



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

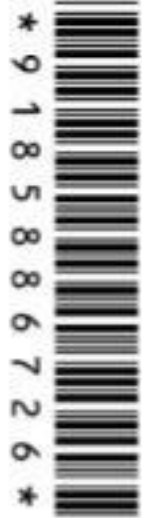
CANDIDATE  
NAME

CENTRE  
NUMBER

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**MATHEMATICS**

**0580/21**

Paper 2 (Extended)

**May/June 2010**

**1 hour 30 minutes**

Candidates answer on the Question Paper.

Additional Materials:

Electronic calculator  
Mathematical tables (optional)

Geometrical Instruments  
Tracing paper (optional)

**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 a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

If working is needed for any question it must be shown below that question.

Electronic calculators should be used.

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  $\pi$ , use either your calculator value or 3.142.

At the end of the examination, **fasten** all your work securely together.

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 70.

This document consists of **12** printed pages.



- 1 Write the numbers in order of size with the **smallest** first.

$$\begin{array}{cccc}
 \sqrt{10} & 3.14 & \frac{22}{7} & \pi \\
 \downarrow & \downarrow & \downarrow & \downarrow \\
 3.1622\dots & 3.14 & 3.1428\dots & 3.1415\dots \\
 4 & 1 & 3 & 2
 \end{array}$$

Answer  $3.14\dots < \pi < \frac{22}{7} < \sqrt{10}$  [2]

- 2 Michel changed \$600 into pounds (£) when the exchange rate was £1 = \$2.40.  
He later changed all the pounds back into dollars when the exchange rate was £1 = \$2.60.

How many dollars did he receive?

$$\text{£1} = \$2.40$$

$$x = \$600$$

$$\Rightarrow x = \frac{\$600}{\$2.40} \times \text{£1} = \underline{\underline{\text{£250}}}$$

$$\text{£1} = \$2.60$$

$$\text{£250} = y$$

$$\Rightarrow y = \frac{\text{£250}}{\text{£1}} \times \$2.60 = \underline{\underline{\$650}}$$

Answer \$ 650 [2]

- 3  $p$  is the largest prime number between 50 and 100.  
 $q$  is the smallest prime number between 50 and 100.

Calculate the value of  $p - q$ .

$$\star p - q = 97 - 53$$

$$\Rightarrow p - q = \underline{\underline{44}}$$

Answer 44 [2]

- 4 A person in a car, travelling at 108 kilometres per hour, takes 1 second to go past a building on the side of the road.

Calculate the length of the building in metres.

$$\star L = v \times t$$

$$\Rightarrow L = 108 \frac{\text{km}}{\text{h}} \times 1 \text{ s}$$

$$\Rightarrow L = 108 \times \frac{10^3 \text{ m}}{3600 \text{ s}} \times 1 \text{ s} = \underline{\underline{30 \text{ m}}}$$

Answer 30 m [2]



- 5 Calculate the value of  $5(6 \times 10^3 + 400)$ , giving your answer in standard form.

$$\begin{array}{c} \downarrow \\ \begin{array}{cccc} 4 & 3 & 2 & 1 \\ 3 & 2 & 0 & 0 & 0 \end{array} \\ \hline 3.2 \times 10^4 \end{array}$$

Answer .....  $3.2 \times 10^4$  ..... [2]

- 6 Calculate the value of  $\frac{1}{2}\sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2}}}$

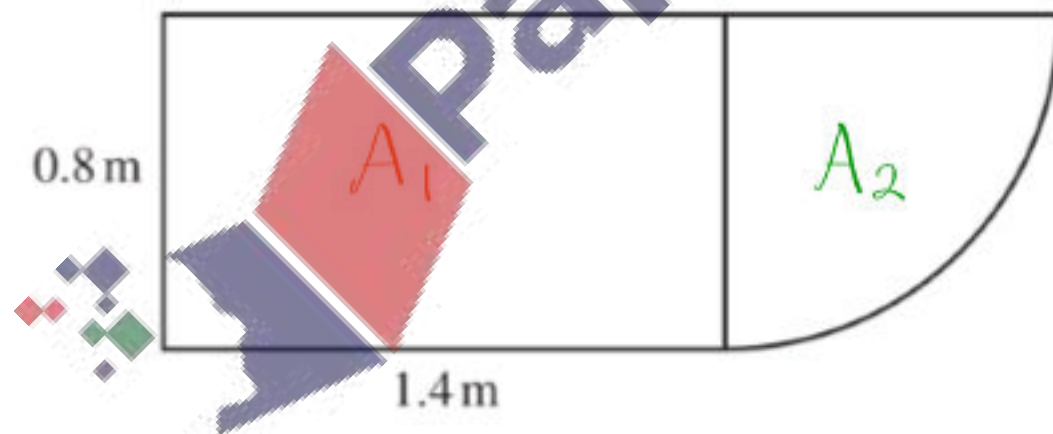
(a) writing down all the figures in your calculator answer,

Answer(a) ..... 0.46193976626 ..... [1]

(b) writing your answer correct to 4 significant figures.

Answer(b) ..... 0.4619 ..... [1]

7



The top of a desk is made from a rectangle and a quarter circle.  
The rectangle measures 0.8m by 1.4m.

Calculate the surface area of the top of the desk.

$$\star A_T = A_1 + A_2$$

$$\Rightarrow A_T = (l \times b) + \left(\frac{\pi r^2}{4}\right)$$

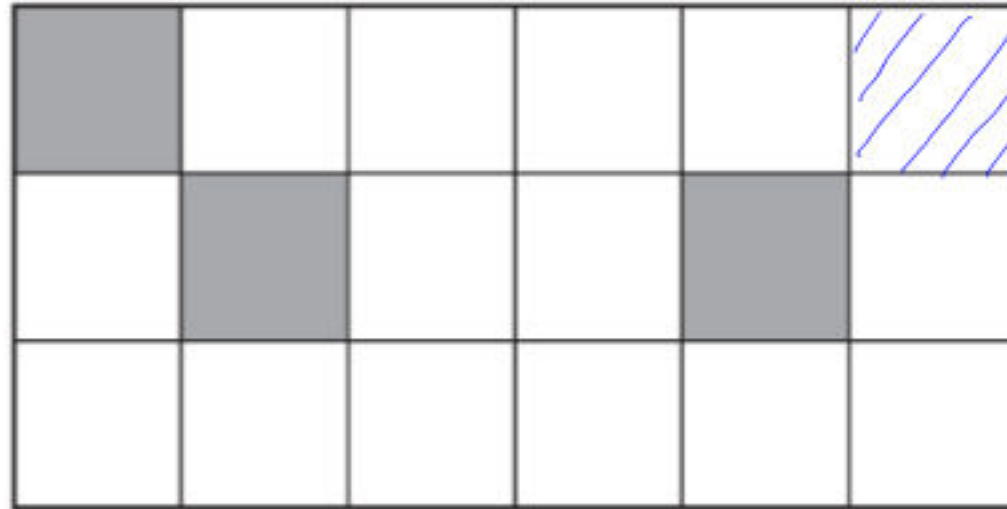
$$\Rightarrow A_T = (0.8 \times 1.4) \text{ m}^2 + \left(\frac{\pi(0.8)^2}{4}\right) \text{ m}^2$$

$$\Rightarrow A_T = \underline{1.62} \text{ m}^2 \text{ (3 sig. figs.)}$$

Answer ..... 1.62 ..... m<sup>2</sup> [3]

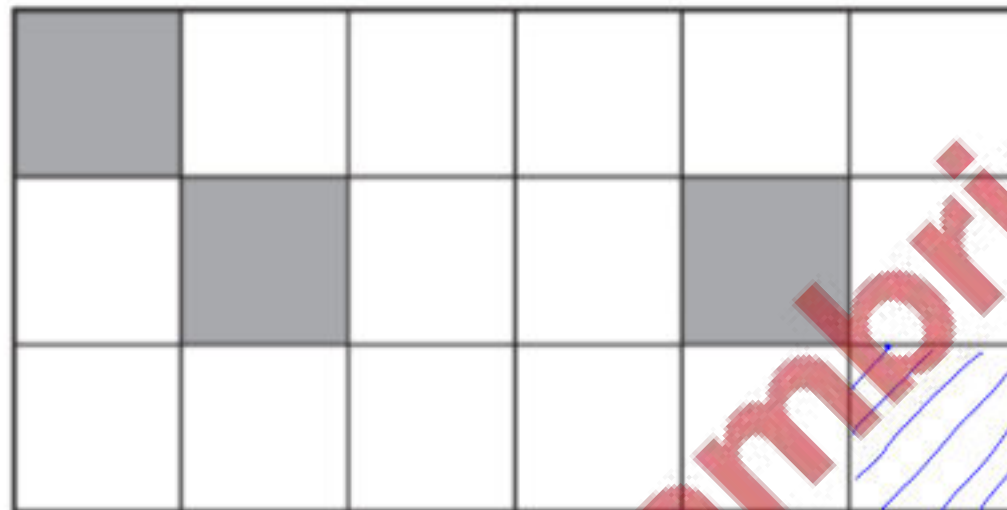
8 (a) Shade **one** square in each diagram so that there is

(i) one line of symmetry,



[1]

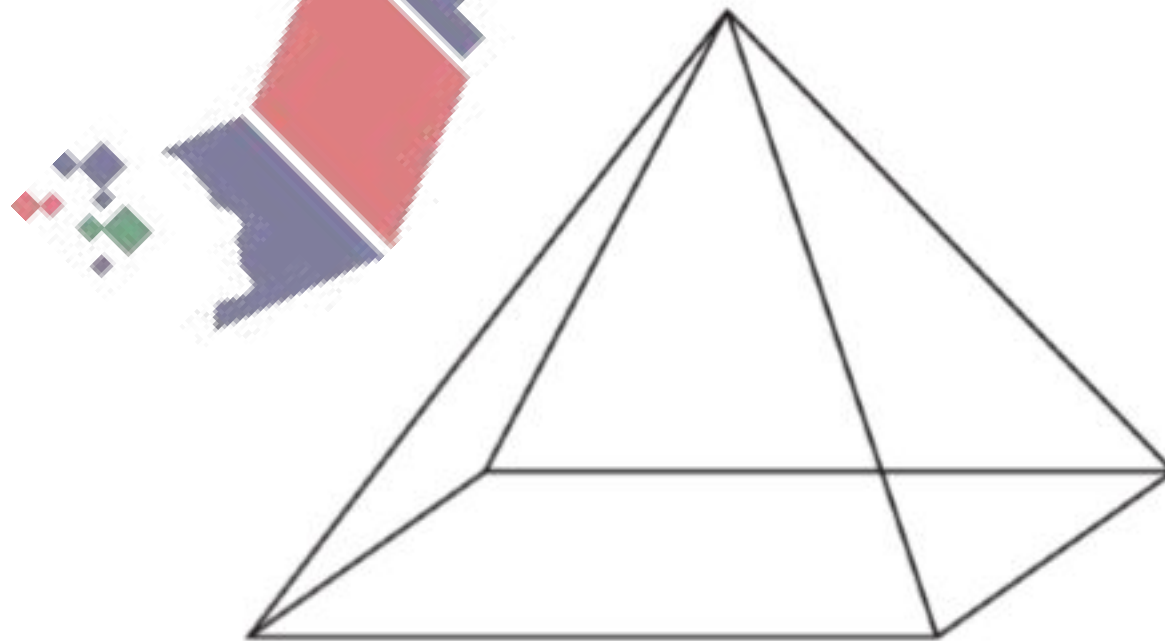
(ii) rotational symmetry of order 2.



[1]

(b) The pyramid below has a rectangular base.  
The vertex of the pyramid is vertically above the centre of the base.

Write down the number of **planes** of symmetry for the pyramid.



Answer(b) ..... 2 ..... [1]

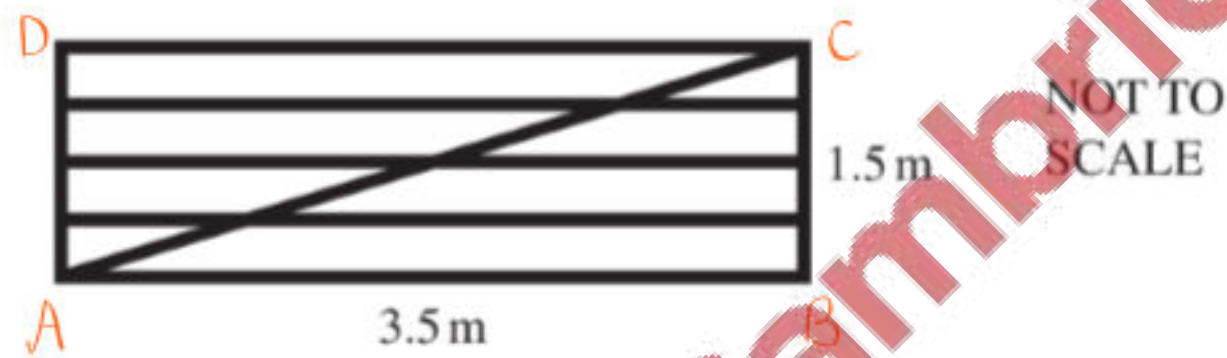
- 9 A cyclist left Melbourne on Wednesday 21 May at 09 45 to travel to Sydney.  
The journey took 97 hours.

Write down the day, date and time that the cyclist arrived in Sydney.

$$\star 97 \text{ hours} = \underline{4 \text{ days } 1 \text{ hour}}$$

Answer Day Sunday Date 25 May Time 10 45 [3]

10



The diagram represents a rectangular gate measuring 1.5 m by 3.5 m.  
It is made from eight lengths of wood.

Calculate the total length of wood needed to make the gate.

$$\star T_L = (5 \times AB) + (2 \times BC) + AC$$

$$\Rightarrow T_L = (5 \times 3.5) \text{ m} + (2 \times 1.5) \text{ m} + (\sqrt{3.5^2 + 1.5^2}) \text{ m}$$

$$\Rightarrow T_L = \underline{24.3} \text{ m (3 sig. figs.)}$$

Answer 24.3 m [3]



11 Make  $d$  the subject of the formula  $c = \frac{5d + 4w}{2w}$ .

$$\Rightarrow 2wc = 5d + 4w$$

$$\Rightarrow 5d = 2wc - 4w$$

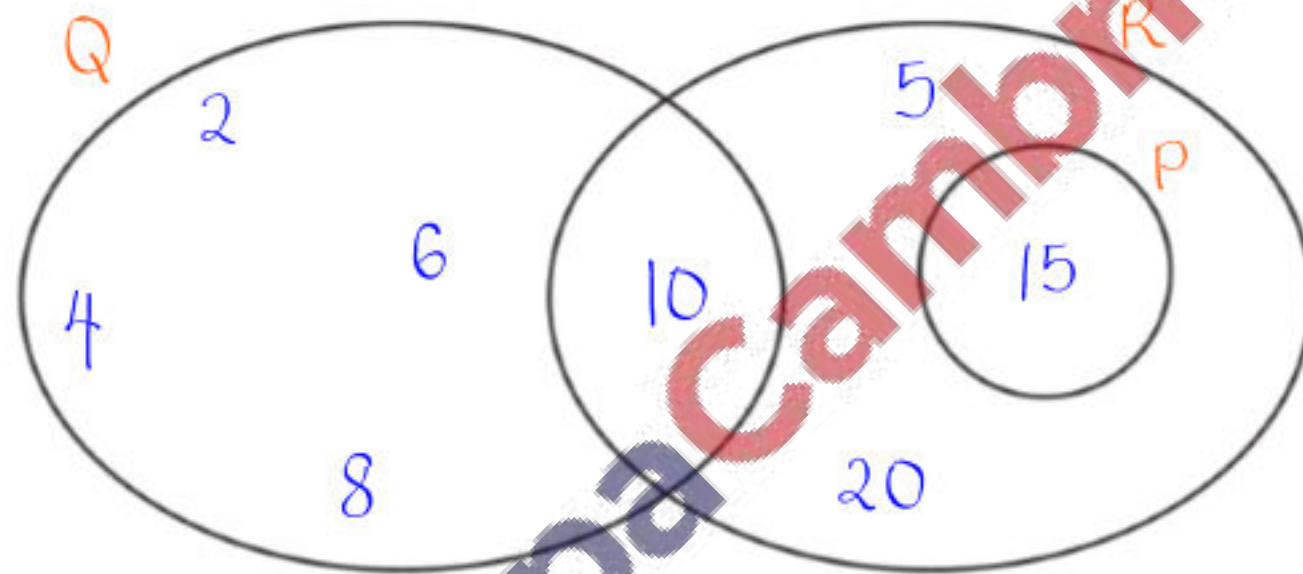
$$\Rightarrow d = \frac{2wc - 4w}{5}$$

$$\text{Answer } d = \frac{2wc - 4w}{5}$$

[3]

12  $Q = \{2, 4, 6, 8, 10\}$  and  $R = \{5, 10, 15, 20\}$ .  
 $15 \in P$ ,  $n(P) = 1$  and  $P \cap Q = \emptyset$ .

Label each set and complete the Venn diagram to show this information.



[3]

13 Solve the simultaneous equations.

$$\frac{2x + y}{2} = 7 \quad \Rightarrow \quad 2x + y = 14 \quad \text{--- (1)}$$

$$\frac{2x - y}{2} = 17 \quad \Rightarrow \quad 2x - y = 34 \quad \text{--- (2)}$$

$$(1) + (2) : (2+2)x = 14 + 34$$

$$\Rightarrow 4x = 48$$

$$\Rightarrow \underline{x = 12}$$

• Finding  $y$  :

$$\Rightarrow 2(12) + y = 14$$

$$\Rightarrow y = \underline{-10}$$

$$\text{Answer } x = \dots\dots\dots 12 \dots\dots\dots$$

$$y = \dots\dots\dots -10 \dots\dots\dots \quad [3]$$

- 14  $y$  varies inversely as the square of  $x$ .  
 $y = 1.5$  when  $x = 8$ .

Find  $y$  when  $x = 5$ .

$$\begin{aligned} \star y &\propto \frac{1}{x^2} && \Rightarrow y = \frac{96}{x^2} \\ \Rightarrow y &= \frac{k}{x^2} && \text{when } x=5, \\ & && \Rightarrow y = \frac{96}{5^2} \\ \bullet \text{ Finding } k: & && \\ \Rightarrow 1.5 &= \frac{k}{8^2} && \Rightarrow y = \underline{3.84} \\ \Rightarrow k &= 1.5 \times 8^2 = \underline{96} && \end{aligned}$$

Answer  $y = \dots\dots\dots 3.84 \dots\dots\dots$  [3]

- 15 The points (2, 5), (3, 3) and (k, 1) all lie in a straight line.

(a) Find the value of  $k$ .

$$\begin{aligned} \star \frac{5-3}{2-3} &= \frac{1-5}{k-2} && \Rightarrow k-2 = 2 \\ & && \Rightarrow \underline{k=4} \\ \Rightarrow -2 &= \frac{-4}{k-2} \\ \Rightarrow k-2 &= \frac{-4}{-2} \end{aligned}$$

Answer(a)  $k = \dots\dots\dots 4 \dots\dots\dots$  [1]

(b) Find the equation of the line.

$$\begin{aligned} \star y &= mx + c && \therefore \underline{y = -2x + 9} \\ \bullet m &= \frac{5-3}{2-3} = \underline{-2} \\ \Rightarrow y &= -2x + c \\ \bullet 3 &= -2(3) + c \\ \Rightarrow 3 &= -6 + c \\ \Rightarrow \underline{c} &= \underline{9} \end{aligned}$$

Answer(b)  $\dots\dots\dots y = -2x + 9 \dots\dots\dots$  [3]



## 16 Simplify

(a)  $\left(\frac{p^4}{16}\right)^{0.75}$ ,

$$\Rightarrow \frac{p^{4 \times 0.75}}{16^{0.75}} = \frac{p^3}{8}$$

Answer(a)  $\frac{p^3}{8}$  [2]

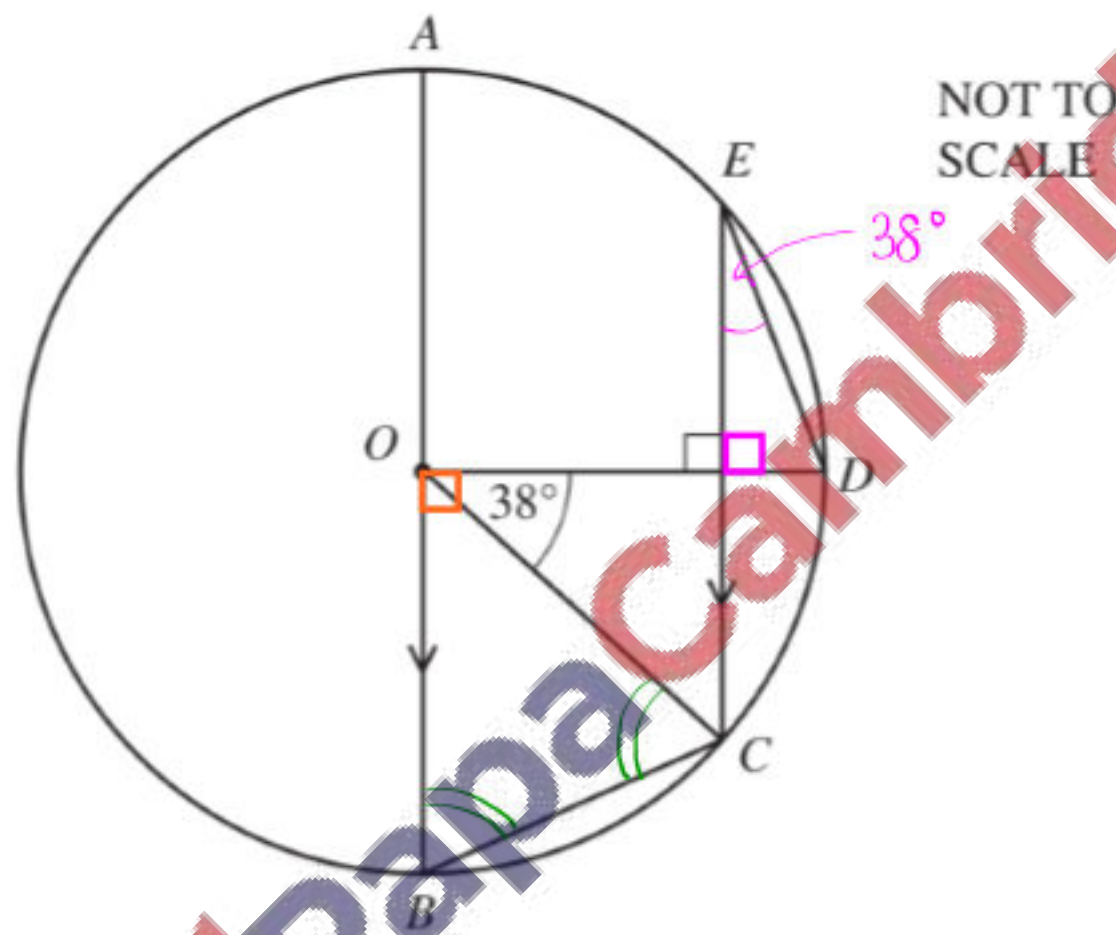
(b)  $3^2q^{-3} \div 2^3q^{-2}$ .

$$\Rightarrow (3^2 \div 2^3)q^{-3-(-2)}$$

$$\Rightarrow \frac{9}{8}q^{-1} \text{ or } \frac{9}{8q}$$

Answer(b)  $\frac{9}{8q}$  [2]

## 17



$AB$  is the diameter of a circle, centre  $O$ .  $C$ ,  $D$  and  $E$  lie on the circle.  $EC$  is parallel to  $AB$  and perpendicular to  $OD$ . Angle  $DOC$  is  $38^\circ$ .

Work out

(a) angle  $BOC$ ,  $\star \hat{BOC} + 38^\circ = 90^\circ$   
 $\Rightarrow \hat{BOC} = 52^\circ$

Answer(a) Angle  $BOC = 52^\circ$  [1]

(b) angle  $CBO$ ,  $\star 2\hat{CBO} + 52^\circ = 180^\circ$   
 $\Rightarrow \hat{CBO} = 64^\circ$

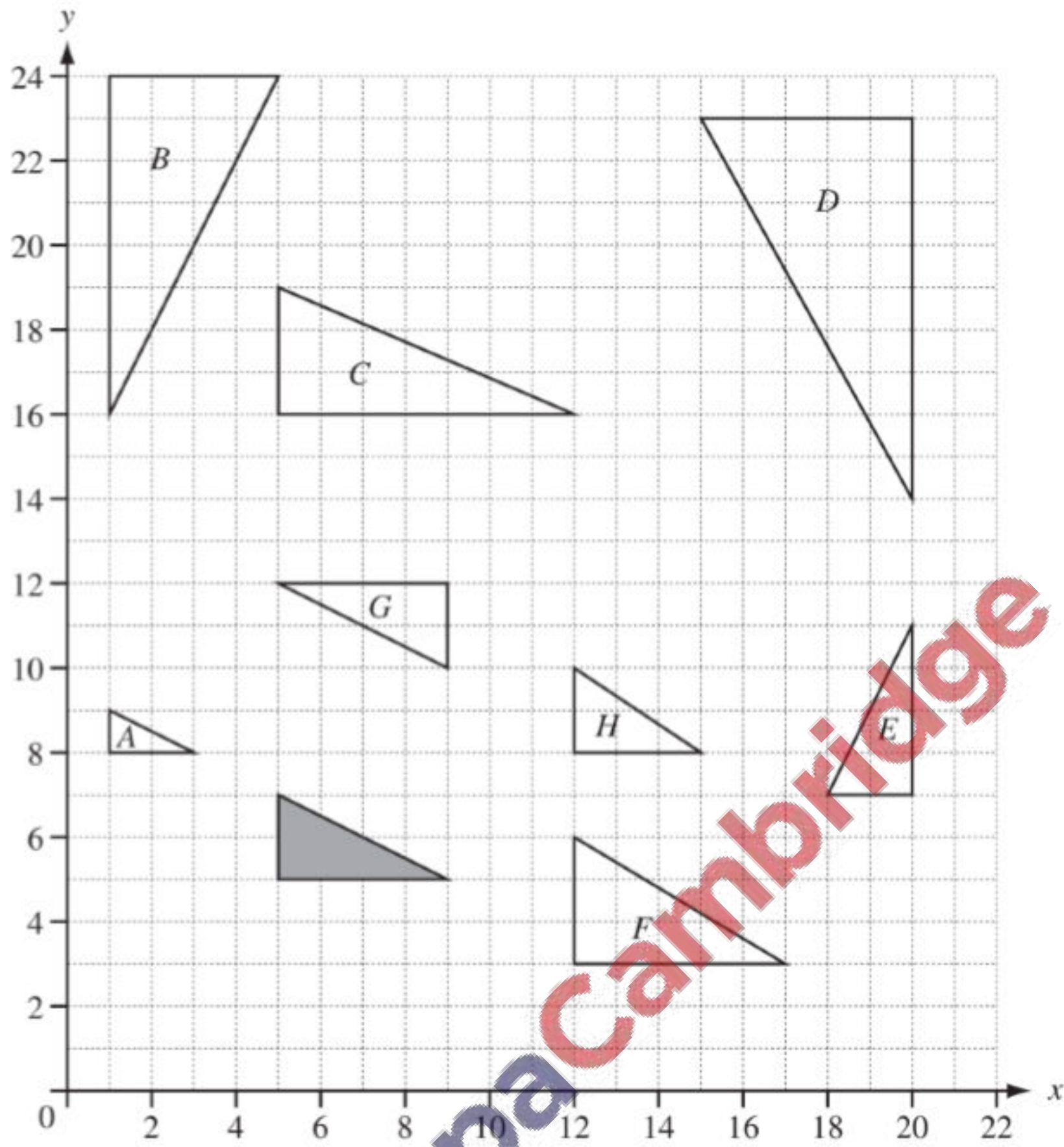
Answer(b) Angle  $CBO = 64^\circ$  [1]

(c) angle  $EDO$ .  $\star \hat{EDO} + 90^\circ + 38^\circ = 180^\circ$   
 $\Rightarrow \hat{EDO} = 71^\circ$

Answer(c) Angle  $EDO = 71^\circ$  [2]



18



Write down the letters of all the triangles which are

(a) congruent to the shaded triangle,

Answer(a) ..... E, G ..... [2]

(b) similar, but not congruent, to the shaded triangle.

Answer(b) ..... A, B ..... [2]

19 The position vector  $\mathbf{r}$  is given by  $\mathbf{r} = 2\mathbf{p} + t(\mathbf{p} + \mathbf{q})$ .

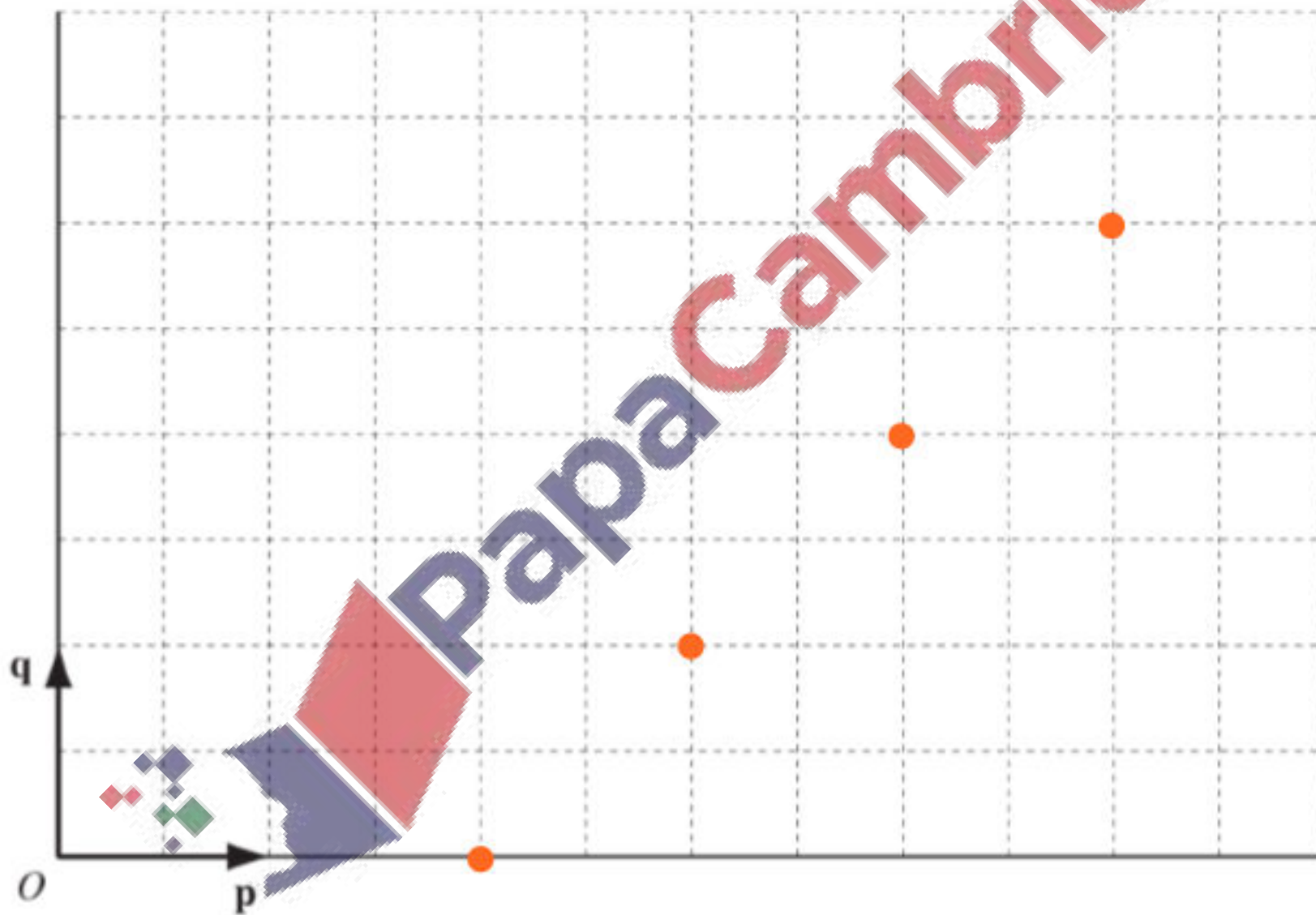
- (a) Complete the table below for the given values of  $t$ .  
Write each vector in its simplest form.  
One result has been done for you.

$t$	0	1	2	3
$\mathbf{r}$	$2\mathbf{p}$	$3\mathbf{p} + \mathbf{q}$	$4\mathbf{p} + 2\mathbf{q}$	$5\mathbf{p} + 3\mathbf{q}$

[3]

(b)  $O$  is the origin and  $\mathbf{p}$  and  $\mathbf{q}$  are shown on the diagram.

- (i) Plot the 4 points given by the position vectors in the table.



[2]

- (ii) What can you say about these four points?

Answer(b)(ii) They form a straight line. [1]



20  $f(x) = (x-1)^3$        $g(x) = (x-1)^2$        $h(x) = 3x+1$

For  
Examiner's  
Use

(a) Work out  $fg(-1)$ .

$$\star fg(x) = ((x-1)^2 - 1)^3$$

$$\Rightarrow fg(-1) = ((-1-1)^2 - 1)^3$$

$$\Rightarrow fg(-1) = \underline{27}$$

Answer(a) ..... 27 ..... [2]

(b) Find  $gh(x)$  in its simplest form.

$$\star gh(x) = (3x+1-1)^2$$

$$\Rightarrow gh(x) = (3x)^2$$

$$\Rightarrow gh(x) = 3^2 x^2 = \underline{9x^2}$$

Answer(b) .....  $9x^2$  ..... [2]

(c) Find  $f^{-1}(x)$ .

$$\star f(x) = (x-1)^3$$

$$\Rightarrow x = (y-1)^3$$

$$\Rightarrow y-1 = \sqrt[3]{x}$$

$$\Rightarrow y = \underline{1 + \sqrt[3]{x}}$$

$$\therefore f^{-1}(x) = \underline{1 + \sqrt[3]{x}}$$

Answer(c) .....  $1 + \sqrt[3]{x}$  ..... [2]

Question 21 is printed on the next page.

- 21 (a) **A** is a  $(2 \times 4)$  matrix, **B** is a  $(3 \times 2)$  matrix and **C** is a  $(1 \times 3)$  matrix.

Which two of the following matrix products is it possible to work out?

**A**<sup>2</sup>   **B**<sup>2</sup>   **C**<sup>2</sup>   **AB**   **AC**   **BA**   **BC**   **CA**   **CB**

$$\star BA : (3 \times 2)(2 \times 4)$$

$$\star CB : (1 \times 3)(3 \times 2)$$

Answer(a) BA and CB [2]

(b) Find the inverse of  $\begin{pmatrix} \frac{1}{2} & \frac{3}{4} \\ \frac{1}{8} & \frac{1}{4} \end{pmatrix}$ .

Simplify your answer as far as possible.

$$\star \text{ Let } D = \begin{pmatrix} \frac{1}{2} & \frac{3}{4} \\ \frac{1}{8} & \frac{1}{4} \end{pmatrix}$$

$$\Rightarrow D^{-1} = \frac{1}{\det D} \begin{pmatrix} \frac{1}{4} & -\frac{3}{4} \\ -\frac{1}{8} & \frac{1}{2} \end{pmatrix}$$

$$\bullet \det D = \left(\frac{1}{2} \times \frac{1}{4}\right) - \left(\frac{1}{8} \times \frac{3}{4}\right) = \frac{1}{32}$$

$$\Rightarrow D^{-1} = \frac{1}{\frac{1}{32}} \begin{pmatrix} \frac{1}{4} & -\frac{3}{4} \\ -\frac{1}{8} & \frac{1}{2} \end{pmatrix}$$

$$\Rightarrow D^{-1} = 32 \begin{pmatrix} \frac{1}{4} & -\frac{3}{4} \\ -\frac{1}{8} & \frac{1}{2} \end{pmatrix} \text{ OR } \begin{pmatrix} 8 & -24 \\ -4 & 16 \end{pmatrix}$$

Answer(b)  $\begin{pmatrix} 8 & -24 \\ -4 & 16 \end{pmatrix}$  [3]

- (c) Explain why the matrix  $\begin{pmatrix} 4 & 2 \\ 6 & 3 \end{pmatrix}$  does not have an inverse.

Answer(c) This is because the determinant of the matrix is 0. [1]