KNOX GRAMMAR SCHOOL

Student Number: _____

Teacher Name: _____

2023 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

Mathematics Standard 2

General Instructions:

- Reading time – 10 minutes.
- Working time – 2 hours and 30 minutes.
- Write using blue or black pen.
- NESA approved calculators may be used.
- Use Multiple-Choice Answer Sheet provided for Section I.
- For questions in Section II, show relevant mathematical reasoning and/or calculations.

Total Marks: 100

Section I – 15 marks (pages 3 – 9)

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

Section II – 85 marks (pages 10 – 29)

- Attempt Questions 16 – 39.
- Allow approximately 2 hours and 5 minutes for this section.

Questions	Mark	Out of
Q1-15		/15
Q16-20		/12
Q21-24		/14
Q25-28		/15
Q29-31		/12
Q32-34		/11
Q35-37		/11
Q38-39		/10
Total		**/100**

BLANK PAGE

Section I
15 marks

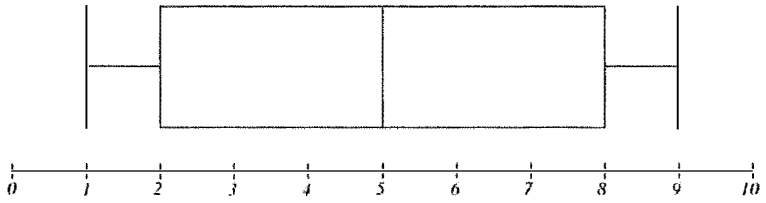
Attempt Questions 1 – 15
Allow about 25 minutes for this section

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

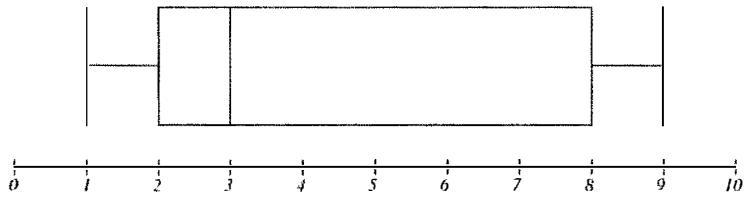
---

1 Which of the following box plots represents positively skewed data?

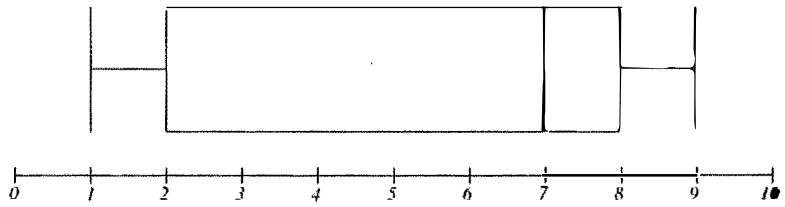
A.



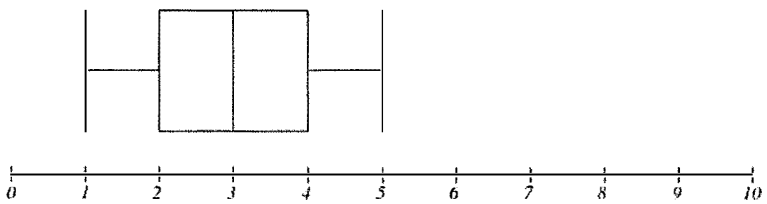
B.



C.



D.



2 Which statement is true about the line $y = 2x - 1$?

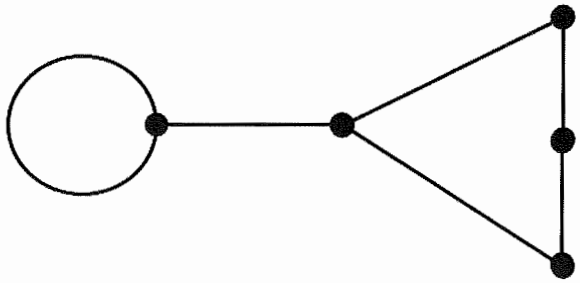
A. The line has a gradient of -1 and a y-intercept of -2.

B. The line has a gradient of -1 and a y-intercept of 2.

C. The line has a gradient of 2 and a y-intercept of -1.

D. The line has a gradient of 2 and a y-intercept of 1.

3 What is the sum of the degrees of all vertices in the network below?



A. 5

B. 6

C. 11

D. 12

4 Sally lives in a city that uses +10 UTC and her mother lives in a city that uses +7 UTC.

If Sally travels via the shortest route to visit her mother, in what direction will Sally definitely travel?

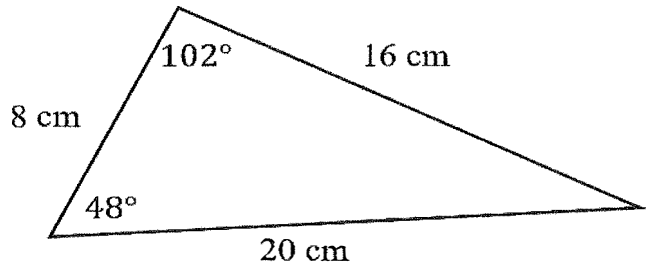
A. North

B. East

C. South

D. West

5 Which of the following will correctly calculate the area of the triangle below?



NOT TO SCALE

A. $A = \frac{1}{2} \times 8 \times 16 \times \sin 48°$

B. $A = \frac{1}{2} \times 8 \times 20 \times \sin 48°$

C. $A = \frac{1}{2} \times 8 \times 20 \times \sin 102°$

D. $A = \frac{1}{2} \times 16 \times 20 \times \sin 102°$

6 A car used 60 litres of fuel to travel a distance of 870 km.

What is the rate of fuel consumption of the car?

A. 5.2 L/100 km

B. 6.9 L/100 km

C. 8.7 L/100 km

D. 14.5 L/100 km

7 The height of adults in Australia is normally distributed with a mean of 172 cm and a standard deviation of 7 cm.

What is the range in height of approximately 95% of Australian adults?

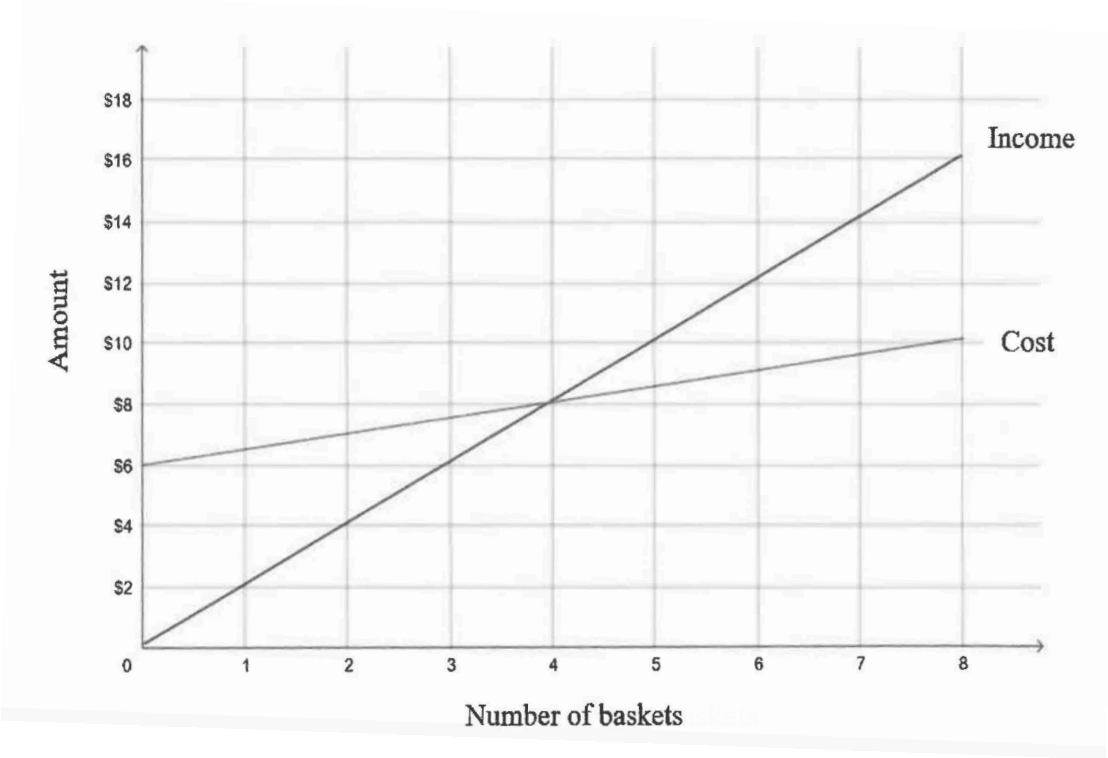
A. 151 cm – 170 cm

B. 151 cm – 193 cm

C. 158 cm – 179 cm

D. 158 cm – 186 cm

8 The graph below shows the cost and income in dollars, for a small business that makes and sells baskets.



Which of the following statements is correct when two baskets are made and sold?

A. There is a loss of $3

B. There is a loss of $7

C. There is a profit of $3

D. There is a profit of $7

9 A painter mixes 80 mL of green paint with 2 L of white paint.

What is the ratio of green to white paint?

A. 1 : 25

B. 1 : 40

C. 2 : 80

D. 8 : 20

10 A teacher gives each student in her class a small bag of lollies. The number of lollies in each bag is recorded in the frequency distribution table below.

Number of lollies	*Frequency*
8	1
9	6
10	13
11	4

What is the relative frequency of a bag of lollies containing 10 or more lollies?

A. $\frac{10}{13}$

B. $\frac{13}{17}$

C. $\frac{13}{24}$

D. $\frac{17}{24}$

11 A pair of boots can be purchased for \$288.75 including 10% goods and services tax (GST).

How much GST is paid in this purchase?

A. \$8.75

B. \$14.44

C. \$26.25

D. \$28.88

12 Which description best fits the correlation of the following bivariate data?

x	12	14	15	17	22
y	-92	-85	-79	-80	-72

A. Weak, negative correlation

B. Strong, positive correlation

C. Strong, negative correlation

D. Moderate, positive correlation

13 Henry invests \$2500 into an account that earns interest at the rate of 3.6% per annum, compounded quarterly.

What is the value of Henry's investment after $2\frac{1}{2}$ years?

A. \$2591.22

B. \$2731.11

C. \$2734.33

D. \$2879.91

14 Which of the following correctly expresses a as the subject equation of $d = \dfrac{w}{3+a}$?

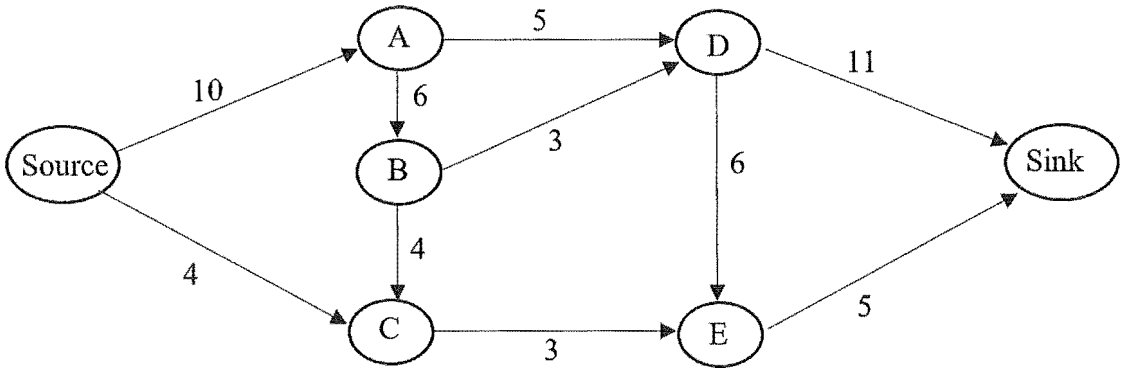
A. $a = \dfrac{3d}{w}$

B. $a = \dfrac{w}{d} - 3$

C. $a = \dfrac{3-w}{d}$

D. $a = w - 3$

15 What is the maximum flow from the source to the sink in the network below?



A. 11

B. 14

C. 16

D. 26

Section II
85 marks

Attempt Questions 16 – 39
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 30 – 31. If you use this space, clearly indicate which question you are answering.

Question 16 (2 marks)

Monica drank 5 large glasses of wine between 4:00 pm and 11:30 pm. Each glass of wine contained 1.4 standard drinks. **2**

Given that Monica weighs 72 kg, use the formula below to estimate her blood alcohol content (BAC) at 11:30 pm.

$$BAC_{Female} = \frac{10N - 7.5H}{5.5M}$$

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.

Give the estimate of Monica's BAC correct to three decimal places.

.....

.....

.....

.....

.....

.....

.....

.....

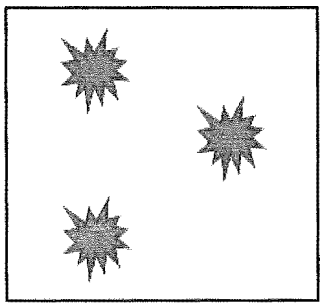
.....

Question 17 (2 marks)

Madeleine is tiling a kitchen wall measuring 2.7 metres × 3.3 metres. **2**

She will be using tiles that are 30 cm × 30 cm each.

Each tile has three starbursts on it.



How many starbursts in total will be on the tiled kitchen wall?

.....

.....

.....

.....

Question 18 (2 marks)

A netball uniform that has a selling price of $88, will increase in price by 1.3% each quarter due to inflation. **2**

To the nearest dollar, how much will a netball uniform cost in 5 years' time?

.....

.....

.....

.....

Question 19 (3 marks)

A study of the turtles in Centennial Park uses the "capture-recapture" technique to estimate the size of the turtle population.

In the first stage of the study, 36 turtles were caught, tagged and released.

In the second stage of the study, 40 turtles were captured. Six of these turtles were found to be already tagged.

(a) What percentage of the turtles captured in the second stage of the study were already tagged? **1**

.....

.....

(b) Calculate the estimated number of turtles in Centennial Park. **2**

.....

.....

.....

.....

Question 20 (3 marks)

Andrew has budgeted to spend $75 per week on fuel. His car has a fuel consumption of 6.8 litres/100 km and he pays an average fuel cost of $1.79 per litre. **3**

How many kilometres can Andrew travel per year within his fuel budget? Give your answer correct to two significant figures.

.....

.....

.....

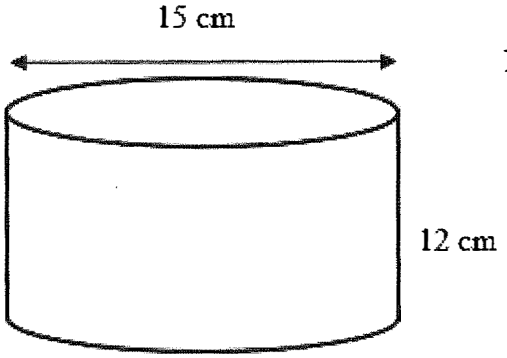
.....

.....

.....

Question 21 (6 marks)

A cylindrical pot has a diameter of 15 cm and a height of 12 cm. The pot is closed at the bottom and is open at the top.



(a) Calculate the surface area of the open pot. Give your answer correct to one decimal place. **3**

.....

.....

.....

.....

.....

.....

(b) Meg needs a container that has enough capacity to hold 2 litres of liquid. **3**

Does this pot have enough capacity? Use calculations to support your answer.

.....

.....

.....

.....

.....

.....

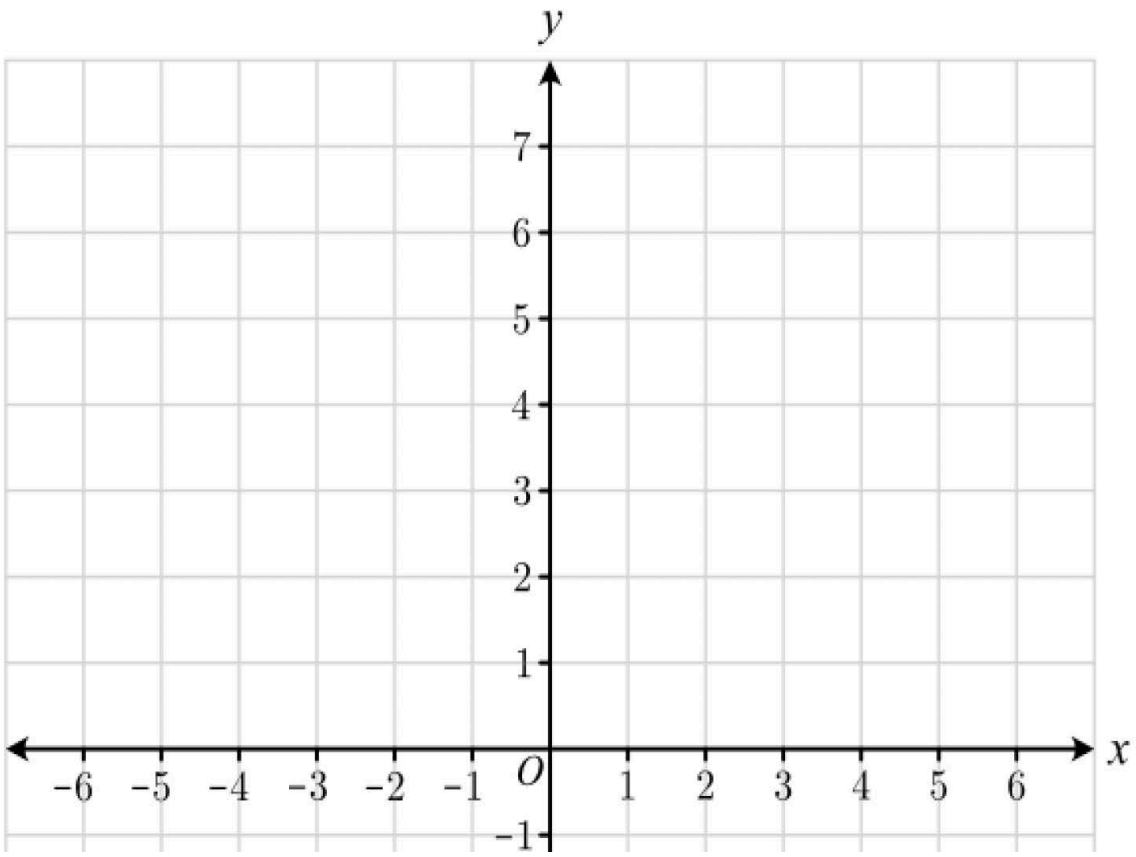
.....

Question 22 (3 marks)

The table of values below shows four points that form a linear relationship. **3**

x	-2	0	2	4
y	1	2	3	4

Graph the straight line on the number plane below and determine the equation of the line.



Equation of the line: ……..

Question 23 (2 marks)

A hospital patient requires 900 mL of medication to be delivered through a drip over 6 hours. Each mL of fluid is equivalent to 16 drops. **2**

How many drops per minute need to be delivered?

.....

.....

.....

.....

.....

Question 24 (3 marks)

The letters of the word ALGEBRA are written on seven separate cards.

A	L	G	E	B	R	A

Two cards are chosen at random without replacement.

(a) What is the probability that the first card chosen is the letter A? **1**

.....

(b) What is the probability that exactly one of the cards chosen is the letter A? **2**

.....

.....

.....

.....

.....

.....

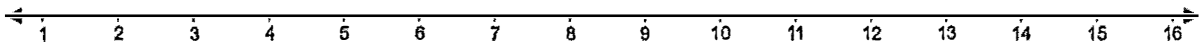
Question 25 (3 marks)

A basketball player recorded the points that he scored each game throughout a 15-game season. **3**

The player's points scored per game were:

6 8 15 3 2 7 2 14 4 5 7 2 4 3 12

Construct a box and whisker plot below to represent this data.



Question 26 (2 marks)

Penny owns 2400 shares in a company with a market price of $17.50 per share. **2**

She received a total dividend payment of $504.

Calculate the dividend yield on Penny's shares.

……

……

……

……

……

……

Question 27 (4 marks)

Last month eight houses were sold in Oldsville.

The selling prices of the houses were:

$480 000 $505 000 $517 000 $528 000 $528 000 $552 000 $580 000 $980 000

(a) Show that the value of the most expensive house sold is an outlier for this data set. **2**

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Explain the effect of the outlier on the mean and median selling prices for this data set. Justify your answer with relevant calculations. **2**

.....

.....

.....

.....

.....

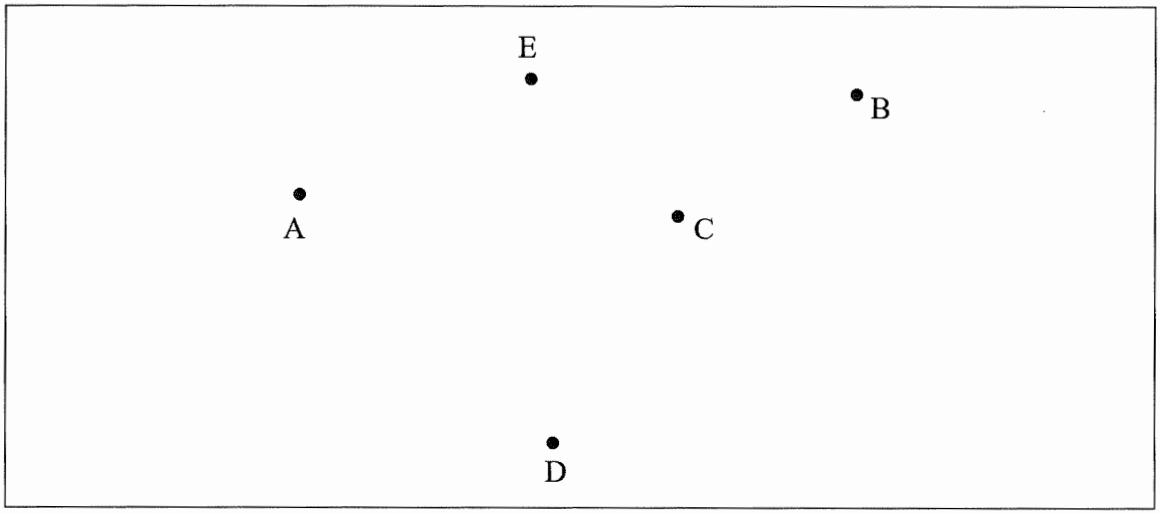
.....

Question 28 (6 marks)

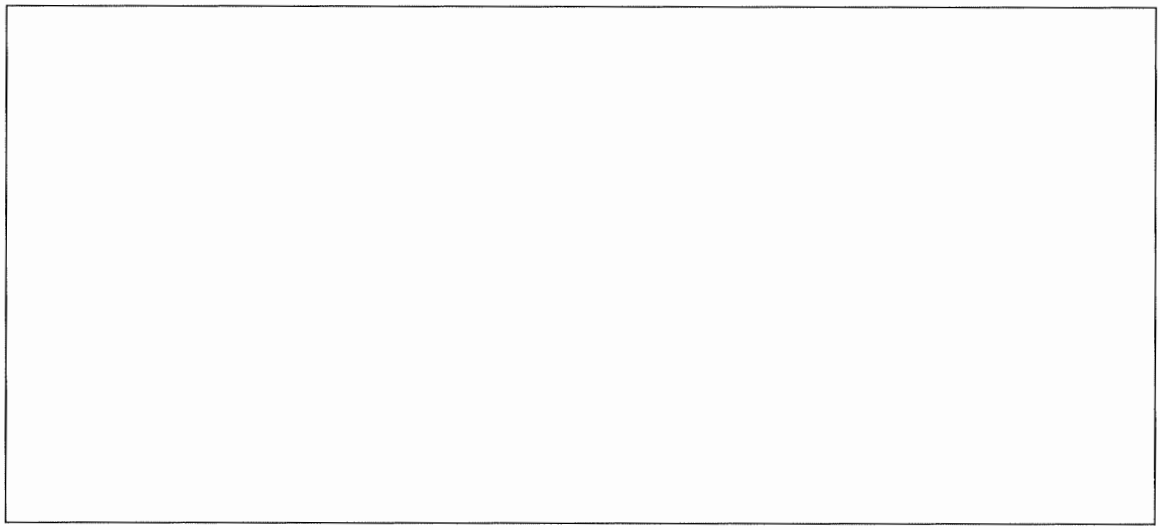
The table below represents a computer network in a small office. The numbers in the table represent the lengths of optical cable, in metres, required to connect the two computers.

	A	**B**	**C**	**D**	**E**
A	-	-	400	700	300
B	-	-	550	-	200
C	400	550	-	-	350
D	700	-	-	-	-
E	300	200	350	-	-

(a) Complete a network diagram below to represent the information given in the table. **2**



(b) Draw the minimum spanning tree for the network. **2**



Question 28 continues on page 19

Question 28 (continued)

(c) What minimum length of optical cable is required to connect the network? **1**

.....

.....

.....

(d) The optical cable connecting computers B and E has been removed due to a fault and will not be replaced. **1**

What is the increase in the length of the minimum spanning tree now required to connect the network?

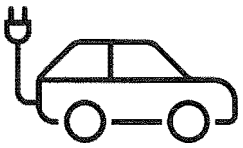
.....

.....

.....

Question 29 (2 marks)

An electric car charging station uses 75 kW to charge electric cars. **2**



Given an electricity cost of 27.5 cents/kWh, calculate the cost for an electric car to be connected to the station for 90 minutes.

.....

.....

.....

.....

Question 30 (7 marks)

The activity chart below shows the immediate prerequisites and required hours for each activity to be completed in a project.

Activity	*Immediate Prerequisite(s)*	*Duration (in hours)*
A	-	*2*
B	-	*3*
C	*B*	*4*
D	*A, C*	*3*
E	*B*	*5*
F	*B*	*1*
G	*F*	*1*
H	*D, E*	*2*

(a) Complete a network diagram for this project and determine the minimum time required to complete the project. **3**

Minimum completion time = _____

Question 30 continues on page 21

Question 30 (continued)

(b) Determine the critical path for this project. **1**

.....

(c) What is the float time for Activity A? **1**

.....

(d) Explain the impact that an increase in the time taken to complete Activity F would have on the completion time of the project. **2**

.....

.....

.....

.....

.....

Question 31 (3 marks)

The shoe size of women in a town is normally distributed with a mean size of 8 and a standard deviation of 1. **3**

A shoe shop in the town sells women's shoes ranging from size 5 to size 10.

Given that there are 4000 women in the town, how many would be expected to find shoes that fit them in this shop?

.....

.....

.....

.....

.....

.....

.....

.....

Question 32 (6 marks)

Sam invested \$10 000 into a bank account earning interest at 10% per annum, compounded annually.

To calculate his final amount at the end of any year, Sam uses the formula:

$$A = 10000(1.1)^n$$

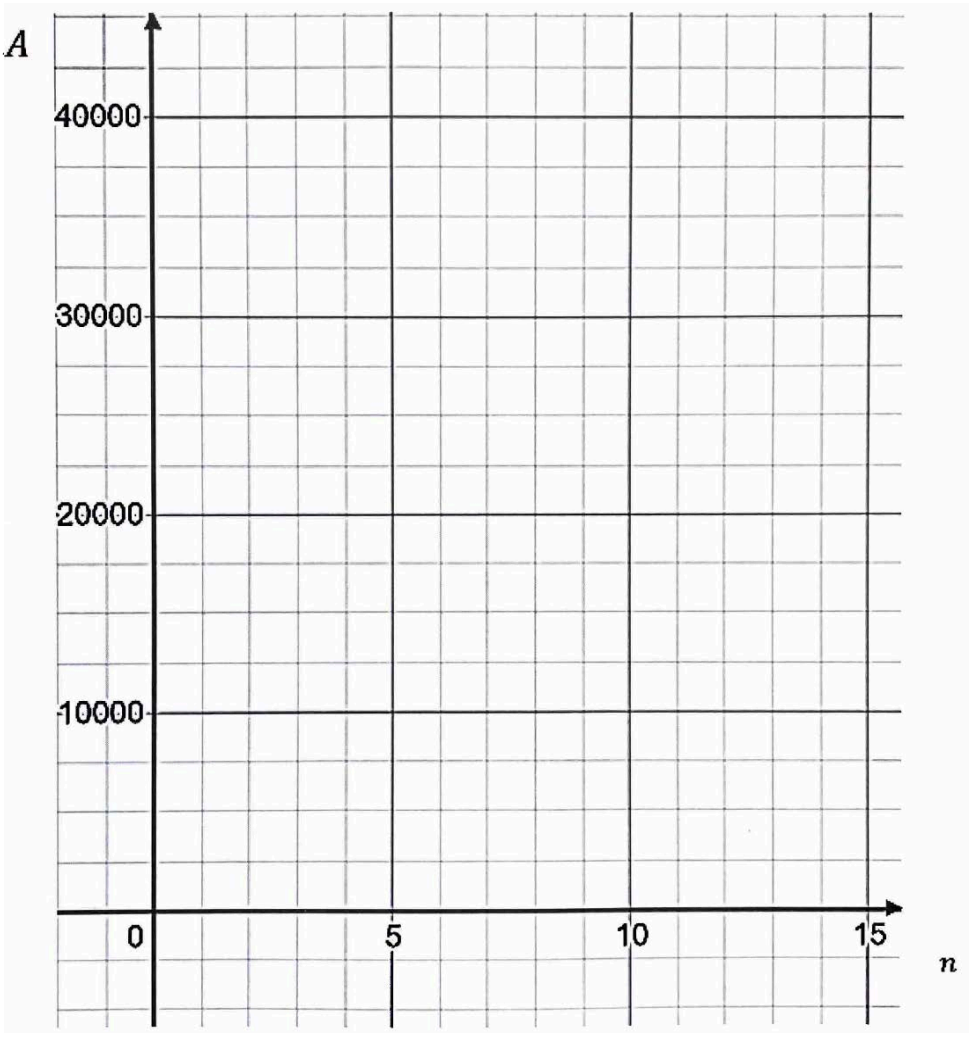
where:

A is the final amount in dollars

n is the number of years

(a) Complete the table below and use the values to sketch a graph of the investment over the first 15 years. **4**

n	0	5	10	15
A				



Question 32 continues on page 23

Question 32 (continued)

(b) Use your graph in part (a) to estimate how long it will take for the value of Sam's investment to double from the initial investment. **1**

.....

.....

(c) Explain why Sam's investment is an example of exponential growth. **1**

.....

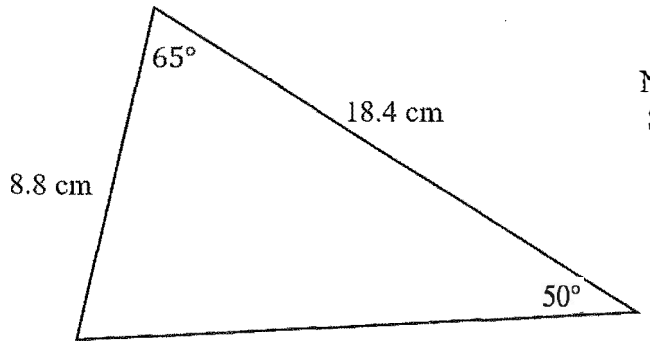
.....

.....

.....

Question 33 (2 marks)

Calculate the area of the triangle below. Give your answer correct to one decimal place. **2**



NOT TO SCALE

.....

.....

.....

.....

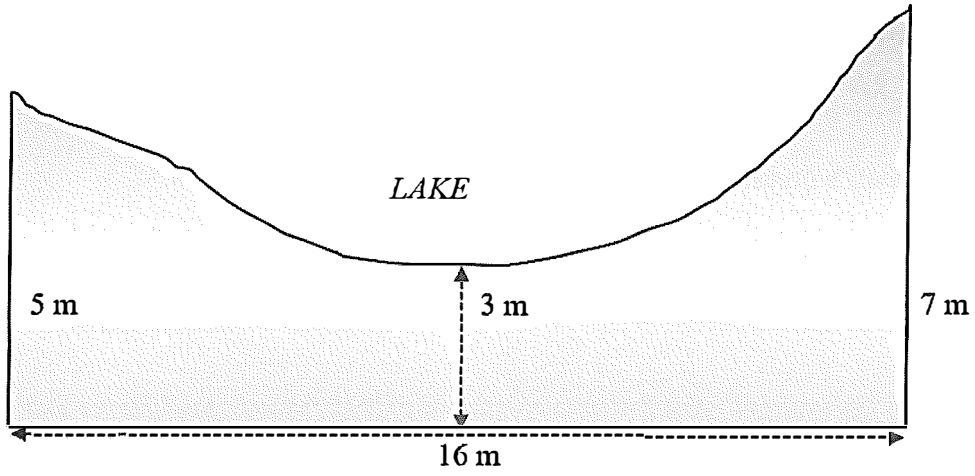
.....

.....

.....

Question 34 (3 marks)

The dimensions of a garden that borders a lake are shown in the diagram below.



NOT TO SCALE

(a) Use two applications of the trapezoidal rule to calculate the approximate area of the garden. **2**

……

……

……

……

……

……

……

(b) Explain why the approximate area calculated in (a) would be greater than the actual area of the garden. **1**

……

……

……

……

Question 35 (5 marks)

The table below shows the future value of a $1 annuity at different interest rates over different time periods. The contribution is made at the end of each period.

Time Period	Interest Rate per time period			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1846	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8984
8	8.2857	8.5830	8.8923	9.2142

(a) Scarlett is planning a holiday in three years' time that will cost $3100. She contributes $500 at the end of every six months into an annuity with an interest rate of 4% per annum, compounded half yearly. **3**

Does Scarlett have enough money after three years to pay for the holiday? Justify your answer with calculations.

.....

.....

.....

.....

.....

.....

(b) Scarlett has decided that she would like to go on the holiday in two years' time instead of three years' time. **2**

If she receives the same interest rate of 4% per annum, compounded half yearly, and the cost of the holiday is also the same, what amount will Scarlett need to contribute into the account every six months to pay for the holiday in two years' time?

.....

.....

.....

.....

Question 36 (2 marks)

Will and Ivan both sat a class test. The class results of the test had a standard deviation of 8. The table below shows Will's result in the test and the z-score for both students. **2**

	Result	z-score
Will	62	-1.75
Ivan		1.75

Calculate the result that Ivan achieved in the test.

.....

.....

.....

Question 37 (4 marks)

A car salesperson records the age in years and the price in dollars of six cars that are for sale.

Age (A)	3	5	5	6	8	10
Price (P)	23 000	18 000	16 500	12 000	9700	7000

(a) Find the equation of the least-squares regression line, giving each value to the nearest whole number, and use the equation to estimate the cost of a car that is 4 years old. **3**

.....

.....

.....

.....

.....

(b) John has a rare classic car that is now 50 years old. Explain why the least-squares regression line in part (a) cannot be used to determine the value of John's car. **1**

.....

.....

.....

Question 38 (5 marks)

Maroun deposits $500 000 into a retirement fund which earns compound interest at the rate of 0.3% per month.

Maroun withdraws spending money from the retirement fund at the end of each month.

The incomplete table below shows the account activity for the first four months and the balance at the end of the fifth month.

Month	Principal (P)	Interest (I)	Withdrawal (M)	Balance ($P + I - M$)
1	500 000.00	1500.00	2000	499 500.00
2	499 500.00	1498.50	2500	498 498.50
3	498 498.50	1495.50	3000	496 994.00
4	496 994.00	1490.98	3800	
5				491 969.03

(a) Calculate the amount of money that Maroun withdrew at the end of the fifth month. **3**

.....

.....

.....

.....

(b) Maroun is going to withdraw $7500 at the end of each month, starting from the end of the sixth month. **2**

The recurrence relation $A_n = A_{n-1} \times 1.003 - 7500$ models this situation, where A_n is the balance in the retirement fund at the end of the nth month.

Calculate the balance in Maroun's retirement fund at the end of the seventh month.

.....

.....

.....

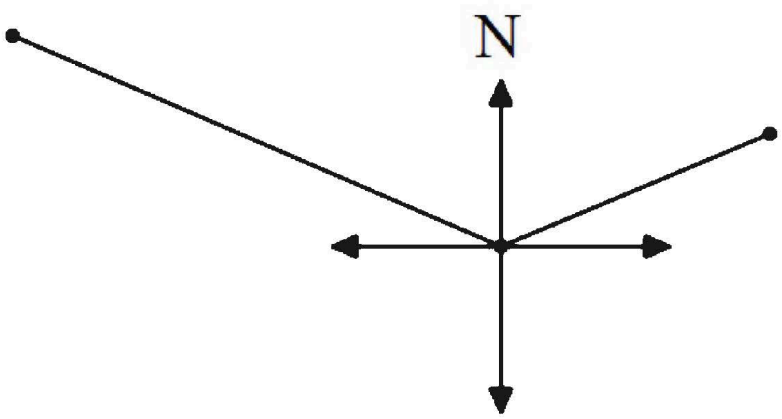
.....

.....

Question 39 (5 marks)

Two hikers decide to leave a campsite (C) to visit some natural landmarks in the area. One hiker walks 16 km on a bearing of 65° to see a lake (L); the other hiker walks 26 km on a bearing of 285° to reach the top of a mountain (M).

(a) Calculate the distance between the mountain and the lake (complete the diagram below to guide you). Give your answer correct to the nearest kilometre. **2**



……..

……..

……..

……..

……..

……..

……..

……..

Question 39 continues on page 29

Question 39 (continued)

(b) Hence, or otherwise, find the bearing of the lake from the mountain, correct to the nearest degree. **3**

End of Examination

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.

KNOX GRAMMAR SCHOOL

Student Number: Solutions

Teacher Name: _____

2023 HIGHER SCHOOL CERTIFICATE TRIAL EXAMINATION

General Instructions:

- Reading time – 10 minutes.
- Working time – 2 hours and 30 minutes.
- Write using blue or black pen.
- NESA approved calculators may be used.
- Use Multiple-Choice Answer Sheet provided for Section I.
- For questions in Section II, show relevant mathematical reasoning and/or calculations.

Total Marks: 100

Section I – 15 marks (pages 3 – 9)

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

Section II – 85 marks (pages 10 – 29)

- Attempt Questions 16 – 39.
- Allow approximately 2 hours and 5 minutes for this section.

Questions	Mark	Out of
Q1-15		/15
Q16-20		/12
Q21-24		/14
Q25-28		/15
Q29-31		/12
Q32-34		/11
Q35-37		/11
Q38-39		/10
Total		**/100**

BLANK PAGE

Section I
15 marks

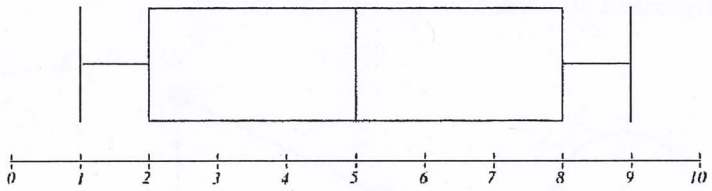
Attempt Questions 1 – 15
Allow about 25 minutes for this section

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

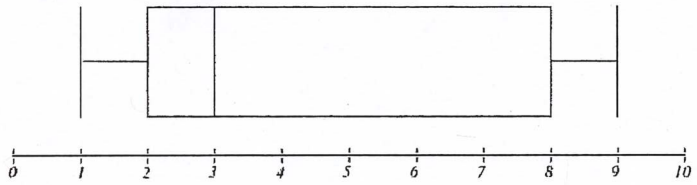
---

1 Which of the following box plots represents positively skewed data?

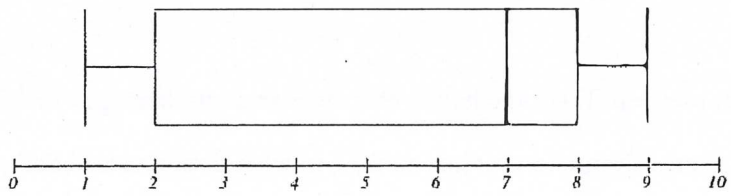
A.



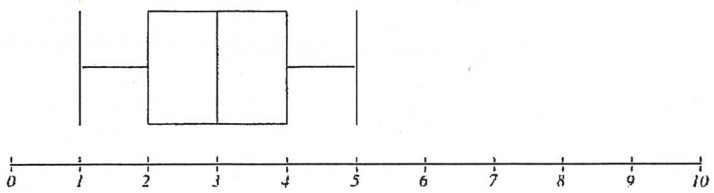
B.



C.



D.



$y = mx + b$

2 Which statement is true about the line $y = 2x - 1$?

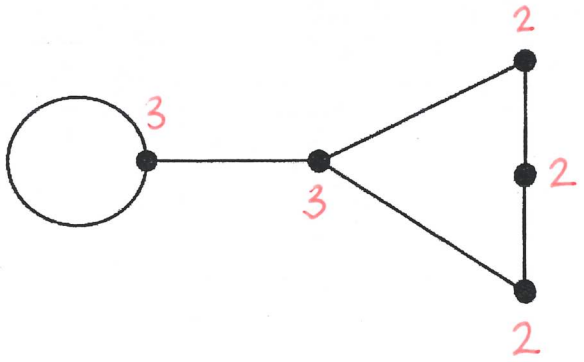
A. The line has a gradient of -1 and a y-intercept of -2.

B. The line has a gradient of -1 and a y-intercept of 2.

C. The line has a gradient of 2 and a y-intercept of -1.

D. The line has a gradient of 2 and a y-intercept of 1.

3 What is the sum of the degrees of all vertices in the network below?



A. 5

B. 6

C. 11

D. 12

4 Sally lives in a city that uses +10 UTC and her mother lives in a city that uses +7 UTC.

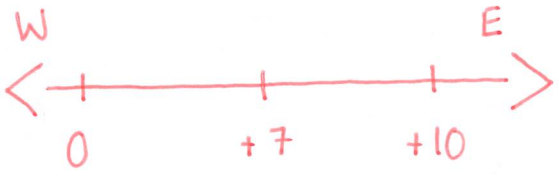
If Sally travels via the shortest route to visit her mother, in what direction will Sally definitely travel?

A. North

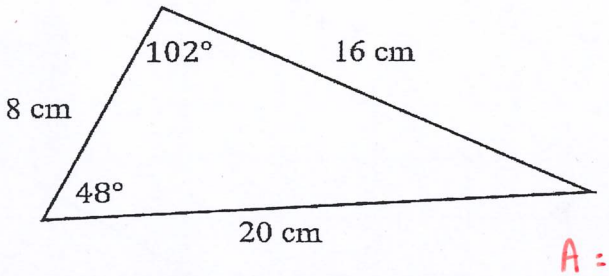
B. East

C. South

D. West



5 Which of the following will correctly calculate the area of the triangle below?



NOT TO SCALE

$A = \frac{1}{2}absinC$

$= \frac{1}{2} \times 8 \times 20 \times \sin 48°$

A. $A = \frac{1}{2} \times 8 \times 16 \times \sin 48°$

B. $A = \frac{1}{2} \times 8 \times 20 \times \sin 48°$

C. $A = \frac{1}{2} \times 8 \times 20 \times \sin 102°$

D. $A = \frac{1}{2} \times 16 \times 20 \times \sin 102°$

6 A car used 60 litres of fuel to travel a distance of 870 km.

What is the rate of fuel consumption of the car?

60L : 870 km

6.8965 L : 100 km

6.9L : 100 km

A. 5.2 L/100 km

B. 6.9 L/100 km

C. 8.7 L/100 km

D. 14.5 L/100 km

7 The height of adults in Australia is normally distributed with a mean of 172 cm and a standard deviation of 7 cm.

What is the range in height of approximately 95% of Australian adults?

↳ lies within 2 SD

A. 151 cm – 170 cm

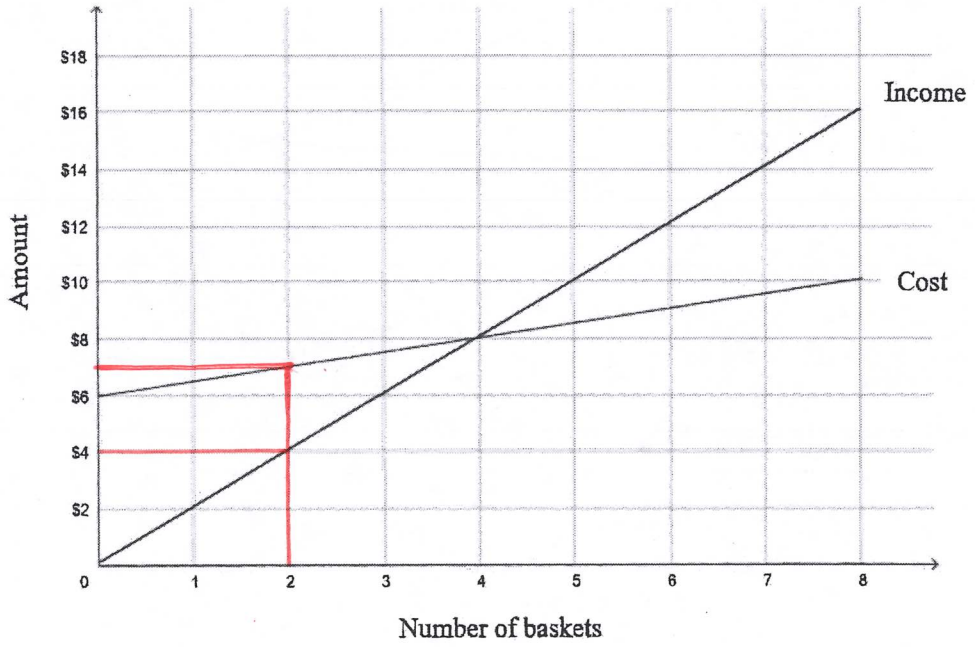
B. 151 cm – 193 cm

C. 158 cm – 179 cm

D. 158 cm – 186 cm

1	1	1	1	1
158	165	172	179	186
-2	-1	0	1	2

8 The graph below shows the cost and income in dollars, for a small business that makes and sells baskets.



Which of the following statements is correct when two baskets are made and sold?

A. There is a loss of $3

B. There is a loss of $7

C. There is a profit of $3

D. There is a profit of $7

$7 - $4 = $3

9 A painter mixes 80 mL of green paint with 2 L of white paint.

What is the ratio of green to white paint?

A. 1 : 25

B. 1 : 40

C. 2 : 80

D. 8 : 20

G : W

80 : 2000

8 : 200

1 : 25

10 A teacher gives each student in her class a small bag of lollies. The number of lollies in each bag is recorded in the frequency distribution table below.

Number of lollies	*Frequency*
8	1
9	6
10	13
11	4

} 10 or more

What is the relative frequency of a bag of lollies containing 10 or more lollies?

A. $\frac{10}{13}$

B. $\frac{13}{17}$

C. $\frac{13}{24}$

D. $\frac{17}{24}$

$\frac{13+4}{24} = \frac{17}{24}$

11 A pair of boots can be purchased for $288.75 including 10% goods and services tax (GST).

How much GST is paid in this purchase?

A. $8.75

B. $14.44

C. $26.25

D. $28.88

110 % : $ 288.75

10 % : $ 26.25

12 Which description best fits the correlation of the following bivariate data?

x	12	14	15	17	22
y	−92	−85	−79	−80	−72

A. Weak, negative correlation

B. Strong, positive correlation

C. Strong, negative correlation

D. Moderate, positive correlation

13 Henry invests \$2500 into an account that earns interest at the rate of 3.6% per annum, compounded quarterly.

What is the value of Henry's investment after $2\frac{1}{2}$ years?

$r = 0.009$

$n = 10$

A. \$2591.22

B. \$2731.11

C. \$2734.33

D. \$2879.91

$A = P(1+r)^n$

$= 2500(1+0.009)^{10}$

$= 2734.33$

14 Which of the following correctly expresses a as the subject equation of $d = \frac{w}{3+a}$?

A. $a = \frac{3d}{w}$

B. $a = \frac{w}{d} - 3$

C. $a = \frac{3-w}{d}$

D. $a = w - 3$

$(3+a) \times d = \frac{w}{3+a} \times (3+a)$

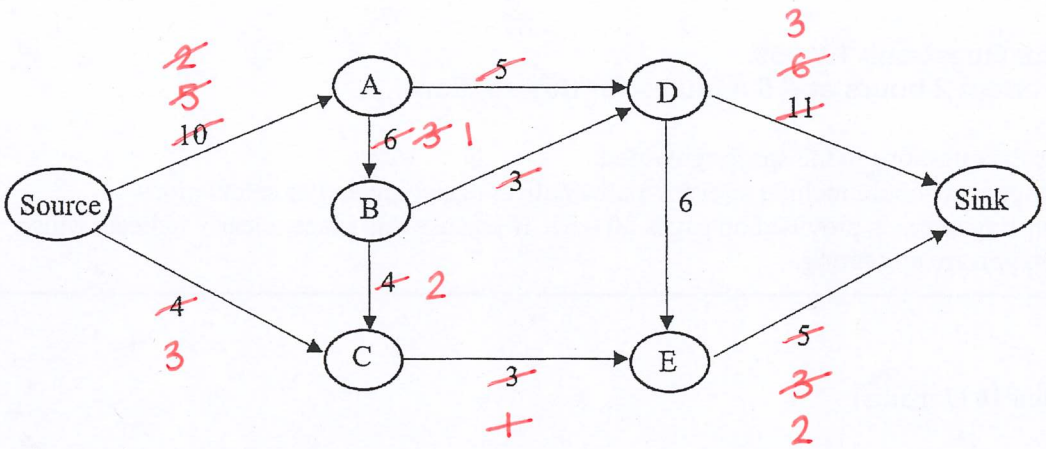
$\frac{d(3+a)}{d} = \frac{w}{d}$

$3 + a = \frac{w}{d} - 3$

$-3 \quad\quad -3$

$a = \frac{w}{d} - 3$

15 What is the maximum flow from the source to the sink in the network below?



A. 11

B. 14

C. 16

D. 26

SADS = 5

SABDS = 3

SABCES = 2

SCES = 1

Max Flow = 11

Section II
85 marks

Attempt Questions 16 – 39
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 30 – 31. If you use this space, clearly indicate which question you are answering.

Question 16 (2 marks)

Monica drank 5 large glasses of wine between 4:00 pm and 11:30 pm. Each glass of wine contained 1.4 standard drinks. **2**

Given that Monica weighs 72 kg, use the formula below to estimate her blood alcohol content (BAC) at 11:30 pm.

$$BAC_{Female} = \frac{10N - 7.5H}{5.5M}$$

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.

Give the estimate of Monica's BAC correct to three decimal places.

$N = 5 \times 1.4 = 7$

$H = 7.5$

$M = 72$

$$BAC = \frac{10(7) - (7.5)(7.5)}{5.5(72)}$$

$BAC = 0.034722222222$

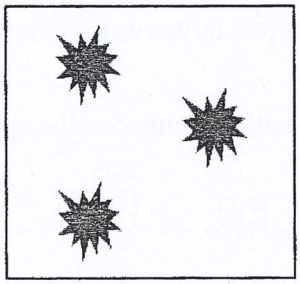
≈ 0.035 (to 3 dp)

Question 17 (2 marks)

Madeleine is tiling a kitchen wall measuring 2.7 metres × 3.3 metres. **2**

She will be using tiles that are 30 cm × 30 cm each.

Each tile has three starbursts on it.



How many starbursts in total will be on the tiled kitchen wall?

A of wall = 270 x 330 = 89100

A of tile = 30 x 30 = 900

89100 ÷ 900 = 99 tiles

99 x 3 = 297 starbursts

Question 18 (2 marks)

A netball uniform that has a selling price of $88, will increase in price by 1.3% each quarter due to inflation. **2**

To the nearest dollar, how much will a netball uniform cost in 5 years' time?

$A = P(1+r)^n$ $r = 0.013$

$= 88(1 + 0.013)^{20}$ $n = 20$

$= 113.9387838$

= $114 (to nearest $)

Question 19 (3 marks)

A study of the turtles in Centennial Park uses the "capture-recapture" technique to estimate the size of the turtle population.

In the first stage of the study, 36 turtles were caught, tagged and released.

In the second stage of the study, 40 turtles were captured. Six of these turtles were found to be already tagged.

(a) What percentage of the turtles captured in the second stage of the study were already tagged? **1**

$\frac{6}{40} \times 100 = 15\ \%$

(b) Calculate the estimated number of turtles in Centennial Park. **2**

$\frac{36}{x} = \frac{6}{40}$

$6x = 1440$

$x = 240$

OR

$36 = 15\ \%$

$12 = 5\ \%$

$240 = 100\ \%$

Question 20 (3 marks)

Andrew has budgeted to spend \$75 per week on fuel. His car has a fuel consumption of 6.8 litres/100 km and he pays an average fuel cost of \$1.79 per litre. **3**

How many kilometres can Andrew travel per year within his fuel budget? Give your answer correct to two significant figures.

$\$75 \div \$1.79 = 41.89944134$ L of petrol per week

$41.89944134 \div 6.8 = 6.16168255 \times 100$

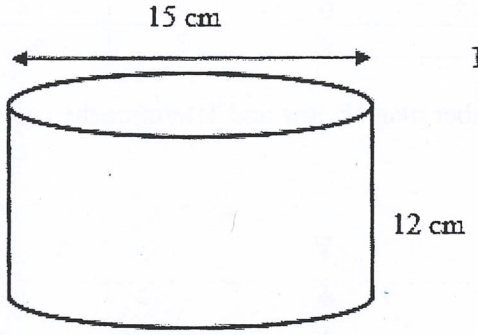
$= 616.168255$ km p/w

$616.168255 \times 52 = 32040.74926$

≈ 32000 km (to 2sf)

Question 21 (6 marks)

A cylindrical pot has a diameter of 15 cm and a height of 12 cm. The pot is closed at the bottom and is open at the top.



(a) Calculate the surface area of the open pot. Give your answer correct to one decimal place. **3**

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

$= \pi(7.5)^2 + 2\pi(7.5)(12)$

$= 56.25\pi + 180\pi$

$= 236.25\pi$

$= 742.2012644$

$= 742.2 \text{ cm}^2$ (to 1 dp)

(b) Meg needs a container that has enough capacity to hold 2 litres of liquid. **3**

Does this pot have enough capacity? Use calculations to support your answer.

$V = \pi r^2 h$ $\qquad 2L = 2000 \text{ cm}^3$

$= \pi(7.5)^2(12)$

$= 2120.575041 \text{ cm}^3$

$= 2.12 \text{ L}$

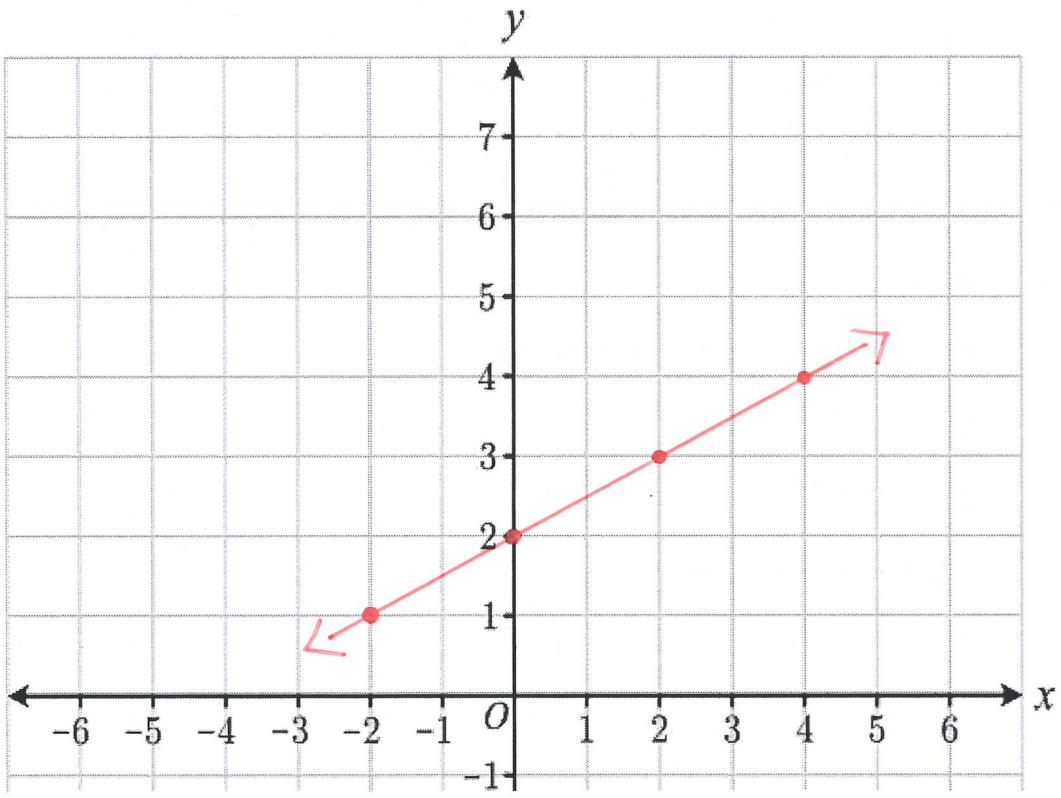
$\therefore$ Yes, as the capacity of the pot $> 2L / 2000 \text{ cm}^3$

Question 22 (3 marks)

The table of values below shows four points that form a linear relationship. **3**

x	-2	0	2	4
y	1	2	3	4

Graph the straight line on the number plane below and determine the equation of the line.



Equation of the line: $y = \frac{1}{2}x + 2$

Question 23 (2 marks)

A hospital patient requires 900 mL of medication to be delivered through a drip over 6 hours. Each mL of fluid is equivalent to 16 drops. **2**

How many drops per minute need to be delivered?

1 mL = 16 drops

900 mL = 14400 drops

6 hrs = 360 minutes

14400 ÷ 360 = 40 drops per minute

Question 24 (3 marks)

The letters of the word ALGEBRA are written on seven separate cards.

A	L	G	E	B	R	A

Two cards are chosen at random without replacement.

(a) What is the probability that the first card chosen is the letter A? **1**

$\frac{2}{7}$

(b) What is the probability that exactly one of the cards chosen is the letter A? **2**

P(A & NotA) + P(Not A & A)

$= \left(\frac{2}{7} \times \frac{5}{6}\right) + \left(\frac{5}{7} \times \frac{2}{6}\right)$

$= \frac{5}{21} + \frac{5}{21}$

$= \frac{10}{21}$

Question 25 (3 marks)

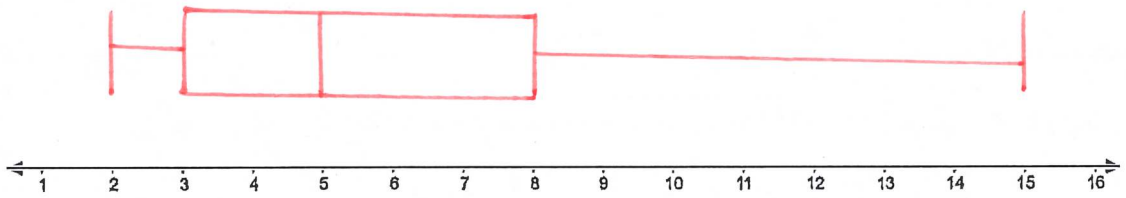
A basketball player recorded the points that he scored each game throughout a 15-game season. **3**

The player's points scored per game were:

~~6~~ ~~8~~ ~~15~~ ~~3~~ ~~2~~ ~~7~~ ~~2~~ ~~14~~ ~~4~~ ~~5~~ ~~7~~ ~~2~~ ~~4~~ ~~3~~ ~~12~~

(2) 2 2 (3) 3 4 4 (5) 6 7 7 (8) 12 14 (15)

Construct a box and whisker plot below to represent this data.



Question 26 (2 marks)

Penny owns 2400 shares in a company with a market price of $17.50 per share. **2**

She received a total dividend payment of $504.

Calculate the dividend yield on Penny's shares.

Value of shares = 2400 x $17.50

= $42000

Dividend yield = $\frac{504}{42000} \times 100 = 1.2\%$

Question 27 (4 marks)

Last month eight houses were sold in Oldsville.

The selling prices of the houses were:

$480 000 $505 000 | $517 000 $528 000 | $528 000 $552 000 | $580 000 $980 000

(a) Show that the value of the most expensive house sold is an outlier for this data set. **2**

Outlier = $Q_3 + 1{\cdot}5 \times IQR$ $Q_3 = \$566000$

$= 566000 + 1{\cdot}5 \times \$55000$ $Q_1 = \$511000$

$= \$648500$ $IQR = \$55000$

$\therefore$ \$980000 is an outlier as $>$ \$648500

(b) Explain the effect of the outlier on the mean and median selling prices for this data set. Justify your answer with relevant calculations. **2**

$\bar{x}$ with outlier = \$583750

$\bar{x}$ without outlier = \$527142·86

→ The mean increases when the outlier is included.

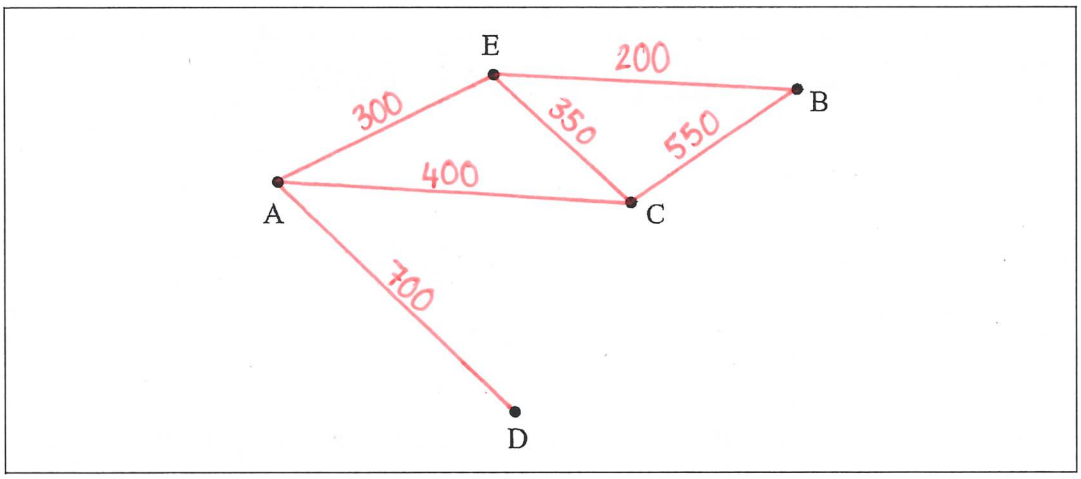
→ The median remains unchanged at \$528000

Question 28 (6 marks)

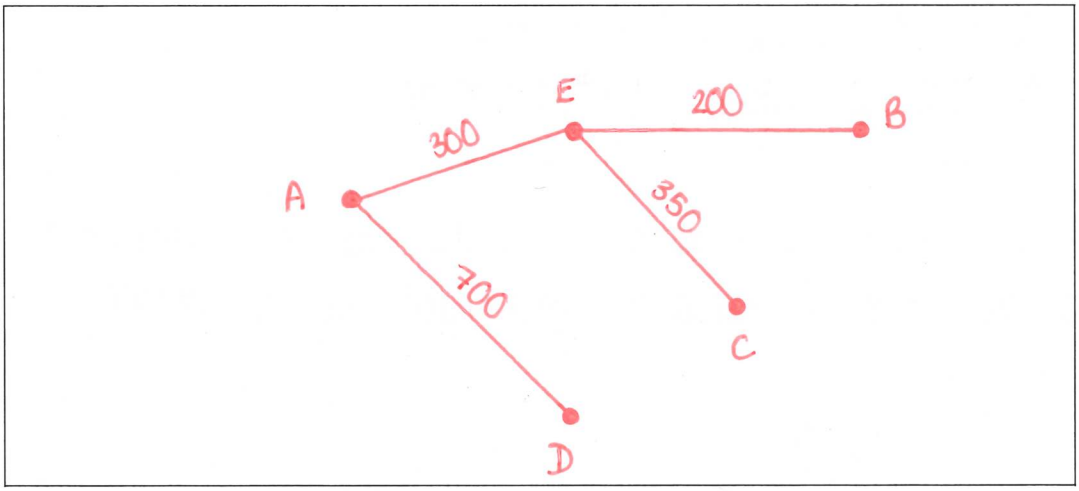
The table below represents a computer network in a small office. The numbers in the table represent the lengths of optical cable, in metres, required to connect the two computers.

	A	B	C	D	E
A	-	-	400	700	300
B	-	-	550	-	200
C	400	550	-	-	350
D	700	-	-	-	-
E	300	200	350	-	-

(a) Complete a network diagram below to represent the information given in the table. **2**



(b) Draw the minimum spanning tree for the network. **2**



Question 28 continues on page 19

Question 28 (continued)

(c) What minimum length of optical cable is required to connect the network? 1

200 + 300 + 350 + 700 = 1550 m

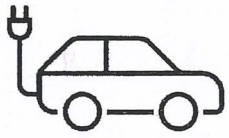
(d) The optical cable connecting computers B and E has been removed due to a fault and will not be replaced. 1

What is the increase in the length of the minimum spanning tree now required to connect the network?

550 - 200 = 350 m

Question 29 (2 marks)

An electric car charging station uses 75 kW to charge electric cars. 2



Given an electricity cost of 27.5 cents/kWh, calculate the cost for an electric car to be connected to the station for 90 minutes.

75 x 0·275 x 1·5 = $30·9375

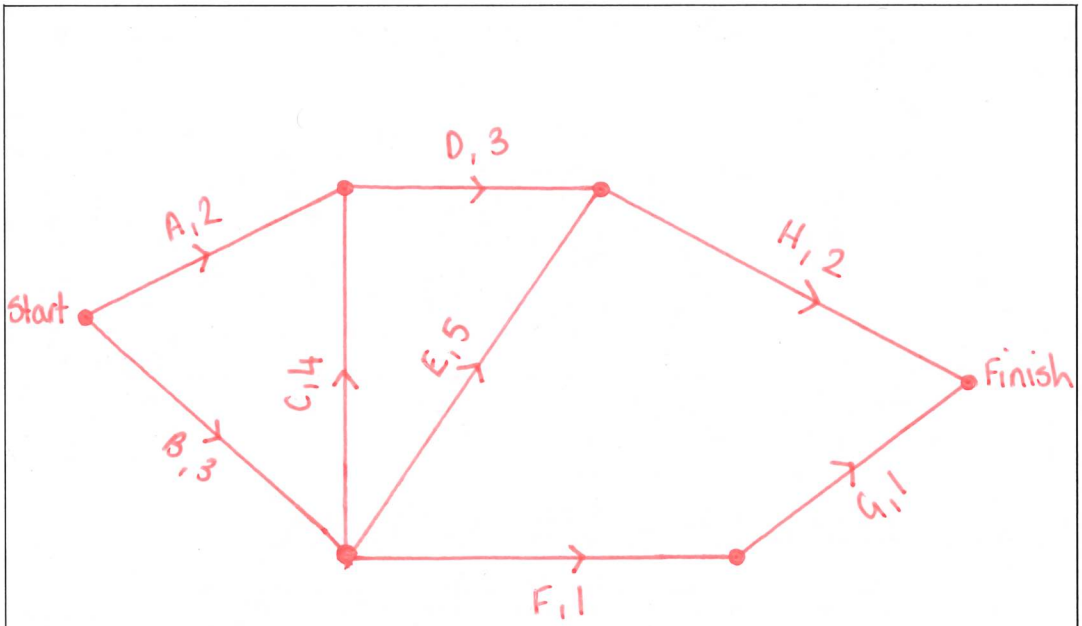
= $30·94

Question 30 (7 marks)

The activity chart below shows the immediate prerequisites and required hours for each activity to be completed in a project.

Activity	*Immediate Prerequisite(s)*	*Duration (in hours)*
A	-	*2*
B	-	*3*
C	*B*	*4*
D	*A, C*	*3*
E	*B*	*5*
F	*B*	*1*
G	*F*	*1*
H	*D, E*	*2*

(a) Complete a network diagram for this project and determine the minimum time required to complete the project. **3**



Minimum completion time = 12 hours

Question 30 continues on page 21

Question 30 (continued)

(b) Determine the critical path for this project. **1**

BCDH

(c) What is the float time for Activity A? **1**

7 - 2 - 0 = 5 hours

(d) Explain the impact that an increase in the time taken to complete Activity F would have on the completion time of the project. **2**

An increase in 7 hours, or less, will have no impact as it is not on the critical path.
However, if F is increased by more than 7 hours, the critical path would change, thus increasing the completion time of the project.

Question 31 (3 marks)

The shoe size of women in a town is normally distributed with a mean size of 8 and a standard deviation of 1. **3**

A shoe shop in the town sells women's shoes ranging from size 5 to size 10.

Given that there are 4000 women in the town, how many would be expected to find shoes that fit them in this shop?

Size 5 = 3 SD below mean → $\frac{99.7\%}{2}$ = 49.85 %

Size 10 = 2 SD above mean → $\frac{95\%}{2}$ = 47.5 %

∴ 97.35 % lie between size 5 & 10.

4000 x 97.35 % = 3894

∴ 3894 women would be expected to find shoes that fit.

Question 32 (6 marks)

Sam invested \$10 000 into a bank account earning interest at 10% per annum, compounded annually.

To calculate his final amount at the end of any year, Sam uses the formula:

$$A = 10000(1.1)^n$$

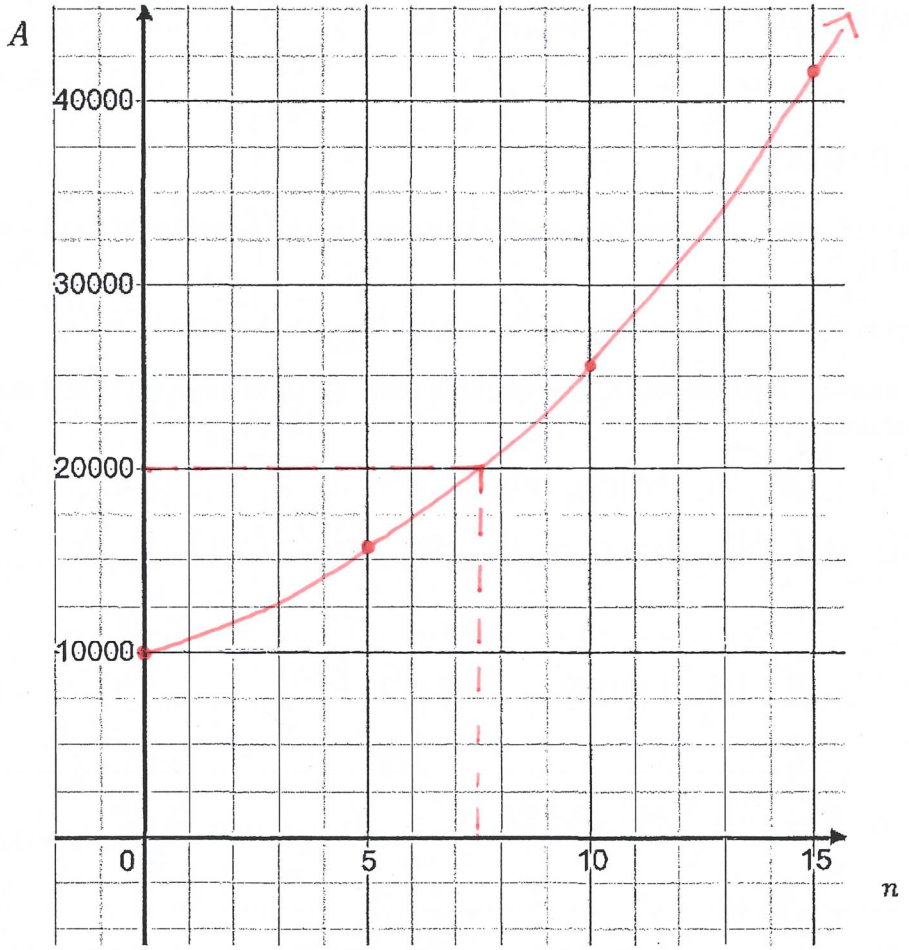
where:

A is the final amount in dollars

n is the number of years

(a) Complete the table below and use the values to sketch a graph of the investment over the first 15 years. **4**

n	0	5	10	15
A	10000	16105.10	25937.42	41772.48



Question 32 continues on page 23

Question 32 (continued)

(b) Use your graph in part (a) to estimate how long it will take for the value of Sam's investment to double from the initial investment. 1

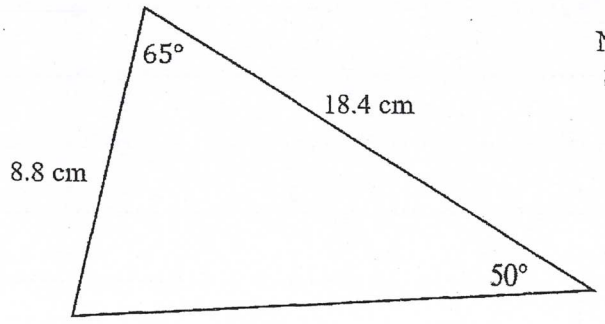
Approximately 7·5 years

(c) Explain why Sam's investment is an example of exponential growth. 1

It is an example of exponential growth as the original investment is growing by an increasing amount per annum.

Question 33 (2 marks)

Calculate the area of the triangle below. Give your answer correct to one decimal place. 2



NOT TO SCALE

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

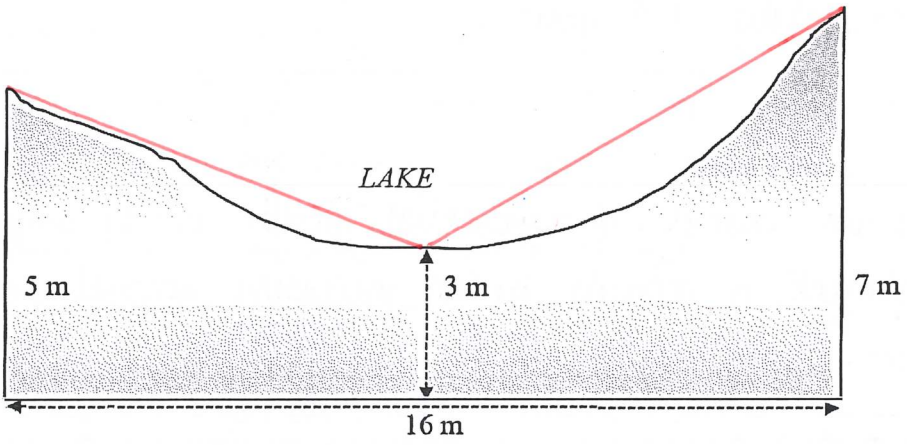
$= \frac{1}{2} \times 8{\cdot}8 \times 18{\cdot}4 \times \sin 65°$

$= 73{\cdot}37467844$

$\approx 73{\cdot}4 \text{ cm}^2$

Question 34 (3 marks)

The dimensions of a garden that borders a lake are shown in the diagram below.



NOT TO SCALE

(a) Use two applications of the trapezoidal rule to calculate the approximate area of the garden. **2**

$A = \frac{8}{2}(5+3) + \frac{8}{2}(3+7)$

$= 4(8) + 4(10)$

$= 32 + 40$

$= 72\ m^2$

(b) Explain why the approximate area calculated in (a) would be greater than the actual area of the garden. **1**

It would be greater as the trapezoidal rule is based on the dimensions given in relation to straight edges. As seen above, the garden boundaries fall below an actual trapezium, thus over-estimating the garden area.

Question 35 (5 marks)

The table below shows the future value of a \$1 annuity at different interest rates over different time periods. The contribution is made at the end of each period.

Time Period	Interest Rate per time period			
	1%	2%	3%	4%
1	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400
3	3.0301	3.0604	3.0909	3.1216
4	4.0604	4.1216	4.1846	4.2465
5	5.1010	5.2040	5.3091	5.4163
6	6.1520	6.3081	6.4684	6.6330
7	7.2135	7.4343	7.6625	7.8984
8	8.2857	8.5830	8.8923	9.2142

$n = 2 \times 3 = 6$

$r = \frac{4\%}{2} = 2\%$

(a) Scarlett is planning a holiday in three years' time that will cost \$3100. She contributes \$500 at the end of every six months into an annuity with an interest rate of 4% per annum, compounded half yearly. **3**

Does Scarlett have enough money after three years to pay for the holiday? Justify your answer with calculations.

FV = 500 x 6.3081

= \$3154.05

∴ She will have enough as the future value of her annuity > \$3100.

(b) Scarlett has decided that she would like to go on the holiday in two years' time instead of three years' time. **2**

If she receives the same interest rate of 4% per annum, compounded half yearly, and the cost of the holiday is also the same, what amount will Scarlett need to contribute into the account every six months to pay for the holiday in two years' time?

$3100 = x \times 4.1216$

$x = 3100 \div 4.1216$

$x = \$752.14$ (to nearest ¢)

Question 36 (2 marks)

Will and Ivan both sat a class test. The class results of the test had a standard deviation of 8. The table below shows Will's result in the test and the z-score for both students. **2**

	Result	z-score
Will	62	-1.75
Ivan		1.75

Calculate the result that Ivan achieved in the test.

$-1.75 = \frac{62 - \bar{x}}{8}$

$\bar{x} = 76$

Ivan's mark $= 76 + (1.75 \times 8)$

$= 90$

Question 37 (4 marks)

A car salesperson records the age in years and the price in dollars of six cars that are for sale.

Age (A)	3	5	5	6	8	10
Price (P)	23 000	18 000	16 500	12 000	9700	7000

(a) Find the equation of the least-squares regression line, giving each value to the nearest whole number, and use the equation to estimate the cost of a car that is 4 years old. **3**

$A = 28460$

$B = -2285$

$y = Bx + A$

$P = -2285A + 28460$

$P = -2285(4) + 28460$

$P = \$19320$

(b) John has a rare classic car that is now 50 years old. Explain why the least-squares regression line in part (a) cannot be used to determine the value of John's car. **1**

Extrapolation → outside the range of data, making the equation invalid for a car of this age.

Question 38 (5 marks)

Maroun deposits \$500 000 into a retirement fund which earns compound interest at the rate of 0.3% per month.

Maroun withdraws spending money from the retirement fund at the end of each month.

The incomplete table below shows the account activity for the first four months and the balance at the end of the fifth month.

Month	Principal (P)	Interest (I)	Withdrawal (M)	Balance ($P + I - M$)
1	500 000.00	1500.00	2000	499 500.00
2	499 500.00	1498.50	2500	498 498.50
3	498 498.50	1495.50	3000	496 994.00
4	496 994.00	1490.98	3800	494 684.98
5	494 684.98	1484.05	4200	491 969.03

(a) Calculate the amount of money that Maroun withdrew at the end of the fifth month. **3**

(494684.98 + 1484.05) - M = 491969.03

M = \$496169.03 - \$491969.03

M = \$4200

(b) Maroun is going to withdraw \$7500 at the end of each month, starting from the end of the sixth month. **2**

The recurrence relation $A_n = A_{n-1} \times 1.003 - 7500$ models this situation, where A_n is the balance in the retirement fund at the end of the nth month.

Calculate the balance in Maroun's retirement fund at the end of the seventh month.

A_6 = 491969.03 × 1.003 - 750 = \$485944.9371

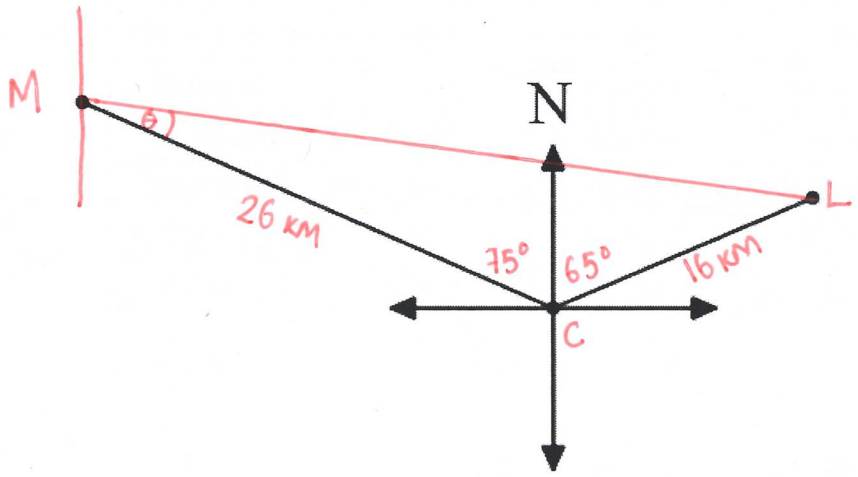
A_7 = 485944.94 × 1.003 - 750 = \$479902.77

Balance = \$479902.77

Question 39 (5 marks)

Two hikers decide to leave a campsite (C) to visit some natural landmarks in the area. One hiker walks 16 km on a bearing of 65° to see a lake (L); the other hiker walks 26 km on a bearing of 285° to reach the top of a mountain (M).

(a) Calculate the distance between the mountain and the lake (complete the diagram below to guide you). Give your answer correct to the nearest kilometre. **2**



$ML^2 = 16^2 + 26^2 - 2(16)(26)\cos(140)$

$= 1569.348977$

$ML = 39.61500949$

≈ 40 km

Question 39 continues on page 29

Question 39 (continued)

(b) Hence, or otherwise, find the bearing of the lake from the mountain, correct to the nearest degree. **3**

$\frac{\sin\theta}{16} = \frac{\sin 140}{39.61500949}$

$\theta = 15.04714555$

Bearing $= 180° - 75° - 15°$

$= 90°$ (to nearest degree)

End of Examination

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.

BLANK PAGE