

Monday 11 November 2019 – Afternoon

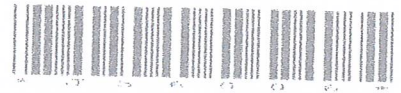
GCSE (9–1) Mathematics

J560/06 Paper 6 (Higher Tier)

Time allowed: 1 hour 30 minutes

You may use:

- a scientific or graphical calculator
- geometrical instruments
- tracing paper



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

First name(s)

Last name

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION

- The total mark for this paper is **100**.
- The marks for each question are shown in brackets [].
- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
- This document consists of **20** pages.

Answer all the questions.

- 1 Solve $3x - 5 \geq 10$.
Show your solution on the number line.

$$3x \geq 15$$

$$x \geq 5$$



[4]

- 2 Amrit's income is 32% more than Bethan's income.
Amrit and Bethan's combined income is £54 868.

Calculate Amrit's income.

Amrit: 132%.

Bethan: 100%.

$$\begin{array}{r} 232\% = 54868 \\ 1\% = 236.5 \\ 132\% = 31218 \end{array} \left. \begin{array}{l}) \div 232 \\) \times 132 \end{array} \right\}$$

£ 31,218 [5]

- 3 Jacob, Amelie and Reuben each roll a fair six-sided dice.
What is the probability that all three roll a number less than 3?

Give your answer as a fraction in its simplest form.

$$P(\text{roll a number less than 3}) = \frac{1}{3}$$

$$\left(\frac{1}{3}\right)^3 = \frac{1}{27}$$

..... $\frac{1}{27}$ [3]

- 4 The diagram shows two rectangles, A and B.



Rectangle A has a width of 25 cm and a height of 12 cm.
The width of rectangle B is three times the height of rectangle B.

The area of rectangle A is equal to the area of rectangle B.

Find the perimeter of rectangle B.

$$\underline{A} \quad \text{area: } 25 \times 12 = 300 \text{ cm}^2$$

$$\underline{B} \quad \text{area: } 3x^2 = 300$$

$$x^2 = 100$$

$$x = 10$$

$$\text{Perimeter: } 8x = 8 \times 10 = 80$$

..... 80 cm [5]

- 5 Kay invests £1500 in an account paying 3% **compound** interest per year.
Neil invests £1500 in an account paying $r\%$ **simple** interest per year.

At the end of the 5th year, Kay and Neil's accounts both contain the same amount of money.

Calculate r .

Give your answer correct to 1 decimal place.

Kay: $1500 \times 1.03^5 = 1738.9111145$

Neil: $\frac{1738.9111145 - 1500}{5} = \frac{238.9111145}{5}$ per year
 $= 47.782$

~~$\frac{238.9111145}{1500} \times 100 = 15.9$~~

$\frac{47.782}{1500} \times 100 = 3.185\dots$

$= 3.2\%$

$r = \dots\dots\dots 3.2 \dots\dots\dots [6]$

- 6 The table shows the children nominated to win the subject prize in Mathematics and the subject prize in English.

Mathematics	English
Alice	Alice
Ben	Claire
Emma	Gabi
Paddy	Simon

The winner of each subject prize is picked at random.
It is possible for Alice to win both prizes.

In what percentage of the combinations of prize winners does Alice win at least one prize?

combinations where Alice wins at least once: AA, AC, AG, AS, BA, EA, PA

total combinations: 16

$$\frac{7}{16} \times 100 = 43.75$$

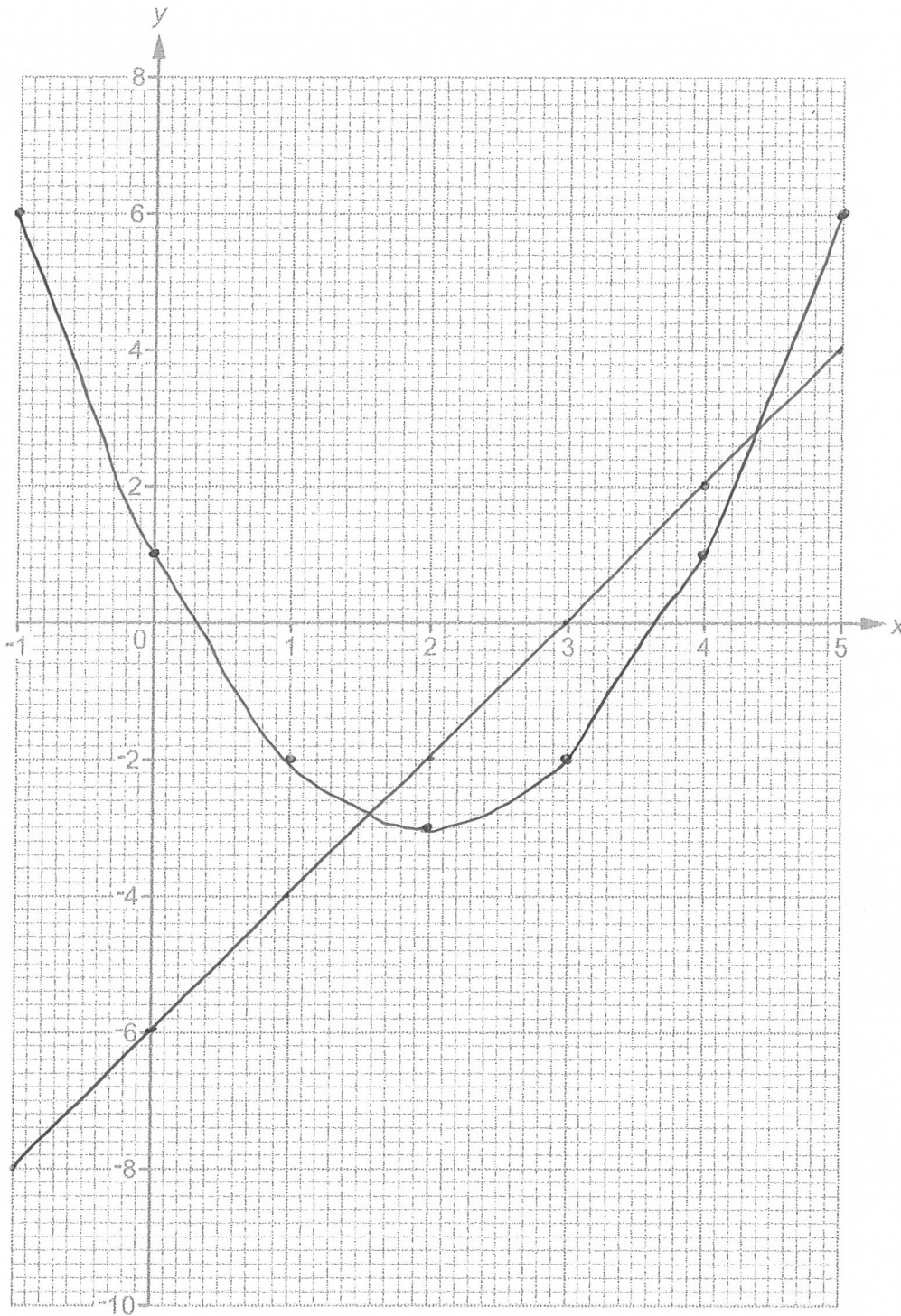
..... 43.75 % [4]

- 7 (a) Complete the table for $y = x^2 - 4x + 1$.

x	-1	0	1	2	3	4	5
y	6	1	-2	-3	-2	1	6

[2]

- (b) Draw the graph of $y = x^2 - 4x + 1$ for $-1 \leq x \leq 5$.



[3]

(c) On the same grid, draw the graph of $y = 2x - 6$ for $-1 \leq x \leq 5$.

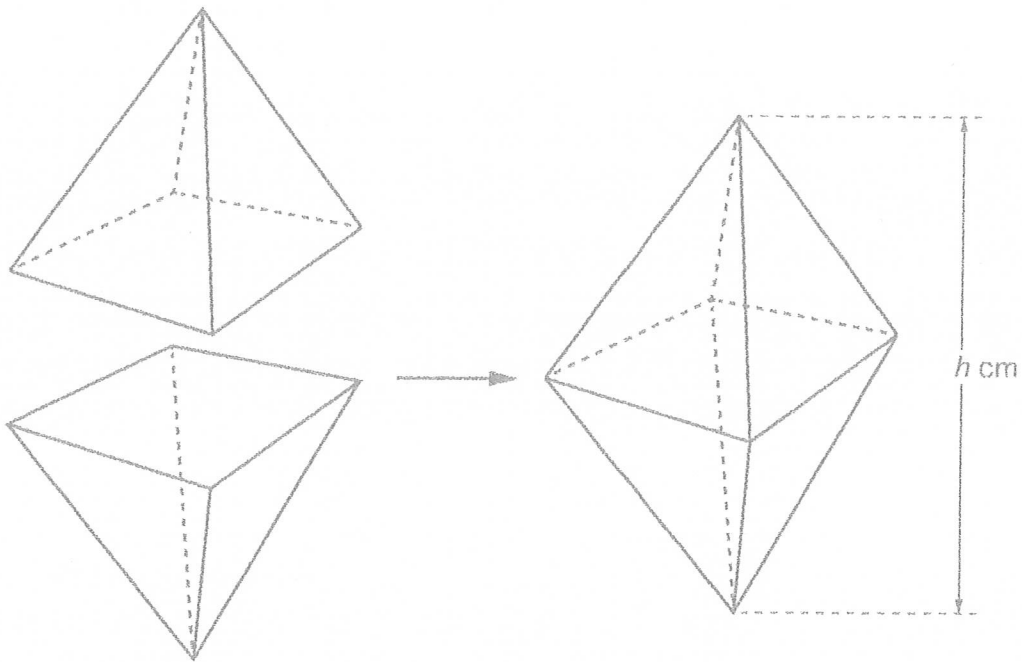
[3]

(d) Use your graphs to solve the equation $x^2 - 4x + 1 = 2x - 6$.

Give your answers to 1 decimal place.

(d) $x = \dots\dots\dots 1.6 \dots\dots\dots$ or $x = \dots\dots\dots 4.4 \dots\dots\dots$ [2]

- 8 An octahedron is formed from two identical square based pyramids. The square bases are stuck together as shown.



The volume of the octahedron is 60 cm^3 .

The length of the side of each pyramid's square base is 5 cm.

Work out the height h cm of the **octahedron**.

[The volume of a pyramid is $\frac{1}{3} \times \text{area of base} \times \text{perpendicular height}$]

$$\left(\frac{1}{3} \times 5^2 \times \frac{h}{2} \right) \times 2 = 60$$

$$\frac{25}{3} h = 60$$

$$25h = 180$$

$$h = 7.2$$

$$h = \dots\dots\dots 7.2 \dots\dots\dots \text{ cm [4]}$$

9 Vector $\mathbf{a} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ and vector $\mathbf{b} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$.

(a) Find the values of k and n so that

$$k(\mathbf{a} + \mathbf{b}) = \begin{pmatrix} 10 \\ n \end{pmatrix}.$$

$$k \left(\begin{pmatrix} 3 \\ -1 \end{pmatrix} + \begin{pmatrix} 1 \\ 3 \end{pmatrix} \right) = \begin{pmatrix} 10 \\ n \end{pmatrix}$$

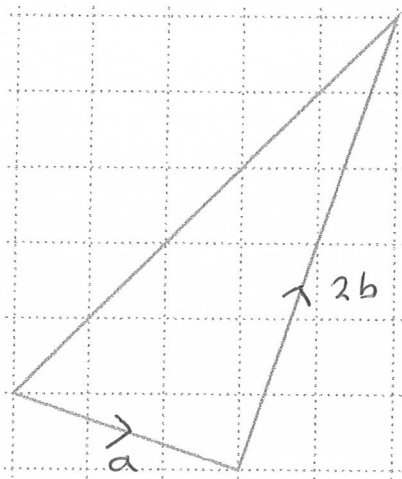
$$\begin{pmatrix} 4k \\ 2k \end{pmatrix} = \begin{pmatrix} 10 \\ n \end{pmatrix}$$

$$\begin{aligned} 4k &= 10 \\ k &= 2.5 \\ 2 \times 2.5 &= n \\ n &= 5 \end{aligned}$$

(a) $k = \dots 2.5 \dots$

$n = \dots 5 \dots$ [3]

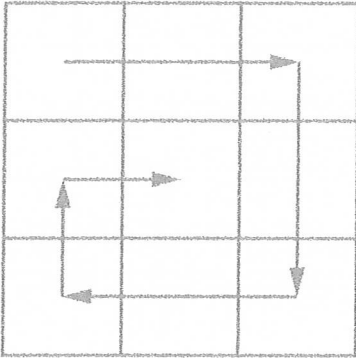
(b) Gavin starts to draw a diagram to show that $\mathbf{a} + 2\mathbf{b} = \begin{pmatrix} 5 \\ 5 \end{pmatrix}$.



Complete Gavin's diagram.

[3]

- 10 Nine consecutive numbers are written on a 3-by-3 grid. They are arranged, in ascending order, in a spiral as shown.



- (a) Karen writes the numbers 3 to 11 on her grid.

3	4	5
10	11	6
9	8	7

The total of the first column is $3 + 10 + 9 = 22$.

Karen says

The total of the first column is one less than the total of the second column.

Show that this is correct for Karen's grid.

[1]

$$4 + 11 + 8 = 23$$

(b) Victor says

If any nine consecutive numbers are arranged in ascending order in this spiral on a 3-by-3 grid, the total of the first column will always be one less than the total of the second column.

Prove that Victor is correct.

[5]

$$\text{first column: } n + n + 7 + n + 6 = 3n + 13$$

$$\text{second column: } n + 1 + n + 8 + n + 5 = 3n + 14$$

$$3n + 14 - (3n + 13) = 1$$

11 A sequence is defined by the rule $u_{n+1} = 5u_n - 15$.

(a) If $u_3 = 6$, calculate

(i) u_5

$$u_4 = 5 \times 6 - 15 = 15$$

$$u_5 = 5 \times 15 - 15 = 60$$

(a)(i) $u_5 = \dots\dots\dots 60 \dots\dots\dots$ [3]

(ii) u_2

$$6 = 5u_2 - 15$$

$$21 = 5u_2$$

$$u_2 = 4.2$$

(ii) $u_2 = \dots\dots\dots 4.2 \dots\dots\dots$ [3]

(b) Trevor says

$$\text{If } u_1 = 3.75 \text{ then } u_{100} = 3.75$$

Show that Trevor is correct.

[2]

$$u_2 = 5 \times 3.75 - 15 = 3.75$$

if $u_1 = u_2$ then all terms are equal

5000m
13

12 (a) Arron ran a distance of 5 km at an average speed of 2.2 m/s.

How long did Arron run for?

Give your answer in minutes and seconds, to the nearest second.



$$T = \frac{D}{S} = \frac{5000}{2.2} = 2,272.\dot{7}\dot{2}$$

$$\frac{2,272.\dot{7}\dot{2}}{60} = 37.\dot{8}\dot{7} \text{ minutes}$$

$$0.\dot{8}\dot{7} \times 60 = 52.\dot{7}\dot{2} = 53 \text{ seconds}$$

(a) 37 minutes 53 seconds [4]

(b) Claudine cycled a distance of 53 km in 2.7 hours.
The distance is measured correct to the nearest km.
The time is given correct to 1 decimal place.

Calculate the lower and upper bounds of her average speed.

Give your answers correct to 2 decimal places.

$$52.5 < \text{distance} < 53.5$$

$$2.65 < \text{time} < 2.75$$

$$S = \frac{D}{T}$$

$$\frac{52.5}{2.75} = 19.09$$

$$\frac{53.5}{2.65} = 20.19$$

(b) lower bound = 19.09 km/h

upper bound = 20.19 km/h [6]

- 13 Dani has a pack of 45 cards.
Each card is either red or black.

One-third of the cards in the pack are red.

She picks two cards from the pack, without replacement.

Calculate the probability that Dani picks two black cards.

$$\text{red} : 15$$

$$\text{black} : 30$$

$$P(\text{two black cards}) = \frac{2}{3} \times \frac{29}{44} = \frac{29}{66}$$

..... [5]

- 14 Write $(\sqrt[4]{8})^5$ as a power of 2.

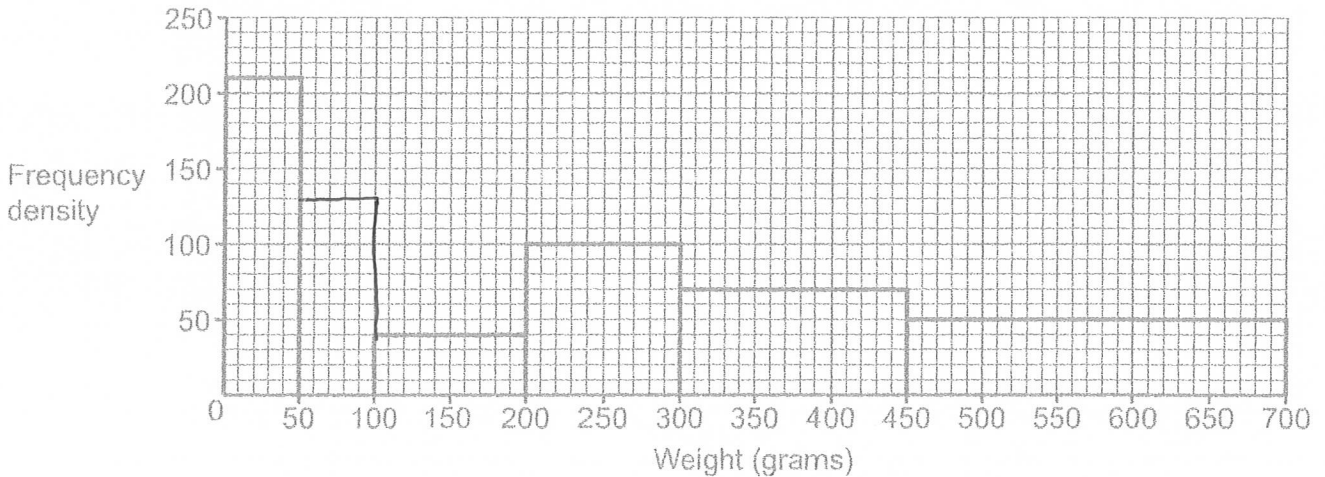
$$8 = 2^3$$

$$\left(2^{\frac{3}{4}}\right)^5 = 2^{\frac{15}{4}}$$

$$2^{\frac{15}{4}}$$

..... [3]

15 The histogram shows information about the weights of some of the parcels handled by a delivery company in one month.



(a) Zoe says

There are fewer parcels weighing between 450g and 700g than parcels weighing between 300g and 450g.

Is Zoe correct?
Show how you decide.

$$\begin{array}{l}
 300 - 450 = 150 \quad 150 \times 70 = 10500 \quad \text{parcels} \\
 700 - 450 = 250 \quad 250 \times 50 = 12500 \quad \text{parcels}
 \end{array}$$

Zoe isn't correct. $12500 > 10500$

.....

.....

.....

..... [4]

(b) The delivery company delivered 6500 parcels weighing between 50g and 100g.

Complete the histogram to show this information. [2]

(c) Zoe uses the histogram to calculate the number of parcels weighing between 200g and 250g.

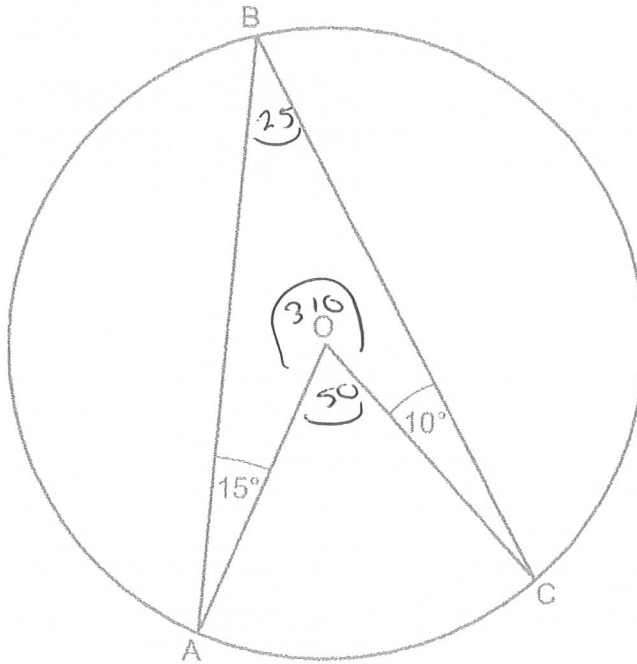
Explain why Zoe's answer is unlikely to be reliable.

the weights of parcels may not be evenly distributed

..... [1]

16 (a) In the diagram,

- A, B and C are points on the circumference of a circle
- O is the centre of the circle
- angle OAB = 15°
- angle BCO = 10° .



Not to scale

Calculate the acute angle AOC.

$$\angle ABC = 25^\circ$$

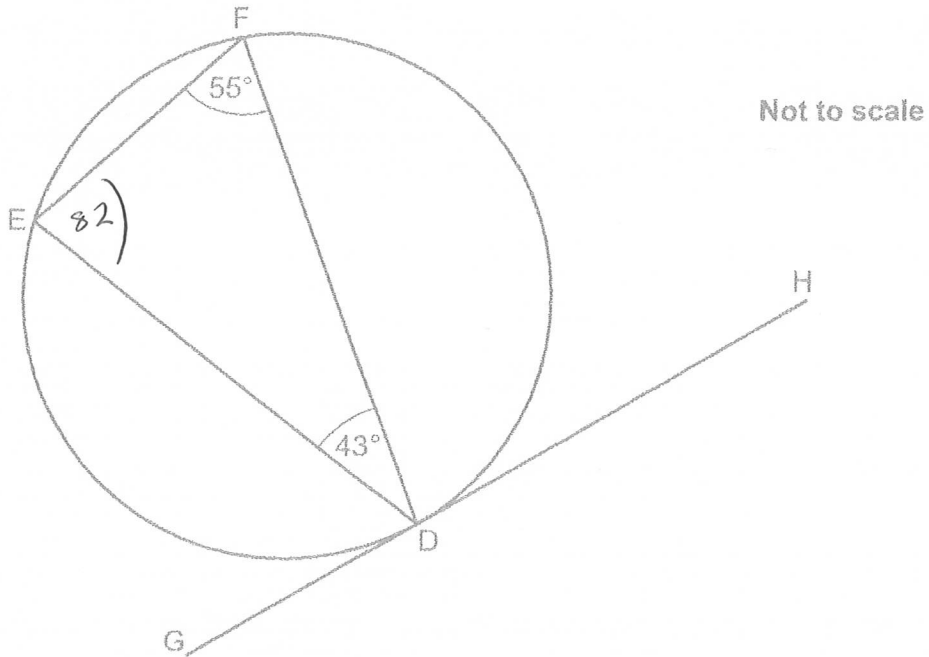
$$360 - 25 - 15 - 10 = 310$$

$$360 - 310 = 50$$

(a) 50 ° [4]

(b) In the diagram,

- E, F and D are points on the circumference of the circle
- G, D and H lie on a tangent to the circle
- angle EFD = 55°
- angle FDE = 43° .



Explain why angle HDF is 82° .

$$\angle DEF : 180 - (43 + 55) = 82 \quad (\text{angles in a triangle add to } 180^\circ)$$

$$\angle HDF = \angle DEF = 82 \quad (\text{alternate segment theorem})$$

.....

.....

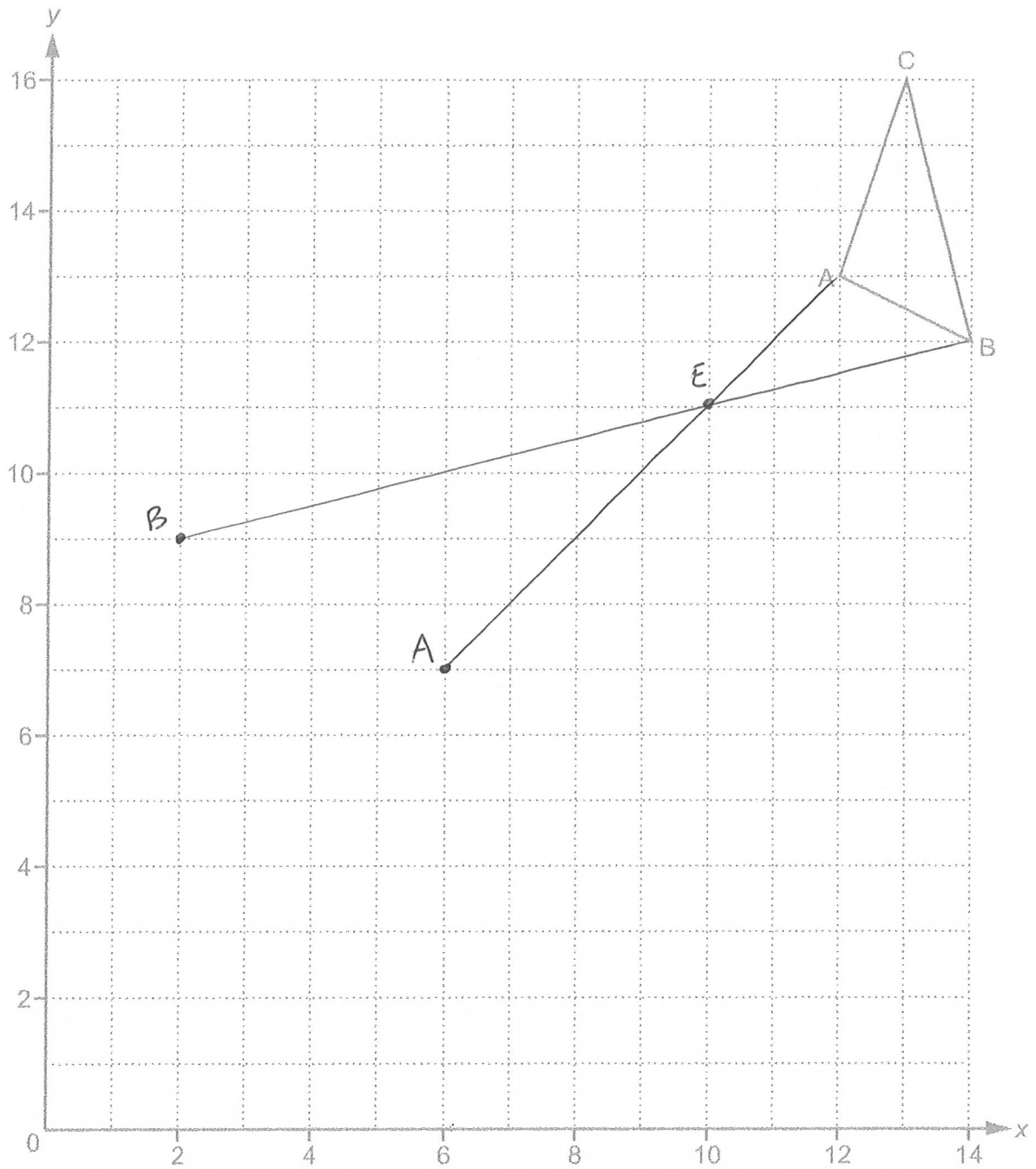
.....

.....

.....

[4]

17 A triangle has vertices A, B and C.



The triangle is enlarged with scale factor f and centre of enlargement E.

Vertex A maps to (6, 7).

Vertex B maps to (2, 9).

(a) Find the coordinates of the centre of enlargement, E.

(a) (10, 11) [2]

(b) Find the scale factor, f .

(b) -2 [2]

(c) Vertex C maps to the point R.
Find the coordinates of R.

(c) (..... 4 , 1 ) [2]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large rectangular area with horizontal dotted lines for writing, intended for providing additional answer space. The area is bounded by a solid vertical line on the left and a solid horizontal line at the top and bottom.



Oxford Cambridge and RSA

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series. If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact The OCR Copyright Team, The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.