Ascham School

NESA Number: _____

Teacher: LD KS

July 2022
TRIAL EXAMINATION

Mathematics Standard 2

Writing time	2 hours 30 minutes
Reading time	10 minutes
Total Marks	100

General Instructions

- Write using black, non-erasable pen.
- Diagrams must be drawn using pencil.
- A NESA-approved calculator may be used.
- All relevant working should be shown for each question.

Additional materials needed

- Reference Sheet
- Multiple-Choice Answer Sheet

Structure & Suggested Time Spent

- **Section I** (Multiple Choice) **15 Marks**
  Attempt all questions.
  Allow about 20 minutes.

- **Section II** (Extended Response) **85 Marks**
  Attempt all questions.
  Answer in the space provided.
  Allow about 2 hours and 10 minutes.

Section I	**Section II**		
Q1 - 15	Q16 - 29	Q30 - 39	TOTAL
/15	/43	/42	/100

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Section I

15 marks
Attempt Questions 1-15
Allow about 20 minutes for this section.

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

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

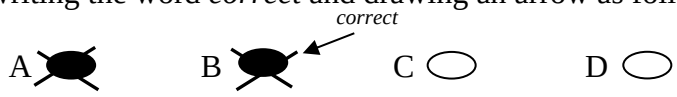
Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

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

A ● B ⊗ C ○ D ○

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



1 A farmer has 175 chickens and 275 sheep.
What is the simplified ratio of sheep to chickens?

(A) 3 : 1

(B) 7 : 11

(C) 11 : 7

(D) 175 : 275

2 Last week, Paola earned $358.40 when she worked 16 hours at a normal rate in her part-time job. This week she worked 12 hours at a normal rate and 3 hours at time-and-a-half.
How much did she earn this week?

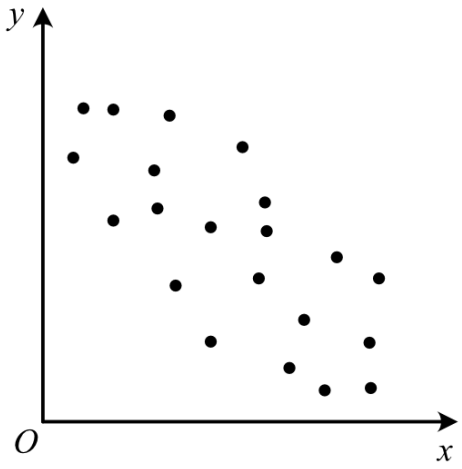
(A) $268.80

(B) $336.00

(C) $369.60

(D) $403.20

3 Which description best describes the relationship shown in the scatterplot below?



(A) Linear, negative, weak

(B) Non-linear, positive, strong

(C) Non-linear, negative, weak

(D) Linear, positive, strong

4 A pencil is measured to be 13.6 cm long.

What is the percentage error of this measurement, correct to two decimal places?

(A) 0.60%

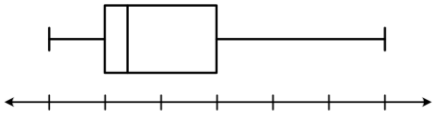
(B) 0.37%

(C) 0.74%

(D) 4.41%

5 Which of the data sets below represents a distribution that is positively skewed?

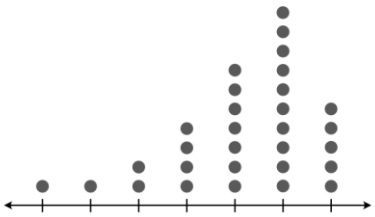
(A)



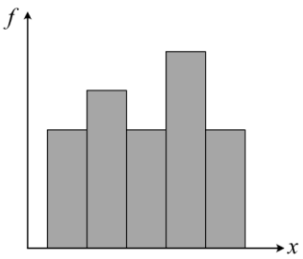
(B)

stem	leaf
14	6 9
15	2 3 4 8 8
16	4 4 5 7 7 7
17	1 2 6 8 9
18	0 1

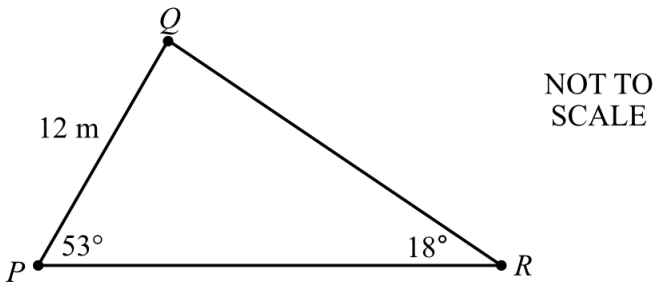
(C)



(D)



6 What is the distance from Q to R in the diagram below, correct to the nearest metre?



(A) 5 m

(B) 31 m

(C) 35 m

(D) 39 m

7 Ben weighs 85 kg and drinks 3 glasses of beer between 8 pm and 10:30 pm on a Saturday night. Each glass of beer is equivalent to 1.6 standard drinks. Ben's blood alcohol content (BAC) can be calculated using the following formula:

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

where $N =$ number of standard drinks
$H =$ number of hours drinking
$M =$ male's mass, in kilograms

What is Ben's approximate BAC at 10:30 pm?

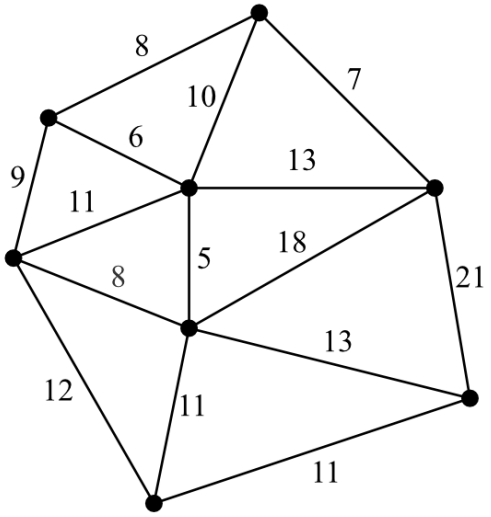
(A) 0.063

(B) 0.050

(C) 0.024

(D) 0.006

8 What is the length of the minimum spanning tree in the network below?



(A) 55

(B) 56

(C) 57

(D) 58

9 Flour is sold in 4 different-sized packs.

Which pack is the best buy?

(A) 250 g pack for $0.70

(B) 500 g pack for $1.30

(C) 1 kg pack for $2.30

(D) 2 kg pack for $4.80

10 Juliette is driving along the highway at 100 km/h. She notices a possum on the road and applies the brakes 1.6 seconds after noticing the possum. Her braking distance is 98 metres. What is her approximate stopping distance?

(A) 48 m

(B) 57 m

(C) 63 m

(D) 142 m

11 Craig's target heart rate when exercising is calculated using the following formula:

$$\text{THR} = I \times (\text{MHR} - \text{RHR}) + \text{RHR}$$

where I = exercise intensity
MHR = maximum heart rate
RHR = resting heart rate

Craig wants to undertake an exercise of 0.85 intensity and achieve a target heart rate of 165. If he has a resting heart rate of 80 beats per minute, what is his maximum heart rate?

(A) 185 bpm

(B) 180 bpm

(C) 175 bpm

(D) 170 bpm

12 Electricity prices have risen by 3.4% p.a. over the past few years.

If the average electricity bill in 2012 was $425, what was the average electricity bill in 2020?

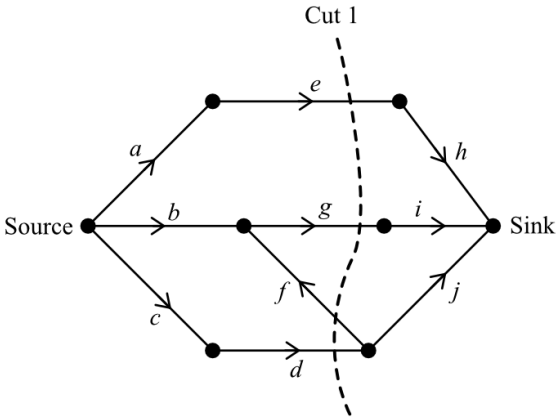
(A) $437.75

(B) $489.22

(C) $523.67

(D) $555.33

13 Water pipes connect 8 locations. The flow network below shows the capacities of the pipes.



What is the capacity of cut 1?

(A) $e+g+f$

(B) $e+g-f+d$

(C) $e+g+d$

(D) $c+d$

14 Remy achieved a z-score of 2.2 on her latest Geography test.

If the test scores were normally distributed with a mean of 64 and a standard deviation of 5, what was Remy's actual test mark?

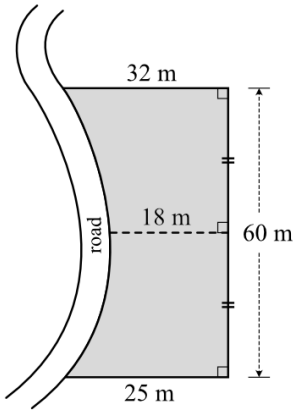
(A) 58

(B) 65

(C) 72

(D) 75

15 The shaded region represents a block of land bounded on one side by a road.



NOT TO SCALE

What is the approximate area of the block of land using two applications of the Trapezoidal rule?

(A) 2790 m^2

(B) 1395 m^2

(C) 1710 m^2

(D) 1080 m^2

End of Section I

Section II

85 marks

Attempt all questions.

Allow about 2 hours and 10 minutes for this section.

Answer each question in the space provided.

Show all relevant working in questions involving calculations.

Marks

16 Eliza had saved $300 to use on fuel for a road trip during her holidays. **2**

Her car has a fuel consumption of 6.4 L/100 km and she paid $1.98 per litre for fuel throughout the trip.

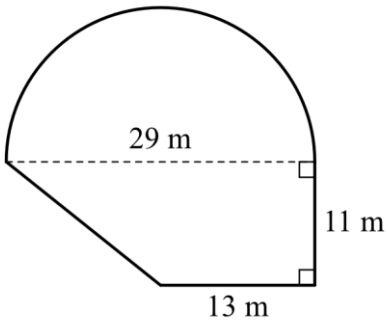
How many kilometres was Eliza able to travel using the money she'd saved? Answer correct to the nearest kilometre.

17 Solve the following equations.

(a) $8m + 2 = 24 - 3m$ **2**

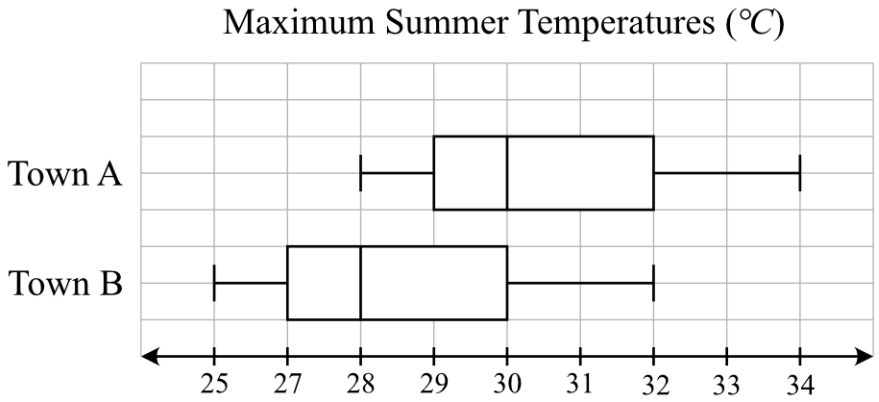
(b) $\frac{k-2}{4} + 5 = 7$ **2**

18 The composite shape below is made up of a semicircle and a trapezium. Calculate the perimeter of the shape, correct to the nearest metre. **3**



NOT
TO
SCALE

19 In one particular Australian summer, the summer months of December, January and February had a total of 90 days.
The box plots below display data on the maximum daily temperatures in town A and town B during these summer months.

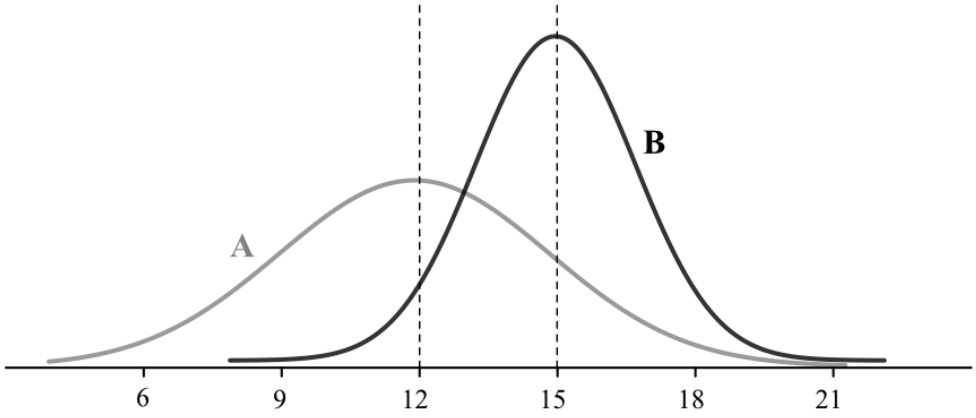


(a) What is the median maximum summer temperature of Town A? **1**

(b) What percentage of summer days in Town A were warmer than Town B's warmest day? **1**

(c) How many summer days in Town B were at least $28°C$? **2**

20 The diagram below shows two different normal distribution curves A and B. **2**



Compare the curves using the terms ‘mean’ and ‘standard deviation’.

21 In a normally distributed set of scores, the mean is 35 and the standard deviation is 3. What percentage of scores lie between 26 and 29? **2**

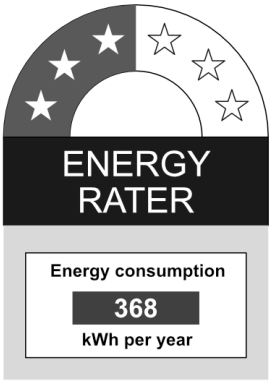
22 Cairo in Egypt is located at (30° N, 31° E). **3**
Sydney, in Australia, is located at (33° S, 151° E).

Camilla lives in Sydney and needs to attend an online meeting with her business partners in Cairo starting at 11:00 am on Monday, local time in Cairo.

What time and day, in Sydney, does Camilla need to log on to the meeting?

Ignore daylight saving.

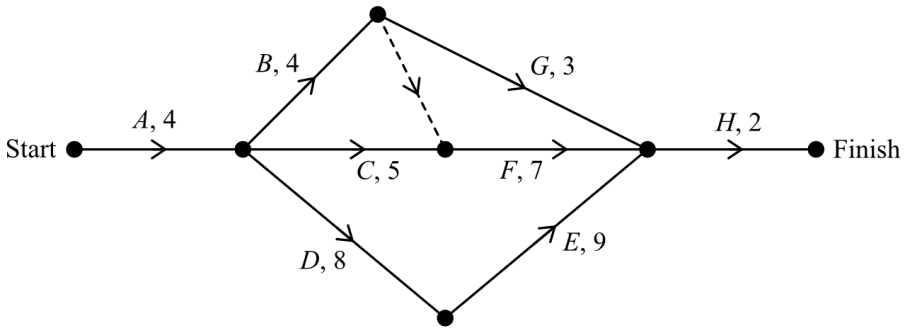
23 A 2500-watt vacuum cleaner has the following energy label on it. **3**



The energy label assumes that a typical household would consume 368 kWh of energy per year using the vacuum cleaner.

How many hours and minutes of usage would this equate to each week? Give your answer correct to the nearest minute. Assume 52 weeks per year.

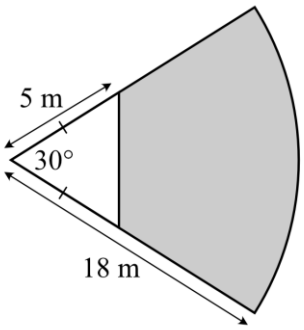
24 The network below shows the activities that need to occur for a project to be completed. **3**



Complete the activity table below for the network shown.

Activity	Duration	Immediate predecessor
A	4	
	4	*A*
C		
D		*A*
	9	
F		
G		
H	2	

25 Calculate the area of the shaded region in the sector below, correct to two decimal places. **3**



NOT TO SCALE

26 Sophia purchased 1500 shares for $3.25 and later sold them for $4.90 per share. Sophia paid brokerage fees on the purchase and sale of the shares as shown in the table. **3**

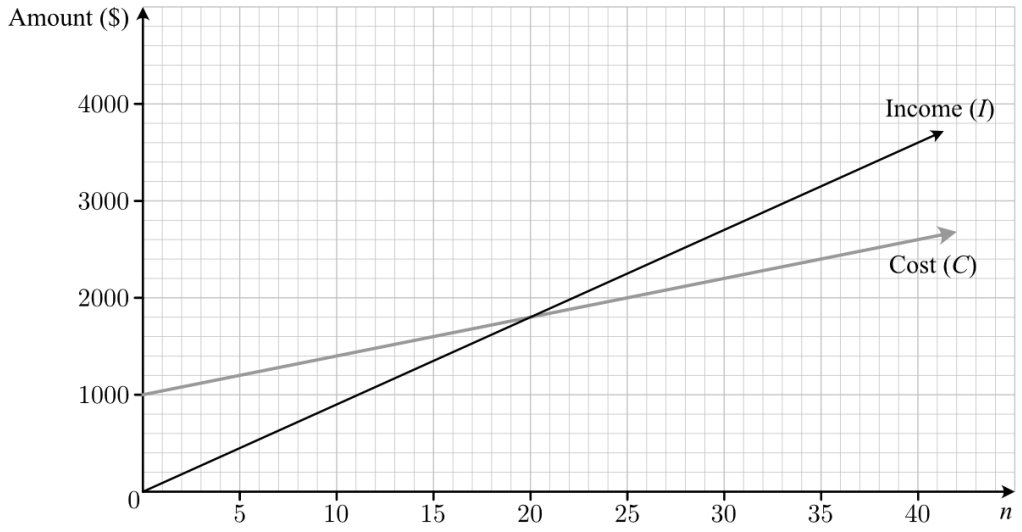
Brokerage fees	
Purchase of shares	2% of the purchase price
Sale of shares	3% of the sale price

Given that she did not receive any dividend, calculate the profit that Sophia earned from the shares.

27 A set of data has a lower quartile of 36 and an upper quartile of 48. **3**

What is the maximum possible range if there are no outliers in the data set?

28 Caitlin plans to set up a furniture business to sell bedside tables.
Below are the income (I) and cost (C) functions for her business.

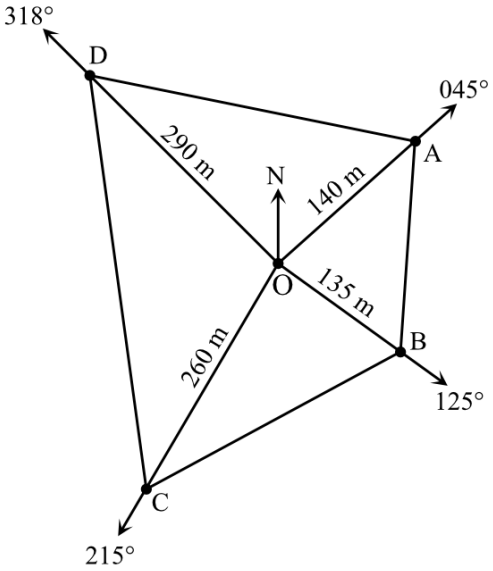


(a) Write the cost function in the form $C = mn + c$ for the cost of making n tables. **2**

(b) For how much does Caitlin plan to sell each bedside table? **1**

(c) If Caitlin sells 30 bedside tables, how much profit or loss will she incur? **2**

29 A compass radial survey for block of land ABCD, is shown in the diagram below.



(a) Calculate the size of angle AOD. **1**

(b) Calculate the distance along the boundary of the land from A to D, correct to the nearest metre. **2**

30 Ella contributes $1200 per month at the start of each month into an investment which pays interest at 3.6 % per annum, compounded monthly.

(a) Show that at the end of the second month, the future value of Ella's investment will be $2410.81. **2**

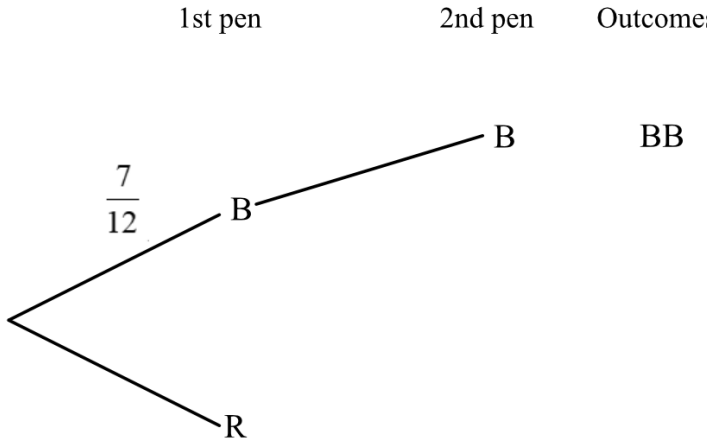
(b) After 18 months, the future value of Ella's investment will be $22 226.19. **2**

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 3.6% per annum, compounded monthly.

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

31 Karim has a box containing 7 blue pens and 5 red pens. He selects a pen at random from the box and places it on a table. He then selects a second pen and places it on the table next to the first pen.

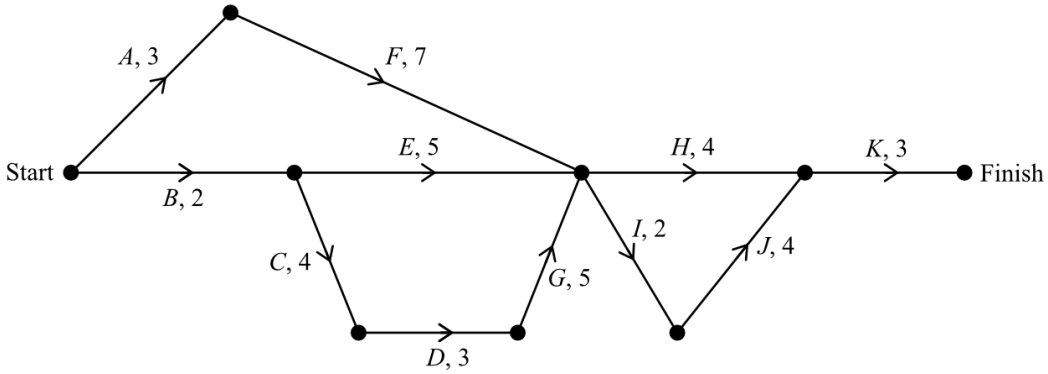
(a) Complete the tree diagram below by drawing the missing branches, writing the probabilities on each branch and listing all possible outcomes. **2**



(b) What is the probability that the pens on the table are both red? **1**

(c) What is the probability that the pens on the table are different colours? **2**

32 The network diagram shows tasks that must be completed to finish a project.
Each edge weight represents the time taken to complete the task, in days.



(a) What is the earliest start time (EST) of activity *H*? **2**

(b) What is minimum completion time for the project? **1**

(c) What is the critical path for the project? **2**

(d) What is the float time of activity *E*? **1**

33 Lauren spends $6000 on a new photocopier for her business.

She uses the declining-balance method to calculate the depreciation of the photocopier. She claims this amount as a tax deduction each year. She can only claim the depreciation for that particular year.

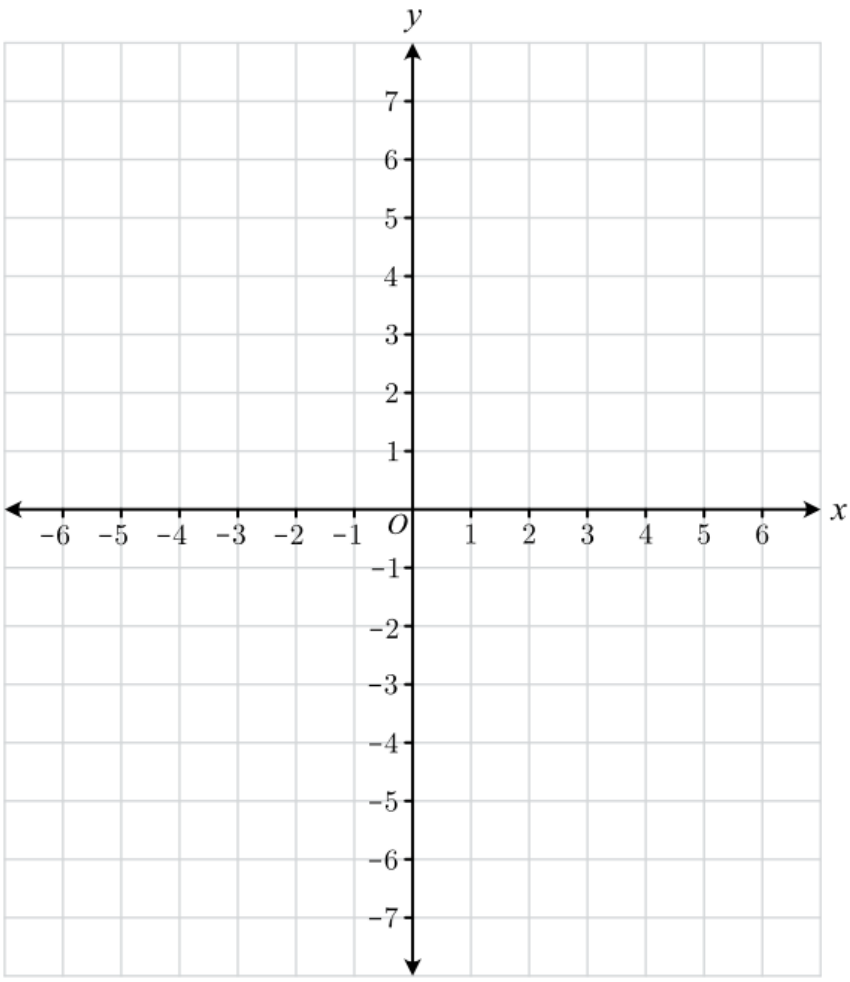
(a) If the rate of depreciation is 26% per annum, show that the depreciation she can claim in the second year is equal to $1154, rounded correct to the nearest dollar. **2**

(b) Lauren earned $110 000 for the last financial year. The depreciation for her photocopier in part (a) is the only tax deduction she claims. **3**
Using the tax table below and ignoring the Medicare levy, calculate the amount of tax she needs to pay.

Income tax rates for Australian residents

Taxable income	**Tax on this income**
0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $90 000	$3572 plus 32.5c for each $1 over $37 000
$90 001 – $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

34 On the number plane below, graph the equations $y = -\frac{x}{2} + 1$ and $y = 2x + 6$, and hence, solve the equations simultaneously. **3**



Solution: _____

35 Alexa is buying her first car. She takes out a loan for $15 000 and agrees to repay the loan in monthly repayments at 7.2% per annum for 5 years. **3**

Use the present value of an annuity table to determine how much interest she will pay on the loan.

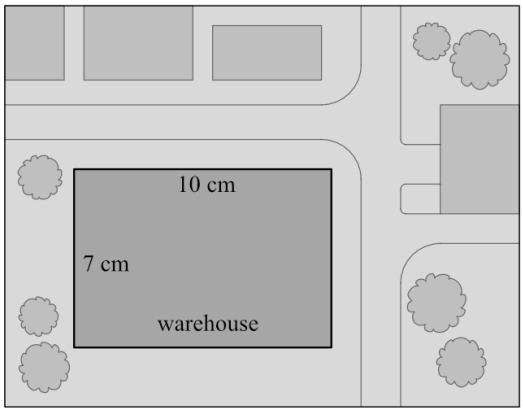
Table of present value interest factors

r / *N*	*Interest rate per period*					
	0.5%	0.6%	0.7%	0.8%	0.9%	1%
36	32.8710	32.2907	31.7247	31.1723	30.6334	30.1075
48	42.5803	41.5988	40.6486	39.7284	38.8372	37.9740
60	51.7256	50.2621	48.8559	47.5042	46.2047	44.9550
72	60.3395	58.3253	56.4041	54.5710	52.8212	51.1504

36 A company buys a new warehouse to improve their manufacturing capacity. They plan to save money by collecting rainwater from the entire area of the rectangular roof of the warehouse.

The diagram below shows a plan view of the warehouse and its location within its surroundings.

The dimensions of the warehouse on the diagram are 10 cm and 7 cm.

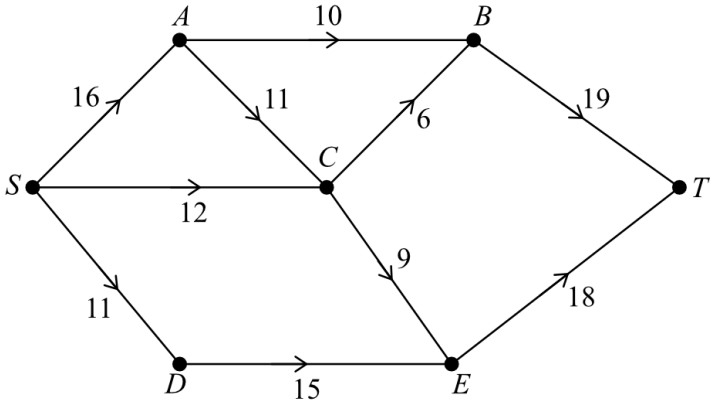


NOT TO SCALE

(a) If 10 cm on the diagram represents 100 m, what would be the scale of the diagram? Express the scale as a ratio in simplest form. **1**

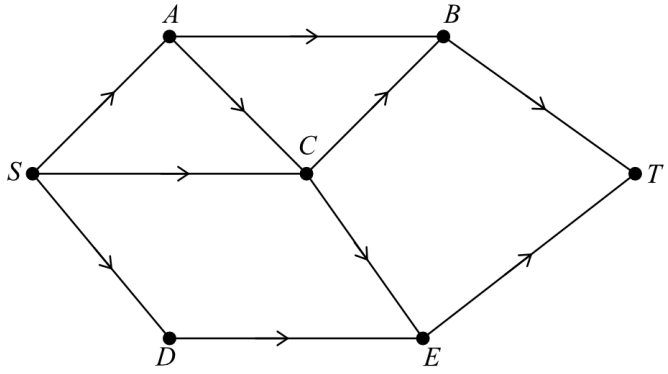
(b) If the company's goal is to collect 1200 kL of water from the roof, how much rain must fall? Answer in millimetres, correct to the nearest millimetre. **3**

37 The flow of water through a series of pipes is shown in the network below. The water flows from the source (S) to the sink (T) and the numbers on the edges show the maximum capacity of each pipe in litres per minute.



(a) Find the maximum flow from S to T. **2**

(b) On the diagram below, label the flows along each edge that would be required to achieve the maximum flow. **1**



(c) By increasing the capacity of one edge in the network, the maximum flow could be increased by 3 litres per minute. Identify the edge that could be increased. **1**

38 Tom has a total of \$80 000 in an investment account earning interest at a rate of 0.6% per month. Each month, immediately after the interest has been paid, Tom withdraws \$1200 from the account.

The amount in the account immediately after the *n*th withdrawal can be determined using the recurrence relation

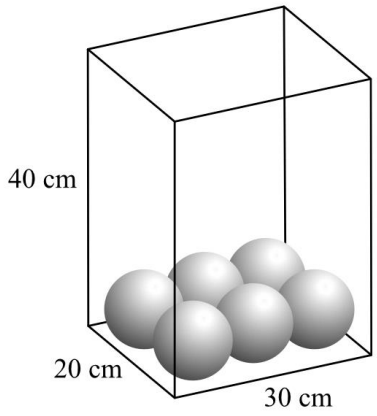
$$A_n = A_{n-1}(1.006) - 1200$$

where $n = 1,\ 2,\ 3,\ \ldots$ and $A_0 = 80\,000$

(a) Use the recurrence relation to find the amount of money in the account immediately after the third withdrawal. **2**

(b) Calculate the amount of interest earned in the first three months. **2**

39 Solid spherical balls of diameter 10 cm are stacked inside a box as shown below. The box is in the shape of a rectangular prism such that 6 balls will fit snuggly in each layer. **4**



The balls are stacked in the same manner as in the bottom layer until the box is full.

Calculate the percentage of the box that is empty space. Give your answer correct to the nearest percentage.

Ascham School

NESA Number: SOLUTIONS

Teacher: LD KS

July 2022
TRIAL EXAMINATION

Mathematics Standard 2

Writing time	2 hours 30 minutes
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Total Marks	100

General Instructions

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15	43	42	100

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

A ○ B ● C ○ D ○

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

A ● B ⊗ C ○ D ○

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

correct ↙

A ⊗ B ⊗ C ○ D ○

1 A farmer has 175 chickens and 275 sheep.
What is the simplified ratio of sheep to chickens?

(A) 3 : 1

(B) 7 : 11

(C) 11 : 7

(D) 175 : 275

sheep : chickens
27 : 175
= 11 : 7

2 Last week, Paola earned $358.40 when she worked 16 hours at a normal rate in her part-time job. This week she worked 12 hours at a normal rate and 3 hours at time-and-a-half.
How much did she earn this week?

(A) $268.80

(B) $336.00

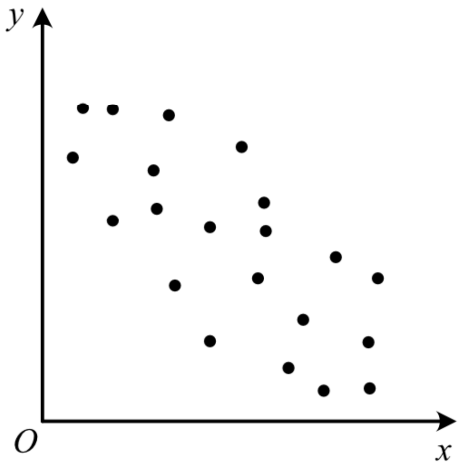
(C) $369.60

(D) $403.20

normal rate $= \$358.40 \div 16$
$= \$22.40$

earnings $= 12 \times 22.40 + 3 \times 1.5 \times 22.40$
$= \$369.60$

3 Which description best describes the relationship shown in the scatterplot below?



(A) Linear, negative, weak

(B) Non-linear, positive, strong

(C) Non-linear, negative, weak

(D) Linear, positive, strong

4 A pencil is measured to be 13.6 cm long.

What is the percentage error of this measurement, correct to two decimal places?

(A) 0.60%

(B) 0.37%

(C) 0.74%

(D) 4.41%

precision = 0.1 cm

absolute error = $\frac{1}{2}$ x precision

= 0.5 x 0.1

= 0.05 cm

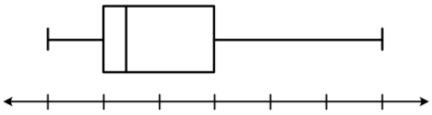
$$\%\text{error} = \frac{\text{absolute error}}{\text{measurement}} \times 100$$

$$= \frac{0.05}{13.6} \times 100$$

$$= 0.367\ldots = 0.37\% \text{ (2dp)}$$

5 Which of the data sets below represents a distribution that is positively skewed?

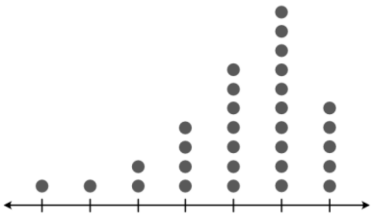
(A)



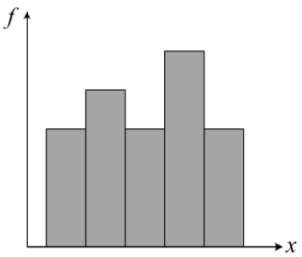
(B)

stem	leaf
14	6 9
15	2 3 4 8 8
16	4 4 5 7 7 7
17	1 2 6 8 9
18	0 1

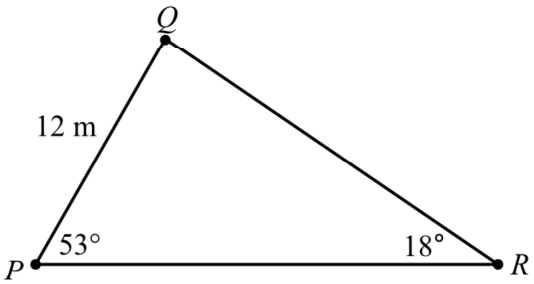
(C)



(D)



6 What is the distance from Q to R in the diagram below, correct to the nearest metre?



NOT TO SCALE

(A) 5 m

(B) 31 m

(C) 35 m

(D) 39 m

$\frac{QR}{\sin 53^\circ} = \frac{12}{\sin 18^\circ}$ (sine rule)

$QR = \frac{12 \sin 53^\circ}{\sin 18^\circ}$

$= 31.013...$

$= 31$ m (nearest m)

7 Ben weighs 85 kg and drinks 3 glasses of beer between 8 pm and 10:30 pm on a Saturday night. Each glass of beer is equivalent to 1.6 standard drinks. Ben's blood alcohol content (BAC) can be calculated using the following formula:

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

where N = number of standard drinks
H = number of hours drinking
M = malc's mass, in kilograms

What is Ben's approximate BAC at 10:30 pm?

$H = 10{:}30 - 8 = 2.5$ hours

$N = 3 \times 1.6 = 4.8$ standard drinks

$BAC_{male} = \frac{10 \times 4.8 - 7.5 \times 2.5}{5.5 \times 85}$

$= 0.0625...$

$= 0.063$ (3dp)

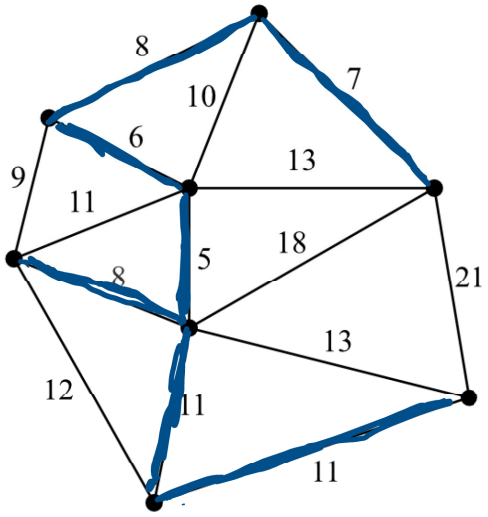
(A) 0.063

(B) 0.050

(C) 0.024

(D) 0.006

8 What is the length of the minimum spanning tree in the network below?



(A) 55

(B) 56

(C) 57

(D) 58

length = 5 + 6 + 7 + 8 + 8 + 11 + 11
= 56

9 Flour is sold in 4 different-sized packs.

Which pack is the best buy?

(A) 250 g pack for $0.70

(B) 500 g pack for $1.30

(C) 1 kg pack for $2.30

(D) 2 kg pack for $4.80

Convert each option to 250g or equivalent

Option A: 250g for $0.70

Option B: 500g for $1.30 ÷2 = 250g for $0.65 ÷2

Option C: 1kg for $2.30 ÷4 = 250g for $0.575 ÷4

Option D: 2kg for $4.80 ÷8 = 250g for $0.60 ÷8

∴ option C is the best buy

10 Juliette is driving along the highway at 100 km/h. She notices a possum on the road and applies the brakes 1.6 seconds after noticing the possum. Her braking distance is 98 metres. What is her approximate stopping distance?

(A) 48 m

(B) 57 m

(C) 63 m

(D) 142 m

$S = 100\text{km/h}$

$= 100\,000 \div 3600 = 27.77\ldots \text{ m/s}$

Reaction time distance:

$D = S \times T$

$= 27.77\ldots \times 1.6$

$= 44.44\ldots \text{ m}$

$\therefore$ stopping distance = reaction time distance + braking distance

$= 44.44\ldots + 98$

$= 142.44\ldots \approx 142 \text{ m}$

11 Craig's target heart rate when exercising is calculated using the following formula:

$$\text{THR} = I \times (\text{MHR} - \text{RHR}) + \text{RHR}$$

where I = exercise intensity
MHR = maximum heart rate
RHR = resting heart rate

Craig wants to undertake an exercise of 0.85 intensity and achieve a target heart rate of 165. If he has a resting heart rate of 80 beats per minute, what is his maximum heart rate?

(A) 185 bpm

(B) 180 bpm

(C) 175 bpm

(D) 170 bpm

$\text{THR} = I \times (\text{MHR} - \text{RHR}) + \text{RHR}$

$165 = 0.85 \times (\text{MHR} - 80) + 80$ ↓ subtract 80 from both sides

$85 = 0.85 \times (\text{MHR} - 80)$ ↓ divide both sides by 0.85

$100 = \text{MHR} - 80$ ↓ add 80 to both sides

$180 = \text{MHR}$

12 Electricity prices have risen by 3.4% p.a. over the past few years.

If the average electricity bill in 2012 was $425, what was the average electricity bill in 2020?

(A) $437.75

(B) $489.22

(C) $523.67

(D) $555.33

2012 → 2020 is 8 years ∴ $n = 8$

$r = 3.4\% = 0.034$

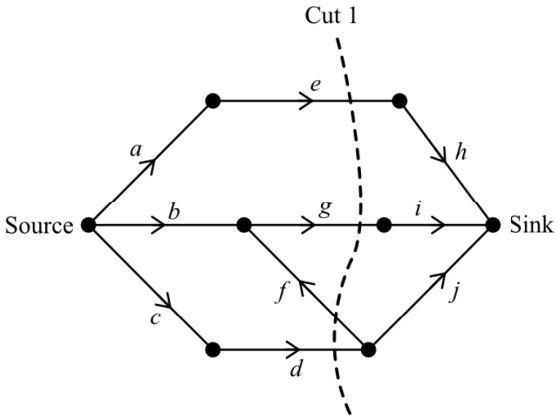
$FV = PV(1+r)^n$

$= 425(1+0.034)^8$

$= 425 \times 1.034^8$

$= \$555.33$

13 Water pipes connect 8 locations. The flow network below shows the capacities of the pipes.



What is the capacity of cut 1?

(A) $e+g+f$

(B) $e+g-f+d$

(C) $e+g+d$

(D) $c+d$

edge f is ignored because it flows from sink to source

14 Remy achieved a z-score of 2.2 on her latest Geography test.

If the test scores were normally distributed with a mean of 64 and a standard deviation of 5, what was Remy's actual test mark?

(A) 58

(B) 65

(C) 72

(D) 75

$$2 = \frac{x - \bar{x}}{\sigma}$$

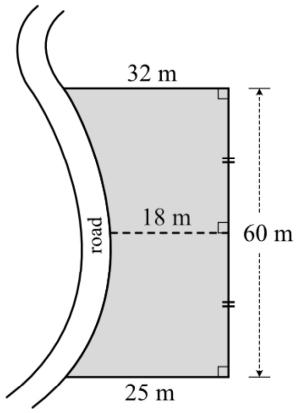
$$2.2 = \frac{x - 64}{5}$$

$$11 = x - 64$$

$$75 = x$$

$$x = 75$$

15 The shaded region represents a block of land bounded on one side by a road.



NOT TO SCALE

What is the approximate area of the block of land using two applications of the Trapezoidal rule?

(A) 2790 m^2

(B) 1395 m^2

(C) 1710 m^2

(D) 1080 m^2

$$h = \frac{60}{2} = 30 \text{ m}$$

$$A \approx \frac{30}{2}(32 + 18) + \frac{30}{2}(18 + 25)$$

$$\approx 750 + 645$$

$$\approx 1395 \text{ m}^2$$

End of Section I

Section II

85 marks

Attempt all questions.

Allow about 2 hours and 10 minutes for this section.

Answer each question in the space provided.

Show all relevant working in questions involving calculations.

Marks

16 Eliza had saved $300 to use on fuel for a road trip during her holidays. **2**

Her car has a fuel consumption of 6.4 L/100 km and she paid $1.98 per litre for fuel throughout the trip.

How many kilometres was Eliza able to travel using the money she'd saved?
Answer correct to the nearest kilometre.

Litres of fuel she can afford = $300 ÷ $1.98

= 151.515... L ✓

6.4L for 100 km

÷6.4 ÷64

1L for 15.625 km

×151.515... ×151.515...

151.515... 2367.42...

She can travel 2367 km ✓ (nearest km)

17 Solve the following equations.

(a) $8m + 2 = 24 - 3m$ **2**

$8m + 2 = 24 - 3m$

$+3m \qquad +3m$

$11m + 2 = 24$ ✓

$-2 \qquad -2$

$11m = 22$

$\div 11 \qquad \div 11$

$m = 2$ ✓

(b) $\frac{k-2}{4} + 5 = 7$ **2**

$\frac{k-2}{4} + 5 = 7$

$-5 \qquad -5$

$\frac{k-2}{4} = 2$ ✓

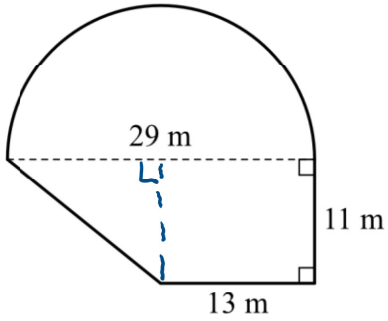
$\times 4 \qquad \times 4$

$k - 2 = 8$

$+2 \qquad +2$

$k = 10$ ✓

18 The composite shape below is made up of a semicircle and a trapezium. Calculate the perimeter of the shape, correct to the nearest metre. **3**

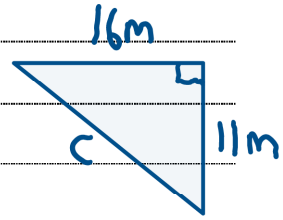


NOT TO SCALE

$r = 29 \div 2 = 14.5$ m

arc length $= \frac{1}{2} \times 2 \times \pi \times 14.5$

$= 14.5\pi$ m (45.55.. m) ✓



Length of sloping side

$c^2 = 16^2 + 11^2$ (Pythagoras)

$= 377$

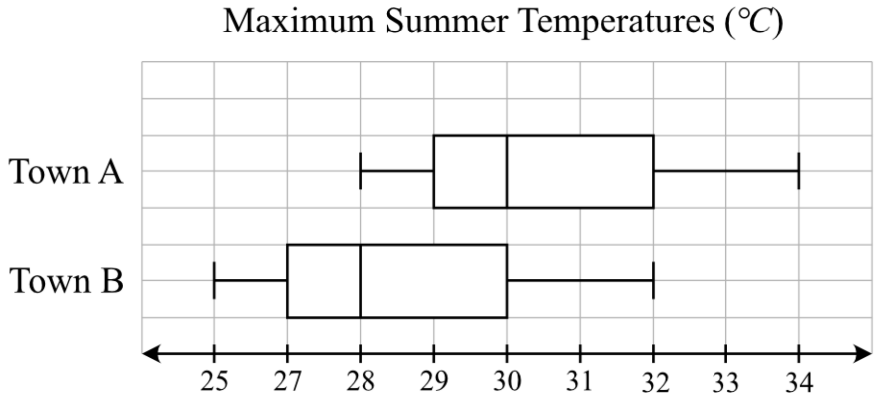
$c = \sqrt{377}$ m (19.41... m) ✓

Perimeter $= 14.5\pi + \sqrt{377} + 13 + 11$

$= 88.969...$ m

$= 89$ m ✓ (nearest metre)

19 In one particular Australian summer, the summer months of December, January and February had a total of 90 days.
The box plots below display data on the maximum daily temperatures in town A and town B during these summer months.



(a) What is the median maximum summer temperature of Town A? **1**

30 °C

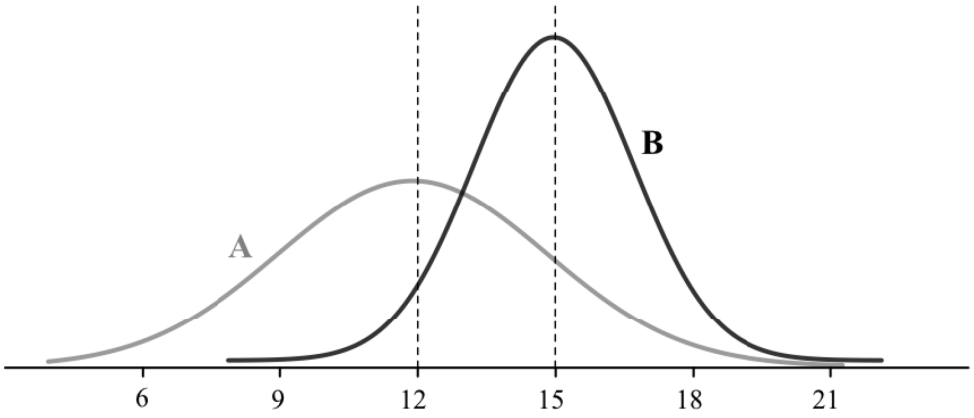
(b) What percentage of summer days in Town A were warmer than Town B's warmest day? **1**

25 %

(c) How many summer days in Town B were at least $28°C$? **2**

28°C is the median for Town B
50% of temperatures are greater than 28°C
50% of 90 = 45 days

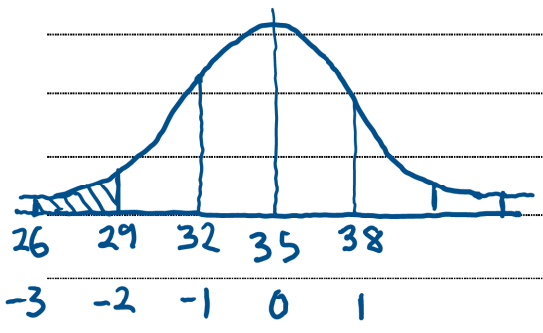
20 The diagram below shows two different normal distribution curves A and B. **2**



Compare the curves using the terms 'mean' and 'standard deviation'.

Curve A has a lower mean but higher standard deviation than curve B.

21 In a normally distributed set of scores, the mean is 35 and the standard deviation is 3. What percentage of scores lie between 26 and 29? **2**



or diagram showing region

$\frac{99.7}{2} - \frac{95}{2} = 2.35$

$\therefore$ 2.35% of scores lie between 26 and 29.

22 Cairo in Egypt is located at (30° N, 31° E). **3**
Sydney, in Australia, is located at (33° S, 151° E).

Camilla lives in Sydney and needs to attend an online meeting with her business partners in Cairo starting at 11:00 am on Monday, local time in Cairo.

What time and day, in Sydney, does Camilla need to log on to the meeting?

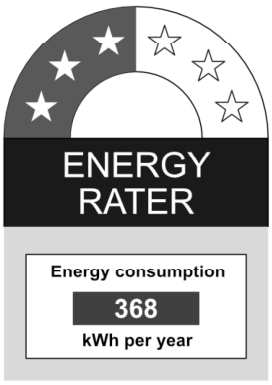
Ignore daylight saving.

difference in longitude = 151° − 31°
= 120° ✓

time difference = $\frac{120^\circ}{15^\circ}$ (since 15° = 1 hour)
= 8 hours ✓

local time in Sydney when meeting starts = 11am Monday + 8 hours
= 7pm Monday ✓

23 A 2500-watt vacuum cleaner has the following energy label on it. **3**



The energy label assumes that a typical household would consume 368 kWh of energy per year using the vacuum cleaner.

How many hours and minutes of usage would this equate to each week? Give your answer correct to the nearest minute. Assume 52 weeks per year.

Assumed number of kWh per week = $\frac{368}{52}$

= 7.076... kWh ✓

energy rating of vaccum = 2500 W

= 2.5 kW

Power consumption = power rating x time

$7.076... = 2.5 \times t$

$t = \frac{7.076...}{2.5}$

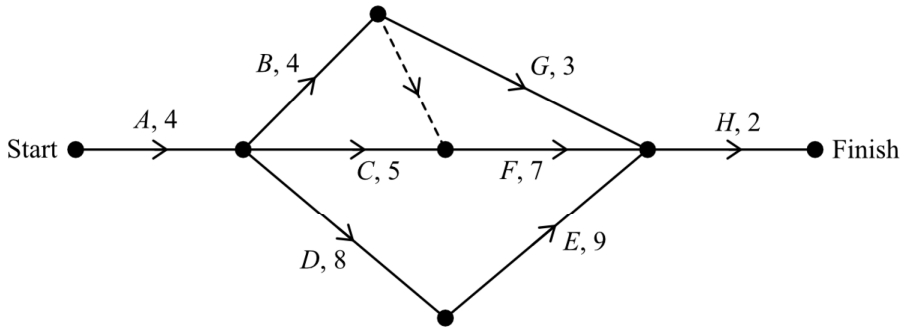
= 2.8307... h ✓

= 2h 49 min 50.77 sec.

= 2 hours 50 mins (nearest min) ✓

correct rounding

24 The network below shows the activities that need to occur for a project to be completed. **3**



Complete the activity table below for the network shown.

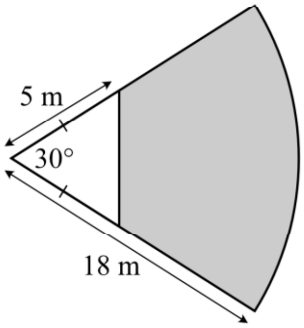
Activity	Duration	Immediate predecessor
A	4	–
B	4	*A*
C	5	A
D	8	*A*
E	9	D
F	7	B, C
G	3	B
H	2	E, F, G

1 mark

1 mark

1 mark for the Activity and Duration columns correct

25 Calculate the area of the shaded region in the sector below, correct to two decimal places. **3**



NOT TO SCALE

Area of sector $= \frac{30}{360} \times \pi \times 18^2$

$= 27\pi \text{ m}^2$ ✓ $(84.82\ldots \text{m}^2)$

Area of triangle $= \frac{1}{2} \times 5 \times 5 \times \sin 30^\circ$

$= 6.25 \text{ m}^2$ ✓

shaded area $= 27\pi - 6.25$

$= 78.573\ldots$

$= 78.57 \text{ m}^2$ (2dp) ✓

26 Sophia purchased 1500 shares for $3.25 and later sold them for $4.90 per share. Sophia 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 she did not receive any dividend, calculate the profit that Sophia earned from the shares.

Purchase price = 1500 × $3.25
= $4875

Total purchase cost = purchase price + brokerage
= $4875 + 0.02 × 4875
= $4875 + $97.50
= $4972.50 ✓

sale price = 1500 × $4.90
= $7350

Total income from selling = sale price − brokerage
= $7350 − 0.03 × 7350
= $7350 − $220.50
= $7129.50 ✓

Profit = $7129.50 − $4972.50
= $2157 ✓

27 A set of data has a lower quartile of 36 and an upper quartile of 48. **3**

What is the maximum possible range if there are no outliers in the data set?

$Q_1 = 36 \quad Q_3 = 48$

$IQR = Q_3 - Q_1$

$= 48 - 36$

$= 12$ ✓

Outlier lower bound $= Q_1 - 1.5 \times IQR$

$= 36 - 1.5 \times 12$

$= 18$

Outlier upper bound $= Q_3 + 1.5 \times IQR$ ✓ attempt to calculate these bounds

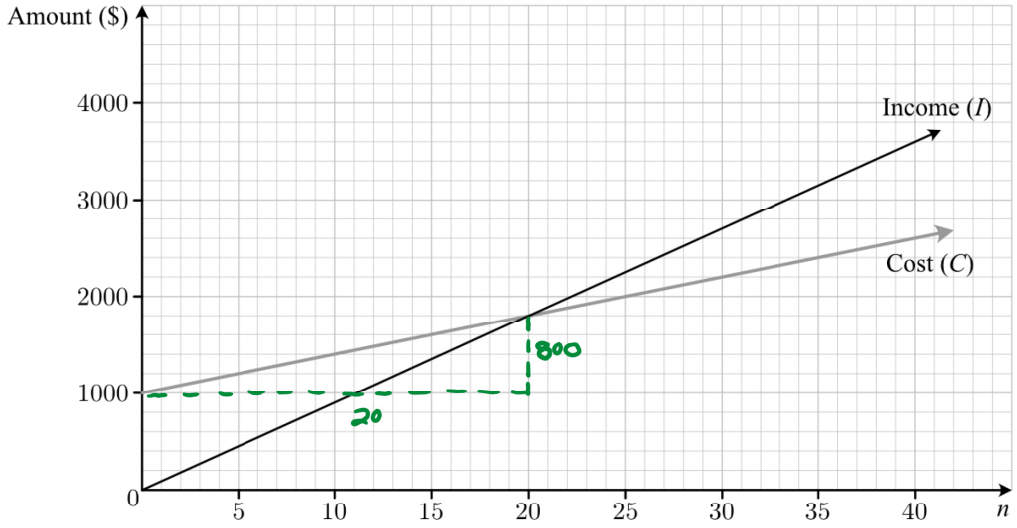
$= 48 + 1.5 \times 12$

$= 66$

max. possible range $= 66 - 18$

$= 48$ ✓

28 Caitlin plans to set up a furniture business to sell bedside tables.
Below are the income (I) and cost (C) functions for her business.



(a) Write the cost function in the form $C = mn + c$ for the cost of making n tables. **2**

$m = \frac{\text{rise}}{\text{run}} = \frac{800}{20} = 40$ ✓ $\quad c = 1000$

$\therefore C = 40n + 1000$ ✓

(b) For how much does Caitlin plan to sell each bedside table? **1**

gradient of income graph $= \frac{\text{rise}}{\text{run}} = \frac{1800}{20} = 90$

$\therefore I = 90n$

$\therefore$ price of each table $= \$90$ ✓

(c) If Caitlin sells 30 bedside tables, how much profit or loss will she incur? **2**

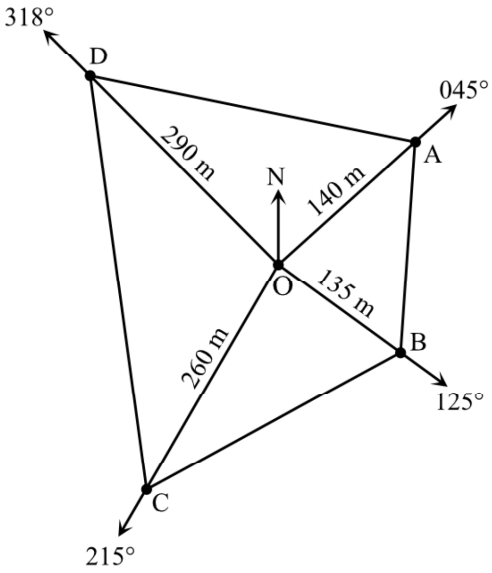
$C = 40 \times 30 + 1000 = \$2200$ ✓ substitution into equation or estimate from graph

$I = 90 \times 30 = \$2700$

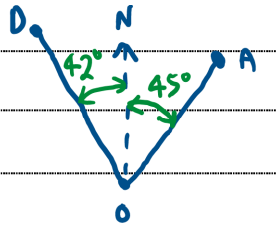
Profit $= 2700 - 2200$

$= \$500$ ✓

29 A compass radial survey for block of land ABCD, is shown in the diagram below.



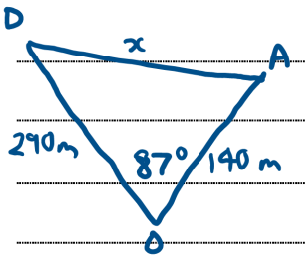
(a) Calculate the size of angle AOD. **1**



$\angle AOD = (360° - 318°) + 45°$

$= 87°$ ✓

(b) Calculate the distance along the boundary of the land from A to D, correct to the nearest metre. **2**



Let x be distance from A to D

$x^2 = 140^2 + 290^2 - 2 \times 140 \times 290 \times \cos 87°$ ✓ (cosine rule)

$= 99450.32...$

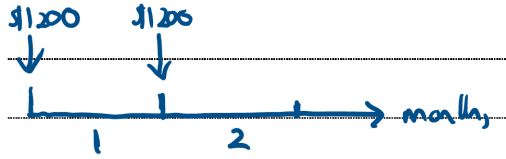
$x = \sqrt{99450.32}$

$= 315.357...$

$= 315$ m (nearest m) ✓

30 Ella contributes \$1200 per month at the start of each month into an investment which pays interest at 3.6 % per annum, compounded monthly.

(a) Show that at the end of the second month, the future value of Ella's investment will be \$2410.81. **2**



$r = 3.6\%$ pa

$= \frac{3.6}{12}\%$ per month

$= 0.3\%$

$= 0.003$

At end of 2nd month $FV = 1200(1.003)^2 + 1200(1.003)^1$

$= \$2410.8108$

$= \$2410.81$

(b) After 18 months, the future value of Ella's investment will be \$22 226.19. **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 3.6% per annum, compounded monthly.

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

$P = \$21\,600$ $r = 1.003$ $n = 18$

Beth's account: $FV = 21600(1.003)^{18}$

$= \$22796.62$

difference between FV for Ella and Beth

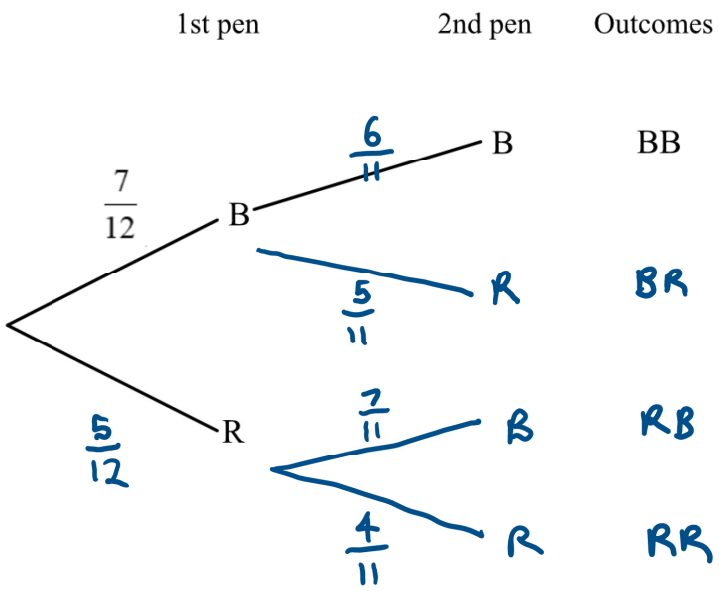
$= 22796.62 - 22226.19$

$= \$570.43$

∴ Beth will have \$570.43 more in her account after 18 months

31 Karim has a box containing 7 blue pens and 5 red pens. He selects a pen at random from the box and places it on a table. He then selects a second pen and places it on the table next to the first pen.

(a) Complete the tree diagram below by drawing the missing branches, writing the probabilities on each branch and listing all possible outcomes. **2**



✓ correct probabilities

✓ outcomes correct

(b) What is the probability that the pens on the table are both red? **1**

$P(\text{both red}) = P(RR)$

$= \frac{5}{12} \times \frac{4}{11}$

$= \frac{5}{33}$ ✓

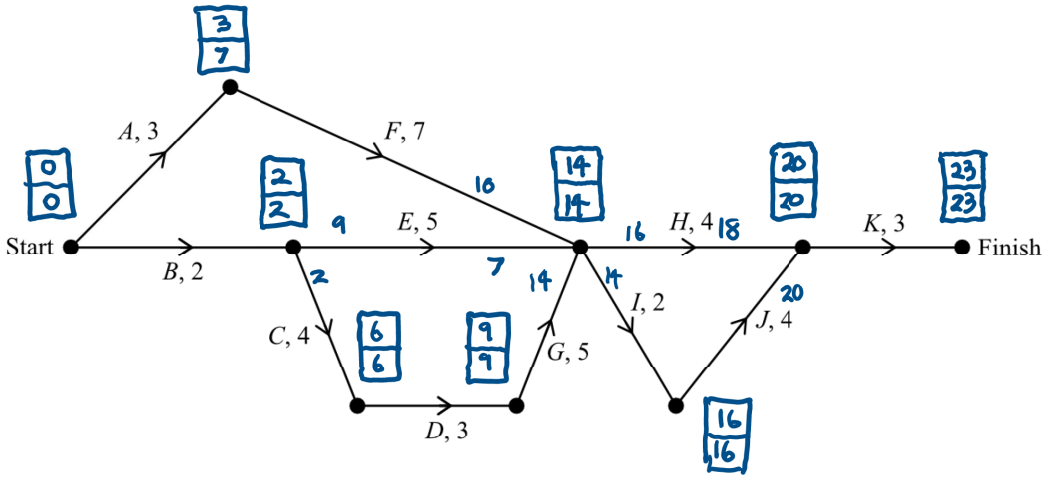
(c) What is the probability that the pens on the table are different colours? **2**

$P(\text{different colour}) = P(BR) + P(RB)$

$= \left(\frac{7}{12} \times \frac{5}{11}\right) + \left(\frac{5}{12} \times \frac{7}{11}\right)$ ✓

$= \frac{35}{66}$ ✓

32 The network diagram shows tasks that must be completed to finish a project.
Each edge weight represents the time taken to complete the task, in days.



(a) What is the earliest start time (EST) of activity *H*? **2**

14 days

✓ evidence of calculating EST on diagram
✓ correct EST

(b) What is minimum completion time for the project? **1**

23 days

(c) What is the critical path for the project? **2**

B-C-D-G-I-J-K

✓ backward scan or equivalent
✓ correct path

(d) What is the float time of activity *E*? **1**

float time = $LST_{next} - EST - duration$
= 14 − 2 − 5
= 7 days ✓

33 Lauren spends $6000 on a new photocopier for her business.
She uses the declining-balance method to calculate the depreciation of the machine.
She claims this amount as a tax deduction each year. She can only claim the depreciation for that particular year.

(a) If the rate of depreciation is 26% per annum, show that the depreciation she can claim in the second year is equal to $1154, rounded correct to the nearest dollar. **2**

$r = 26\%$ pa $= 0.26$

After 1 year:

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

$= 6000(1-0.26)^1$

$= \$4440$ ✓

After 2 years:

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

$= 6000(1-0.26)^2$

$= \$3285.60$

$\therefore$ depreciation in 2nd year $= 4440 - 3285.60$ ✓

$= \$1154.40$

$= \$1154$ (nearest $)

(b) Lauren earned $110 000 for the last financial year. The depreciation for her photocopier in part (a) is the only tax deduction she claims. **3**
Using the tax table below and ignoring the Medicare levy, calculate the amount of tax she needs to pay.

Income tax rates for Australian residents

Taxable income	Tax on this income
0 – $18 200	Nil
$18 201 – $37 000	19c for each $1 over $18 200
$37 001 – $90 000	$3572 plus 32.5c for each $1 over $37 000
$90 001 – $180 000	$20 797 plus 37c for each $1 over $90 000
$180 001 and over	$54 097 plus 45c for each $1 over $180 000

taxable income = gross income − deductions

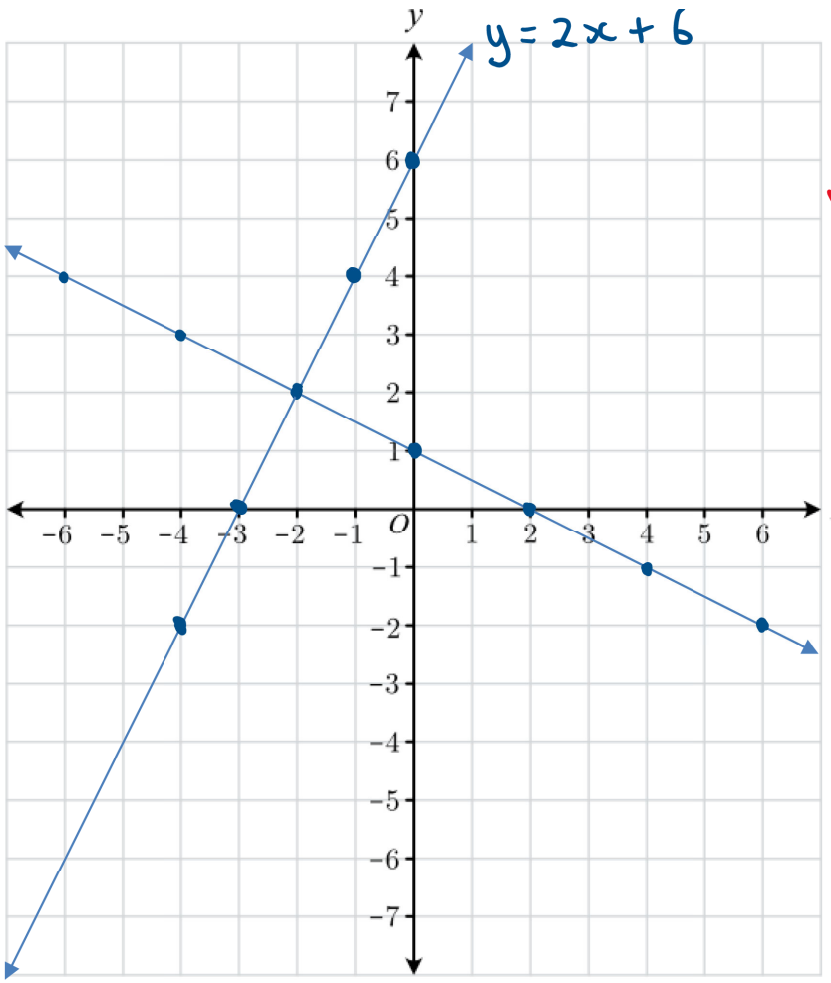
$= \$110000 - \$1154$

$= \$108846$ ✓

tax $= 20797 + 0.37(108846 - 90000)$ ✓

$= \$27770.02$ ✓

34 On the number plane below, graph the equations $y = -\frac{x}{2} + 1$ and $y = 2x + 6$, and hence, solve the equations simultaneously. **3**



✓ graph of $y = 2x + 6$ correct

✓ graph of $y = -\frac{x}{2} + 1$ correct

Lines are graphed by substituting selected x values into each equation.

Point of intersection of lines $= (-2, 2)$

✓ solution matches point of intersection

Solution: $x = -2$, $y = 2$

35 Alexa is buying her first car. She takes out a loan for $15 000 and agrees to repay the loan in monthly repayments at 7.2% per annum for 5 years. **3**

Use the present value of an annuity table to determine how much interest she will pay on the loan.

Table of present value interest factors

r / *N*	*Interest rate per period*					
	0.5%	0.6%	0.7%	0.8%	0.9%	1%
36	32.8710	32.2907	31.7247	31.1723	30.6334	30.1075
48	42.5803	41.5988	40.6486	39.7284	38.8372	37.9740
60	51.7256	50.2621	48.8559	47.5042	46.2047	44.9550
72	60.3395	58.3253	56.4041	54.5710	52.8212	51.1504

$r = 7.2\%$ pa
$= 7.2 \div 12$ % per month
$= 0.6\%$

$n = 5$ year
$= 5 \times 12$ months
$= 60$

table value $= 50.2621$ ✓

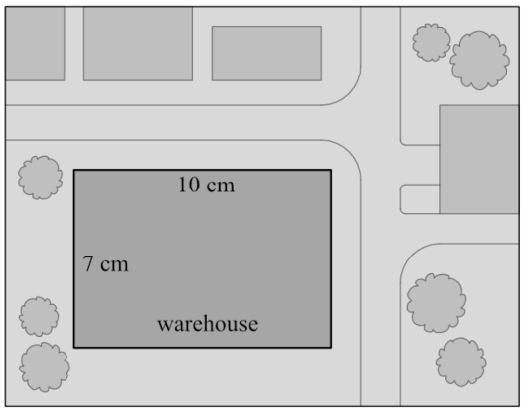
$PV = a \times$ table value
$15000 = a \times 50.2621$
$\frac{15000}{50.2621} = a$
$a = 298.4356...$
$= \$298.44$ ✓

interest $= (\$298.44 \times 60) - \$15000$
$= 17906.40 - 15000$
$= \$2906.40$ ✓

36 A company buys a new warehouse to improve their manufacturing capacity. They plan to save money by collecting rainwater from the entire area of the rectangular roof of the warehouse.

The diagram below shows a plan view of the warehouse and its location within its surroundings.

The dimensions of the warehouse on the diagram are 10 cm and 7 cm.



NOT TO SCALE

(a) If 10 cm on the diagram represents 100 m, what would be the scale of the diagram? Express the scale as a ratio in simplest form. **1**

10cm = 100m

∴ 10cm = 10000 cm

∴ scale = 10 : 10000

= 1 : 1000 ✓

(b) If the company's goal is to collect 1200 kL of water from the roof, how much rain must fall? Answer in millimetres, correct to the nearest millimetre. **3**

Actual roof measurements : 70m and 100m

area of roof = 70 × 100 = 7000 m^2 ✓

V = 1200 kL = 1200 m^3

V = Ah

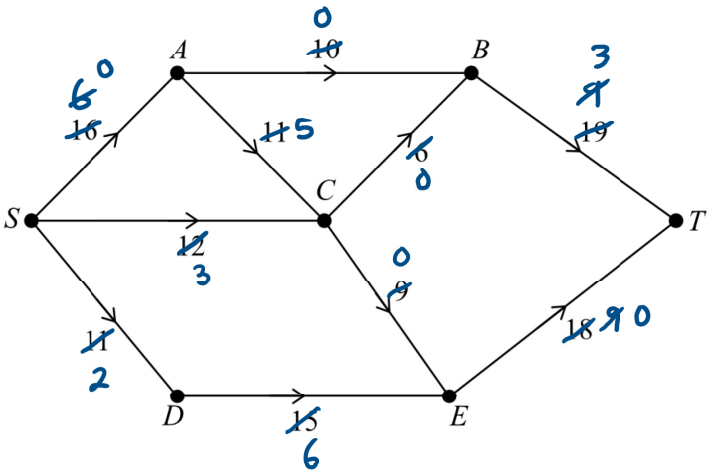
1200 = 7000 × h ✓

$\frac{1200}{7000} = h$

h = 0.171428... m

= 171 mm ✓ (nearest mm)

37 The flow of water through a series of pipes is shown in the network below. The water flows from the source (S) to the sink (T) and the numbers on the edges show the maximum capacity of each pipe in litres per minute.

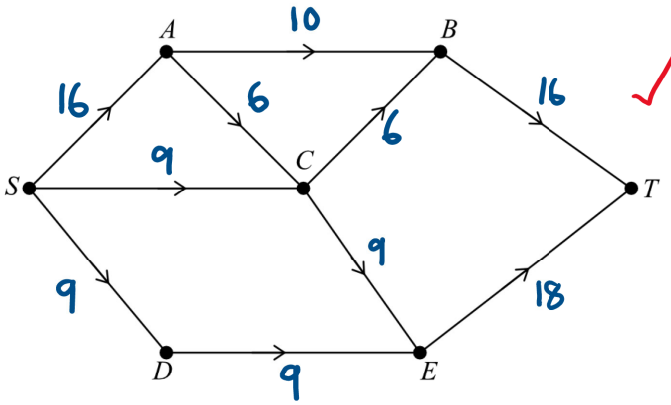


SABT 10
SACBT 6
SCET 9
SDET 9
34 ✓

(a) Find the maximum flow from S to T. **2**

maximum flow = 10 + 6 + 9 + 9
= 34 L/min ✓

(b) On the diagram below, label the flows along each edge that would be required to achieve the maximum flow. **1**



All values correct for 1 mark ✓

½ mark if 1 error

(c) By increasing the capacity of one edge in the network, the maximum flow could be increased by 3 litres per minute. Identify the edge that could be increased. **1**

The minimum cut passes through AB, CB and ET so only changes to these edges will affect the minimum flow. Only edge CB has the potential for increase by 3 ✓

38 Tom has a total of \$80 000 in an investment account earning interest at a rate of 0.6% per month. Each month, immediately after the interest has been paid, Tom withdraws \$1200 from the account.

The amount in the account immediately after the nth withdrawal can be determined using the recurrence relation

$$A_n = A_{n-1}(1.006) - 1200$$

where $n = 1,\ 2,\ 3,\ \ldots$ and $A_0 = 80\,000$

(a) Use the recurrence relation to find the amount of money in the account immediately after the third withdrawal. **2**

$A_0 = \$80000$

$A_1 = 80000(1.006) - 1200$

$= \$79280$ ✓ method

$A_2 = 79280(1.006) - 1200$

$= \$78555.68$

$A_3 = 78555.68(1.006) - 1200$

$= \$77827.01408$

$= \$77827.01$ ✓

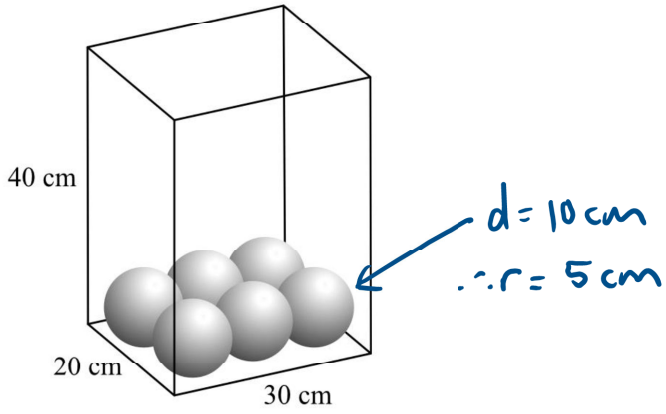
(b) Calculate the amount of interest earned in the first three months. **2**

interest $= 77827.01 + (1200 \times 3) - 80000$ ✓

$= 81427.01 - 80000$

$= \$1427.01$ ✓

39 Solid spherical balls of diameter 10 cm are stacked inside a box as shown below. The box is in the shape of a rectangular prism such that 6 balls will fit snuggly in each layer. **4**



The balls are stacked in the same manner as in the bottom layer until the box is full.

Calculate the percentage of the box that is empty space. Give your answer correct to the nearest percentage.

Height of box is 40 cm and diameter of each ball is 10 cm ∴ 4 layers of balls will fit.

number of balls = 4×6
$= 24$ ✓

Volume of balls = $24 \times \frac{4}{3} \times \pi \times 5^3$
$= 12566.370...$
$= 12566 \text{ cm}^3$ ✓ (nearest cm^3)

Volume of box = $20 \times 30 \times 40$
$= 24000 \text{ cm}^3$

Volume of space = $24000 - 12566$
$= 11434 \text{ cm}^3$ ✓

% space = $\frac{11434}{24000} \times 100$

$= 47.641...$
$= 48\%$ ✓ (nearest %)