KNOX GRAMMAR SCHOOL

2022 **HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION**

Mathematics Standard 2

General Instructions:

- Reading Time – 10 mins
- Working time – 2 hours and 30 minutes
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided as on a separate document
- For 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
- Allow about 25 minutes for this section

Section II – 85 marks (pages 10–28)

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

Questions	Mark	Out of
Q1-15		/15
Q16-21		/16
Q22-25		/15
Q26-30		/15
Q31-35		/15
Q36-39		/15
Q40-41		/9
Total		**/100**

This paper is issued in accordance with CSSA Terms and Conditions.

Section I

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

Use the Multiple-Choice Answer Sheet for Questions 1 - 15.

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1 Amy is paid by commission only for working as a salesperson.

Which of the following situations would ensure Amy earns more money?

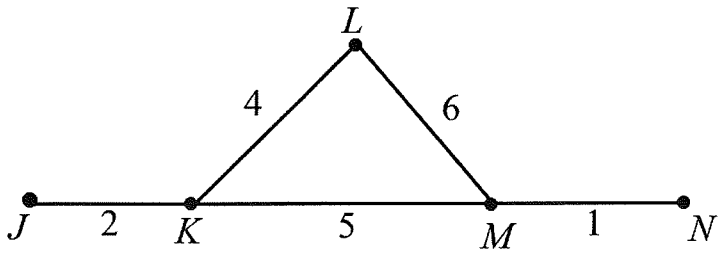
(A) Working from home.

(B) Working on the weekend.

(C) Working extra hours at night.

(D) Increasing the value of her sales.

2 A weighted network is shown below.



What is the weight of the minimum spanning tree?

(A) 8

(B) 12

(C) 13

(D) 18

3 The graph of $y = 3^x$ is

(A) a straight line.

(B) a parabola.

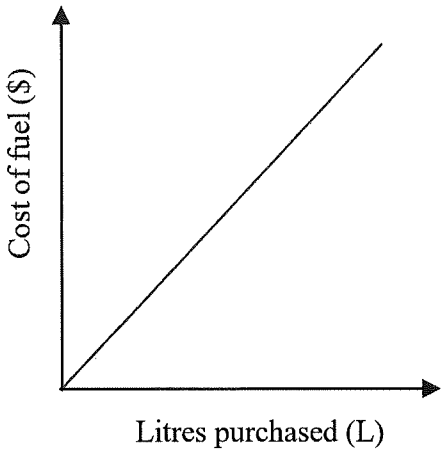
(C) a hyperbola.

(D) an exponential.

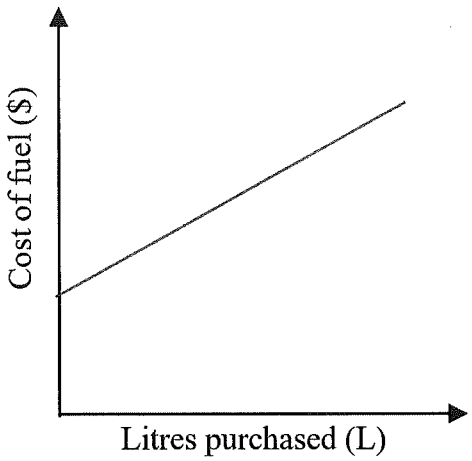
4 The total cost paid for fuel varies directly with the number of litres of fuel purchased.

Which of the following graphs represents this variation?

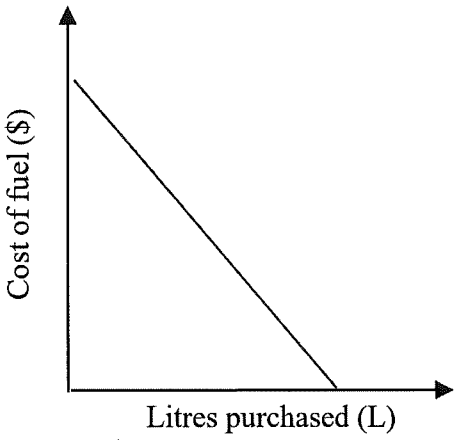
(A)



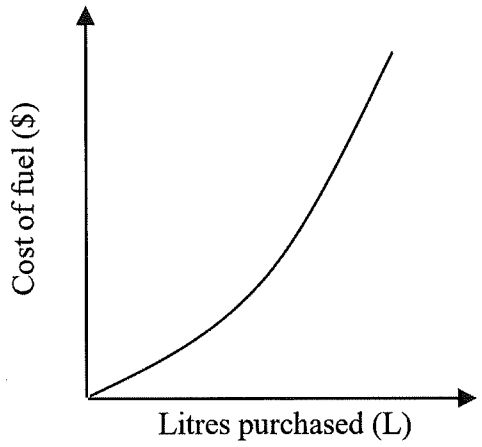
(B)



(C)



(D)



5 Angus has received four quotes for the cost of new carpet to be purchased and installed in his bedroom.

	Carpet Cost	Installation Cost
Quote A	\$75 per m^2	\$90 per m^2
Quote B	\$90 per m^2	\$1000
Quote C	\$175 per m^2	Free
Quote D	\$1800	\$800

Given that the rectangular bedroom is 3 metres by 5 metres, which quote is the best buy?

(A) Quote A

(B) Quote B

(C) Quote C

(D) Quote D

6 The area of New South Wales is 801 150 km^2.

What is the area of New South Wales when written in standard form, correct to two significant figures?

(A) 8.0×10^5

(B) 8.01×10^5

(C) 8.1×10^5

(D) 80.12×10^5

7 Mr Miller gave his Year 7 Mathematics class a topic test.

On the first attempt, the class had a mean mark of 65 and a standard deviation of 5.

The class was given a chance to sit the test again and every student improved by exactly 20 marks.

Which of the following is correct about the marks of the second test?

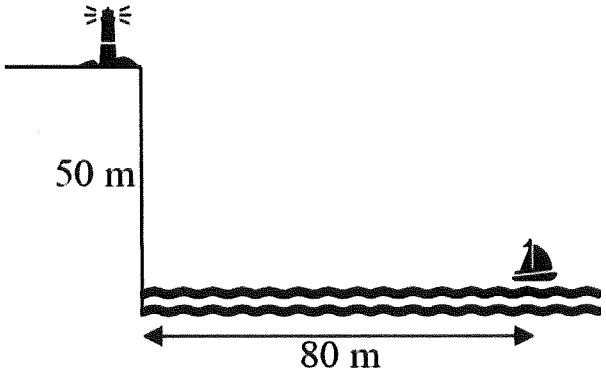
(A) The mean and standard deviation both increased.

(B) The mean remained the same and the standard deviation increased.

(C) The mean increased and the standard deviation remained the same.

(D) The mean remained the same and the standard deviation decreased.

8 A lighthouse sits on top of a 50 metre high cliff. A yacht is 80 metres out to sea below the lighthouse.



NOT TO SCALE

What is the angle of depression of the yacht from the base of the lighthouse to the nearest degree?

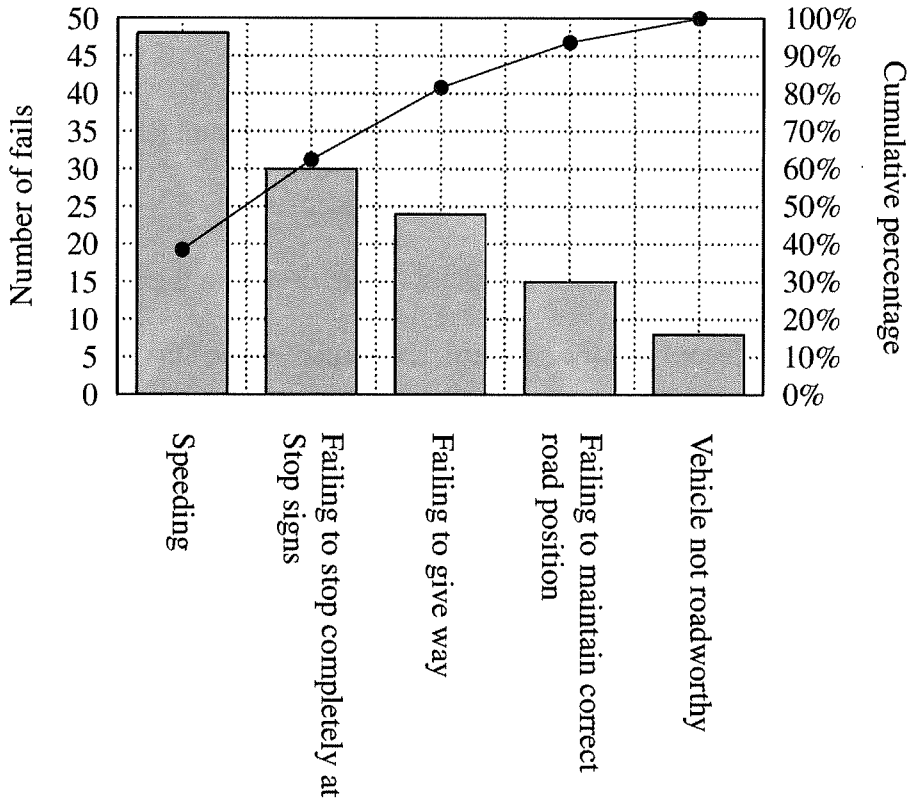
(A) 32°

(B) 39°

(C) 51°

(D) 58°

9 The Pareto chart below show the reasons why learner drivers at a particular testing centre failed their driving test.



Approximately what percentage of learner drivers failed because they did not stop completely at stop signs?

(A) 75%

(B) 62%

(C) 40%

(D) 24%

10 The world's largest passenger plane is the Airbus A380 which is 73 metres long.

A toy model of an Airbus A380 is 36.5 cm long.

What is the scale of the toy model?

(A) 1:20

(B) 1:50

(C) 1:200

(D) 1:500

11 What is the value of $a^2 - b$, when $a = -5$ and $b = -3$?

(A) 28

(B) 22

(C) -8

(D) -22

12 The price of a loaf of bread is \$2.85.

Given that the price is only increasing due to inflation at a rate of 1.3% per annum, what is the expected price of a loaf of bread after 14 years?

(A) \$3.37

(B) \$3.41

(C) \$4.15

(D) \$6.26

13 A regular deck of playing cards contains the same number of cards of each suit – hearts, diamonds, spades and clubs.

Kate conducted an experiment where she randomly selected a card from a regular deck, recorded the suit of the card, returned it to the deck and shuffled the cards.

She repeated this experiment 20 times and her results are recorded in the table below.

Hearts	♥	5
Diamonds	♦	4
Spades	♠	4
Clubs	♣	7

Which of the following statements about Kate's experiment is FALSE?

(A) Kate's experimental probability was equal to the theoretical probability for hearts.

(B) Kate's experimental probability was lower than the theoretical probability for diamonds.

(C) Kate's experimental probability was higher than the theoretical probability for spades.

(D) Kate's experimental probability was higher than the theoretical probability for clubs.

14 Given that $\sin\theta = \dfrac{10 \times \sin 70°}{20}$ and θ is obtuse, what is the size of θ, correct to the nearest degree?

(A) 94°

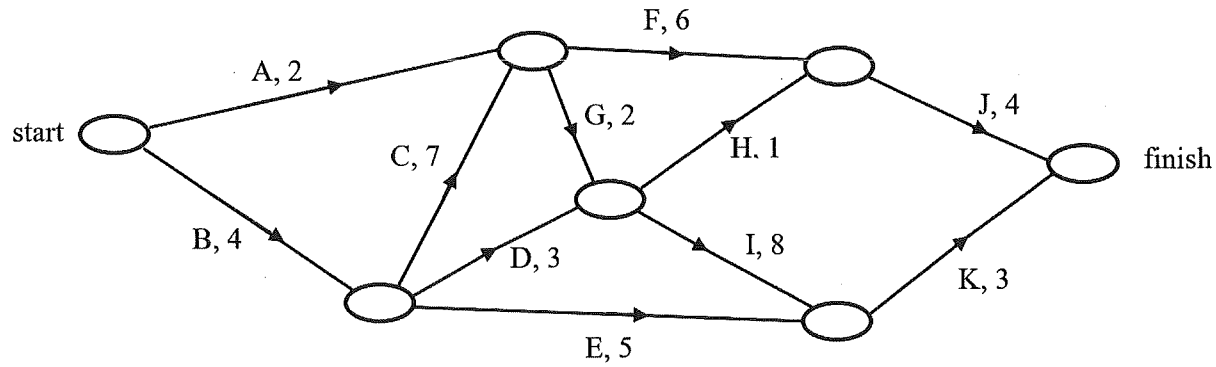
(B) 118°

(C) 128°

(D) 152°

15 A project which requires activities A to K to be completed is shown in the network diagram below.

The minimum time for the project to be completed is 24 days.



What is the float time for activity E?

(A) 5 days

(B) 11 days

(C) 12 days

(D) 16 days

Section II

85 marks
Attempt Questions 16 - 41
Allow about 2 hours and 5 minutes for this section

Answer the questions in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.
Extra writing space is provided on pages 29-31. If you use this space, clearly indicate which question you are answering.

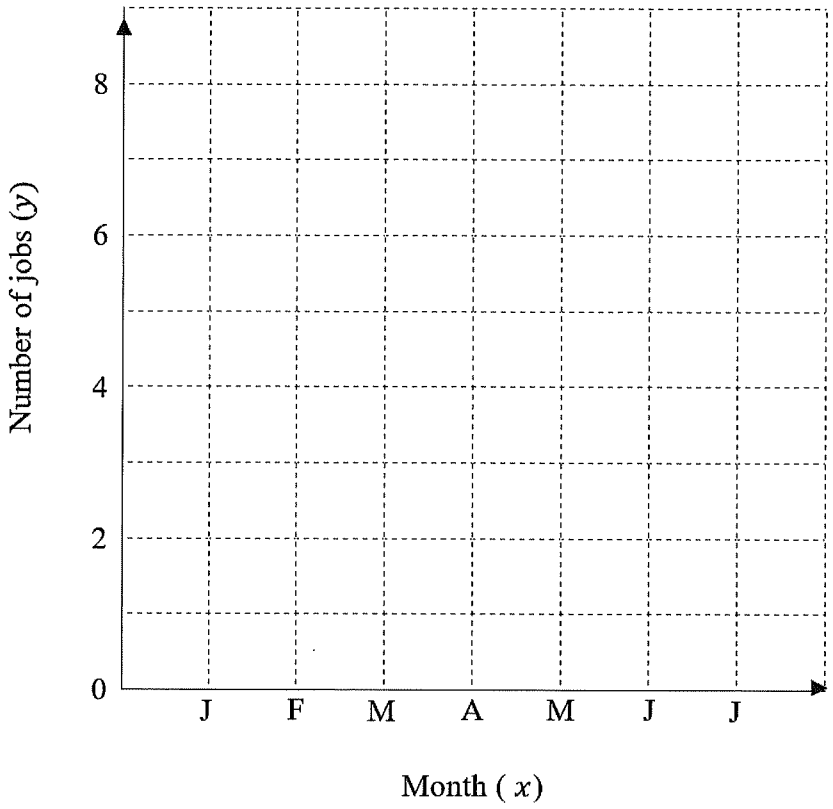
Question 16 (3 marks)

Joseph owns and operates a concreting business.

The number of jobs that Joseph did each month for the first seven months of the year are shown in the table below.

Month (x)	Jan	Feb	March	April	May	June	July
Number of jobs (y)	3	6	5	4	6	8	7

(a) Draw a scatterplot for this data. **2**



(b) Draw a line of best fit by eye on the scatterplot that you have drawn above. **1**

Question 17 (2 marks)

Natalie is a swimming instructor who is paid $27.60 per hour. **2**

What is Natalie paid for working 15 hours at normal time and 6 hours at time-and-a-half?

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Question 18 (2 marks)

Ethel had a budget $200 for fuel for a road trip during the holidays. Her car has a fuel consumption of 6.2 L/100km and she paid $1.79 per litre for fuel throughout the trip. **2**

To the nearest kilometre, how many kilometres was Ethel able to travel within her budget?

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Question 19 (3 marks)

Prince Edward Island is located at 46°N, 63°W.

La Palma is located at 29°N, 18°W.

(a) Which is the difference in longitude between Prince Edward Island and La Palma? **1**

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(b) What is the local time on Prince Edward Island when it is 10 am in La Palma? **2**

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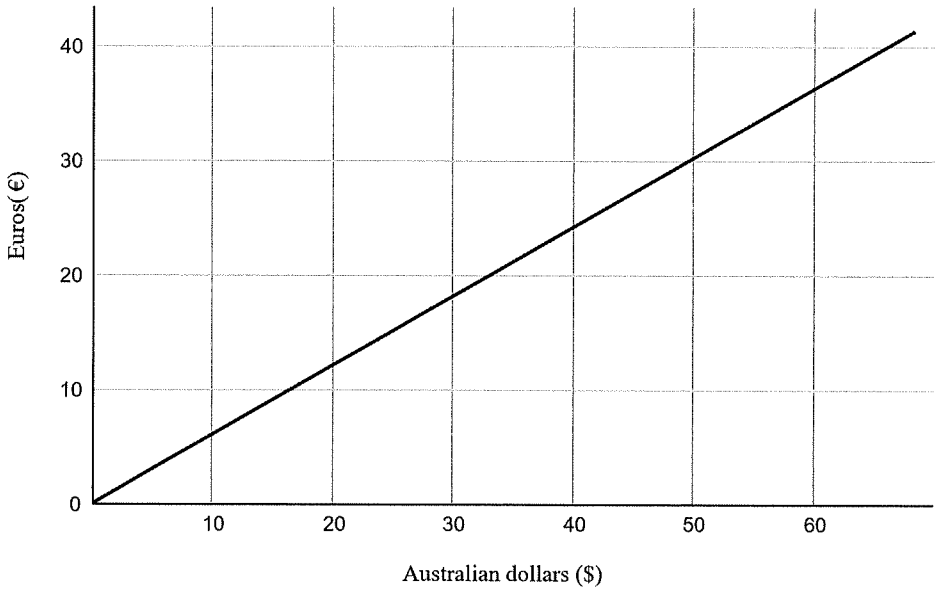
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Question 20 (2 marks)

Davis is shopping online. He is looking at items in various currencies. **2**

Davis knows that currently 1 Australian dollar is equivalent to 0.75 US dollars.

He also has the conversion graph below which converts between Australian dollars and Euros.



Davis has decided to purchase an item costing 40 Euros.

Use the information given to determine the value of Davis' purchase in US dollars.

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Question 21 (4 marks)

The height, in centimetres, of the twelve players in the Australian Netball Team are:

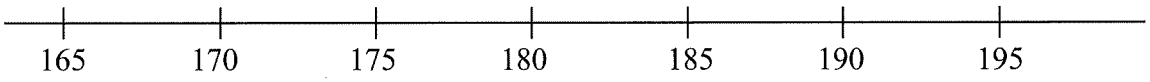
168 176 179 181 182 185 187 188 190 190 193 195

(a) What is the mean height of the Australian netball players? **1**

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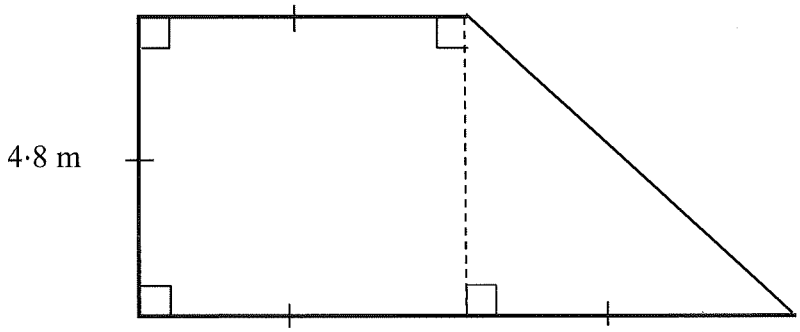
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(b) Construct the box plot for this data. **3**



Question 22 (3 marks)

The courtyard shown in the sketch below is to be fenced around the outside boundary. **3**



NOT TO SCALE

Given the fence costs $52 per metre, calculate the total cost of the fence around the courtyard.

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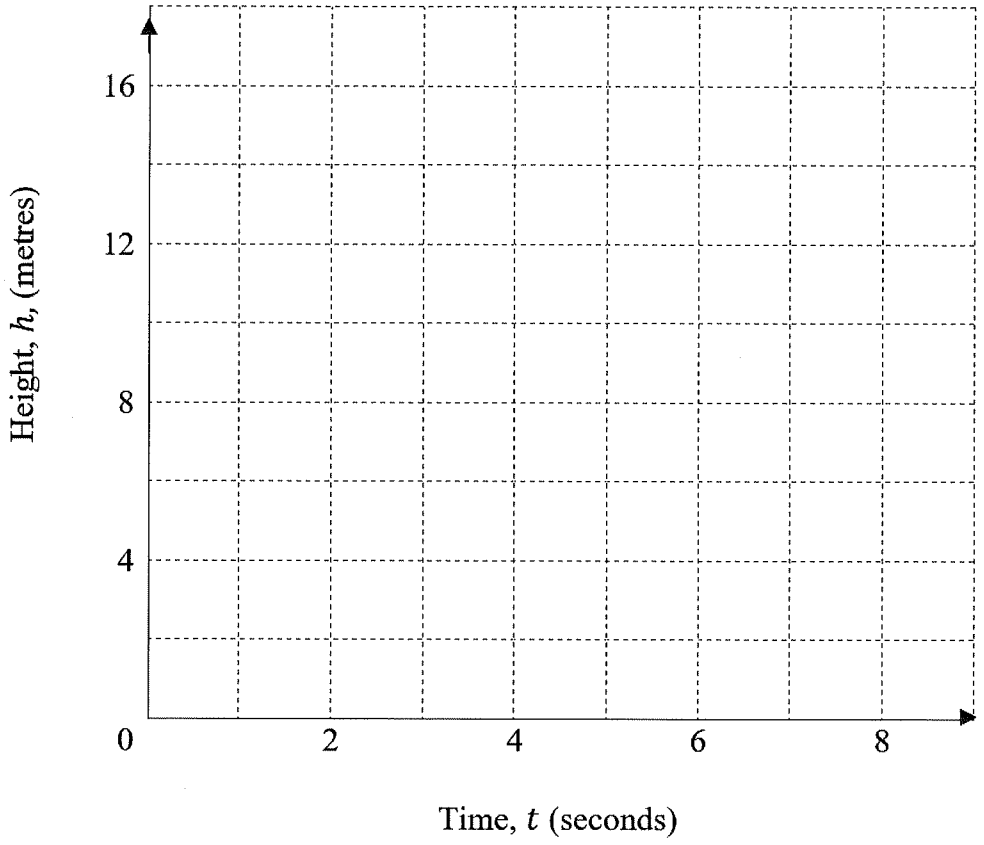
Question 23 (5 marks)

Gideon threw a ball into the air.

The height of the ball, h metres, can be modelled by the quadratic equation, $h = -t^2 + 8t + 1$, where t is the time in seconds since the ball was thrown.

(a) Complete the table of values and draw the graph to model the height of the ball on the axes below. **4**

t	0	2	4	6	8
h					



(b) How long after being thrown does the ball reach its maximum height? **1**

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Question 24 (3 marks)

Sarah is delivering furniture from a warehouse in Auburn (A), to homes in Bankstown (B), Chatswood (C) and Dundas (D).

The table below show the distances, in kilometres, between each location.

	A	B	C	D
A	-	10	21	7
B	10	-	26	16
C	21	26	-	18
D	7	16	18	-

(a) Draw a network diagram to represents the information given in the table. **2**

(b) Sarah began the delivery at the Auburn warehouse and then travelled to Dundas, Chatswood and Bankstown, in that order. She then returned to the warehouse at Auburn. **1**

What is the total distance that Sarah travelled?

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Question 25 (4 marks)

Harry and John are brothers who live 3 km from their school. Harry walks to school at an average speed of 5 km/h and John rides his bicycle to school at an average speed of 12 km/h. **4**

If Harry leaves home at 8:10 am, what time must John leave home so that he arrives at school at the same time as his brother?

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Question 26 (3 marks)

Tim purchased 500 shares for $2.35 per share and later sold them for $3.50 per share. Tim paid brokerage fees on the purchase and sale of the shares as shown in the table. **3**

Brokerage Fees	
Purchase of shares	2% of the purchase price
Sale of shares	3% of the sale price

Given that he did not receive any dividend, calculate the profit that Tim earned from the shares.

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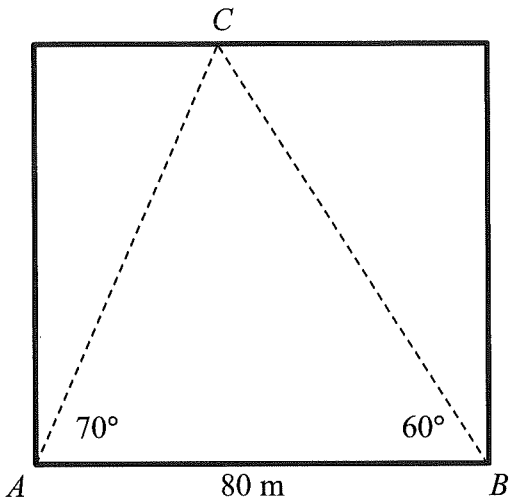
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Question 27 (4 marks)

Ann, Bo Lai and Corinne are positioned at points A, B and C respectively on a rectangular playground as shown in the diagram below.

The length of the playground is 80 metres, $\angle ABC = 60°$ and $\angle BAC = 70°$.



NOT TO SCALE

(a) Calculate the distance from Bo Lai to Corinne. Give your answer correct to the nearest metre. **2**

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(b) Calculate the width of the playground. Give your answer correct to the nearest metre. **2**

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Question 28 (3 marks)

The weight of babies born in a hospital were found to be normally distributed with a mean of 3.5 kg and a standard deviation of 1.0 kg.

(a) Raphael was born weighing 4.25 kg. **1**

What is the value of the z-score of Raphael's birth weight?

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(b) A baby is considered to have Very Low Birth Weight (VLBW) if they are born weighing less than 1.5 kg. **2**

Given that in 2020, the hospital recorded 8 babies born with VLBW, how many babies would be expected to have been born in total in the hospital that year?

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Question 29 (2 marks)

Re-arrange the following equation to make a the subject. **2**

$$c = \frac{x^2 - a}{b}$$

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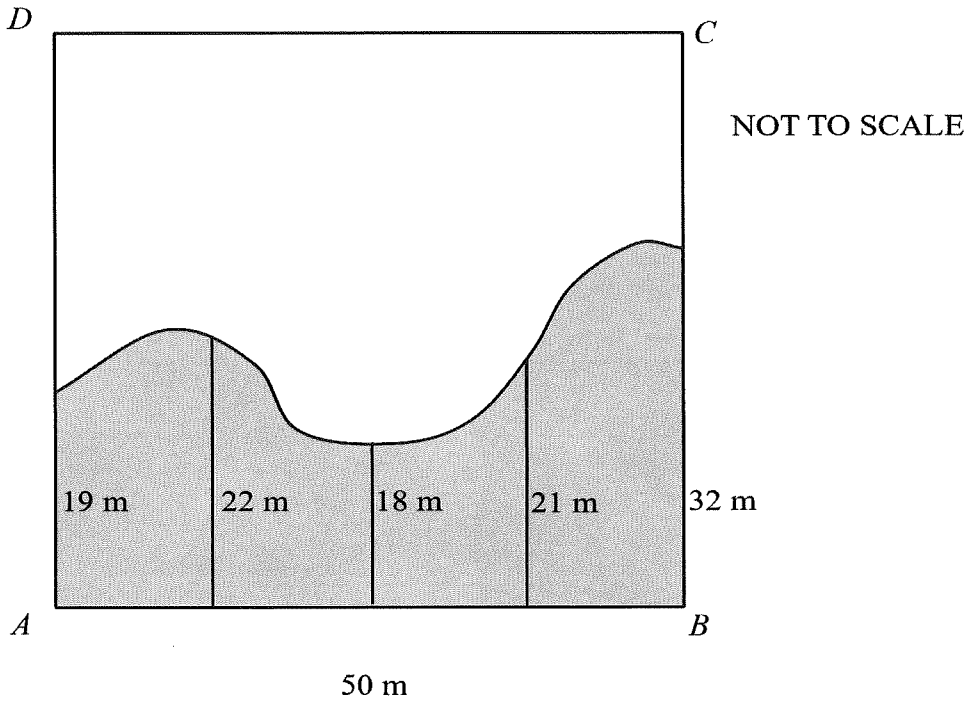
Question 30 (3 marks)

Archaeologists are excavating a square plot *ABCD* measuring 50 metres by 50 metres.

The plot is divided into four sections of equal width as shown in the diagram below.

At the end of the first phase of digging, the shaded area has been excavated.

Measurements made to the edges of the excavated area are also shown on the diagram.



(a) Use the trapezoidal rule with each of the measurements given to estimate the shaded area. **2**

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(b) Express the shaded area as a percentage of the total area. Give your answer correct to two decimal places. **1**

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Question 31 (3 marks)

Emma is saving for a new car. She deposits $2200 into an annuity account at the end of each year for four years. The account pays 3% per annum interest, compounding annually. **3**

The table below shows future values of an annuity of $1.

Years	Interest rate per annum						
	1%	**1.5%**	**2%**	**2.5%**	**3%**	**3.5%**	**4%**
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0150	2.0200	2.0250	2.0300	2.0350	2.0400
3	3.0301	3.0452	3.0604	3.0756	3.0909	3.1062	3.1216
4	4.0604	4.0909	4.1216	4.1525	4.1836	4.2149	4.2465
5	5.1010	5.1523	5.2040	5.2563	5.3091	5.3625	5.5256

How much interest does Emma earn on her investment over the four years?

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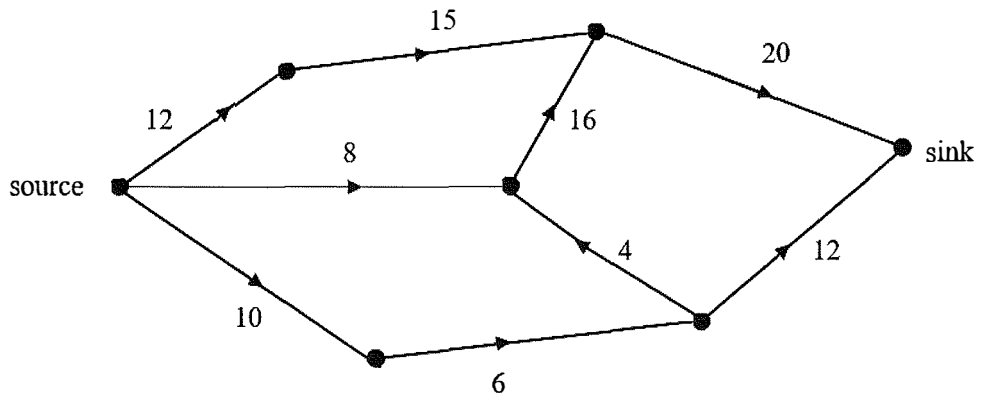
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Question 32 (2 marks)

The network below shows the maximum possible flow between vertices. **2**

Draw the minimum cut on the network diagram and calculate the maximum flow between the source and the sink.



Maximum flow = ……

Question 33 (3 marks)

Steve and Stella take out a loan of \$50 000 for home renovations at 3% per annum compounded monthly. They make regular repayments of \$750 at the end of each month. **3**

The recurrence relation to model this situation is given by the formula

$$A_n = A_{n-1}\,(1.0025) - 750$$

How much have Steve and Stella paid off the amount they borrowed after the first three repayments?

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Question 34 (4 marks)

A football coach is studying the relationship between the weight in kilograms of players and their vertical jump in metres. The coach believes that players who weigh less are able to jump higher.

The data from ten players is shown in the table below.

weight, (w)	84.5	83.3	58.7	74.1	70.7	72.3	75.8	71.8	63.2	65.9
vertical jump (v)	21.9	20.5	20.8	19.9	20.6	18.8	22.8	20.6	20.0	21.8

(a) Find the equation of the least-squares regression line. Give each value correct to two decimal places. **2**

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(b) By calculating Pearson's correlation coefficient for the data, correct to three decimal places, justify whether the data confirms the association between weight and vertical jump. **2**

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Question 35 (3 marks)

A washing machine uses 2025 kilojoules of energy during a 90 minute washing cycle.

(a) Calculate the power consumption of the washing machine in watts (W). **2**

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(b) Calculate the cost of running the washing machine for one hour, given the cost of electricity is \$0.3159 per kilowatt-hour. **1**

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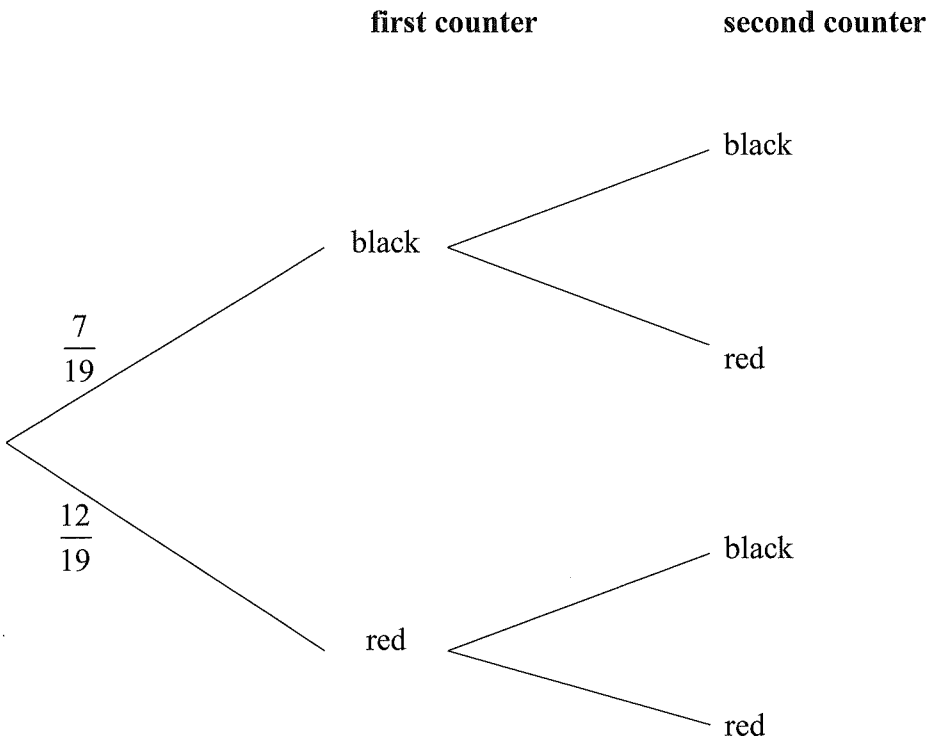
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Question 36 (3 marks)

A bag contains 7 black and 12 red counters.

Lucas selects two counters from the bag at random without replacement.

(a) Complete the probability tree below, showing the probability of each of the four possible selections for the second counter. **1**



(b) By using the probability tree, or otherwise, determine whether Lucas is more likely to select two counters of the same colour or two counters of different colours. **2**

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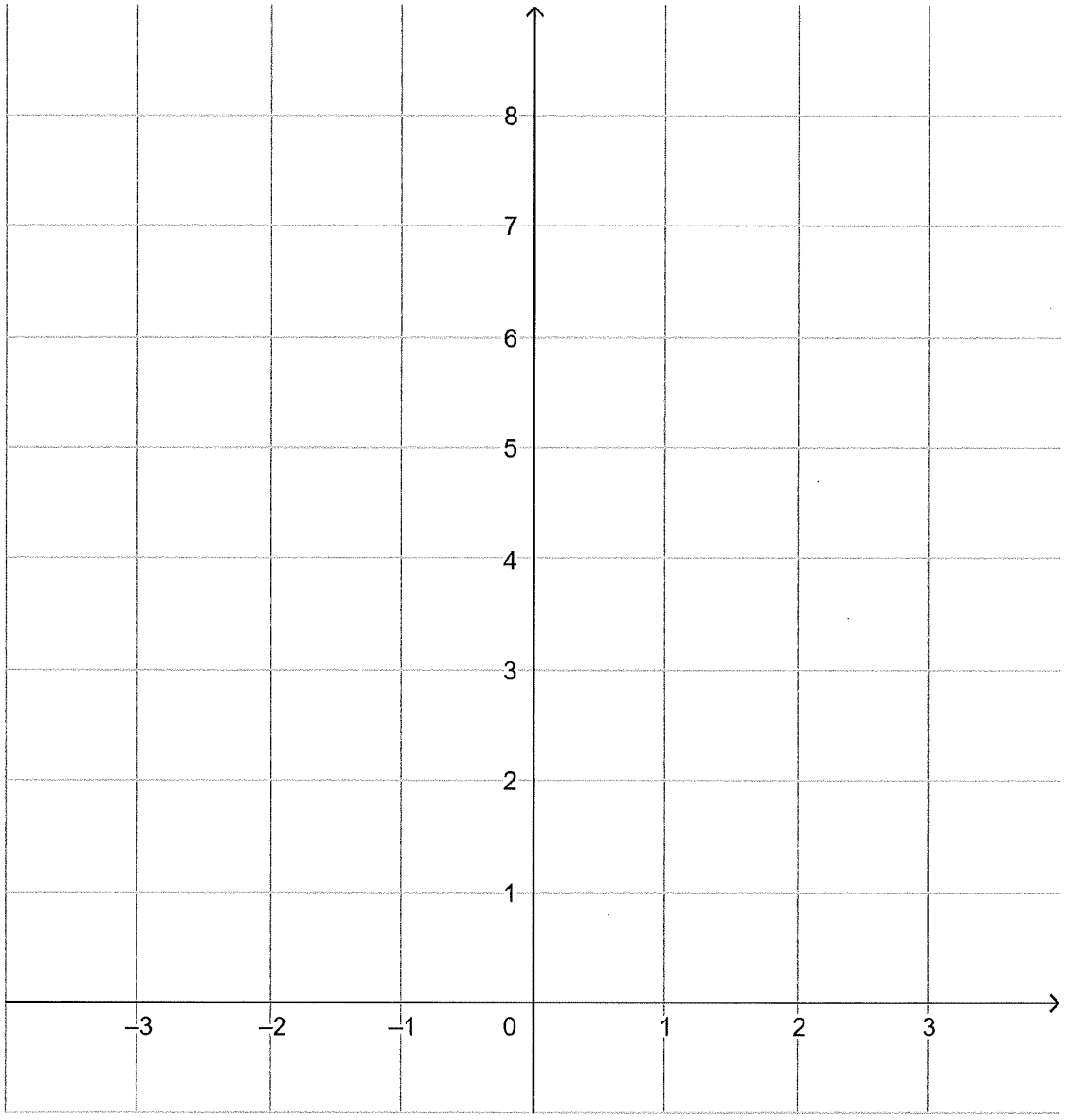
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Question 37 (3 marks)

Graph the following pair of equations and identify the co-ordinates of the point of intersection of the two lines. **3**

$$y = \frac{x}{2} + 4 \qquad \text{and} \qquad y = 2x + 7$$



Co-ordinates of the point of intersection = ...

Question 38 (5 marks)

The activity chart below shows the tasks that are required to be completed by a building company for the construction of a new house.

Activity	Duration (weeks)	Prerequisites
A	3	-
B	7	-
C	4	A
D	2	A
E	3	B
F	1	D, E
G	1	B
H	5	C
I	3	F, G

(a) Draw a network diagram to represent this activity chart. **4**

On your diagram, show the earliest start time (EST) and latest start time (LST) of each activity by completing forward and backward scanning.

(b) List the activities that make up the critical path for this project. **1**

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Question 39 (4 marks)

A farmer is purchasing a tractor for $54 000.

(a) The tractor depreciates by the declining balance method of depreciation at a rate of 8.3% per annum. **1**

Calculate the value of the tractor after 10 years.

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(b) The farmer is taking out a loan for the purchase of the tractor. **3**

The loan repayment is $723 paid monthly over 10 years.

Calculate the equivalent annual flat rate of interest for the loan, correct to two decimal places.

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Question 40 (4 marks)

Ella contributes $1200 per month at the start of each month into an investment account which pays interest at 3.2% per annum, compounded monthly.

(a) Show that at the end of the second month, the future value of Ella's investment will be $2409.61. **2**

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(b) After 18 months, the future value of Ella's investment will be $22 155.56. **2**

Beth has a lump sum of $21 600 which is equivalent to the total of Ella's contributions. Beth invests her lump sum into the same investment account paying 3.2% per annum, compounded monthly.

How much more than Ella will Beth have in her investment account after 18 months?

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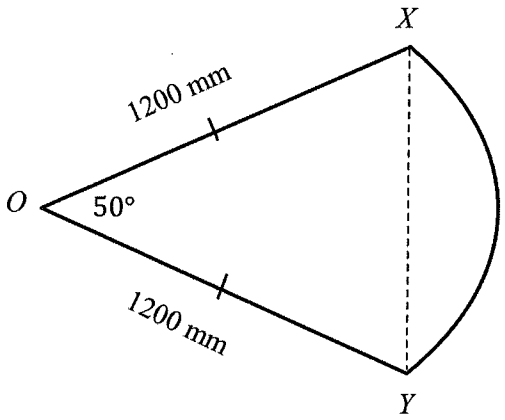
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Question 41 (5 marks)

OXY is a sector of a circle with an angle of 50° at the centre and a radius of 1200 mm. **5**



NOT TO SCALE

How much longer, to the nearest millimetre, is the arc *XY* than the interval *XY*?

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End of examination

Section II Extra Writing Space

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

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

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

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SOLUTIONS

KNOX GRAMMAR SCHOOL

2022 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Mathematics Standard 2

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Q36-39		/15
Q40-41		/9
Total		**/100**

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Section I

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1 Amy is paid by commission only for working as a salesperson.

Which of the following situations would ensure Amy earns more money?

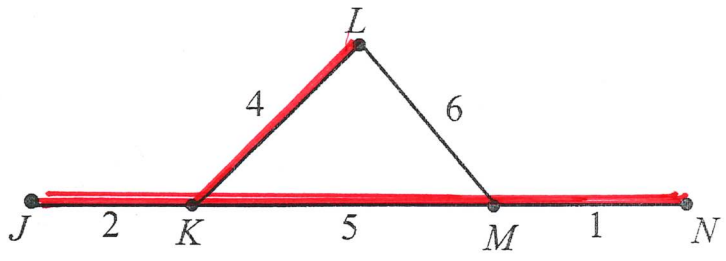
(A) Working from home.

(B) Working on the weekend.

(C) Working extra hours at night.

(D) Increasing the value of her sales.

2 A weighted network is shown below.



What is the weight of the minimum spanning tree?

2 + 5 + 1 + 4 = 12

(A) 8

(B) 12

(C) 13

(D) 18

3 The graph of $y = 3^x$ is

(A) a straight line.

(B) a parabola.

(C) a hyperbola.

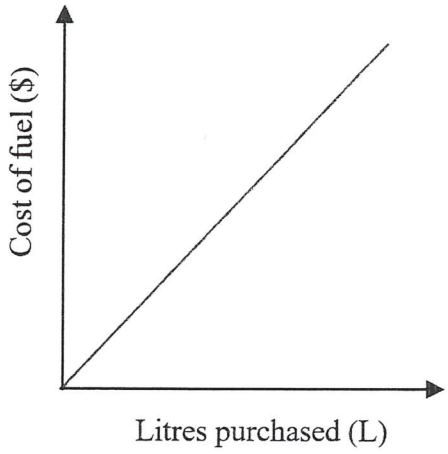
(D) an exponential.

4 The total cost paid for fuel varies directly with the number of litres of fuel purchased.

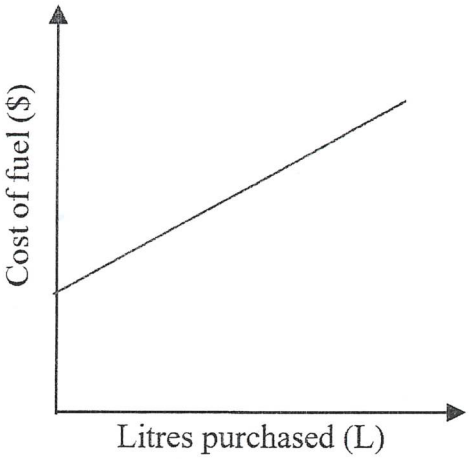
Which of the following graphs represents this variation?

direct variation

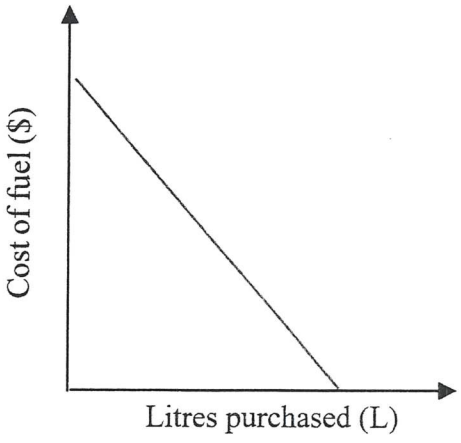
(A)



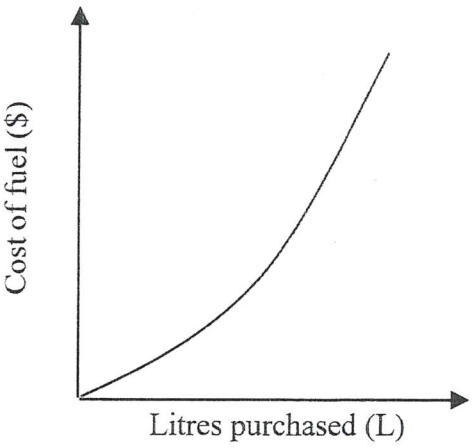
(B)



(C)



(D)



5 Angus has received four quotes for the cost of new carpet to be purchased and installed in his bedroom.

	Carpet Cost	Installation Cost	
Quote A	\$75 per m^2	\$90 per m^2	2475
Quote B	\$90 per m^2	\$1000	2350
Quote C	\$175 per m^2	Free	2625
Quote D	\$1800	\$800	27800

Given that the rectangular bedroom is 3 metres by 5 metres, which quote is the best buy?

(A) Quote A

(B) Quote B

(C) Quote C

(D) Quote D

6 The area of New South Wales is 801 150 km^2.

What is the area of New South Wales when written in standard form, correct to two significant figures?

(A) 8.0×10^5

(B) 8.01×10^5

(C) 8.1×10^5

(D) 80.12×10^5

7 Mr Miller gave his Year 7 Mathematics class a topic test.

On the first attempt, the class had a mean mark of 65 and a standard deviation of 5.

The class was given a chance to sit the test again and every student improved by exactly 20 marks.

Which of the following is correct about the marks of the second test?

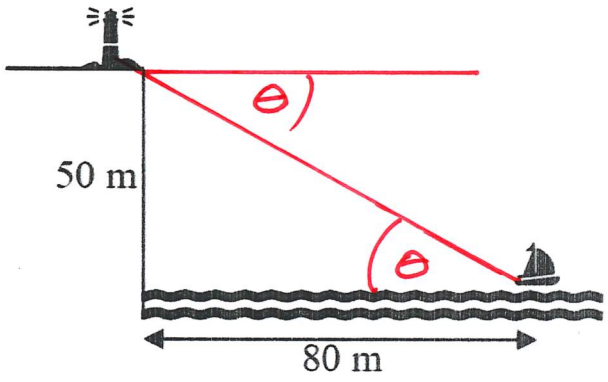
(A) The mean and standard deviation both increased.

(B) The mean remained the same and the standard deviation increased.

(C) The mean increased and the standard deviation remained the same.

(D) The mean remained the same and the standard deviation decreased.

8 A lighthouse sits on top of a 50 metre high cliff. A yacht is 80 metres out to sea below the lighthouse.



NOT TO SCALE

What is the angle of depression of the yacht from the base of the lighthouse to the nearest degree?

$\tan \theta = \frac{50}{80}$

$\theta = 32°$

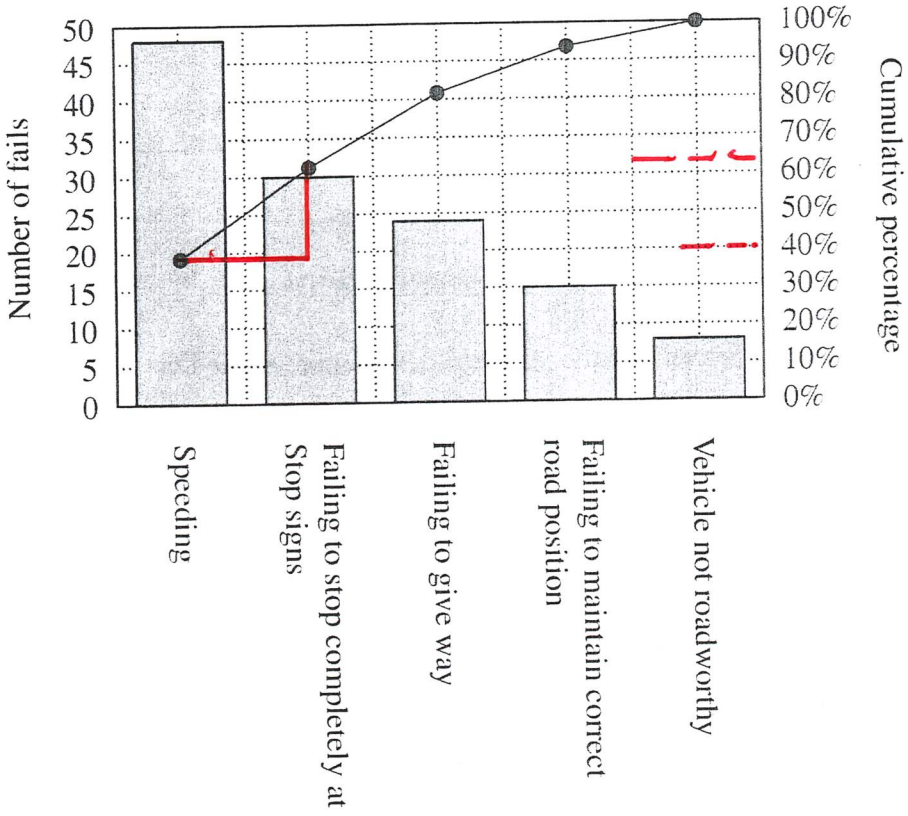
(A) 32°

(B) 39°

(C) 51°

(D) 58°

9 The Pareto chart below show the reasons why learner drivers at a particular testing centre failed their driving test.



Approximately what percentage of learner drivers failed because they did not stop completely at stop signs?

(A) 75%

(B) 62%

(C) 40%

(D) 24%

10 The world's largest passenger plane is the Airbus A380 which is 73 metres long.

A toy model of an Airbus A380 is 36.5 cm long.

What is the scale of the toy model?

(A) 1:20

(B) 1:50

(C) 1:200

(D) 1:500

$\frac{36.5}{73 \times 100} = \frac{1}{200}$

11 What is the value of $a^2 - b$, when $a = -5$ and $b = -3$?

(A) 28

(B) 22

(C) -8

(D) -22

$(-5)^2 - (-3) = 28$

12 The price of a loaf of bread is \$2.85.

Given that the price is only increasing due to inflation at a rate of 1.3% per annum, what is the expected price of a loaf of bread after 14 years?

(A) \$3.37

(B) \$3.41

(C) \$4.15

(D) \$6.26

$2.85 \times (1 + 1.3\%)^{14}$

$= \$3.41$

13 A regular deck of playing cards contains the same number of cards of each suit – hearts, diamonds, spades and clubs.

Kate conducted an experiment where she randomly selected a card from a regular deck, recorded the suit of the card, returned it to the deck and shuffled the cards.

She repeated this experiment 20 times and her results are recorded in the table below.

Hearts	♥	5
Diamonds	♦	4
Spades	♠	4
Clubs	♣	7

Which of the following statements about Kate's experiment is FALSE?

(A) Kate's experimental probability was equal to the theoretical probability for hearts. ✓

(B) Kate's experimental probability was lower than the theoretical probability for diamonds. ✓

(C) Kate's experimental probability was higher than the theoretical probability for spades. ✗

(D) Kate's experimental probability was higher than the theoretical probability for clubs.

14 Given that $\sin\theta = \dfrac{10 \times \sin 70°}{20}$ and θ is obtuse, what is the size of θ, correct to the nearest degree?

Acute $\theta = 28°$

Obtuse $\theta = 180 - 28$

$= 152°$

(A) 94°

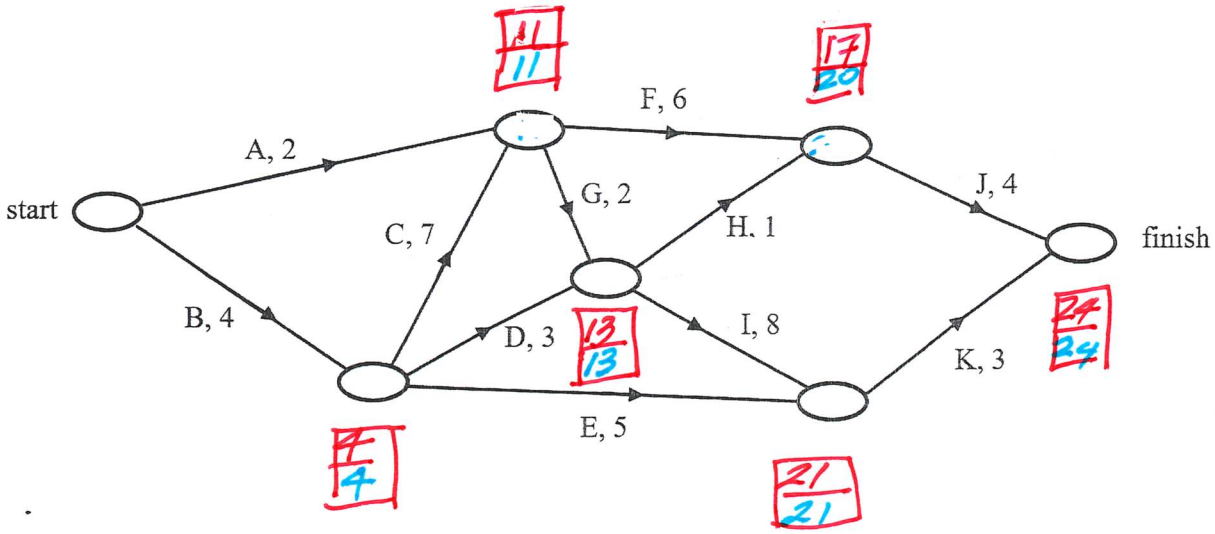
(B) 118°

(C) 128°

(D) 152°

15 A project which requires activities A to K to be completed is shown in the network diagram below.

The minimum time for the project to be completed is 24 days.



What is the float time for activity E?

(A) 5 days

(B) 11 days

(C) 12 days

(D) 16 days

21 - 4 - 5

Section II

85 marks
Attempt Questions 16 - 41
Allow about 2 hours and 5 minutes for this section

Answer the questions in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.
Extra writing space is provided on pages 29-31. If you use this space, clearly indicate which questio
you are answering.

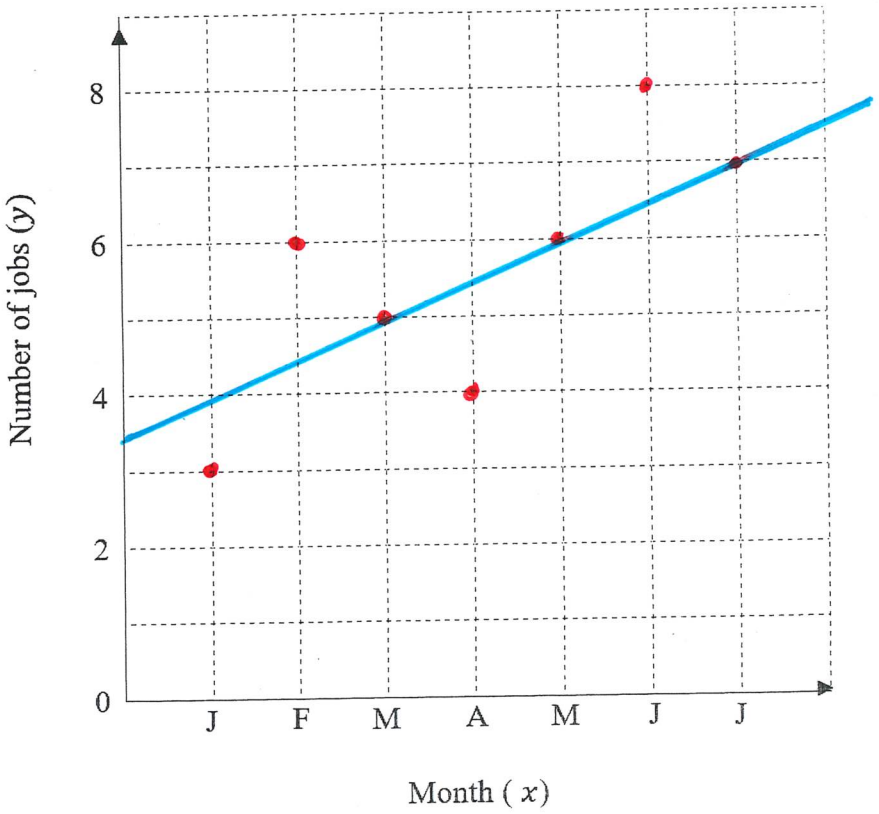
Question 16 (3 marks)

Joseph owns and operates a concreting business.

The number of jobs that Joseph did each month for the first seven months of the year are shown in the table below.

Month (x)	Jan	Feb	March	April	May	June	July
Number of jobs (y)	3	6	5	4	6	8	7

(a) Draw a scatterplot for this data. **2**



(b) Draw a line of best fit by eye on the scatterplot that you have drawn above. **1**

Question 17 (2 marks)

Natalie is a swimming instructor who is paid $27.60 per hour. **2**

What is Natalie paid for working 15 hours at normal time and 6 hours at time-and-a-half?

PAY = 15×27.60 + 6×1.5×27.60 ✓

= $662.40 ✓

Question 18 (2 marks)

Ethel had a budget $200 for fuel for a road trip during the holidays. Her car has a fuel consumption of 6.2 L/100km and she paid $1.79 per litre for fuel throughout the trip. **2**

To the nearest kilometre, how many kilometres was Ethel able to travel within her budget?

$200 ÷ $1.79 = 111.73... ✓

$\frac{N}{111.73..} = \frac{100}{6.2}$ ∴ N = 1802.13(2dp)

= 1802 km ✓

Question 19 (3 marks)

Prince Edward Island is located at 46°N, 63°W.

La Palma is located at 29°N, 18°W.

(a) Which is the difference in longitude between Prince Edward Island and La Palma? **1**

63 - 18 = 45° ✓

(b) What is the local time on Prince Edward Island when it is 10 am in La Palma? **2**

$\frac{45°}{15}$ = 3hrs ✓

Time Prince Edward Is = 10am - 3hrs

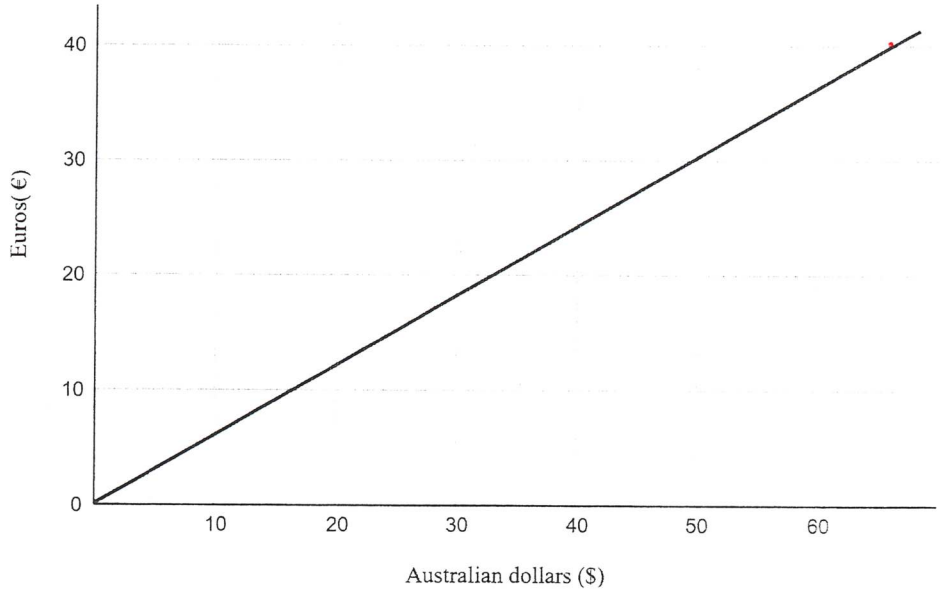
= 7am ✓

Question 20 (2 marks)

Davis is shopping online. He is looking at items in various currencies. **2**

Davis knows that currently 1 Australian dollar is equivalent to 0.75 US dollars.

He also has the conversion graph below which converts between Australian dollars and Euros.



Davis has decided to purchase an item costing 40 Euros.

Use the information given to determine the value of Davis' purchase in US dollars.

40 € = $A66 ✓

$A66 x 0·75 = $US49.50 ✓

Question 21 (4 marks)

The height, in centimetres, of the twelve players in the Australian Netball Team are:

168 176 179 | 181 182 185 | 187 188 190 | 190 193 195

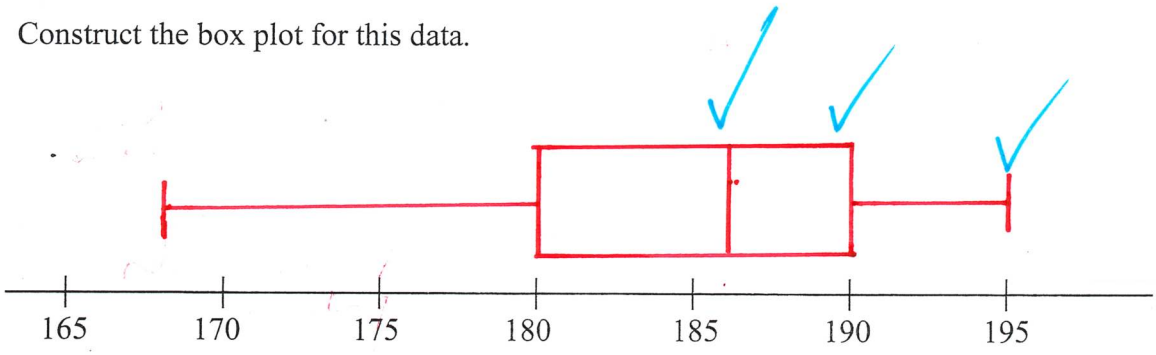
Q1 = 180 MED = 186 Q3 = 190

(a) What is the mean height of the Australian netball players? 1

$\bar{x} = 184.5$ OR $\bar{x} = \frac{2214}{12}$

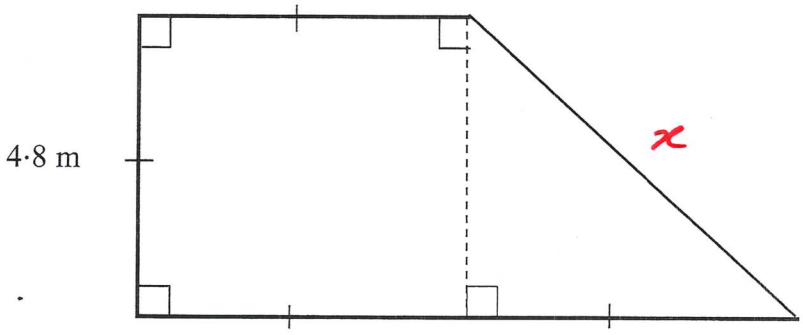
Calculator ✓ $= 184.5$

(b) Construct the box plot for this data. 3



Question 22 (3 marks)

The courtyard shown in the sketch below is to be fenced around the outside boundary. 3



NOT TO SCALE

Given the fence costs \$52 per metre, calculate the total cost of the fence around the courtyard.

$x^2 = 4.8^2 + 4.8^2$

$x^2 = 46.08$

$x = 6.788$ m ✓

$P = 4.8 \times 4 + 6.788$

$= 25.988$ m ✓

Cost $= 25.988 \times \$52$

$= 1351.38$ ✓

using 25.988 2251

Cost = \$1351.39

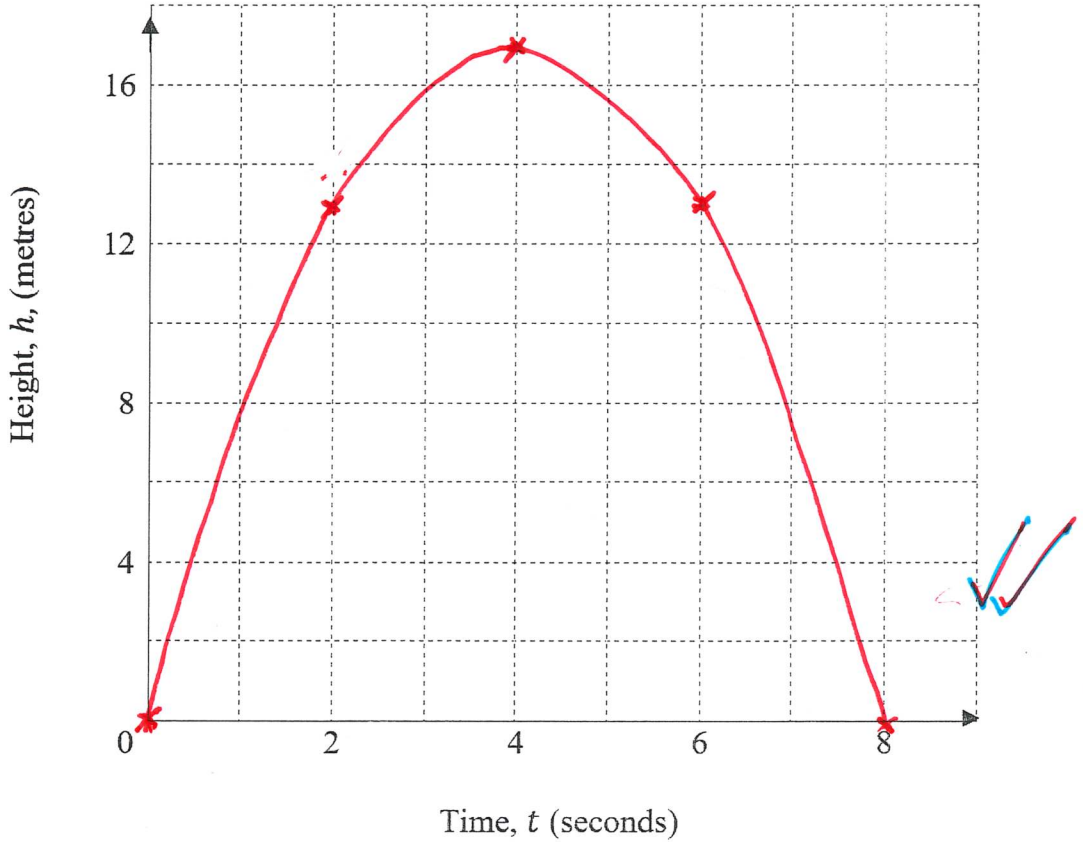
Question 23 (5 marks)

Gideon threw a ball into the air.

The height of the ball, h metres, can be modelled by the quadratic equation, $h = -t^2 + 8t + 1$, where t is the time in seconds since the ball was thrown.

(a) Complete the table of values and draw the graph to model the height of the ball on the axes below. 4

t	0	2	4	6	8
h	1	13	17	13	1



(b) How long after being thrown does the ball reach its maximum height? 1

4 seconds

.....

.....

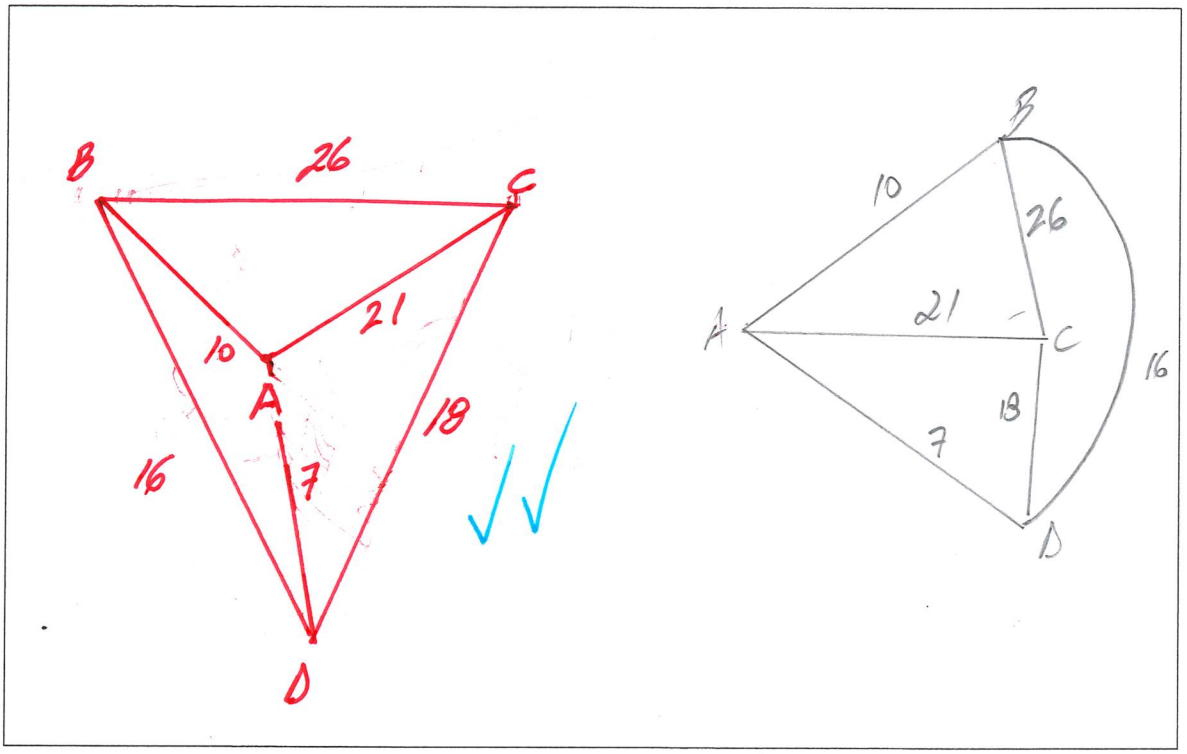
Question 24 (3 marks)

Sarah is delivering furniture from a warehouse in Auburn (A), to homes in Bankstown (B), Chatswood (C) and Dundas (D).

The table below show the distances, in kilometres, between each location.

	A	B	C	D
A	-	10	21	7
B	10	-	26	16
C	21	26	-	18
D	7	16	18	-

(a) Draw a network diagram to represents the information given in the table. **2**



(b) Sarah began the delivery at the Auburn warehouse and then travelled to Dundas, Chatswood and Bankstown, in that order. She then returned to the warehouse at Auburn. **1**

What is the total distance that Sarah travelled?

7 + 18 + 26 + 10 = 61 km

.....

.....

Question 25 (4 marks)

Harry and John are brothers who live 3 km from their school. Harry walks to school at an average speed of 5 km/h and John rides his bicycle to school at an average speed of 12 km/h.

If Harry leaves home at 8:10 am, what time must John leave home so that he arrives at school at the same time as his brother? 4

$t_H = \frac{3}{5} \times 60$ $t_J = \frac{3}{12} \times 60$

$= 36$ mins ✓ $= 15$ mins ✓

Harry = 8:10 + 36 min

= 8:46 am ✓

John = 8:46 - 15 min

= 8:31 am ✓

Question 26 (3 marks)

Tim purchased 500 shares for $2.35 per share and later sold them for $3.50 per share. Tim paid brokerage fees on the purchase and sale of the shares as shown in the table.

Brokerage Fees	
Purchase of shares	2% of the purchase price
Sale of shares	3% of the sale price

Given that he did not receive any dividend, calculate the profit that Tim earned from the shares. 3

Cost = 500 × 2.35 Selling = 500 × 3.50

= $1175 = $1750

Brokerage = 2% × 1175 Brokerage = $32.50

= $23.50

Total = 1175 + 23.50 Sales pay = 1750 - 32.50

= 1198.50 ✓ = $1697.50 ✓

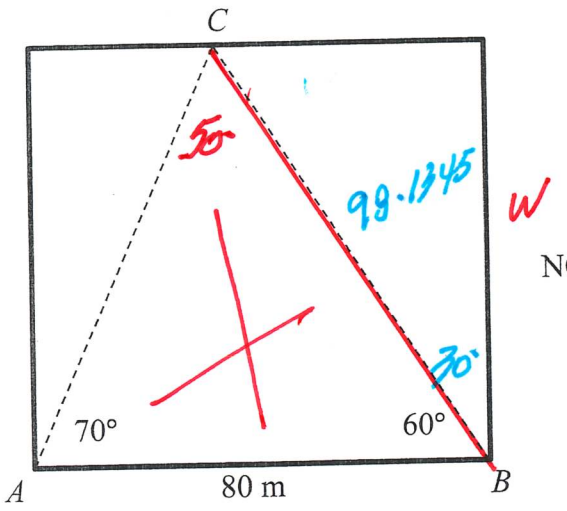
PROFIT = 1697.50 − 1198.50

= $499 ✓

Question 27 (4 marks)

Ann, Bo Lai and Corinne are positioned at points A, B and C respectively on a rectangular playground as shown in the diagram below.

The length of the playground is 80 metres, $\angle ABC = 60°$ and $\angle BAC = 70°$.



NOT TO SCALE

(a) Calculate the distance from Bo Lai to Corinne. Give your answer correct to the nearest metre. **2**

$\frac{BC}{\sin 70°} = \frac{80}{\sin 50°}$ ✓

$BC = \frac{80 \times \sin 70°}{\sin 50°}$

$= 98.1345...$

$= 98$ m (nearest metre) ✓

(b) Calculate the width of the playground. Give your answer correct to the nearest metre. **2**

$\cos 30° = \frac{W}{98.1345}$ ✓

$W = 98.1345 \times \cos 30°$

$= 84.9869...$ ✓

$= 85$ m (nearest metre)

Question 28 (3 marks)

The weight of babies born in a hospital were found to be normally distributed with a mean of 3.5 kg and a standard deviation of 1.0 kg.

(a) Raphael was born weighing 4.25 kg.

What is the value of the z-score of Raphael's birth weight? 1

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

$= \frac{4.25 - 3.5}{1.0}$

$= 0.75$ ✓

(b) A baby is considered to have Very Low Birth Weight (VLBW) if they are born weighing less than 1.5 kg.

Given that in 2020, the hospital recorded 8 babies born with VLBW, how many babies would be expected to have been born in total in the hospital that year? 2

$z = \frac{1.5 - 3.5}{1.0}$

$= -2$

less than -2 : 2.5% ✓

2.5% = 8

100% = $\frac{8}{2.5} \times 100$ ✓

= 320

Question 29 (2 marks)

Re-arrange the following equation to make a the subject. 2

$$c = \frac{x^2 - a}{b}$$

$bc = x^2 - a$ ✓

$a = x^2 - bc$ ✓

OR $a = x^2 - cb$

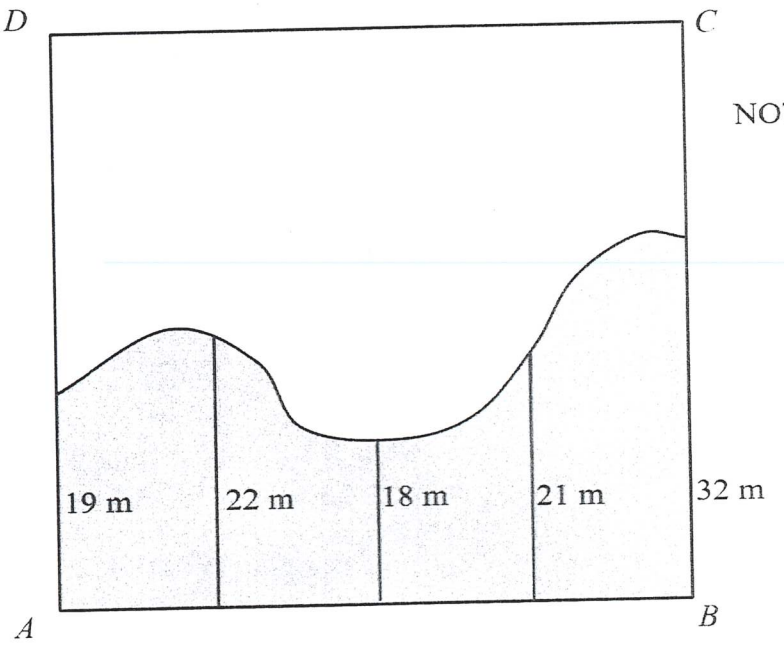
Question 30 (3 marks)

Archaeologists are excavating a square plot *ABCD* measuring 50 metres by 50 metres.

The plot is divided into four sections of equal width as shown in the diagram below.

At the end of the first phase of digging, the shaded area has been excavated.

Measurements made to the edges of the excavated area are also shown on the diagram.



50 ÷ 4 = 12.5

(a) Use the trapezoidal rule with each of the measurements given to estimate the shaded area. 2

$A = \frac{12.5}{2}(19+22) + \frac{12.5}{2}(22+18) + \frac{12.5}{2}(18+21) + \frac{12.5}{2}(21+32)$

$= 256.25 + 250 + 243.75 + 331.25$

$= 1081.25\ m^2$

(b) Express the shaded area as a percentage of the total area. Give your answer correct to two decimal places. 1

$\frac{1081.25}{50^2} \times 100 = 43.25\%$

Question 31 (3 marks)

Emma is saving for a new car. She deposits $2200 into an annuity account at the end of each year for four years. The account pays 3% per annum interest, compounding annually. 3

The table below shows future values of an annuity of $1.

Years	Interest rate per annum						
	1%	1.5%	2%	2.5%	3%	3.5%	4%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0150	2.0200	2.0250	2.0300	2.0350	2.0400
3	3.0301	3.0452	3.0604	3.0756	3.0909	3.1062	3.1216
4	4.0604	4.0909	4.1216	4.1525	4.1836	4.2149	4.2465
5	5.1010	5.1523	5.2040	5.2563	5.3091	5.3625	5.5256

How much interest does Emma earn on her investment over the four years?

FV = Amt x f

= 2200 x 4.1836

= 9203.92 ✓

Investment = 2200 x 4

= $8800 ✓

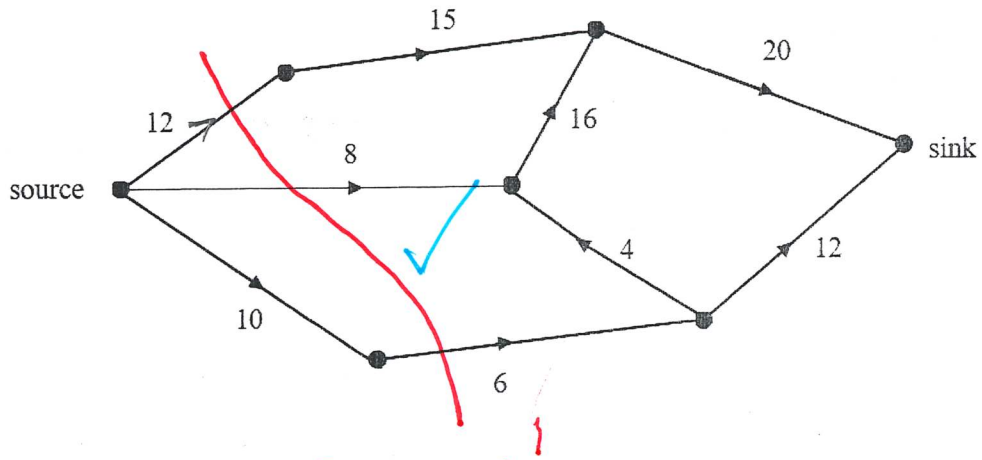
Interest = 9203.92 − 8800

= $403.92 ✓

Question 32 (2 marks)

The network below shows the maximum possible flow between vertices. 2

Draw the minimum cut on the network diagram and calculate the maximum flow between the source and the sink.



Maximum flow = 12 + 8 + 6

= 26 ✓

Question 33 (3 marks)

Steve and Stella take out a loan of \$50 000 for home renovations at 3% per annum compounded monthly. They make regular repayments of \$750 at the end of each month. **3**

The recurrence relation to model this situation is given by the formula

$$A_n = A_{n-1}\,(1.0025) - 750$$

How much have Steve and Stella paid off the amount they borrowed after the first three repayments?

$A_1 = 50000(1.0025) - 750$

$= \$49375$

$A_2 = 49375 \times 1.0025 - 750$ ✓

$= \$48748.44$

$A_3 = 48748.44 \times 1.0025 - 750$ ✓

$= \$48120.31$

Amount paid off $= 50000 - 48120.31$

$= \$1879.69$ ✓

Question 34 (4 marks)

A football coach is studying the relationship between the weight in kilograms of players and their vertical jump in metres. The coach believes that players who weigh less are able to jump higher.

The data from ten players is shown in the table below.

weight, (w)	84.5	83.3	58.7	74.1	70.7	72.3	75.8	71.8	63.2	65.9
vertical jump (v)	21.9	20.5	20.8	19.9	20.6	18.8	22.8	20.6	20.0	21.8

(a) Find the equation of the least-squares regression line. Give each value correct to two decimal places. 2

$V = 0.03W + 18.75$ ✓ ✓

(b) By calculating Pearson's correlation coefficient for the data, correct to three decimal places, justify whether the data confirms the association between weight and vertical jump. 2

$r = 0.199$ ✓

The data does not confirm the predicted negative association.

Rather a weak positive association ✓

Question 35 (3 marks)

A washing machine uses 2025 kilojoules of energy during a 90 minute washing cycle.

(a) Calculate the power consumption of the washing machine in watts (W). 2

$2025\text{kJ} = 2025000\text{J}$ ✓

$2025000 \div 90 \div 60 = 375\text{ W}$ ✓

(b) Calculate the cost of running the washing machine for one hour, given the cost of electricity is \$0.3159 per kilowatt-hour. 1

$\text{Cost} = \frac{375}{1000} \times \$0.3159$

$= 0.118$

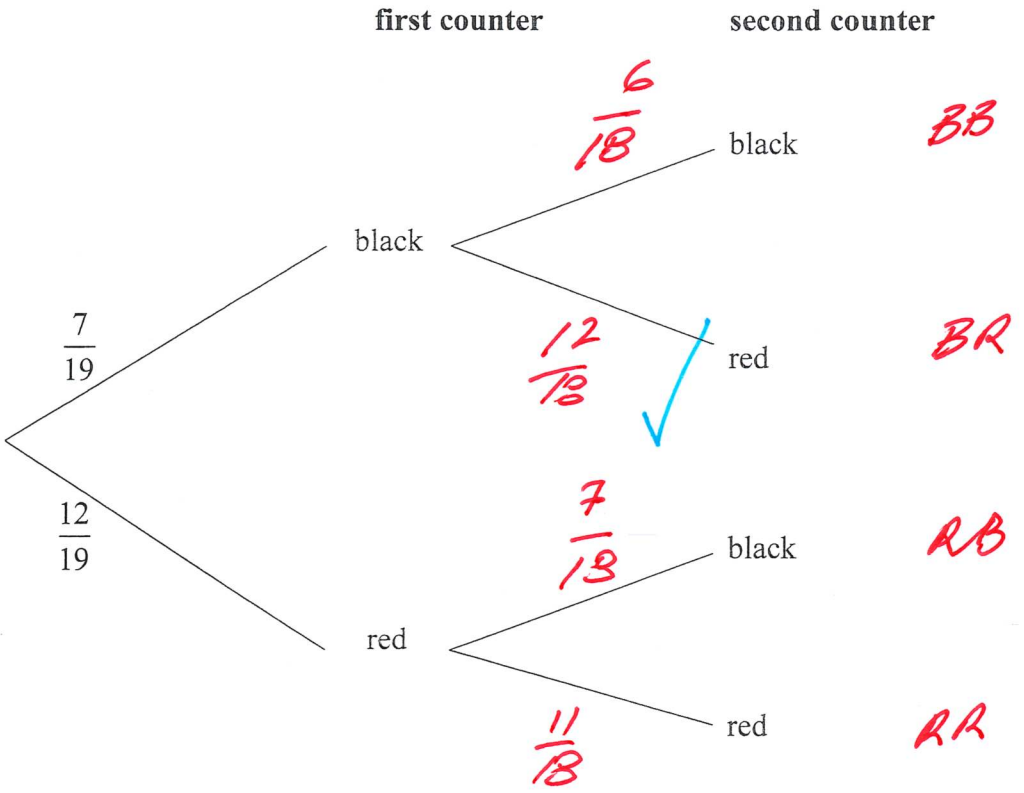
$= \$0.12$ ✓

Question 36 (3 marks)

A bag contains 7 black and 12 red counters.

Lucas selects two counters from the bag at random without replacement.

(a) Complete the probability tree below, showing the probability of each of the four possible selections for the second counter. **1**



(b) By using the probability tree, or otherwise, determine whether Lucas is more likely to select two counters of the same colour or two counters of different colours. **2**

Same $= \frac{7}{19} \times \frac{6}{18} + \frac{12}{19} \times \frac{11}{18}$

$= \frac{29}{51}$

Different $= 1 - \frac{29}{51}$

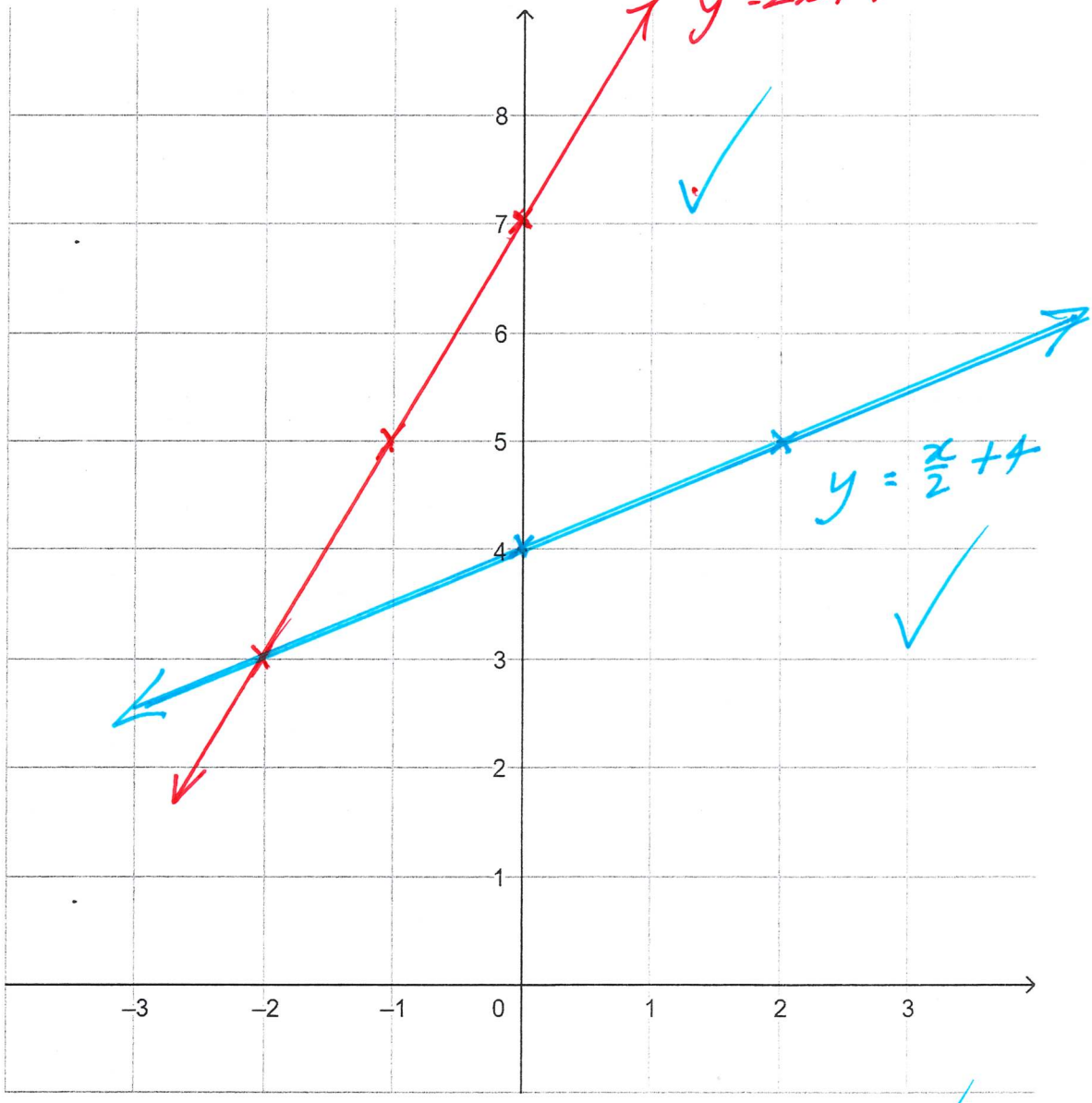
$= \frac{22}{51}$

$\therefore$ Lucas is more likely to select 2 counters that are the same colour

Question 37 (3 marks)

Graph the following pair of equations and identify the co-ordinates of the point of intersection of the two lines. **3**

$y = \frac{x}{2} + 4$ and $y = 2x + 7$



Co-ordinates of the point of intersection = ... (-2, 3) ✓

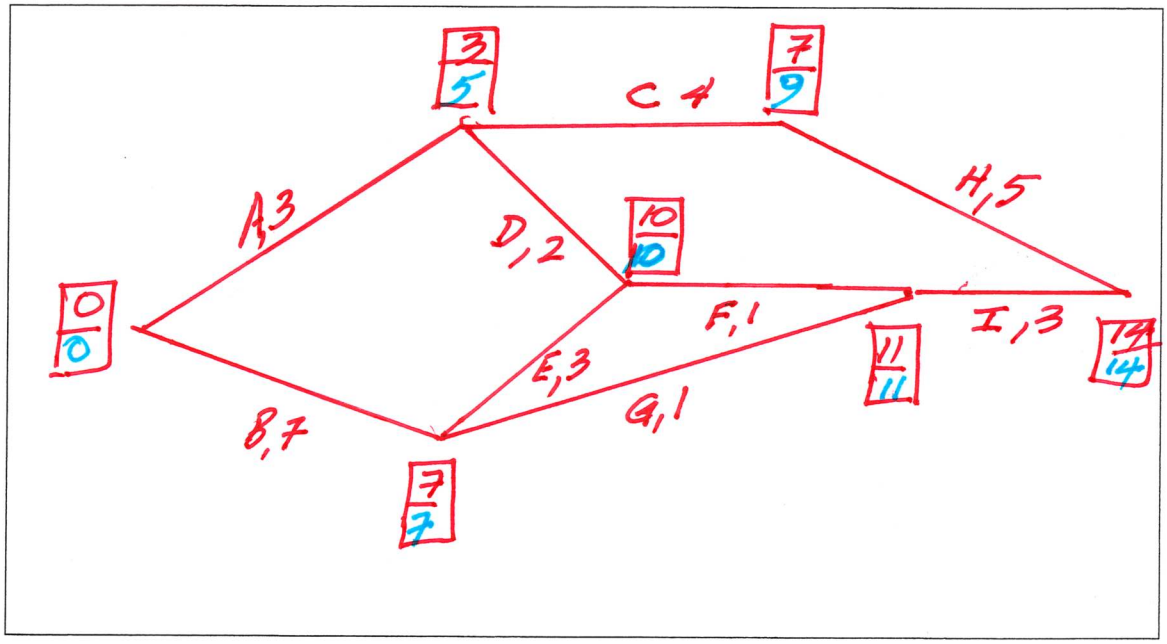
Question 38 (5 marks)

The activity chart below shows the tasks that are required to be completed by a building company for the construction of a new house.

Activity	Duration (weeks)	Prerequisites
A	3	-
B	7	-
C	4	A
D	2	A
E	3	B
F	1	D, E
G	1	B
H	5	C
I	3	F, G

(a) Draw a network diagram to represent this activity chart. **4**

On your diagram, show the earliest start time (EST) and latest start time (LST) of each activity by completing forward and backward scanning.



(b) List the activities that make up the critical path for this project. **1**

Critical path = B E F I

.....

.....

Question 39 (4 marks)

A farmer is purchasing a tractor for $54 000.

(a) The tractor depreciates by the declining balance method of depreciation at a rate of 8.3% per annum. 1

Calculate the value of the tractor after 10 years.

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

$= 54000(1-8.3\%)^{10}$

$= \$22703.20$

(b) The farmer is taking out a loan for the purchase of the tractor. 3

The loan repayment is $723 paid monthly over 10 years.

Calculate the equivalent annual flat rate of interest for the loan, correct to two decimal places.

Total $= \$723 \times 12 \times 10$

$= \$86760$ ✓

Interest $= 86760 - 54000$

$= \$32760$ ✓

$I = PRT$

$32760 = 54000 \times R \times 10$

$R = \frac{32760}{54000 \times 10} \times 100$

$= 6.0666$

$= 6.07\%$ (2dp) ✓

Question 40 (4 marks)

Ella contributes $1200 per month at the start of each month into an investment account which pays interest at 3.2% per annum, compounded monthly.

(a) Show that at the end of the second month, the future value of Ella's investment will be $2409.61. **2**

Balance 1st month = $1200

Interest = $1200 \times \frac{3.2\%}{12}$

= $3.20 ✓

Bal start 2nd Month = 1200 + 3.20 + 1200

= $2403.20

Interest = $2403.20 \times \frac{3.2\%}{12}$

= $6.41

Balance = 2403.20 + 6.41 ✓

= $2409.61

(b) After 18 months, the future value of Ella's investment will be $22 155.56. **2**

Beth has a lump sum of $21 600 which is equivalent to the total of Ella's contributions. Beth invests her lump sum into the same investment account paying 3.2% per annum, compounded monthly.

How much more than Ella will Beth have in her investment account after 18 months?

$FV_B = 21600 \times \left(1 + \frac{3.2\%}{12}\right)^{18}$

= $22660.64 ✓

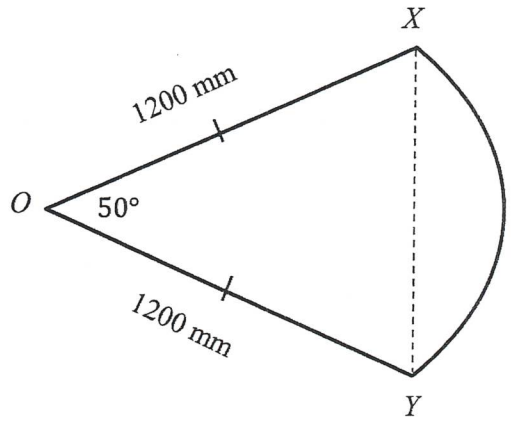
Diff = 22660.64 − 22155.56 ✓

= $505.08

Beth as $505.08 more than Ella

Question 41 (5 marks)

OXY is a sector of a circle with an angle of 50° at the centre and a radius of 1200 mm. **5**



NOT TO SCALE

How much longer, to the nearest millimetre, is the arc *XY* than the interval *XY*?

Arc XY = $\frac{50}{360} \times 2\pi \times 1200$ ✓✓

= 1047.197

= 1047 mm

$XY^2 = 1200^2 + 1200^2 - 2 \times 1200 \times 1200 \times \cos 50°$ ✓

= 1028 771.684

XY = 1014.28

Difference = 1047 − 1014 ✓

= 33m

Therefore the arc length XY is 33mm longer than the interval XY ✓

End of examination