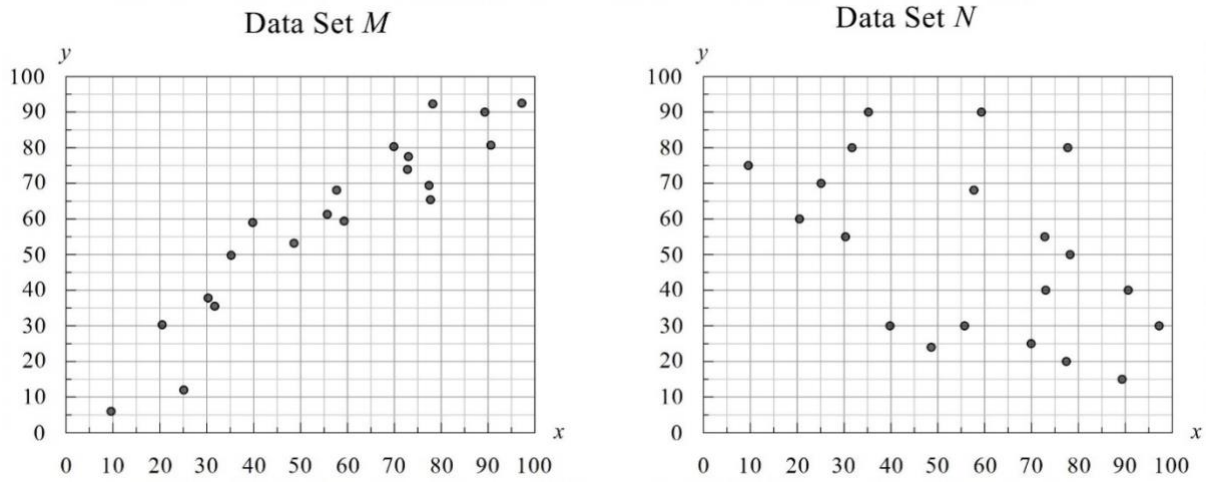
A. 48 m^2

B. 50 m^2

C. 56.25 m^2

D. 100 m^2

8 Scatterplots for two sets of bivariate data are shown below.



Which of the following is the best estimate for the values of the two correlation coefficients?

A. Set M $r = -0.9$ Set N $r = 0.9$

B. Set M $r = -0.5$ Set N $r = 0.5$

C. Set M $r = 0.5$ Set N $r = -0.9$

D. Set M $r = 0.9$ Set N $r = -0.5$

9 Which of the following expresses V as the subject of the formula $u = \dfrac{\sqrt{mV}}{0.5r}$?

A. $V = \dfrac{5ru}{m}$

B. $V = \sqrt{\dfrac{5ru}{m}}$

C. $V = \dfrac{u^2r^2}{4m}$

D. $V = 4u^2r^2m$

$u \times 0.5 \times r = \sqrt{mV}$

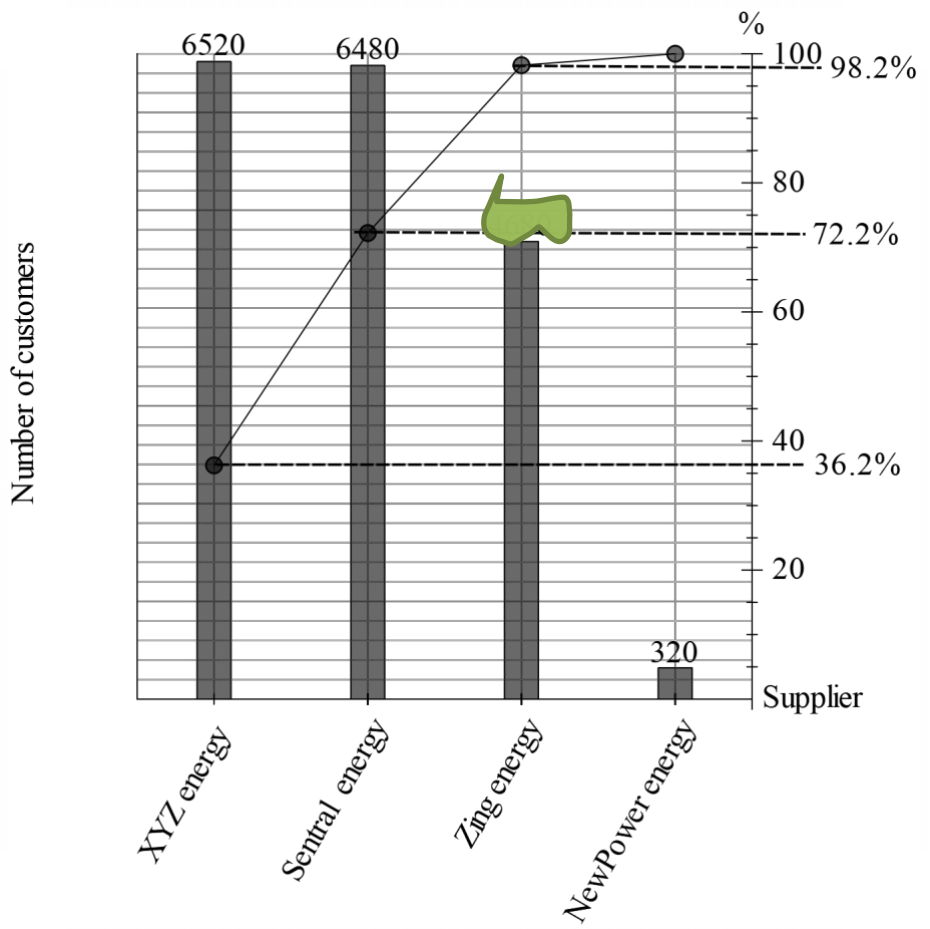
$\frac{ur}{2} = \sqrt{mV}$

$\left(\frac{ur}{2}\right)^2 = mV$

$\frac{u^2r^2}{4} = mV$

$V = \frac{u^2r^2}{4m}$

10 The Pareto chart below shows data indicating the number of customers using various energy supply companies.



The number at the top of the Zing energy column has become smudged. Use the information in the graph to work out to which of the following values it is closest.

A. 4680

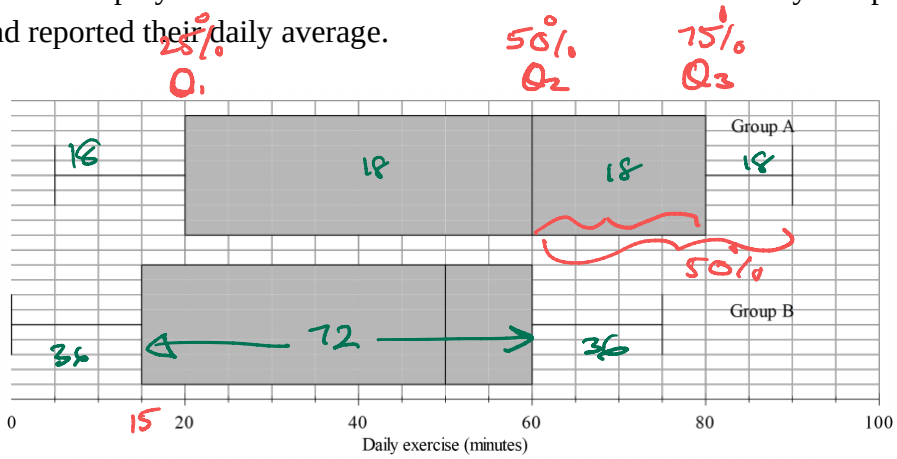
B. 4860

C. 5000

D. 5240

0.722 × 6480 = 4678.6

11 Employees in a workplace were divided into two groups for a fitness challenge over a week. Each employee tracked the number of minutes of exercise they completed each day and reported their daily average.



The parallel box-plots above show the data collected for the two groups.

There were 72 employees in Group A.

The same number of employees in each group recorded an average daily exercise time of more than 60 minutes.

How many employees in Group B recorded less than 15 minutes of average daily exercise time?

A. 15

B. 18

C. 36

D. 72

12 Which of the following expresses the number 2 871 501 in standard form correct to two significant figures?

A. 2.87×10^6

B. 2.9×10^6

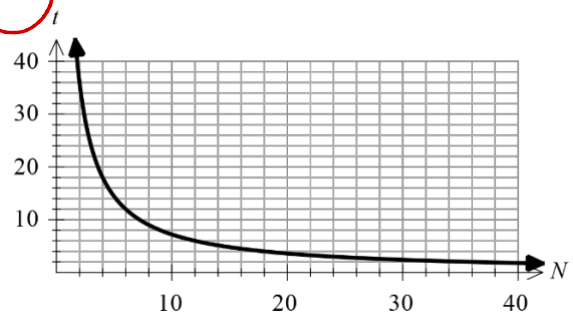
C. 28.7×10^5

D. 2.9×10^7

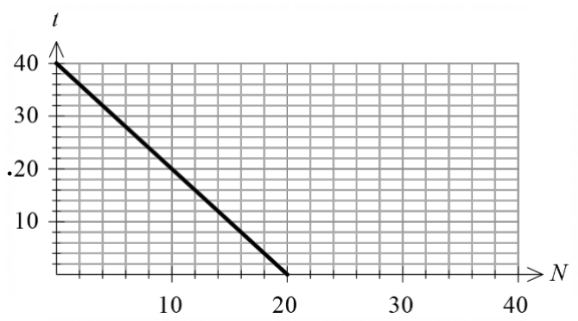
13 The time taken (t days) to paint a house varies inversely with the number of painters (N) on the job.

Which of the following best represents the relationship between number of painters and the time taken to paint a house, given that it takes 4 painters 18 days to paint the same house?

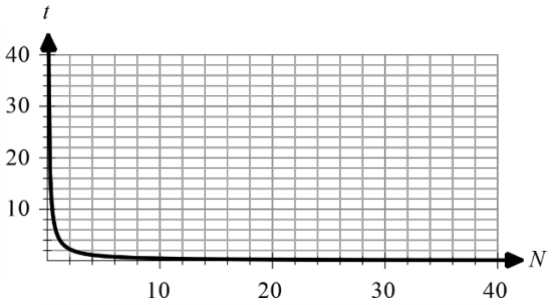
A.



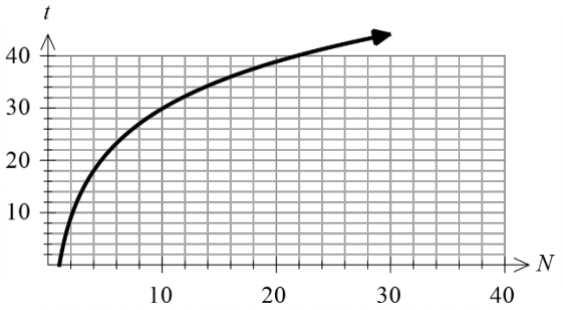
B



C.



D.



14 When it is 9:20 am local time in City M it is 2:20 pm local time in City N the same day.

Which of the following Universal Coordinated Times (UTC) could represent the cities?

	City M	*City N*
A.	+ 2	+ 7
B.	- 4	+ 9
C.	+ 2	- 3
D.	- 2	- 7

mark above average ∴ z-score > 0

15 Hannah's mark in a test was 79%. The average mark for the test was 70%.
What might the z-score be for Hannah's mark?

average z-score = 0

A. -0.9

B. -0.2

C. 0

D. 0.9

MEREWETHER
HIGH SCHOOL

2022 Trial HSC Examination

Mathematics Standard 2

Section II – Answer Booklet

Student Name: _____

85 marks
Attempt Question 16 – 40
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 (3 marks)

3

At a rail station, a train is scheduled to arrive at 9:00 am each morning.

The following data shows times the train arrived on seven consecutive days.

9:03 am, 9:04 am. 9:02 am, 9:11 am, 9:02 am, 9:03 am, 9:01 am

With the aid of calculations, determine whether the arrival time of 9:11 am could be considered an outlier for the presented data.

Q_1 Q_2 Q_3

9:01 9:02 9:02 9:03 9:03 9:04 9:11

IQR = 2mins Outlier = $Q_3 + \frac{3}{2}$ IQR

$= 9:04 + \frac{3}{2} \times 2$

$= 9:04 + 3$

$= 9:07$

∴ 9:11 is an outlier

555 (1)
calc (1)
outlier (1)

Question 17 (2 marks)

The width of a driveway was recorded as 4.75 m.

(a) What is the absolute error of this measurement? **1**

$\pm \frac{0.01}{2} = \pm 0.005$

(b) What is the upper limit of this measurement? **1**

$4.75 + 0.005 = 4.755$

Question 18 (4 marks)

The table shows the income tax rates for the 2021 – 2022 financial year.

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

Michelle earned a gross annual salary of $92 500. She has allowable tax deductions of $1200 for home office expenses. Michelle must also pay a Medicare Levy of 2% of her taxable income. Michelle's employer has deducted $1850 per month from Michelle's pay in Pay As You Go (PAYG) tax.

Determine if Michelle will receive a tax refund or will have to pay a tax bill.

Show calculations, including the amount of the refund or bill. **4**

(1) TI: 92500 − 1200 = 91300

(1) ML = 91300 × 0.02 = $1826

(1) Tax = $5092 + (91300 − 45000) × 0.325

(1) TTP = 5092 + 15047.5 + 1826

= $21965.5

TB = 21965.5 − 22 200 = −234.50

(1) ∴ Refund $234.50

Question 19 (2 marks)

A person owns 286 shares with a market value of $11.05 per share. The total dividend received for these shares is $640.90.

Calculate the percentage dividend yield, correct to 1 decimal place. **2**

(1) dividend per share $640.90 ÷ 286 = $2.24

% div yield = $\frac{2.24}{11.05} \times 100\%$

(1) $= 20.28\%$

$= 20.3\%$

Question 20 (2 marks)

Solve the equation $4x - \frac{2x+1}{3} = 5$ **2**

$-\frac{(2x+1)}{3} = 5 - 4x$

(1) ×3 correctly $-(2x+1) = 15 - 12x$

$-2x - 1 = 15 - 12x$

$10x = 16$

(1) $x = \frac{16}{10} = 1.6$

Check: $4 \times \frac{16}{10} - \frac{2(\frac{16}{10})+1}{3} = \frac{32}{5} - \frac{\frac{16}{5}+1}{3}$

$= \frac{32}{5} - \frac{21}{5} \div 3$

$= \frac{32}{5} - \frac{21}{5} \times \frac{1}{3}$

$= \frac{32-7}{5}$

$= \frac{25}{5}$

$= 5$ ✓

Question 21 (2 marks)

A researcher used the capture-recapture technique to estimate the number of fish in a lake. He captured, tagged and released 36 fish. Later he caught 25 at random and found that 4 had been tagged. What is the estimate for the total fish in the lake? **2**

(1) $\frac{4}{25} = \frac{36}{x}$

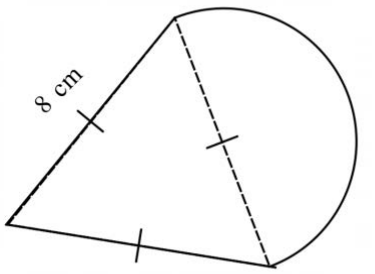
$x = \frac{36 \times 25}{4}$

$= 225$

(1) $\therefore$ approx 225 fish in lake

Question 22 (2 marks)

Calculate the perimeter of this shape consisting of a semicircle and an equilateral triangle, correct to 1 decimal place. **2**



NOT TO SCALE

4cm

(1) $\frac{C}{2} = \frac{2\pi r}{2} = \frac{2 \times \pi \times 4}{2} = \frac{8\pi}{2}$

$P = 2 \times 8 + \frac{8\pi}{2}$

$= 16 + 4\pi$ (12.57)

$= 28.566..$

(1) $\doteq 28.6$

Question 23 (3 marks)

The diagram below shows the cross-section PQRS of a piece of foam (of thickness 4 cm) to be cut from a rectangular piece and used for packing.

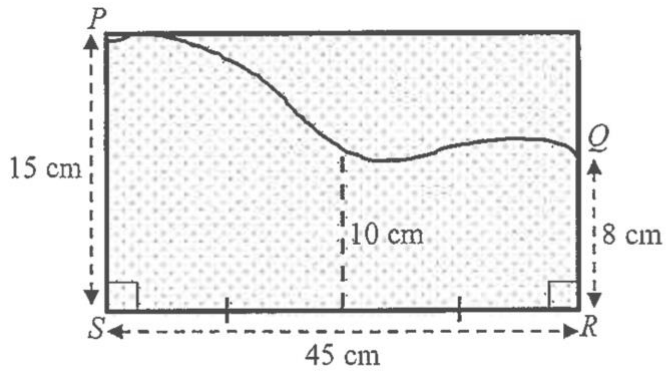


DIAGRAM NOT TO SCALE

By using two applications of the Trapezoidal Rule in your working, calculate the volume, in cubic centimetres, of the piece of foam to be used for packing. **3**

$A = \frac{1}{2} \times \frac{45}{2}(15+10) + \frac{1}{2} \times \frac{45}{2}(10+8)$ cm^2 (1)

$= 281.25 + 202.5$

$= 483.75$ (1)

$V = 483.75 \times 4$

$= 1935\ cm^3$ (1)

Question 24 (4 marks)

A square based pyramid with base edges of length L cm and perpendicular height h cm, is shown.

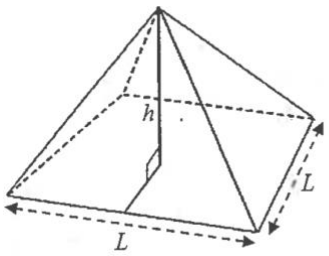


DIAGRAM NOT TO SCALE

The formulas for the volume (V) and surface area (A) of the pyramid in terms of L and h can be given by:

DO NOT SUBSTITUTE IF INTO equation -

$$V = \frac{L^2 h}{3} \quad \text{and} \quad A = L^2 + L\sqrt{L^2 + 4h^2}$$

(a) The pyramid has a surface area of 5184 cm^2 and its base area is 2304 cm^2. **3**

L^2

Show that the perpendicular height of the pyramid is 18 cm.

$5184 = 2304 + \sqrt{2304} \times \sqrt{2304 + 4h^2}$ (1)

$\sqrt{2304} = 48$

$2880 = \sqrt{2304} \times \sqrt{2304 + 4h^2}$

$60 = \sqrt{2304 + 4h^2}$

$3600 = 2304 + 4h^2$

$1296 = 4h^2$ (1)

$324 = h^2$

$h = 18$ (1)

(b) What is the volume of this pyramid? **1**

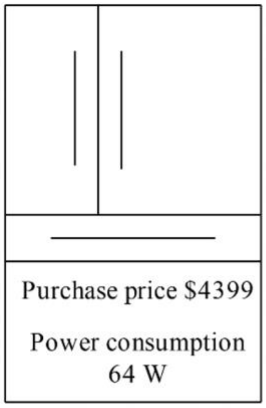
$V = \frac{2304 \times 18}{3}$

$= 13824 \text{ cm}^3$

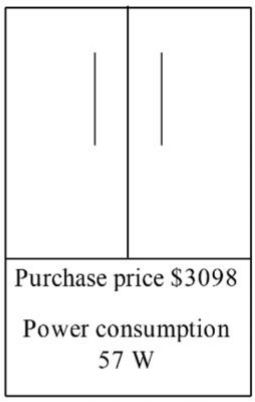
Question 25 (4 marks)

Annika needs to buy a new refrigerator. She has found two brands with all the features she requires. Their prices and power consumption are shown in the following diagrams.

Option A



Option B



The average cost of electricity is 26c/kWh.

Annika's refrigerator will be switched on 24 hours per day, every day.

(a) If Annika chooses Option A, her annual electricity cost for the refrigerator will be $145.77. **1**

Calculate Annika's annual electricity costs if she chooses Option B.

B: Energy = 57 x 24 x 365 W
= 499320 W
= 499.32 kW
Cost = 499.32 x 0.26
= $129.82

Question 25 continues on page 19

Question 25 (continued)

(b) Annika has been offered the following finance deals for the two refrigerators:

Option A	**Option B**
Monthly repayment = $102.27	Monthly repayment = $78.59
Term = 4 years	Term = 5 years

Assuming electricity costs remain the same, the total cost to purchase Option A over the 4 year finance term, including electricity costs is $5492.04. **1**

Calculate the total costs to purchase and run the refrigerator on Option B.

Total costs = $78.59 \times 5 \times 12 + 5 \times 129.82$

$= 4715.40 + 129.82$

$= \$5364.50$

(c) The cost of Option A over a 5 year period (to allow comparison), would include one more year of electricity costs as shown here: **2**

$5492.04 + $145.77 = $5637.81

By how much would the monthly repayments for Option A need to decrease so that its total 5 year cost is the same as for Option B?

Difference = $\$5637.81 - \$5364.50$ (1)

$= \$273.31$

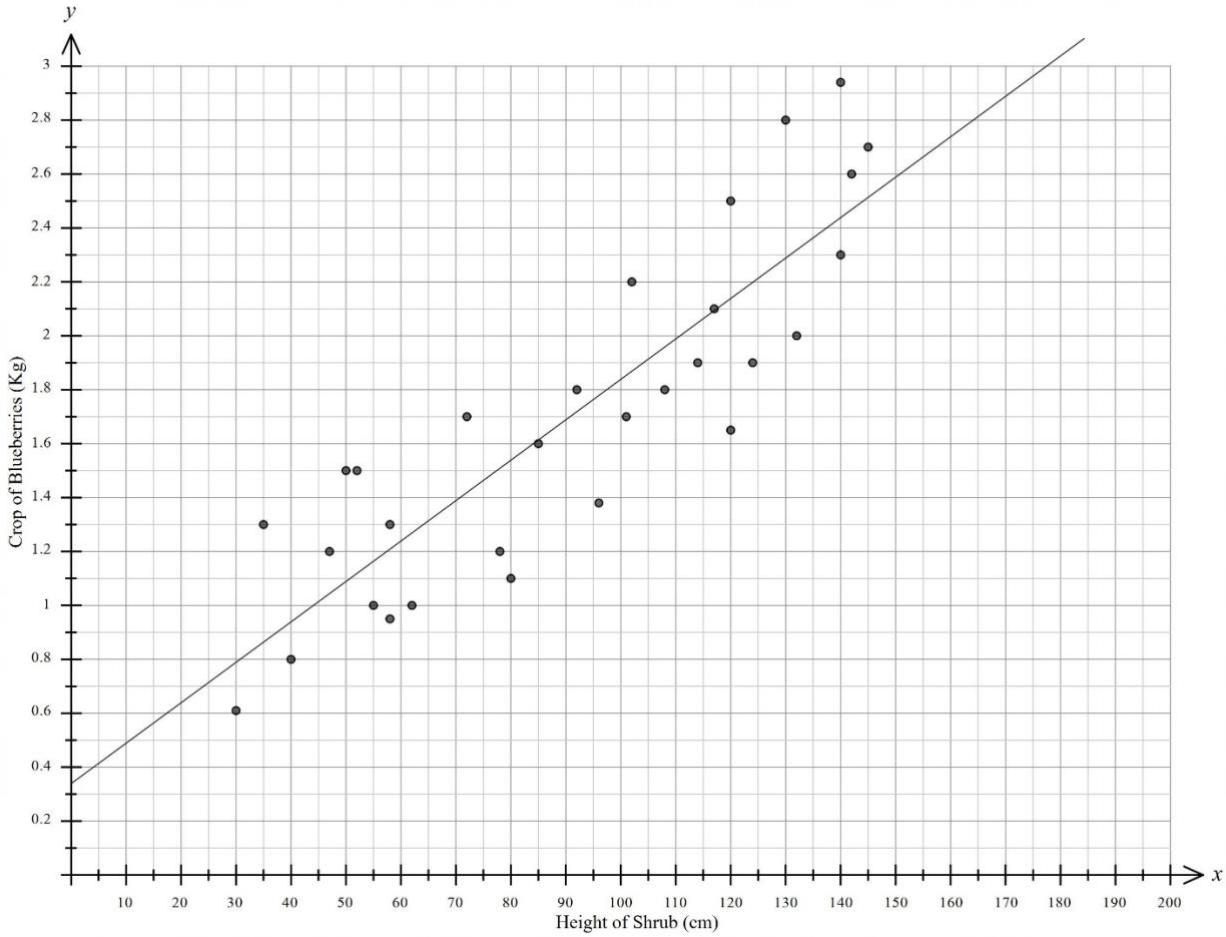
Mthly repayments need to decrease

$273.31 \div 48 = 5.69395$ (1)

$= \$5.69$

Question 26 (2 marks)

A blueberry farmer records the crop size in kilograms from a range of blueberry shrubs on his trial patch. The data includes shrubs which have just begun to produce berries right through to fully mature plants.



Some statistical measures for the data in the Scatterplot are shown below.

Correlation Coefficient (r)= 0.874

Statistical Measure	Height of Shrub (x)	Crop Size (y)
Mean	90.83	1.70
Standard Deviation	35.42	0.61

Question 26 continues on page 21

Question 26 (continued)

An estimate to the gradient of the least-squares regression line can be found using the formula:

$$\text{gradient} = r \times \frac{\text{standard deviation of y scores}}{\text{standard deviation of x scores}} = r\,\frac{\sigma_y}{\sigma_x}.$$

Given that the least-squares regression line crosses the vertical axis at 0.339, find the equation of the regression line and hence predict the crop (in kg) from a 100 cm high shrub. **2**

* algebra Question

gradient = $0.874 \times \frac{0.61}{35.42}$

$= 0.01505195$

Eqn $y = 0.01505195x + 0.339$ (1)

Subst $x = 100$

$y = 0.01505195 \times 100 + 0.339$

$= 1.844195$

$= 1.84$ kg (1)

answer from graph (1)

Question 27 (4 marks)

At Mike's Milkshakes, the ratio of milk to ice cream to chocolate syrup in a chocolate milkshake is 35:10:3.

There is 525 millilitres of milk in Mike's regular sized milkshake.

(a) How many millilitres of chocolate syrup are needed to make one of Mike's regular chocolate milkshakes? **1**

35 parts = 525 ml

1 part = 15 ml

(b) Mike has 8 litres of milk, 2 litres of ice cream and 1 litre of chocolate syrup in stock.

What is the maximum number of regular sized milkshakes he can sell before more supplies arrive? **3**

M

8000 ÷ 525 = 15

I

2000 ÷ 150 = 13

S

1000 ÷ 45 = 22

∴ 13 milkshakes

(2) correct volumes for all 3 ingredients

(1) correct number

Question 28 (5 marks)

After 5 years, the value of a piece of machinery has reduced to $25 000.

The original value of the machinery when purchased new was $80 000.

(a) If the straight-line method was used to depreciate the value of the machinery, what was the annual loss in value as a percentage of the purchase price. **2**

Annual loss = $\frac{80000-25000}{5}$ = \$11 000

$\frac{11\,000}{80000} \times 100\% = 13.75\%$

(b) Show that if the declining balance method was used to depreciate the machinery, the annual loss in value as a percentage of the purchase price was 20.76%. **3**

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

$25000 = 80000(1-r)^5$ (1)

$(1-r)^5 = \frac{25000}{80000}$

$= 0.3125$

$1-r = 0.7924$

$\therefore \quad r = 1 - 0.7924$

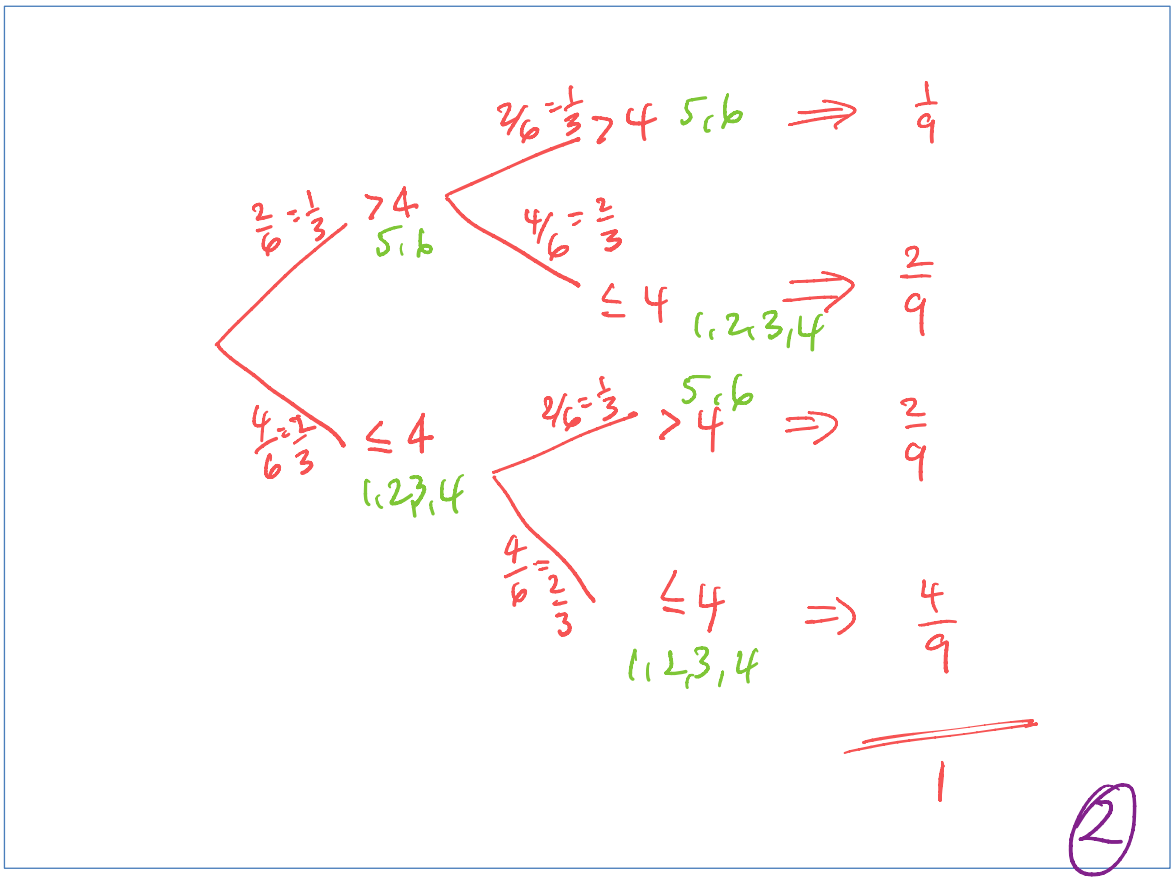
$= 0.20755$ (1)

$= 20.76\%$ (1)

Question 29 (4 marks)

In a particular game of chance, two dice are thrown. If both dice show a number greater than 4 then the person wins $2.50. If only one die shows a number greater than 4 the person wins $1.00. If both dice show numbers of 4 or less then the person loses $2.50.
If the person played the game 10 times, calculate their expected winnings or loss.

With the aid of a probability tree describe this scenario and use appropriate calculations to find the person's expected winnings or loss. **4**



expected win/loss = $10\left(\frac{1}{9} \times \$2.50 + \frac{4}{9} \times \$1.00 + \frac{4}{9} \times 2.\right)$ (1)

$= 10\left(-\frac{7}{18}\right)$

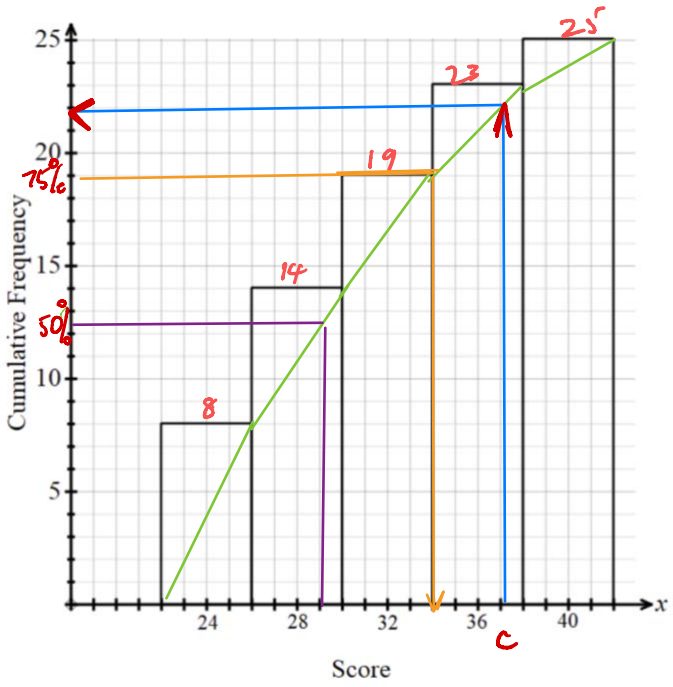
$= -\frac{70}{18}$

loss = $3.89 (1)

Questions 16 – 29 (43 marks)

Question 30 (4 marks)

Sam recorded the scores of 25 footballers who each took 50 shots at goal.
The cumulative frequency graph displays the results.



$25 \times \frac{3}{4} = \frac{75}{4} = 19$

(a) Use the graph to estimate the median number of goals scored. **2**

29

(b) Calculate the mean number of goals scored. (Answer to 1 decimal place.) **1**

$(8 \times 24 + 6 \times 28 + 5 \times 32 + 4 \times 36 + 2 \times 40) \div 25 = \frac{744}{25}$

$\div 29.76$

(c) Estimate the percentage of players that scored 37 goals or more? **1**

$25 - 22 = 3$ students

3 students $\geq$ 37 goals

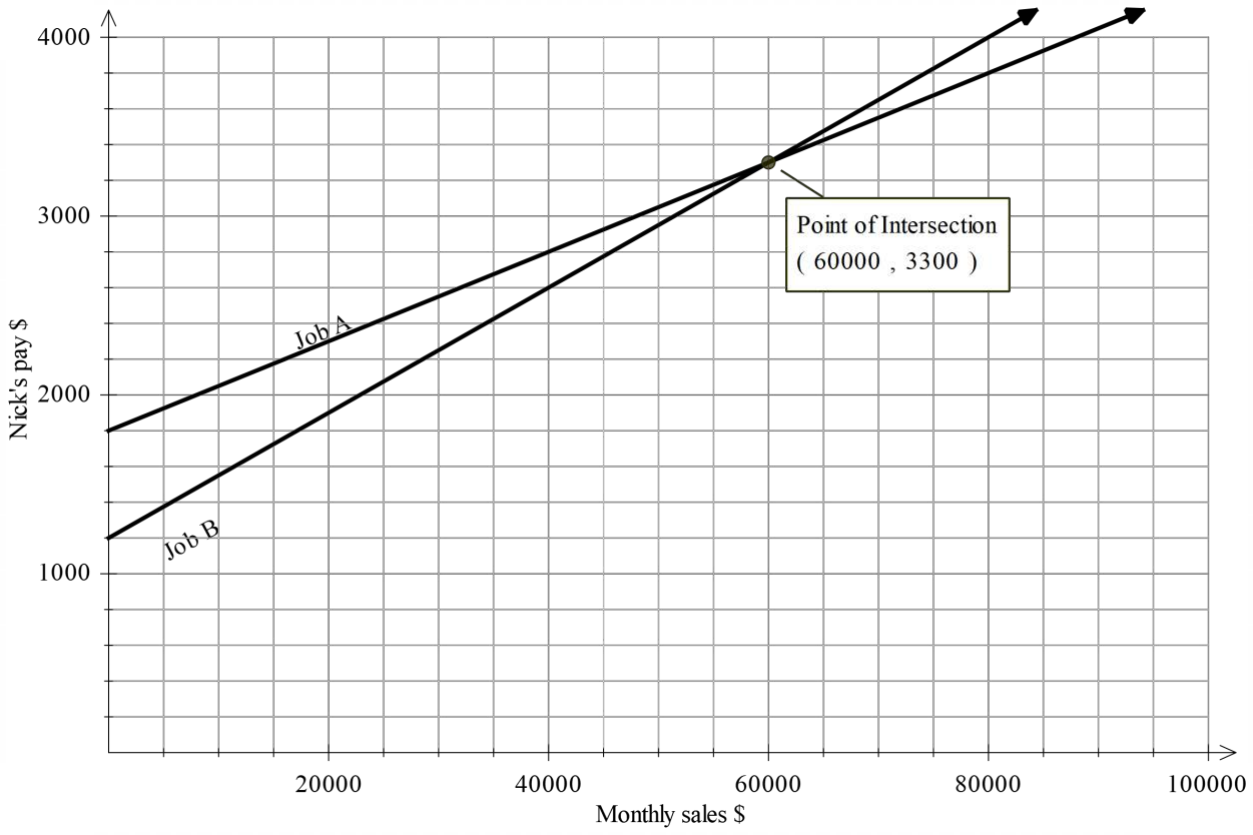
$\frac{3}{25} \times 100\% = 12\%$

Question 31 (3 marks)

Nick was offered two full-time sales positions. Both employers offered:

- a monthly retainer
- a commission on sales

The graph below shows the different pay rates for Job A and Job B.



(a) Calculate the difference in retainers between Job A and Job B. **1**

vertical intercept when monthly sales equal zero Job A $1800 retainer while Job B $1200 retainer

∴ difference = $600

Question 31 continues on page 27

Question 31 (continued)

(b) Calculate the percentage commission Nick would receive if he selected Job B. **2**

% commission = gradient

$= \frac{2100}{60000} \times 100\%$

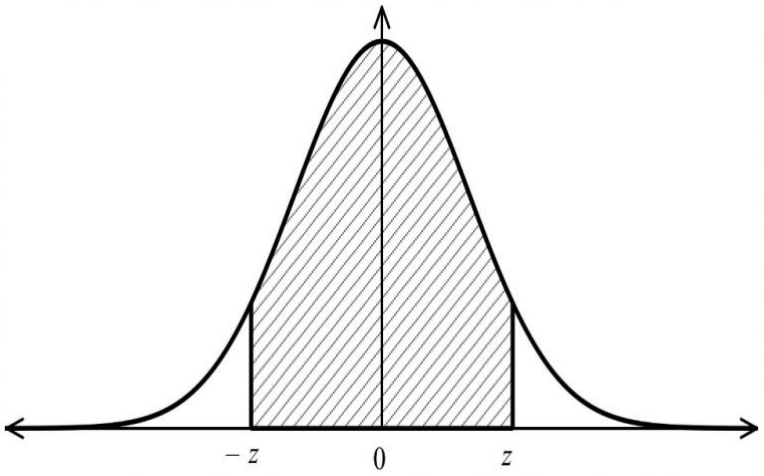
$= 0.035 \times 100\%$

$= 3.5\%$

use vertical intercept (0, 1200)
and point of intersection (60000, 3300)

Question 32 (4 marks)

A random variable is normally distributed with mean 0 and standard deviation 1.
The table gives the probability that this random variable lies between -z and z for different values of z.



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

The probability values given in the table for different values of z are represented by the shaded area in the diagram beside the table.

(a) Using the table, determine the probability that this random variable will lie between $z = -0.50$ and $z = 1.25$. **2**

$P(-0.5 < z < 0.5) = 0.3829$

$P(-1.25 < z < 1.25) = 0.7887$

$P(-0.5 < z < 1.25) = \frac{0.3829}{2} + \frac{0.7887}{2} = 0.5858$

$= 58.6\%$

(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. By first calculating z-scores, use the table above to determine how many of the residents have an arm span greater than 1.5 metres. **2**

$z = \frac{x-u}{\sigma}$

$= \frac{1.5 - 1.68}{0.24}$

$= -0.75$

$P(z > -0.75)$

$= \frac{0.5467}{2} + 0.5$

$= 0.77335$ (1)

$\therefore$ Number of residents

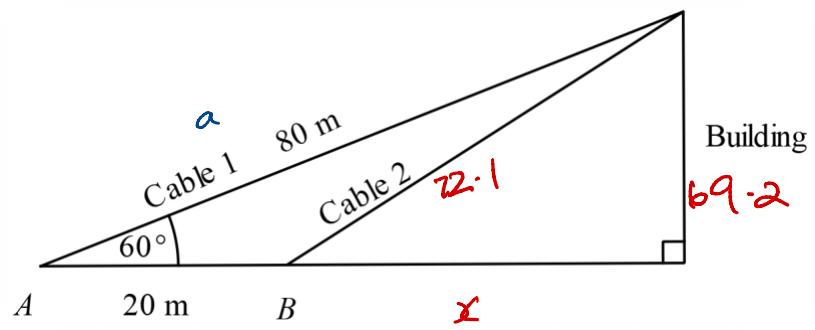
$= 0.77335 \times 1200$

$= 928.02$

$\doteq 928$ (1)

Question 33 (4 marks)

A support cable, 80 metres long, has been secured at an angle of elevation of 60° from point *A* to the top of a building. A second support cable will be secured from point *B*, 20 metres closer to the base of the building than point *A*. This information is shown in the diagram.



(a) Show that the length of the second cable is approximately 72 metres. **2**

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

$= 80^2 + 20^2 - 2 \times 80 \times 20 \cos 60^0$ (1)

$= 5200$

$c = 72.11$ (1)

(b) Given that the height of the building is 69.2 metres, calculate the distance between point *A* and the base of the building. **2**

$72^2 = 69.2^2 + x^2$

$x^2 = 72^2 - 69.2^2$

$= 395.36$

$x = 19.8836...$

Distance from A to base of building is 40 m (nearest metre)

Question 34 (4 marks)

Cases of a new strain of a virus have been tracked over the past few months. Data analysts determined that they could forecast the number of cases for a particular day using the formula:

$$N = 560 \times 1.1^{d}$$

where N is the number of cases and d is the number of days since the day this formula was developed.

(a) Complete the table of values using the formula. **1**

d	5	10	15	20
N	902	1452	2339	3767

.....

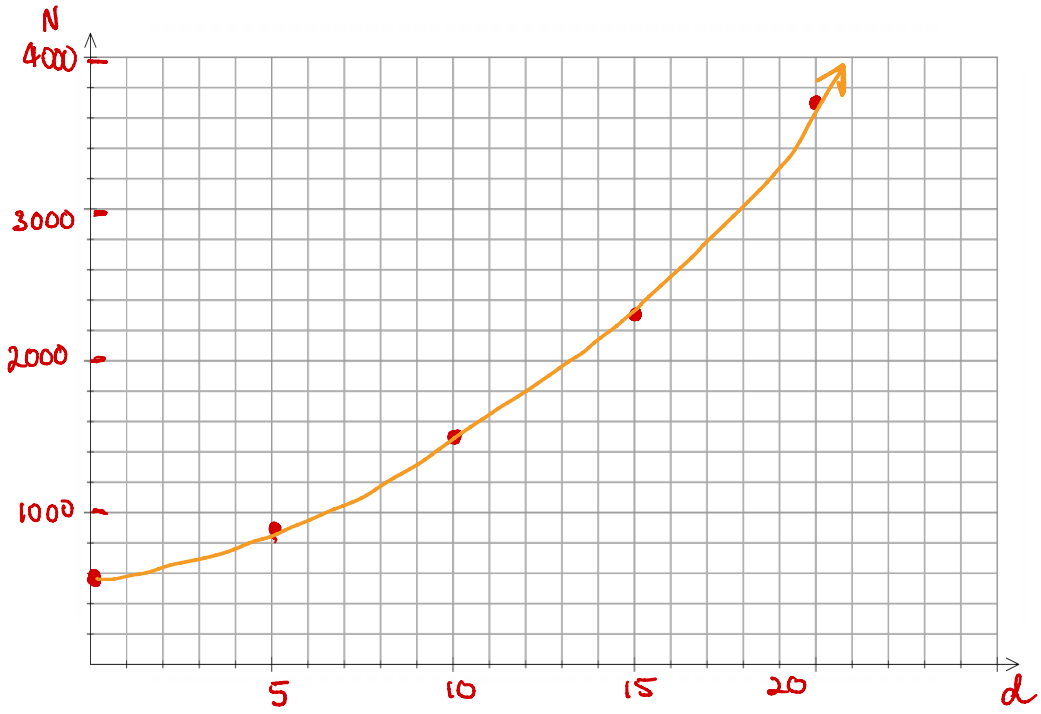
.....

(b) What will the vertical intercept be when the relationship between d and N is graphed? **1**

$d=0 \quad N = 560 \times 1^{0} = 560$

.....

(c) Graph the relationship on the grid provided. **2**



Question 35 (3 marks)

Harrison received a lump sum from his superannuation fund when he retired. He deposited some of this into a new bank account, earning 2% p.a. compounded annually.

The table below shows present value interest factors for an annuity of $1 for various interest rates (r) and numbers of periods (N).

Number of interest periods (N)	Interest rate per period as a decimal r			
	0.01	0.015	0.02	0.025
5	4.8534	4.7826	4.7135	4.6458
10	9.4713	9.2222	8.9826	8.7521
15	13.8651	13.3432	12.8493	12.3814
20	18.0456	17.1686	16.3514	15.5892

(a) For the first 5 years following retirement, Harrison was able to withdraw $36 000 at the end of each year to pay his remaining mortgage and living expenses. **1**

Show that the present value of a $36 000 annuity for 5 years is $169 686.

$PV = 36000 \times 4.7135$

$= \$169\,686$

(b) Harrison wants to be able to withdraw $20 000 per year for ten years, starting 6 years after his retirement. **2**

If the amount he deposited when he opened the account was $340 000, would he be able to make these planned withdrawals over the ten years? Justify your answer with calculations.

$PV = 20000 \times 12.8493 - 20000 \times 4.7135$

$= \$162\,716$ (1)

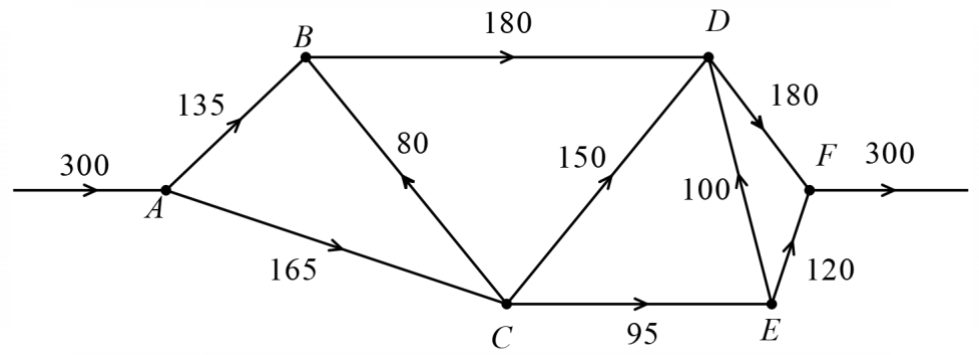
Total needed $= \$162\,716 + \$169\,686$

$= \$332\,402$

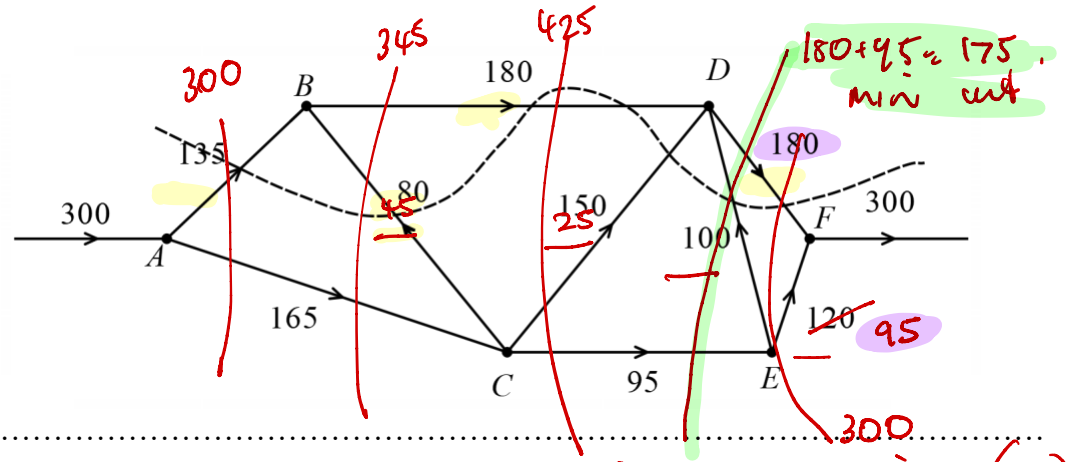
$\therefore$ $340 000 would be enough (1)

Question 36 (3 marks)

The network diagram below shows a series of water pipes and sprinklers in a section of an underground lawn watering system. The vertices *A*, *B*, *C*, *D*, *E* and *F* represent the sprinklers. The edges represent the underground water pipes which connect the sprinklers. The numbers on the edges represent the maximum capacity (in litres per hour) of the water pipes.



(a) In the diagram below, a non-valid cut has been marked on the network. Explain why it is not a valid cut. **1**



source (A) is not cut off from sink (F)
ie ACEF is a valid route.

(b) Determine the maximum flow of the network. **2**

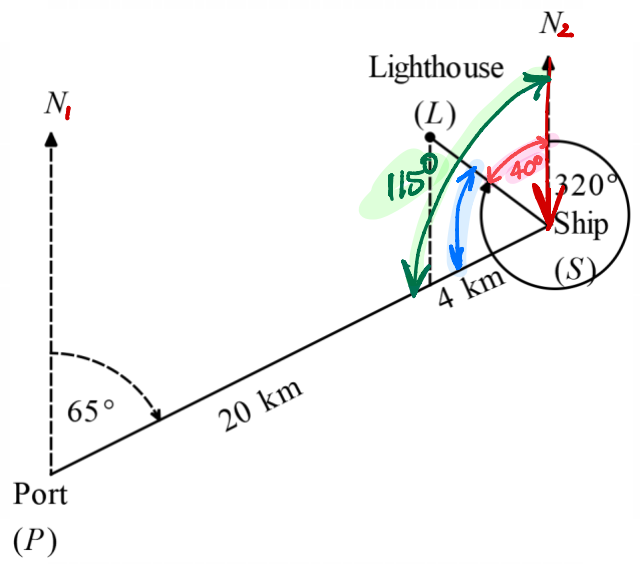
Max flow = 180 + 95
= 275

min cut = 180 + 95 DF DE CE
= 275

Question 37 (4 marks)

A ship leaves port travelling on a bearing of 065°. After travelling 20 kilometres the ship is due south of a lighthouse.

The ship continues on this bearing for a further 4 kilometres, then measures the bearing to the lighthouse to be 320°.



(a) Show that $\angle PSL$ is 75°. **2**

$\angle N_2SP = 180^\circ - 65^\circ = 115^\circ$ (Co-interior angles)

$\angle N_2SL = 360^\circ - 320^\circ = 40^\circ$ (adjacent ∠'s forming a revolution)

$\angle LSP = 115^\circ - 40^\circ = 75^\circ$ (adjacent ∠'s forming $\angle NSP$)

(b) Calculate the distance from the ship to the lighthouse at this time. **2**

$\frac{d}{\sin 65^\circ} = \frac{4}{\sin 40^\circ}$ (1)

$d = \frac{4\sin 65^\circ}{\sin 40^\circ} = 5.6398 \doteq 5.6$ (1)

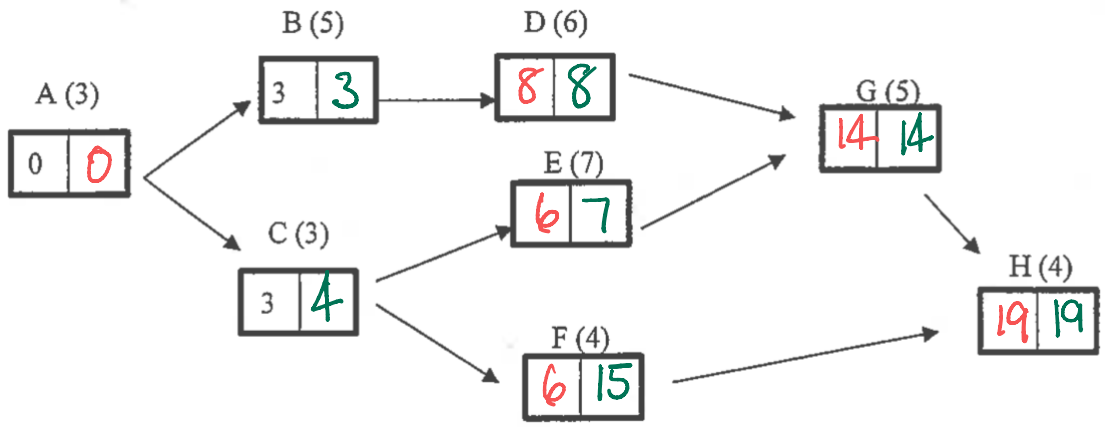
∴ ship approx 5.6 km from lighthouse

Question 38 (5 marks)

There are 8 stages (*A* – *H*) in the production of heavy-duty machines at a manufacturing plant which operates 7 days a week.

The times in days needed for the completion of each stage are indicated on the partly completed network diagram below, with their respective earliest start times (*EST*) and latest start times (*LST*) shown as :

EST	LST



(a) Complete the above network diagram by inserting the missing EST and LST for each stage. **2**

(b) List the critical path in the production of the machines to be completed. **1**

A B D G H EST = LST

(c) What is the minimum time required to complete the production of these machines? **1**

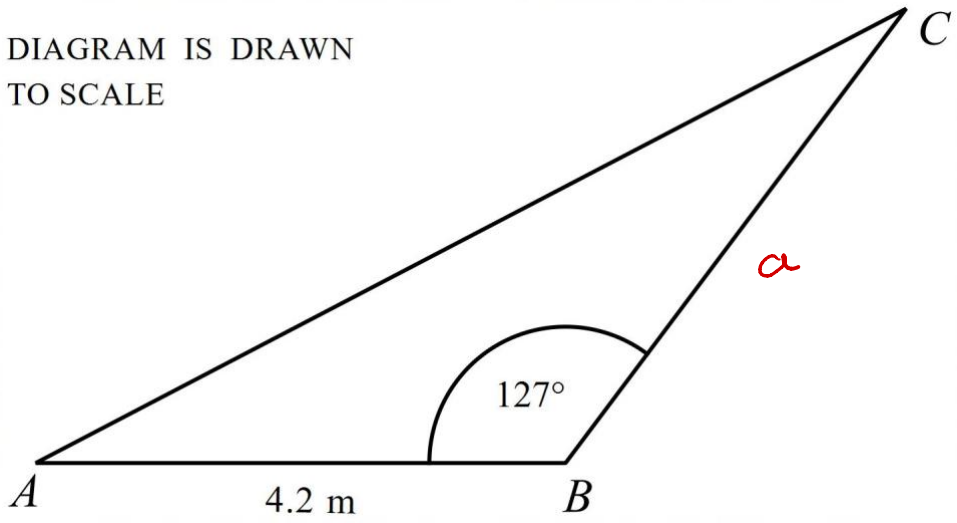
19 + 4 = 23 days.

(d) Which activity has the greatest float time? **1**

F = 15 - 6 = 9 days

Question 39 (4 marks)

This scale drawing represents a triangular section of a garden.



(a) Measure the length of *AB* in the diagram and use this to show that the scale factor is 1:60. **1**

7cm = 4.2 m

7cm = 420 cm

1cm = 60 cm

1 : 60

(b) Calculate the area of the actual triangular garden bed.

Give your answer correct to the nearest tenth of a square metre. **3**

$A = \frac{1}{2}ab\sin C$ $\quad 7\frac{1}{2}\text{cm} = 450\text{cm}$ (1)

$= \frac{1}{2} \times 4.2 \times 4.5 \times \sin 127^{\circ}$ (1)

$= 7.547\ m^2$

$= 7.55\ m^2$ (1)

Question 40 (4 marks)

Connor weighs 72 kilograms. He consumed 4 full-strength beers and 2 cans of pre-mixed spirits between 8:00 pm Tuesday and 12:30 am Wednesday. He then stopped drinking alcohol.

	
Full strength beer 375 ml 4.8% 1.4 standard drinks	Pre-mixed spirits 375 ml 5.0% 1.5 standard drinks

Using the formulas below, calculate the time on Wednesday when Connor's blood alcohol content (BAC) should return to zero.

$$\text{BAC}_{\text{MALE}} = \frac{10N - 7.5H}{6.8M}$$

Time for BAC to return to zero $= \frac{BAC}{0.015}$ hours, **4**

where N is the number of standard drinks and H is the number of hours drinking.

Number standard drinks = $4 \times 1.4 + 2 \times 1.5 = 8.6$ (1)

Drinking time = 4.5 hrs

$\text{BAC}_{\text{Male}} = \frac{10 \times 8.6 - 7.5 \times 4.5}{6.8 \times 72}$

$= 0.106719712$ (1)

Time $= \frac{\text{BAC}}{0.015} = 7.114651416$ hrs

$= 7\text{hr } 6' 52.75''$

$\doteq 7\text{hr } 7\text{mins}$ (1)

Connor's BAC should be back to zero by 7:37am Wednesday (1)

End of paper.