Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5456071467

MATHEMATICS (SYLLABUS D) **4024/21**

Paper 2 **May/June 2017**

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.
Omission of essential working will result in loss of marks.
You are expected to use an electronic calculator to evaluate explicit numerical expressions.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 100.

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Section A [52 marks]

Answer **all** questions in this section.

1 Trevor has a collection of 54 toy vehicles.
Of these, 24 are cars, 12 are vans and the rest are trucks.

(a) Write the ratio of cars to vans to trucks in its simplest form.

Answer ..... : ..... : ..... [2]

(b) Trevor decides that it is time to reduce his collection of vehicles.
He sells c cars, v vans and t trucks.
He finds that the ratio of cars to vans to trucks is now 2 : 2 : 1.

Find c, v and t, given that he has sold

- at least one of each type of vehicle
- the smallest possible number of vehicles.

Answer c = ...

v = ...

t = ... [2]

2 In 2016 Amira's income was \$36 720.

(a) This was 2% more than her income in 2015.

What was her income in 2015?

Answer \$ ..... [2]

(b) In 2016, Amira used her income of \$36 720 in the following way.

\$12 000 was used for rent.
$\frac{2}{5}$ of her income was used for food and to pay bills.
15% of her income was spent on leisure.
The rest of her income was saved.

What percentage of her income did she save?

Answer .....% [4]

3

Humanities:	Geography (G) History (H) Religious studies (R)

Science:	Physics (P) Chemistry (C) Biology (B)

A student has to choose one humanities subject and two different science subjects.

(a) Complete the table to show the possible outcomes.

Answer	Humanities	Science
	G	P and C
	G	P and B

[2]

(b) Khalif chooses his subjects at random.

(i) Find the probability that he chooses Geography.

Answer ..... [1]

(ii) Find the probability that he chooses Physics.

Answer ..... [1]

(iii) Find the probability that he chooses **both** Religious studies and Chemistry.

Answer ..... [1]

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4 $\mathbf{A} = \begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 2 & -1 \\ 6 & -1 \end{pmatrix}$

(a) Calculate

(i) $\mathbf{BA}$,

Answer [2]

(ii) $\mathbf{B}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Given that $\mathbf{A} + 2\mathbf{C} = 3\mathbf{B}$, find $\mathbf{C}$.

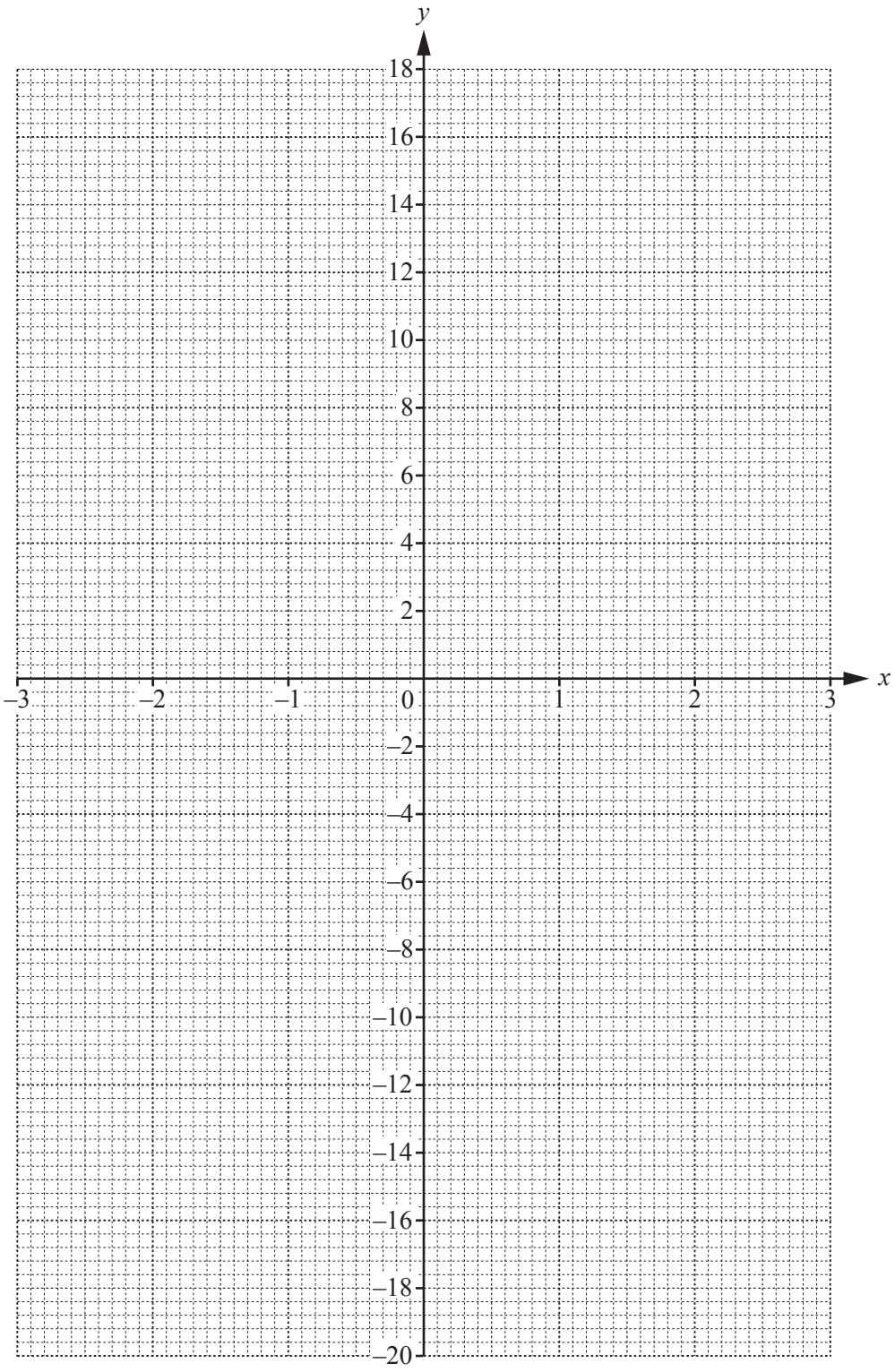
Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

5 The table below is for $y = x^3 - 3x - 1$.

x	–3	–2	–1	0	1	2	3
y	–19	–3	1	–1	–3	1	

(a) Complete the table. [1]

(b) On the grid, draw the graph of $y = x^3 - 3x - 1$.



[3]

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(c) Use your graph to solve $x^3 - 3x - 1 = 0$.

Answer $x =$ ..... [2]

(d) Use your graph to estimate the gradient of the curve when $x = -1.5$.

Answer ..... [2]

(e) (i) On the grid draw the graph of $y = 4x + 3$. [1]

(ii) The line $y = 4x + 3$ and the curve $y = x^3 - 3x - 1$ can be used to solve the equation $x^3 = ax + b$.

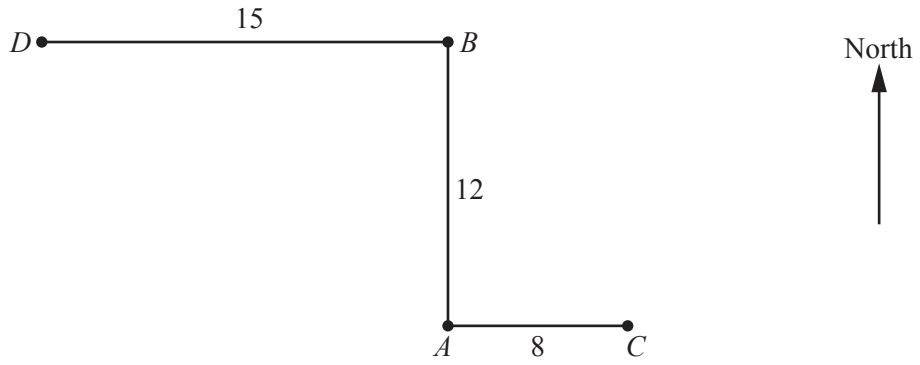
Find the values of a and b.

Answer $a =$ ..... $b =$ ..... [2]

(iii) Use your graph to find one of the **negative** solutions of $x^3 = ax + b$.

Answer $x =$ ..... [1]

6 (a)



A, *B*, *C* and *D* are four towns.
B is 12 km due north of *A*, *C* is 8 km due east of *A* and *D* is 15 km due west of *B*.

(i) Calculate the distance of *B* from *C*.

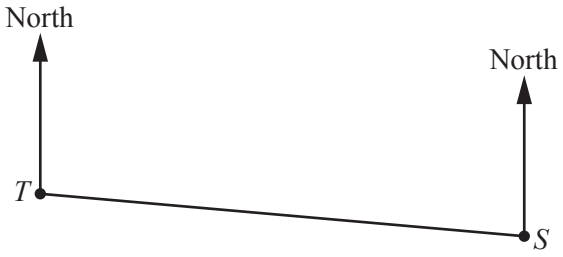
Answer ..... km [2]

(ii) Calculate the bearing of *A* from *D*.

Answer ..... [3]

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(b)



The diagram shows the position of a clock tower, T, and a statue, S, drawn to a scale of 1 cm to 75 m.

(i) Using measurements taken from the diagram, find the actual distance between T and S.

Answer ..... m [2]

(ii) A fountain, F, is situated 450 m from T on a bearing of 210°.

Draw and label F. [2]

(iii) Using measurements taken from the diagram, find the bearing of F from S.

Answer ..... [1]

7 **(a)** Factorise completely $12a^2b - 15ab^3$.

Answer ..... [1]

(b) **(i)** Write $4x^2 + 12x + 9$ in the form $(cx + d)^2$.

Answer ..... [1]

(ii) Hence solve $4x^2 + 12x + 9 = 49$.

Answer $x =$ ..... or ..... [2]

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(c) Express as a single fraction in its simplest form $\frac{(p+1)}{2} - \frac{(p-3)}{4}$.

Answer ..... [3]

(d) Solve $2(3m+4) < 3$.

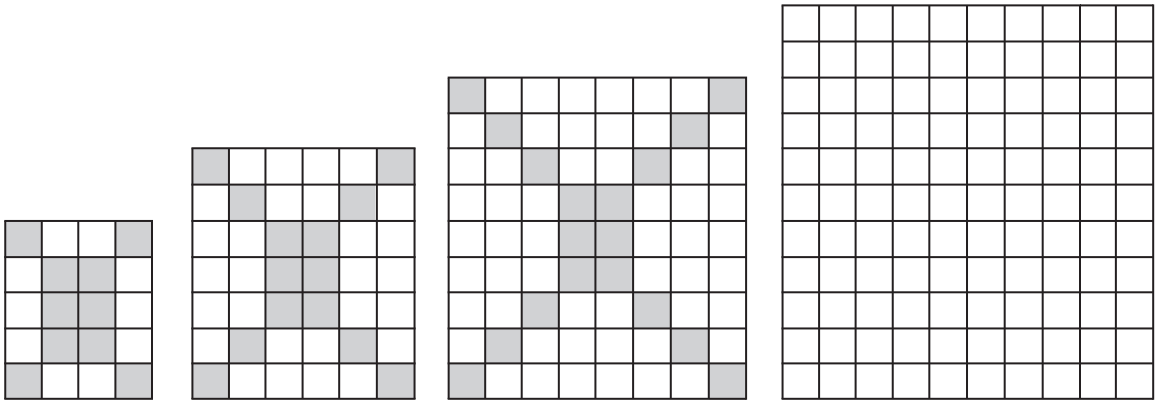
Answer ..... [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

8



Pattern 1 Pattern 2 Pattern 3 Pattern 4

(a) Complete the diagram for pattern 4. [1]

The table below shows some of the information for the number of tiles in pattern n.

Pattern n	1	2	3	4	5
Number of grey tiles	10	14	18		
Number of white tiles	10	28	54		
Total number of tiles	20	42	72	110	156

(b) Complete the table. [2]

(c) Find an expression, in terms of n, for the number of grey tiles in pattern n.

Answer ..... [2]

(d) Pattern x has 110 grey tiles.

Find x.

Answer $x =$ ..... [1]

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(e) By considering the number of tiles along the outer edges of each pattern, show that the total number of tiles in pattern n is $4n^2 + 10n + 6$.

[2]

(f) Hence find an expression, in terms of n, for the number of white tiles in pattern n.

Answer ..... [1]

(g) In pattern p, the **total** number of tiles is equal to 8 times the number of **grey** tiles.

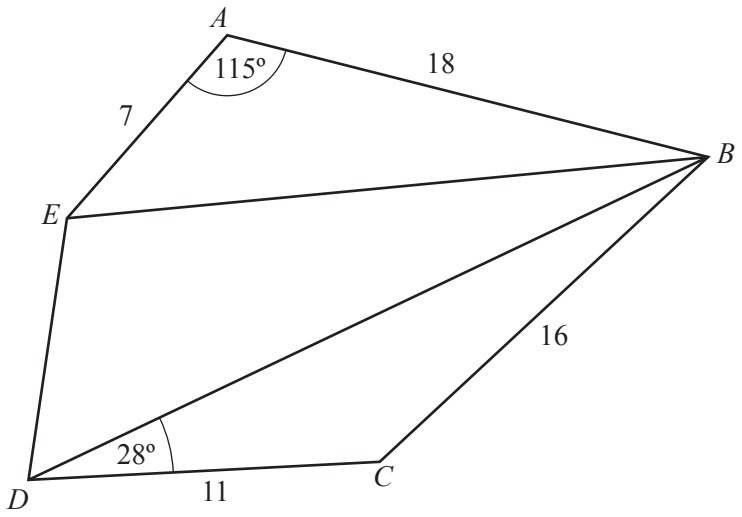
Find p.

Answer $p =$ ..... [3]

9 **(a)** Calculate the interior angle of a regular nine-sided polygon.

Answer ..... [2]

(b)



ABCDE is a pentagon.
$AB = 18\,\text{cm}$, $BC = 16\,\text{cm}$, $CD = 11\,\text{cm}$ and $EA = 7\,\text{cm}$.
$E\hat{A}B = 115°$ and $B\hat{D}C = 28°$.

(i) Show that $BE = 21.9\,\text{cm}$, correct to 3 significant figures.

[3]

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(ii) Calculate angle *DBC*.

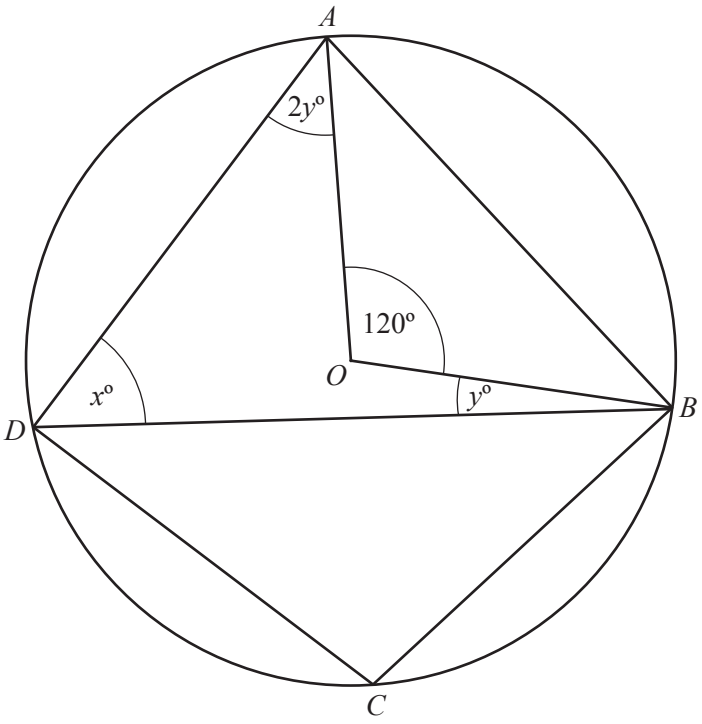
Answer ..... [3]

(iii) The perimeter of the pentagon is 62 cm.

Given that the area of triangle *BDE* is 109 cm^2, calculate the **obtuse** angle *DEB*.

Answer ..... [4]

10 (a)



A, B, C and D lie on the circumference of a circle, centre O.
$A\hat{O}B = 120°$, $A\hat{D}B = x°$, $O\hat{B}D = y°$ and $D\hat{A}O = 2y°$.

(i) Find x, giving a reason for your answer.

Answer $x =$ ..... because .....

..... [2]

(ii) Find $D\hat{A}B$.

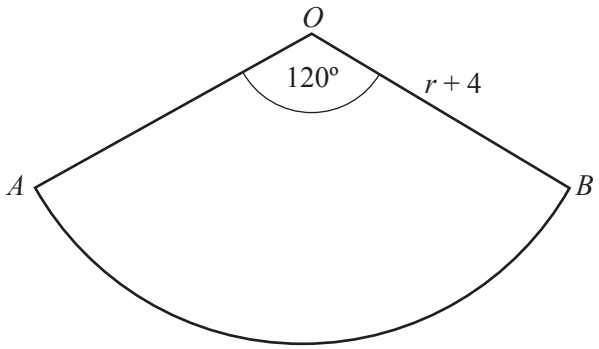
Answer ..... [3]

(iii) Find $B\hat{C}D$.

Answer ..... [1]

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(b)



Sector OAB has radius $(r + 4)$ cm and its area is the same as the area of a circle of radius r cm.

(i) Show that $r^2 - 4r - 8 = 0$.

[3]

(ii) Calculate r.

Answer $r =$ ..... [3]

11 80 people were each asked how much they spent on clothes last month.
The results are summarised in the table below.

Amount spent (\$ c)	Frequency
$0 < c \leqslant 20$	3
$20 < c \leqslant 40$	8
$40 < c \leqslant 60$	14
$60 < c \leqslant 80$	21
$80 < c \leqslant 100$	18
$100 < c \leqslant 120$	9
$120 < c \leqslant 140$	5
$140 < c \leqslant 160$	2

(a) Calculate an estimate of the mean amount spent on clothes last month.

Answer \$ ..... [3]

(b) Complete the cumulative frequency table below.

Amount spent (\$ c)	$c \leqslant 20$	$c \leqslant 40$	$c \leqslant 60$	$c \leqslant 80$	$c \leqslant 100$	$c \leqslant 120$	$c \leqslant 140$	$c \leqslant 160$
Cumulative frequency	3	11						80

[1]

(c) On the grid opposite, draw a cumulative frequency curve to represent this data. [2]

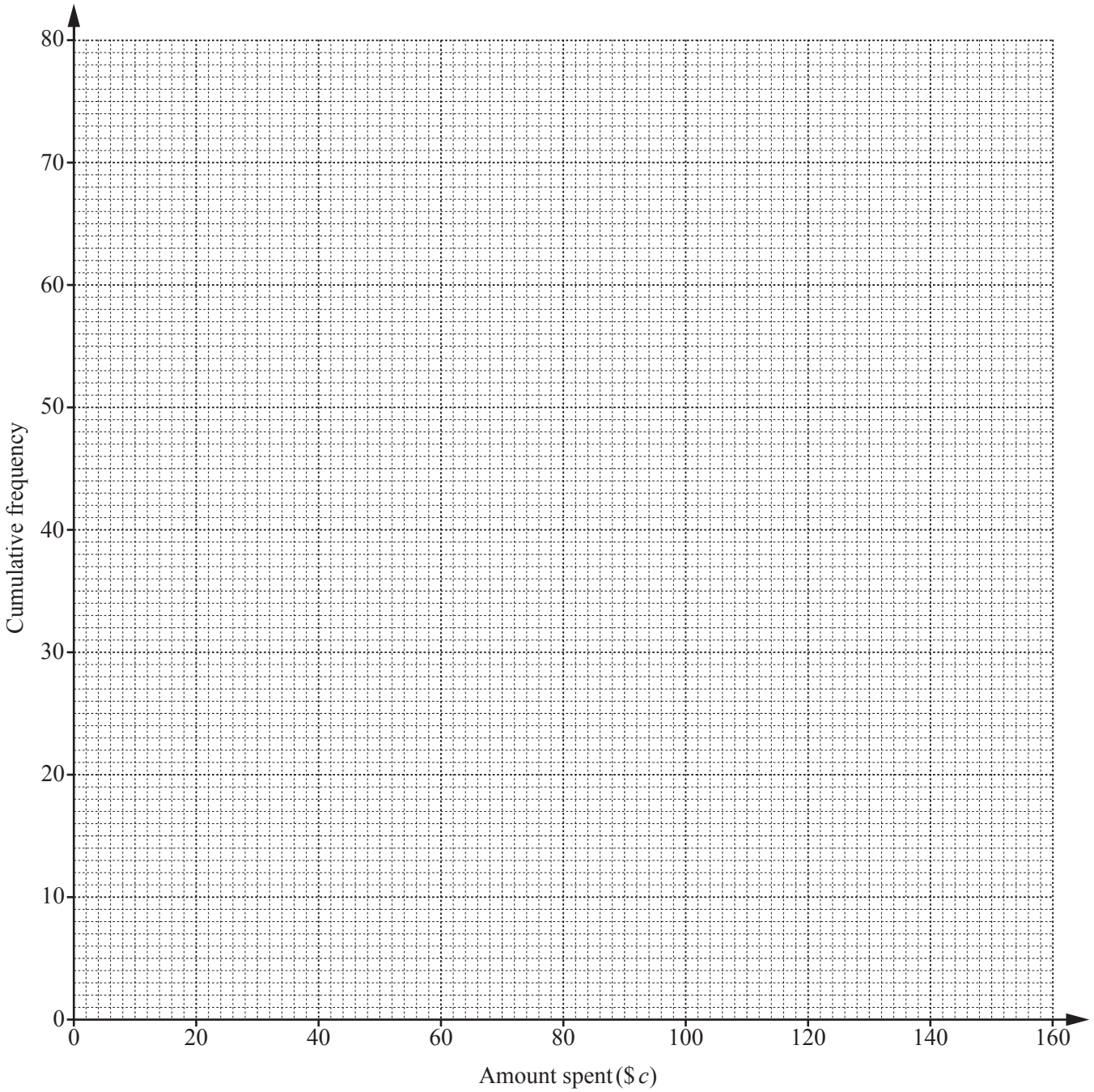
(d) **(i)** Use your graph to estimate the median.

Answer \$ ..... [1]

(ii) Use your graph to estimate the interquartile range.

Answer \$ ..... [2]

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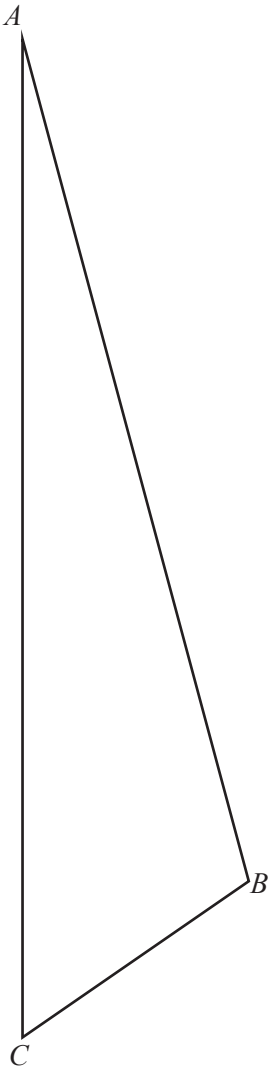


(e) The number of people who spent more than \$85 last month is the same as the number of people who spent between \$$k$ and \$85.

Given that k is less than 85, use your graph to estimate the value of k.

Answer $k =$ ..... [3]

12 (a)



ABC is a triangle.
B and *D* are points on opposite sides of the line *AC*.
$DA = 9$ cm and $CD = 7$ cm.

(i) Accurately draw and label the point *D*. [2]

(ii) Measure $D\hat{A}B$.

Answer $D\hat{A}B =$ ..... [1]

(iii) **(a)** Measure the shortest distance from *B* to *AC*.

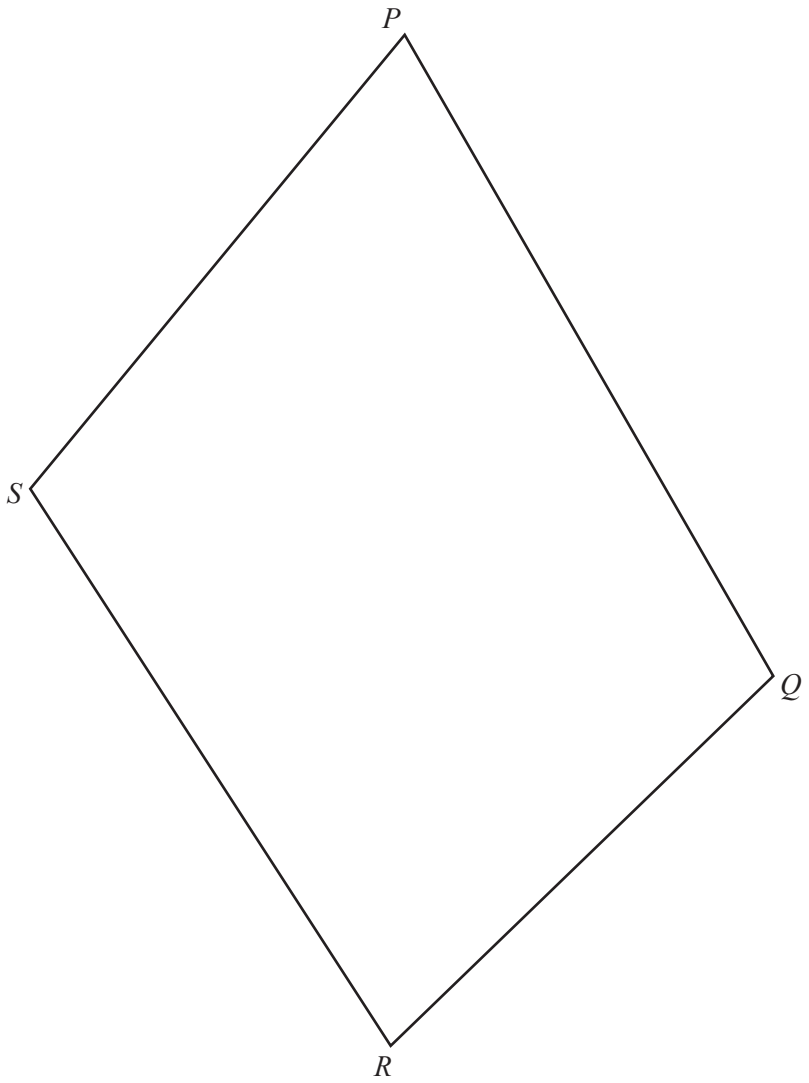
Answer ..... cm [1]

(b) Work out the area of triangle *ABC*.

Answer ..... cm^2 [2]

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(b)



This is an accurate diagram of quadrilateral *PQRS*.

(i) Give a reason why it is **not** possible for *P*, *Q*, *R* and *S* to be points on the circumference of a circle.

Answer .....

..... [1]

(ii) *T* is a point inside *PQRS* such that it is

I more than 6 cm from *R*
II nearer to *R* than *P*
III nearer to *PQ* than *QR*.

(a) Construct and shade the region within which *T* lies. [4]

(b) Find the maximum possible length of *RT*.

Answer ..... cm [1]

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