Carlingford High School

Student Number: _____

2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours and 30 minutes
- Write using black pen
- Approved calculators may be used
- A reference sheet is provided at the back of this paper
- In Questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks : 100

Section I – 15 marks (pages 2 – 9)

- Attempt Questions 1 – 15
- Use the Multiple Choice Answer sheet on page 41
- Allow about 25 minutes for this section

Section II – 85 marks (pages 10 – 35)

- Attempt Questions 16 – 43
- Allow about 2 hours and 5 minutes for this section

Question	Algebra	Measurement	Financial Mathematics	Probability & Statistics	Network Concepts	
1		/1				
2		/1				
3			/1			
4			/1			
5				/1		
6		/1				
7		/1				
8			/1			
9	/1					
10		/1				
11		/1				
12					/1	
13				/1		
14		/1				
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16		/2				
17		/2				
18		/4				
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21		/4				
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27				/3		
28				/3		
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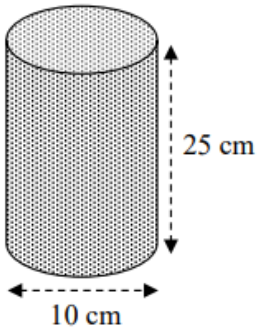
30				/2		
31				/2		
32			/2			
33			/4			
34			/4			
35			/3			
36			/2			
37			/2			
38			/6			
39					/3	
40					/4	
41	/3					
42	/3					
43	/3					
44	/2					
TOTAL	**/12**	**/29**	**/26**	**/25**	**/8**	**/100**

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. What is the total surface area (in cm^2) of this closed cylinder?



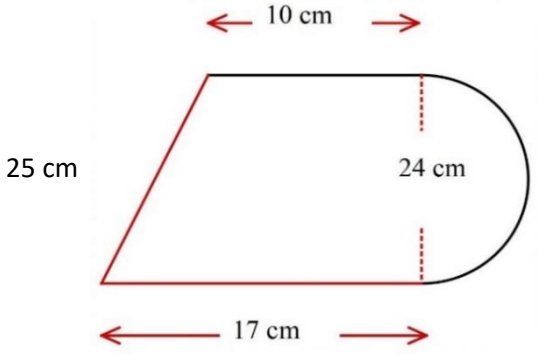
A. 550

B. 942

C. 1963

D. 2199

2. Calculate the perimeter of the shape below, rounded to 3 significant figures.



A. 51.0 cm

B. 81.7 cm

C. 89.7 cm

D. 127.4 cm

3. Lenore invests $4 200 at 4% p.a. compounding annually.

What will be the value of the investment at the end of three years?

A. $504.00

B. $524.43

C. $4 704.00

D. $4 724.43

4. Find the simple interest payable on a loan of $8000 at 6% p.a. for 5 years.

A. $480

B. $2400

C. $10706

D. $20000

5. A new store manager wants to know if the customers are happy with the store's service.

He asked the opinion of every 5^{th} customer.

What type of sampling did the manager do?

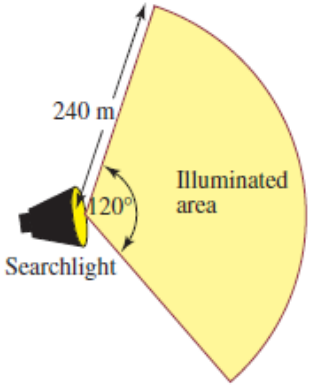
A. discrete

B. categorical

C. systematic

D. random

6. A searchlight lights up the ground to a distance of 240 m. What area does the searchlight illuminate if it can swing through an angle of 120^0.



A. 60 319 m^2

B. 72 382 m^2

C. 90 478 m^2

D. 180 956 m^2

7. 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.

February is a month when NSW has daylight saving time and the USA doesn't.

What it the time in New York when Elizabeth receives the call?

A. 8:30 pm Sunday 23rd February

B. 10:30 pm Sunday 23rd February

C. 2:30 am Tuesday 25th February

D. 4:30 am Tuesday 25th February

8. Nick bought a portfolio of 2000 MNRA shares with his retrenchment payout.

The value of each share is currently $12.50, and Nick is paid an annual dividend of $0.75 per share.

What is the dividend yield on the shares?

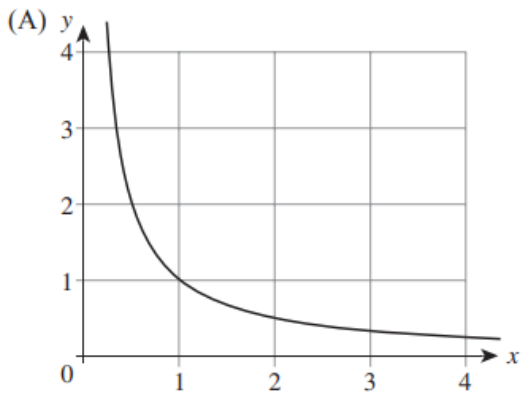
A. 6.0%

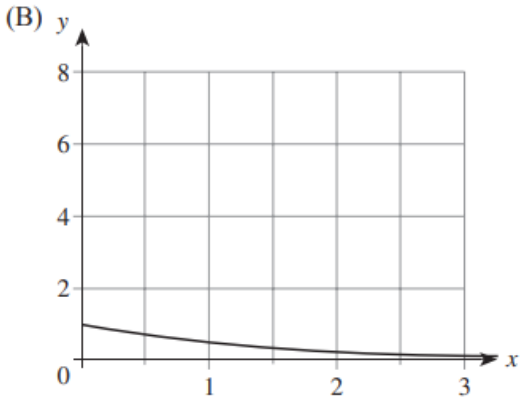
B. 6.25%

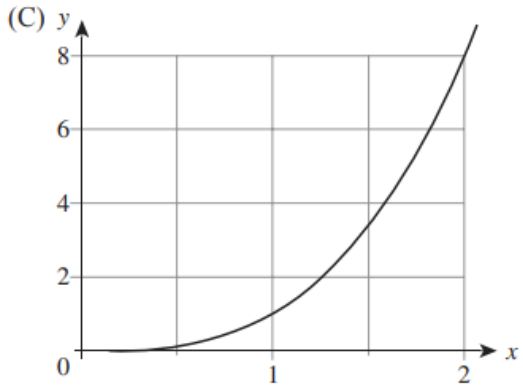
C. 7.5%

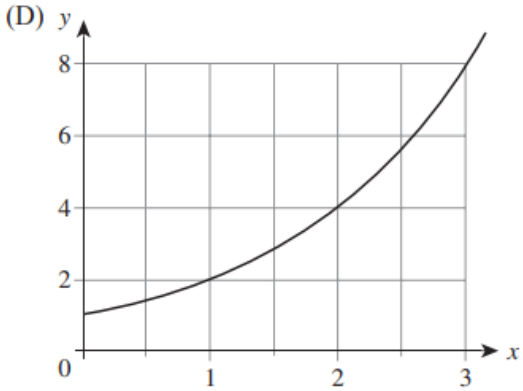
D. 12.5%

9. Which graph best represents $y = (0.5)^x$?



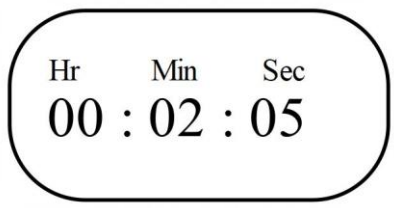






10. Alex measures the number of seconds that it takes his pulse rate to return to normal after exercising.

The time taken is shown below on the timer app that he has on his phone.



What is the percentage error in the measurement of this time?

A. 0.004%

B. 0.4%

C. 0.49%

D. 2.5%

11. The formula below gives the blood alcohol concentration for a male.

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

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.

Charles weighs 80 kg and consumes 6 standard drinks in 3 hours.

What is his BAC, correct to 1 significant figure?

A. 0.04

B. 0.05

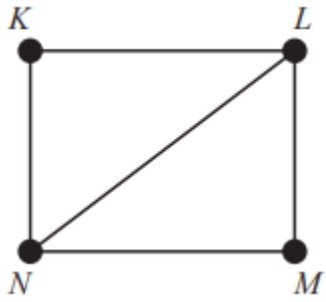
C. 0.06

D. 0.07

12. The graph below represents a friendship network. The vertices represent the four people in the friendship network: Kwan (K), Louise (L), Milly (M) and Narelle (N).

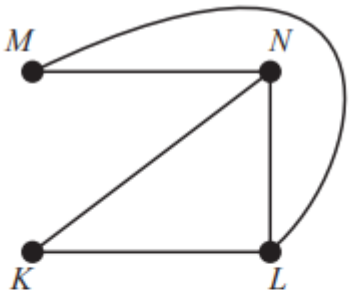
An edge represents the presence of a friendship between a pair of these people.

For example, the edge connecting K and L shows that Kwan and Louise are friends.

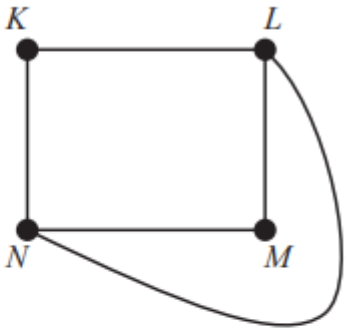


Which one of the following graphs does **not** contain the same information?

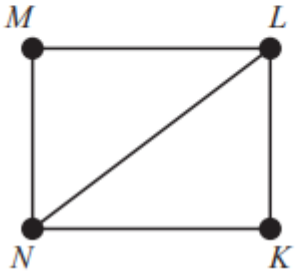
A.



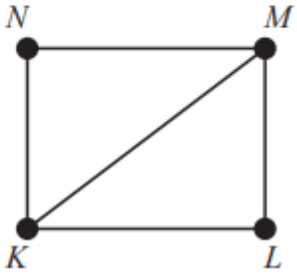
B.



C.



D.



13. A scientist measures the mass of a hive of bees and finds they are normally distributed with a mean of 0.12 grams.

A bee is considered underweight if its mass is less than 0.096 grams.

He finds that 0.15% of bees are underweight.

What was the standard deviation of the bees in the study?

A. 0.008

B. 0.016

C. 0.075

D. 0.150

14. Young's formula is $D = \frac{yA}{y + 12}$, where

D = dosage required for a child (1 – 12 years)

y = age of the child (in years)

A = adults dosage required

John is sick, and according to this formula, the dosage required for his age is 40% of an adult dosage.

How old is John?

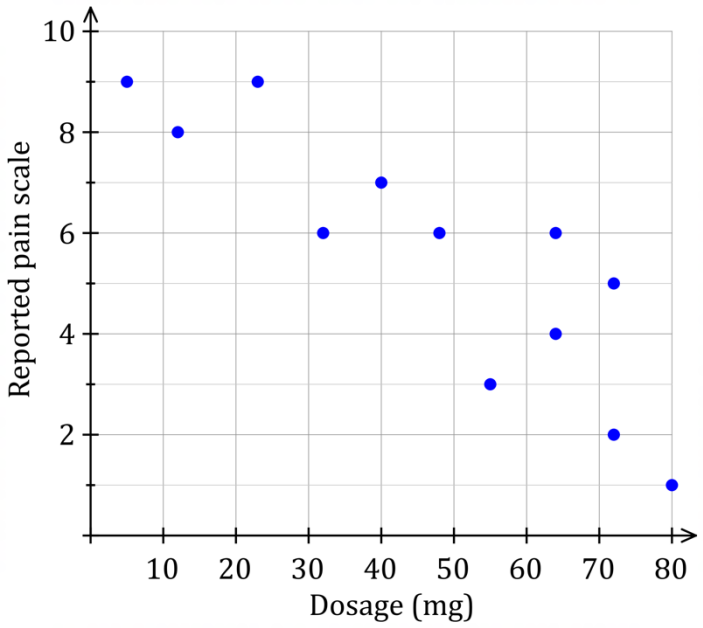
A. 4

B. 6

C. 8

D. 12

15. A scatterplot of pain (as reported by patients) compared to the dosage (in mg) of a drug is shown below.



How could you describe the correlation between the pain and the dosage?

A. A moderate negative correlation

B. A moderate positive correlation

C. A weak positive correlation

D. No correlation

2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Mathematics Standard 2

Carlingford High School

Section II Answer Booklet

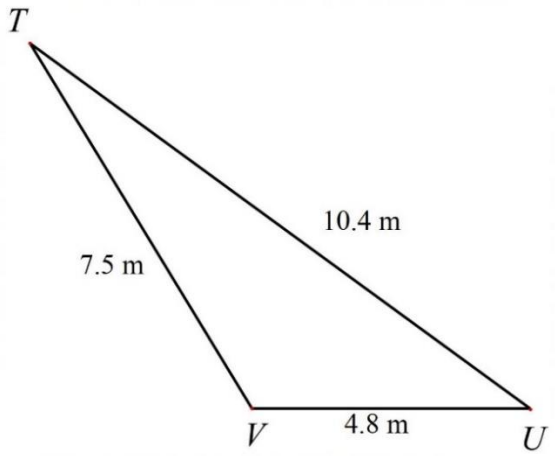
85 marks
Attempt Questions 16-43
Allow about 2 hours and 5 minutes for this section

Instructions

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

Question 16 (2 marks)

In the diagram below, TV = 7.5 m, VU = 4.8 m and TU = 10.4 m. **2**



Use the cosine rule to calculate the size of $\angle TVU$ correct to the nearest degree.

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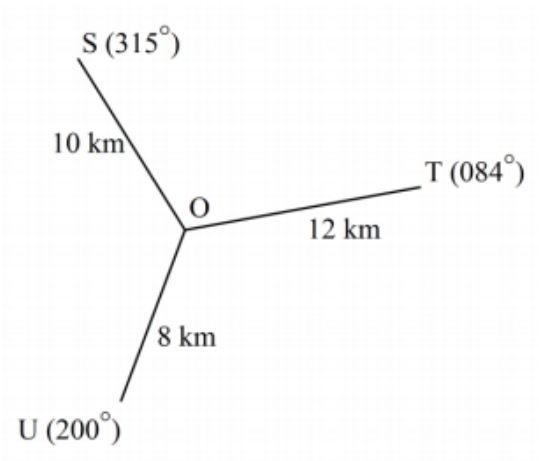
Question 17 (2 marks)

A radial survey of a field produced the diagram below. **2**



Find the area of the triangular section TOS. Give your answer correct to 1 decimal place.

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Question 18 (4 marks)

Lily buys an LCD television which is rated at 80 watts when being used for viewing.

When in stand-by mode it is rated at 4 watts.

Lily and her family use the TV for viewing for 8 hours a day on average and leave it on standby for the remaining time.

(a) Show that the TV uses 0.704 kilowatt hours of energy on an average day. **1**

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(b) Lily pays 30 cents per kWh for electricity. How much money would she save in a year if she turned the TV off when it wasn't being viewed, rather than leaving it on stand-by? **3**

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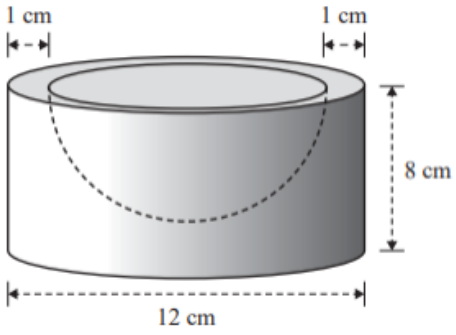
Question 19 (3 marks)

A cylindrical block of wood has a diameter of 12 cm and a height of 8 cm. A hemisphere is removed from the top of the cylinder, 1 cm from the edge, as shown below.



3

Calculate the volume of the block of wood after the hemisphere has been **removed**. Give your answer correct to the nearest cubic centimetre.

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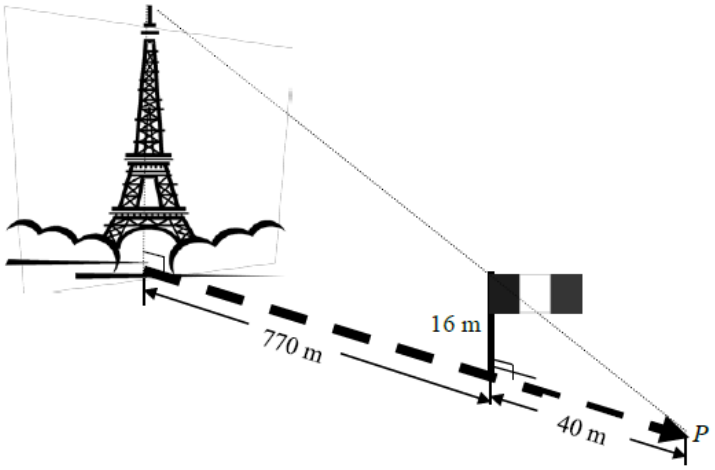
Question 20 (2 marks)

The French flag is on a 16 metre pole perpendicular to the ground at a position 770 metres from the foot of the Eiffel Tower in Paris. The ground is level.



At night, a light beam shines from the top of the tower and reaches a point *P* along the ground, 40 metres from the flag pole. The height of the tower is 324 metres tall.

What is the angle of depression (to the nearest degree) from the top of the tower to the point P on the ground? **2**

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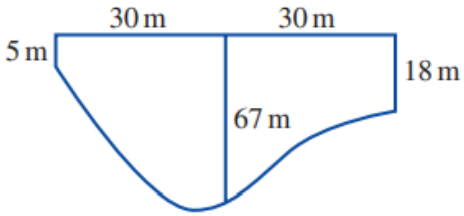
Question 21 (4 marks)

The diagram below shows a cross-section of a river.



(a) Use two applications of the Trapezoidal Rule to estimate the area of the cross-section.

……. **2**

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Question 21 continues on page 15

Question 21 continued

(b) The river is 112 metres long and approximately has the same cross-section for its entire depth. Approximate the capacity of the river to the nearest kilolitre. **2**

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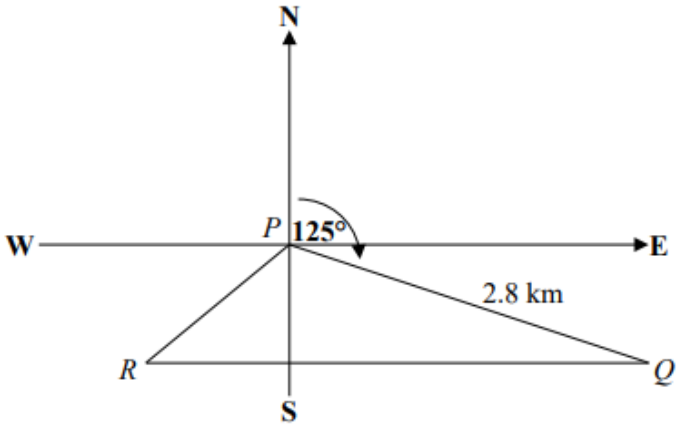
Question 22 (3 marks)

Jay walks 2.8 km from *P* to *Q* on a bearing of 125°, as shown in the diagram. From *Q*, he walks due west until he reaches *R*, which is on a true bearing of 210° from *P*.



(a) Show that the size of angle *QPR* is 85^0. **1**

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…….

(b) Given $\angle PRQ = 60°$, calculate the distance Jay walked from *Q* to *R*. Give your answer correct to one decimal place. **2**

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Question 23 (2 marks)

Madison, who is 18 years old, wants to use her heart rate to guide the intensity of her exercise.

To determine her target heart rate, she must first find her resting heart rate and the maximum heart rate for a person her age.

To calculate her resting heart rate (*R)*, in beats per minute, she counts 18 beats of her heart in 20 seconds, while sitting quietly.

To estimate her maximum heart rate (*M*), she uses a rule of subtracting her age from 220.

To determine her target heart rate (*T*) for exercise she uses the formula below.

$$T = 0.7(M - R) + R$$

2

What is her target heart rate in beats per minute (bpm)?

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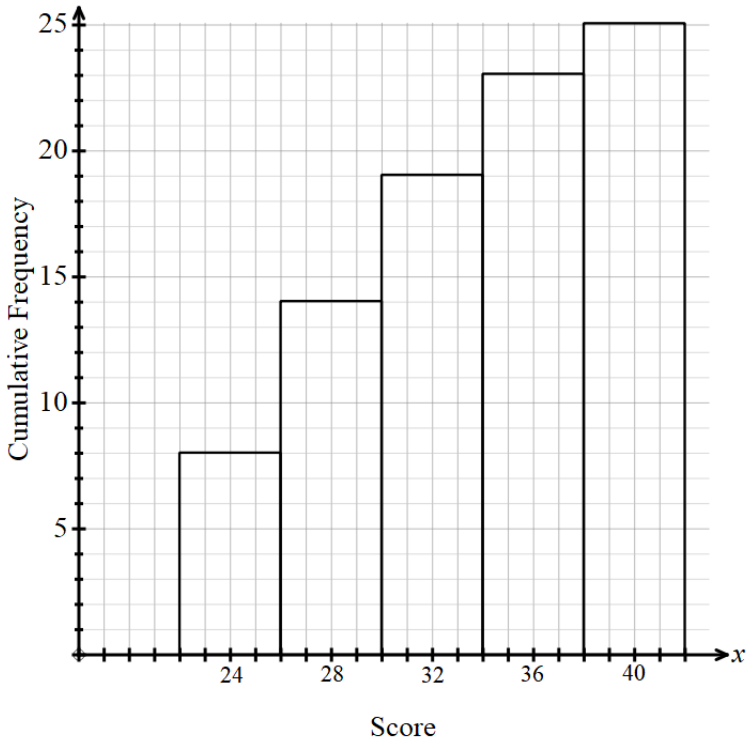
Question 24 (3 marks)

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. **1**

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(b) What percentage of players scored 34 goals or more? **2**

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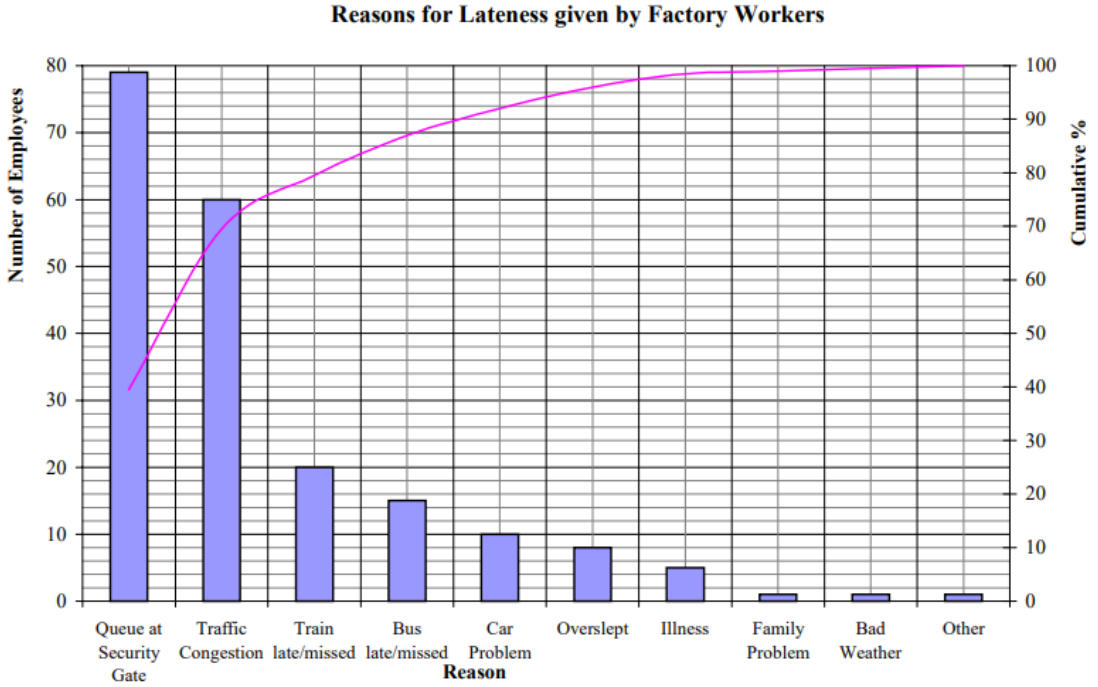
Question 25 (3 marks)

In a survey to find the main causes of lateness in a factory's workforce, a random sample of 200 employees who were late for work were asked the reason why. The Pareto chart below shows the results.



(a) How many latecomers blamed the security gate ? **1**

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(b) What fraction of latecomers blamed traffic congestion? **1**

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……

(c) How many of the main causes does it take to account for 80% of the problems? **1**

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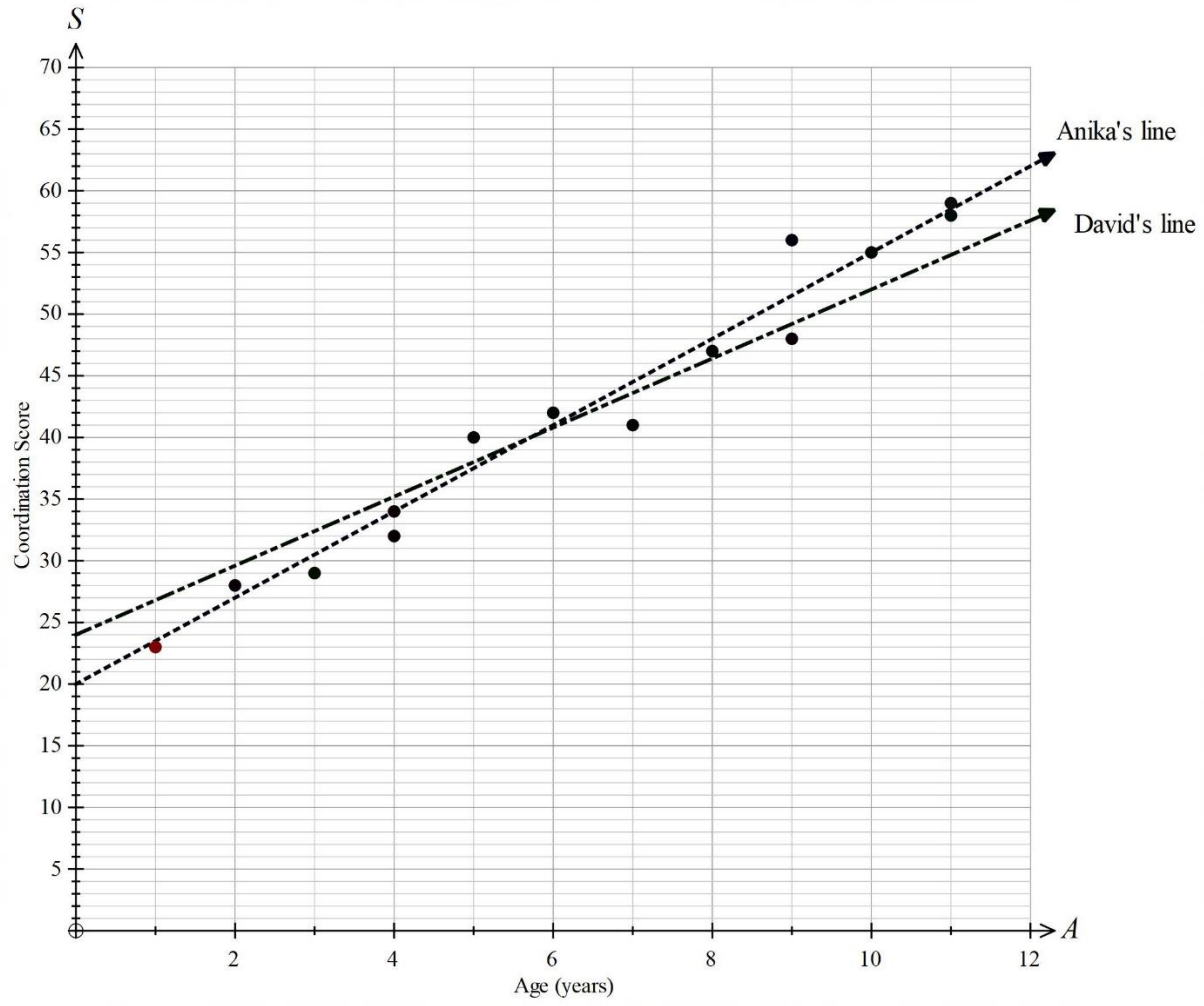
Question 26 (3 marks)

A group of 14 children were tested on their co-ordination skills and the results are shown on the scatter-plot below.



Two researchers, Anika and David, each draw a line of best fit on the graph.

(a) Explain why Anika's line is a better line of best fit. **1**

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(b) Give the equation of Anika's line. **2**

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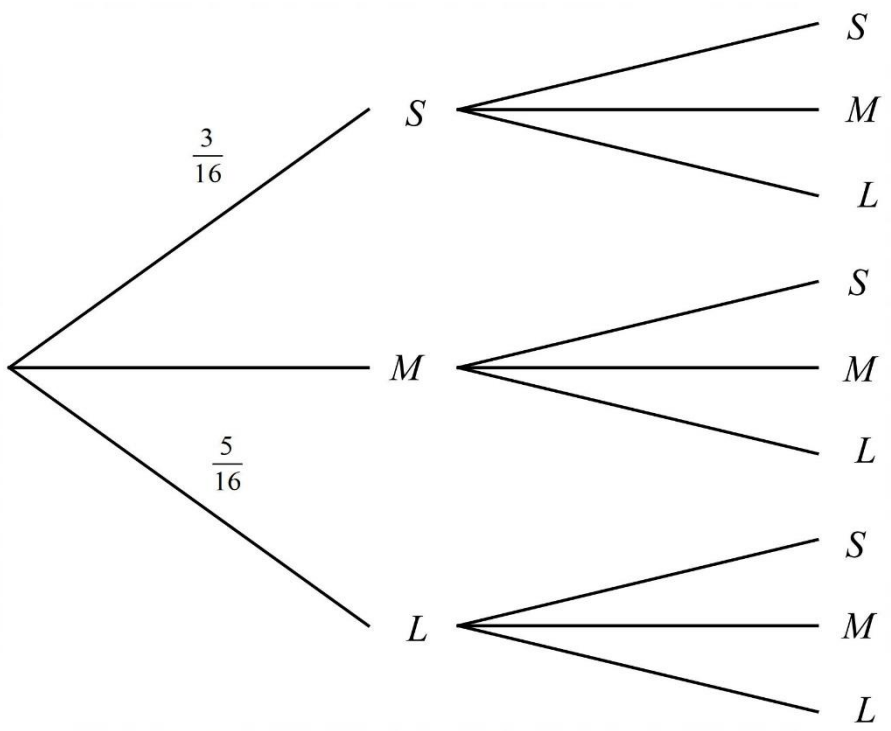
Question 27 (3 marks)

In a laundry basket there are shirts in three sizes, 3 are small, 5 are large and 8 are medium.
Ed takes two shirts from the basket at random.

The tree diagram below has been started to show the probabilities of different combinations.



(a) Complete the tree diagram by writing the probabilities on the remaining branches. **2**

(b) Find the probability that Ed chooses two shirts of the *M* size. **1**

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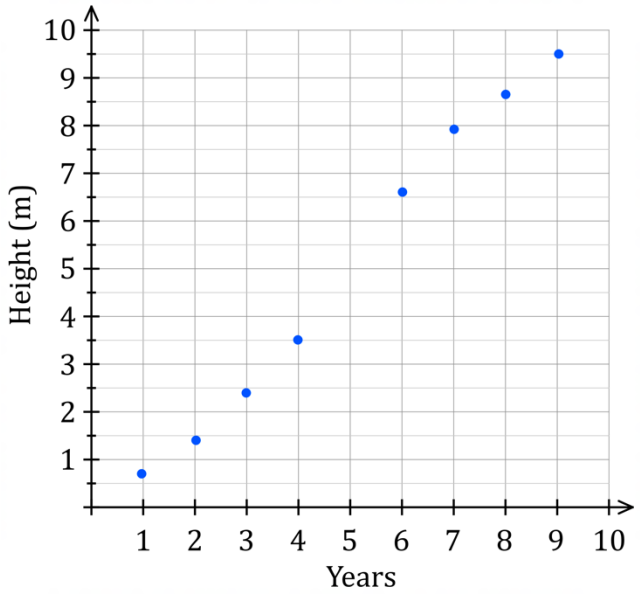
Question 28 (3 marks)

Hayden is an agricultural scientist studying the growth of a particular tree over several years. The data he recorded is shown in the table below.

Years since planting, t	1	2	3	4	5	6	7	8	9
Height of tree, H metres	0.7	1.4	2.4	3.5		6.6	7.9	8.7	9.5

A scatterplot of the data is shown below:



(a) What is Pearson's correlation coefficient? Answer correct to 4 decimal places. **1**

(b) Find the equation of the least-squares line of best fit in terms of years (t) and height (h). Answer correct to 2 decimal places. **1**

(c) Hayden did not record the tree's height after five years. Predict the height after five years, correct to one decimal place. **1**

Question 29 (3 marks)

In a TV speech, 25 000 viewers gave a politician a score out of 50 on his performance.
The scores were normally distributed with a mean of 37 and a standard deviation of 4.

(a) What percentage of viewers gave him a score between 33 and 41? **1**

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(b) How many viewers gave him a score between 41 and 45? **2**

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Question 30 (2 marks)

Seven students scored the following marks in an assessment test:

42 , 46 , 47 , 51 , 52 , 57 , 72

Is the mark of 72 an outlier for this set of data? Justify your answer with calculations. **2**

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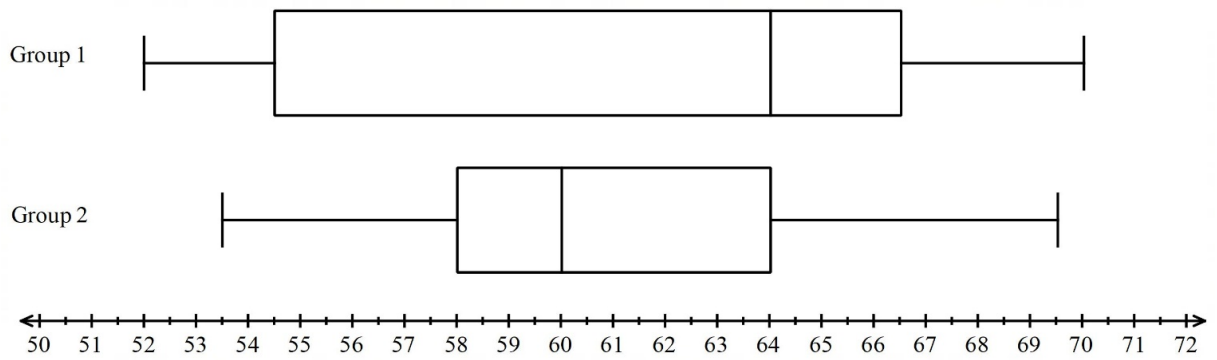
Question 31 (2 marks)

Two groups, with 36 students in each, have their resting heart rate recorded.
The results are shown on the box-plots below.



1

(a) Compare the interquartile ranges for the two groups.

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(b) How many more students had a heart rate above 64 in Group 1 compared to Group 2?

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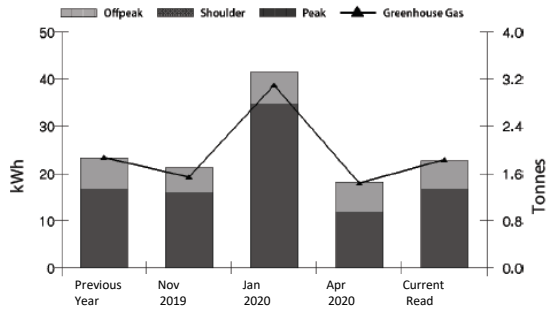
Question 32 (2 marks)

A section of the electricity bill for Corie's share-house is shown below.



Average daily usage cost for this account (incl. STP): $6.70
Average daily usage for this account: 22.76 kWh
Your greenhouse gas emissions: 1.84 tonnes.
For more information see www.energymadeeasy.gov.au

Compare your usage to your local area averages

Number of people in household	1	2	3	4	5
Average daily household usage (kWh)	8.769	13.132	13.934	17.297	19.725
Your average daily usage					22.8

To find out more about how the average household energy usage is calculated, get some energy efficiency tips and compare retail energy prices,

ISSUE DATE 16 AUG 20	
TRANSACTIONS SINCE PREVIOUS ACCOUNT (Incl GST)	
Previous Invoice Amount	**$500.04**
Pay On Time™ Discount (incl GST of $4.55)	**$50.00 Cr**
Payment Received - Thank You	**$450.04 Cr**
Balance Brought Forward	**$0.00**
CURRENT TRANSACTIONS (Incl GST)	
Electricity Charges $643.26	
TOTAL CURRENT TRANSACTIONS (Incl GST)	**$643.26**
TOTAL AMOUNT DUE (Incl GST)	**$643.26**
Total GST for this account is $53.93	
10% PAY ON TIME™ DISCOUNT	**$64.33 Cr**
if paid by 05 SEPT 20	
Total Amount Due with discount (Incl GST)	XXXXXXX

There are five people living in the house who share the electricity costs equally.

If she pays the account on 2nd September, how much would she need to collect from each of her housemates? **2**

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Question 33 (4 marks)

Bethany is offered two similar jobs and wants to compare the gross weekly pay.

The council job pays an hourly wage of $25.60 for a 36-hour week, with overtime at time-and-a-half for any additional hours.

The public service job pays an annual salary of $60 788 for a 40-hour week.

(a) How much would she be paid weekly for the public service job? **1**

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(b) How much would she be paid weekly for the council job if she worked the normal hours only? **1**

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(c) How many hours of overtime would she need to work at the council job to achieve the same weekly pay as the public service job? **2**

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Question 34 (4 marks)

Emma's taxable income is $84 000 per annum.

(a) Medicare levy is 2% of the taxable income. How much is Emma's Medicare levy? **1**

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……

The table below shows personal income tax rates.

Taxable income	*Tax payable*
0–$18 200	Nil
$18 201–$37 000	Nil + 19 cents for each $1 over $18 200
$37 001–$80 000	$3572 + 32.5 cents for each $1 over $37 000
$80 001–$180 000	$17 547 + 37 cents for each $1 over $80 000
$180 001 and over	$54 547 + 45 cents for each $1 over $180 000

(b) What is the tax payable on Emma's taxable income? **1**

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(c) Emma has paid $18 450 in tax instalments. Will Emma receive a refund or will she have to pay more tax? Justify your answer with calculations. **2**

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Question 35 (3 marks)

A year ago, Command Internet Services bought a new computer server for $15 200.

A year later its value had depreciated to $13 376 using the declining balance method.

(a) What is the annual rate of depreciation? **2**

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(b) Calculate its value after a further five years. **1**

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Question 36 (2 marks)

Angel sets up this spreadsheet to track the progress of her loan on a monthly basis.

Principal (P) = $45 000.00
Annual Interest rate (r) = 8%
Monthly repayment (R) = $500.00

This table assumes each month is one twelfth of a year.

N	Principal (P)	Interest (I)	*P + I*	*P + I - R*
1	$45,000.00	$300.00	$45,300.00	$44,800.00
2	$44,800.00	$298.67	$45,098.67	$44,598.67
3	$44,598.67	$297.32	$44,895.99	$44,395.99
4	$44,395.99	$295.97	$44,691.96	$44,191.96
5	$44,191.96			**Y**

Calculate the value that would appear at **Y**. **2**

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Question 37 (2 marks)

The table shows the future values of an annuity of $1 for periods between 4 and 8 years, for different interest rates. The contributions are made at the end of each year.

Years	Interest Rate Per Annum				
	5%	6%	7%	8%	9%
4	4.3101	4.3746	4.4399	4.5061	4.5731
5	5.5256	5.6371	5.7507	5.8666	5.9847
6	6.8019	6.9753	7.1533	7.3359	7.5233
7	8.1420	8.3938	8.6540	8.9228	9.2004
8	9.5491	9.8975	10.2598	10.6366	11.0285

(a) An annuity account is opened with an interest rate of 6% per annum and contributions of $4000 are made at the end of each year for 5 years. **1**

Calculate the value of the annuity after the last contribution is made.

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(b) Using an annuity account with the same interest rate and contributions as above, calculate the size of the contributions necessary to achieve a value of $25 000 after 5 years. **1**

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Question 38 (6 marks)

Mahalia wants to save $12 500 for a river cruise that she is planning to take in 5 years.

Mahalia has decided to deposit $M every 6 months into an on-line savings account which pays interest of 4.5% p.a. compounded 6-monthly.

So that Mahalia can calculate how much each 6-monthly deposit should be, she uses the future value of an annuity formula:

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

(a) Write down the values of ***r*** (as a decimal to 4 places) and ***n*** that Mahalia would use in this formula? **2**

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(b) Calculate the amount that Mahalia needs to deposit every 6 months (to the nearest dollar). **2**

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(c) How much interest will have been paid into Mahalia's account at the end of the 5 years? **2**

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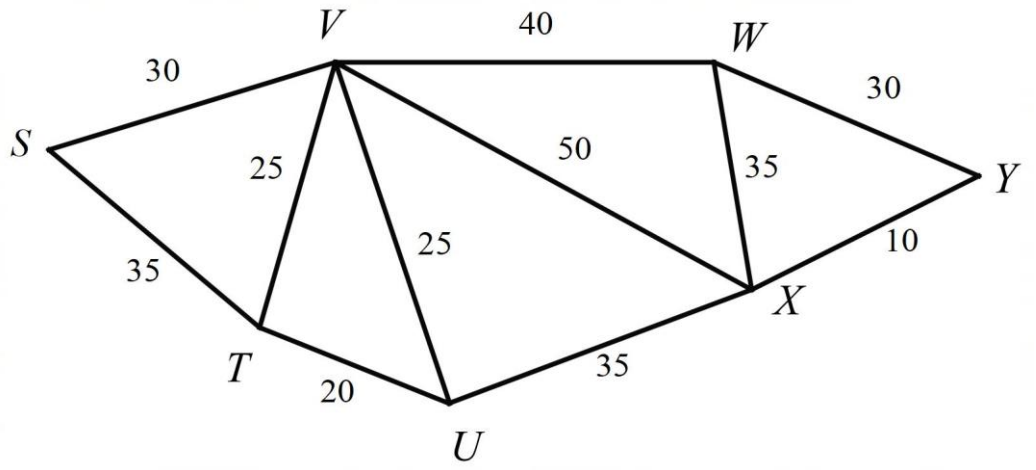
Question 39 (3 marks)

A new electricity supply network is to be constructed for seven buildings on a farm.

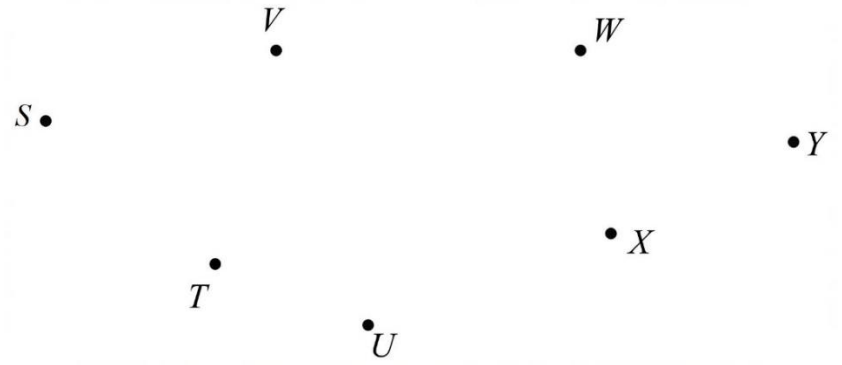
The owners have considered possible routes for the cables connecting the buildings.

The construction cost *in hundreds of dollars* is shown on each cable.

The generator for the network can be located in any building.



(a) Draw a minimum spanning tree for the electricity network on the vertices below. **2**



(b) Calculate the minimum cost of constructing the network of cables. **1**

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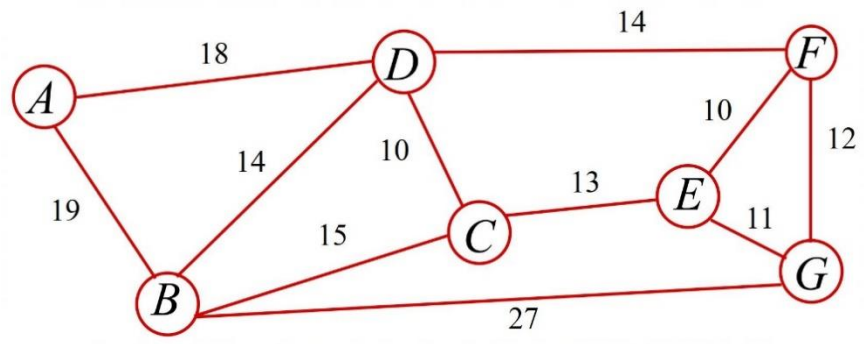
Question 40 (4 marks)

The network diagram below represents a network of tracks joining buildings on a dairy farm.



All tracks can be travelled in either direction.
The numbers indicate the travel time between buildings in minutes.

(a) Complete the missing values in the table below to represent this network diagram. **2**

	A	B	C	D	E	F	G
A		19		18			
B	19		15	14			27
C							
D						14	
E						10	11
F				14	10		12
G		27			11	12	

(b) Determine the shortest travel time between buildings A and G and the tracks which would be followed to achieve this time. **2**

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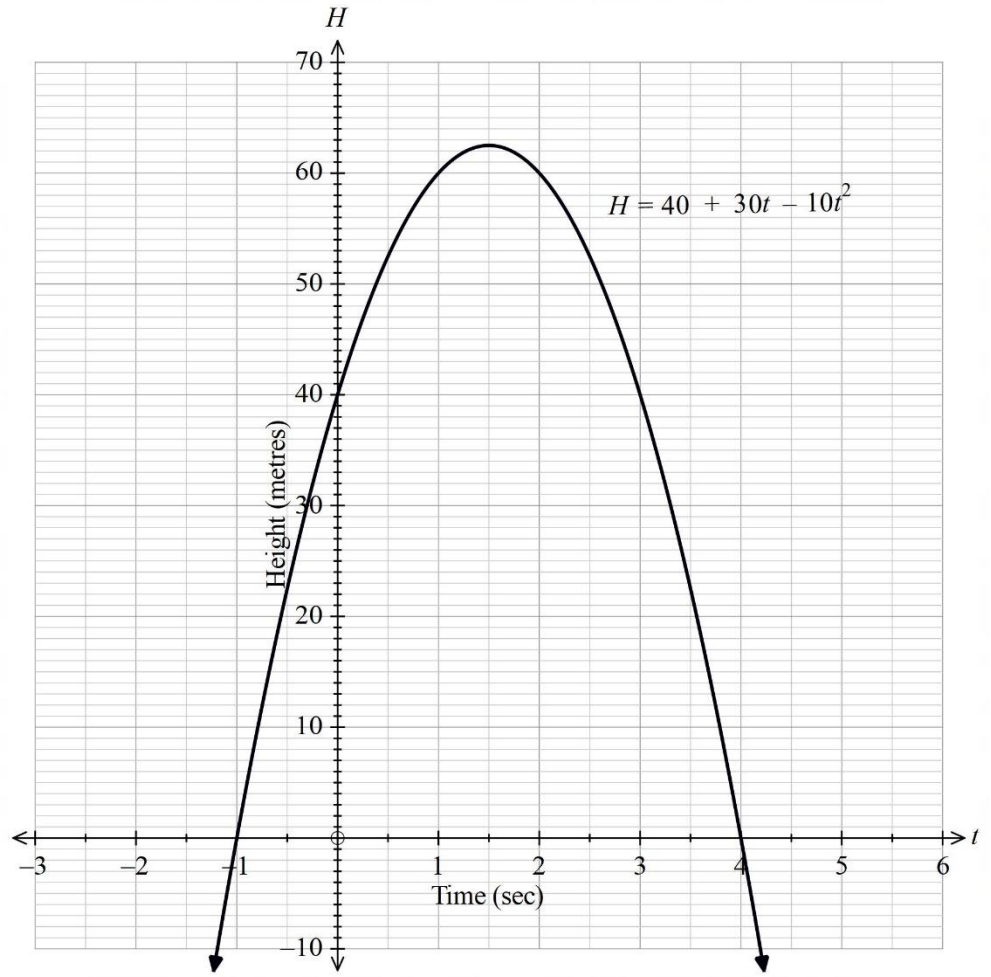
Question 41 (3 marks)

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

She uses a graphics package to draw the graph of the equation, below.



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

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……

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

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(c) For which values of *t* in the graph above does the graph describe the situation of the ball being thrown? **1**

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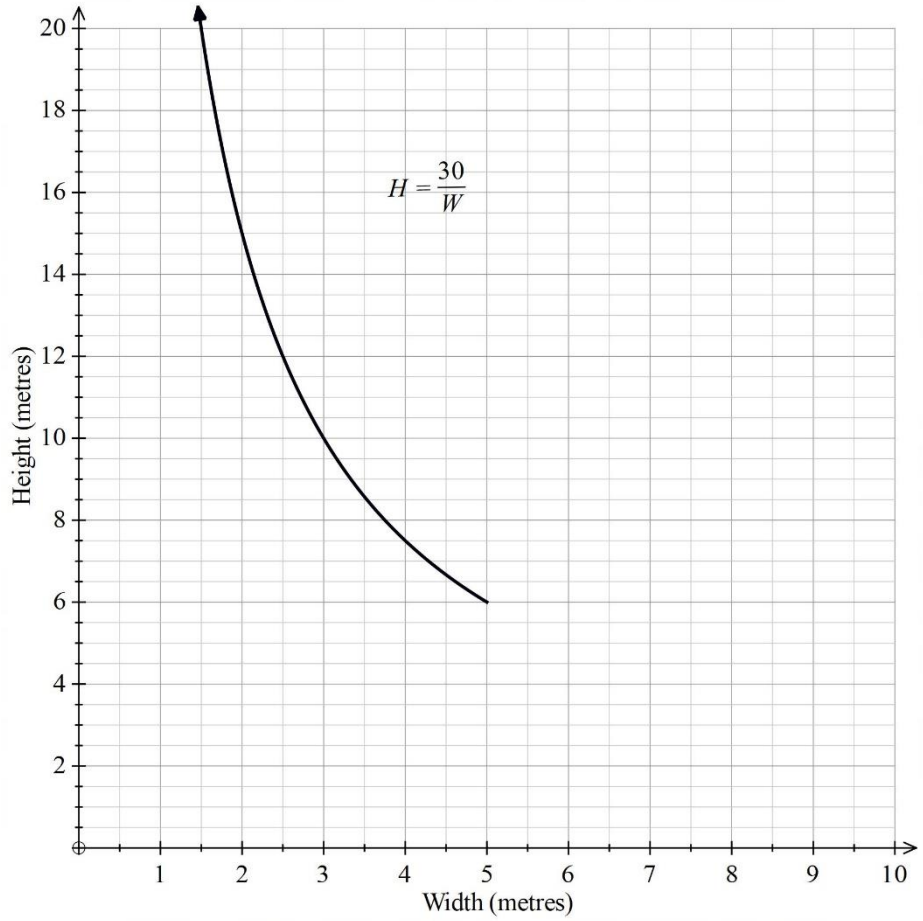
……

Question 42 (3 marks)

A billboard is to be constructed with an area of 30 square metres.

Harry has begun to draw a graph to represent the relationship between the height (H) and width (W) of the billboard using the equation $H = \frac{30}{W}$.



(a) Calculate the height of a billboard which has a width of 7 metres, giving your answer correct to 2 significant figures. **1**

……

……

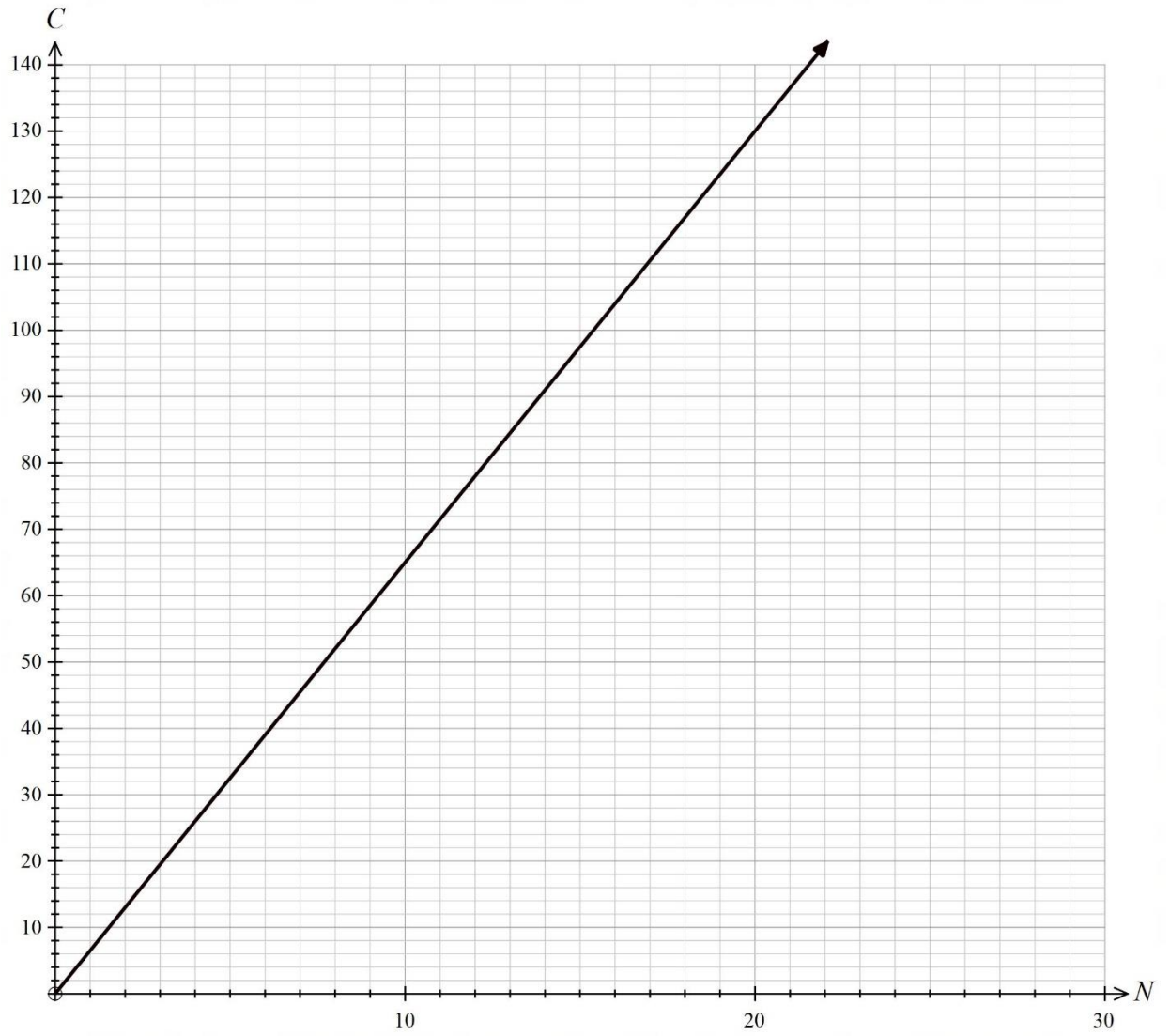
(b) Complete the graph above for widths up to 10 metres. **2**

Question 43 (3 marks)

Millie makes Venus Bars for a fete and sells the bars for $6.50 each.

It costs her $24 to set up to make the bars and then $5.00 per bar for ingredients and cooking.

The line $I = 6.5N$ has been drawn on the graph to represent the income (I) from selling N bars.



(a) Draw the line which represents the equation $C = 24 + 5N$ on the graph above. **1**

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Question 43 continues on page 35

Question 43 continued

(b) Find the number of bars that need to be sold to break even. **1**

……

……

(c) What profit (or loss) would be made if she sold only 5 bars? **1**

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Question 44 (2 marks)

Given the formula $G = \frac{5}{m^2} + f$

Make *m* the subject of the formula. **2**

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END OF EXAM

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Section II Extra writing space

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

Section II Extra writing space

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

Mathematics Standard 1
Mathematics Standard 2

REFERENCE SHEET

Measurement

Limits of accuracy

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

Upper bound = measurement + absolute error

Lower bound = measurement – absolute error

Length

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

Area

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

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

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

Surface area

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

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

Volume

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

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

Trigonometry

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

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

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

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

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

Financial Mathematics

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

Straight-line method of depreciation

$$S = V_0 - Dn$$

Declining-balance method of depreciation

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

Statistical Analysis

An outlier is a score

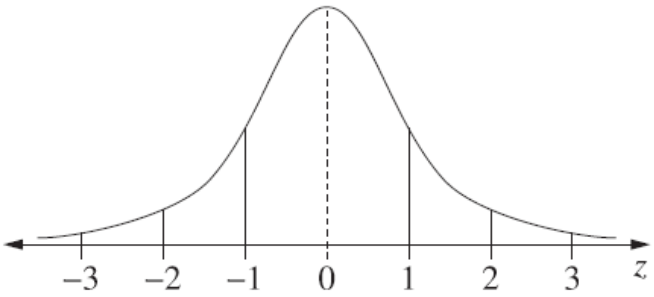
less than $Q_1 - 1.5 \times IQR$

or

more than $Q_3 + 1.5 \times IQR$

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

Normal distribution



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

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Carlingford High School

2020 Trial Higher School Certificate Examination

Mathematics Standard 2

Student Number _____

Section I – Multiple Choice Answer Sheet

Allow about 25 minutes for this section

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

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

A ○ B ● C ○ D ○

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

A ● B ⊗ C ○ D ○

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

A ⊗ B ⊗ (correct) C ○ D ○

1.	A ○	B ○	C ○	D ○
2.	A ○	B ○	C ○	D ○
3.	A ○	B ○	C ○	D ○
4.	A ○	B ○	C ○	D ○
5.	A ○	B ○	C ○	D ○
6.	A ○	B ○	C ○	D ○
7.	A ○	B ○	C ○	D ○
8.	A ○	B ○	C ○	D ○
9.	A ○	B ○	C ○	D ○
10.	A ○	B ○	C ○	D ○
11.	A ○	B ○	C ○	D ○
12.	A ○	B ○	C ○	D ○
13.	A ○	B ○	C ○	D ○
14.	A ○	B ○	C ○	D ○
15.	A ○	B ○	C ○	D ○