Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Time 2 hours

Paper reference **4PM1/02**

Further Pure Mathematics
PAPER 2

Calculators may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You must **NOT** write anything on the formulae page.
  Anything you write on the formulae page will gain NO credit.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

Turn over ▶

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P 6 6 3 0 8 A 0 1 3 6

Pearson

International GCSE in Further Pure Mathematics Formulae sheet

Mensuration

Surface area of sphere = $4\pi r^2$

Curved surface area of cone = $\pi r \times$ slant height

Volume of sphere = $\frac{4}{3}\pi r^3$

Series

Arithmetic series

Sum to n terms, $S_n = \frac{n}{2}[2a + (n-1)d]$

Geometric series

Sum to n terms, $S_n = \frac{a(1-r^n)}{(1-r)}$

Sum to infinity, $S_\infty = \frac{a}{1-r} \quad |r| < 1$

Binomial series

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \ldots + \frac{n(n-1)\ldots(n-r+1)}{r!}x^r + \ldots \quad \text{for} \quad |x| < 1, n \in \mathbb{Q}$$

Calculus

Quotient rule (differentiation)

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{\mathrm{f}(x)}{\mathrm{g}(x)}\right) = \frac{\mathrm{f}'(x)\mathrm{g}(x) - \mathrm{f}(x)\mathrm{g}'(x)}{[\mathrm{g}(x)]^2}$$

Trigonometry

Cosine rule

In triangle ABC: $a^2 = b^2 + c^2 - 2bc\cos A$

$\tan\theta = \frac{\sin\theta}{\cos\theta}$

$\sin(A+B) = \sin A\cos B + \cos A\sin B$ $\quad$ $\sin(A-B) = \sin A\cos B - \cos A\sin B$

$\cos(A+B) = \cos A\cos B - \sin A\sin B$ $\quad$ $\cos(A-B) = \cos A\cos B + \sin A\sin B$

$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A\tan B}$ $\quad$ $\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A\tan B}$

Logarithms

$\log_a x = \frac{\log_b x}{\log_b a}$

Answer all TEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1

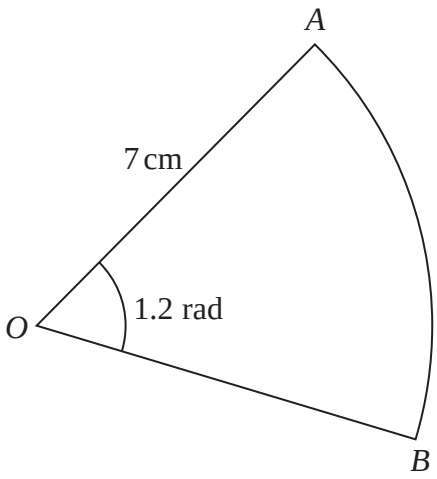

Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows sector *AOB* of a circle with centre *O* and radius 7 cm.

The angle *AOB* is 1.2 radians.

Calculate

(a) the area of sector *AOB*

(2)

(b) the perimeter of sector *AOB*

(2)

(Total for Question 1 is 4 marks)

2 Solve the equation

$$\sin(2\theta - 20)° - \sqrt{3}\cos(2\theta - 20)° = 0 \quad \text{for } 0 \leqslant \theta \leqslant 180$$

(5)

Question 2 continued

(Total for Question 2 is 5 marks)

3 The curve C has equation $y = 9 - x^2$

Use algebraic integration to find the area of the finite region bounded by C and the x-axis.

(5)

Question 3 continued

(Total for Question 3 is 5 marks)

4

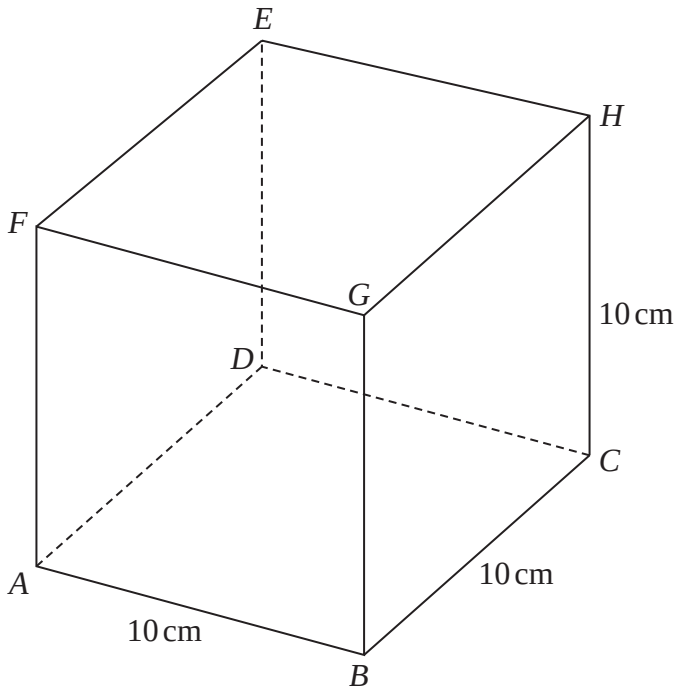

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Figure 2

Figure 2 shows a solid cube *ABCDEFGH* with sides of length 10 cm.

(a) Find, in cm, the exact length of *FC*

(2)

(b) Find, in degrees to one decimal place, the size of $\angle FCA$

(2)

(c) Find, to the nearest degree, the size of the obtuse angle between the plane *BFH* and the plane *BHC*

(5)

Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 9 marks)

5 A particle P is moving along the x-axis. At time t seconds ($t \geqslant 0$) the velocity, v m/s, of P is given by $v = 3t^2 - 23t + 30$

(a) Find the values of t when P is instantaneously at rest.

(3)

At time t seconds the acceleration of P is a m/s^2

(b) Find the range of values of t for which $a > 0$

(2)

When $t = 0$, P is at the point with coordinates $(d, 0)$

Given that, when $t = 8$, P is at the point with coordinates $(26, 0)$

(c) find the value of d

(4)

Question 5 continued

Question 5 continued

Question 5 continued

(Total for Question 5 is 9 marks)

6 The sum of the first n terms of an arithmetic series is S_n where $S_n = n(3 + 2n)$

(a) Find the value of S_{20}

(2)

Given that $S_n = \sum_{r=1}^{n} (Ar + B)$

(b) find the value of A and the value of B

(6)

A different arithmetic series has first term 7 and common difference 4

The sum of the first n terms of this series is T_n

(c) Use algebra to find the value of n for which $T_n = S_n + 252$

(5)

Question 6 continued

Question 6 continued

Question 6 continued

(Total for Question 6 is 13 marks)

7 $f(x) = 2x^2 + px + q$ where p and q are integers

$g(x) = 14x^2 + 37x + 14$

The equation $f(x) = 0$ has roots α and β

The equation $g(x) = 0$ has roots $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$

Given that $p + q = -4$ where $p > 0$ and without solving the equation $g(x) = 0$

(a) find

(i) the value of p

(ii) the value of q

(9)

Given also that $\alpha > \beta$

(b) show that $\alpha^2 - \beta^2 = -\frac{3\sqrt{65}}{4}$

(4)

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Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 13 marks)

8 (a) Given that x is measured in radians, complete the table of values for

$$y = \sin x - 3\cos 2x - 0.5$$

Give your answers to one decimal place.

x	0	0.5	0.8	1	1.6	2	2.5	3
y			0.3	1.6			–0.8	–3.2

(2)

(b) On the grid opposite, draw the graph of $y = \sin x - 3\cos 2x - 0.5$ for $0 \leqslant x \leqslant 3$

(2)

(c) Use a formula from page 2 to show that $\cos 2A = 1 - 2\sin^2 A$

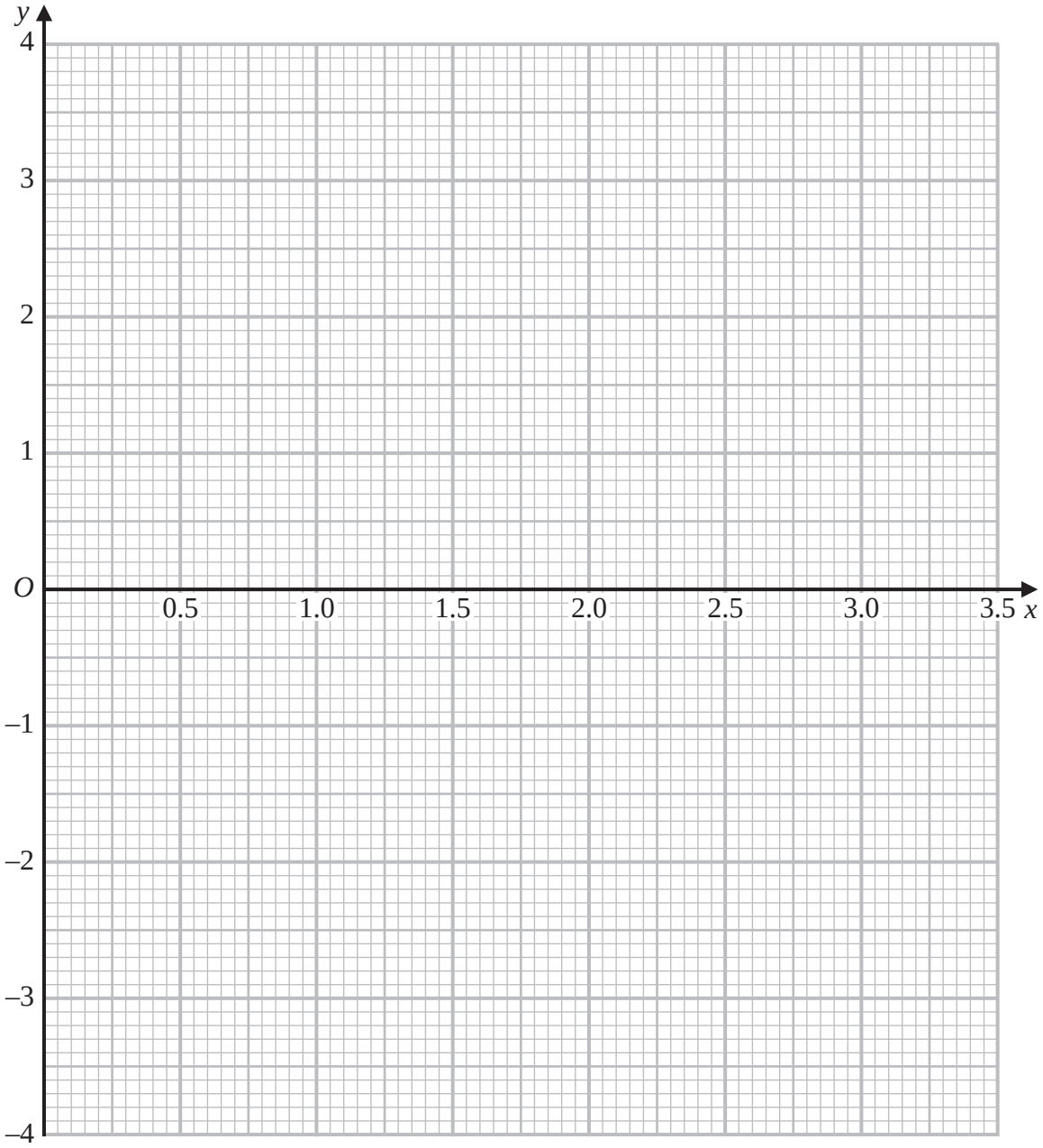
(2)

$$f(x) = 2\sin x + 12\sin^2 x - x - 5$$

(d) By drawing a suitable straight line on the grid, obtain estimates, to one decimal place, of the roots of the equation $f(x) = 0$ in the interval $0 \leqslant x \leqslant 3$

(5)

Question 8 continued

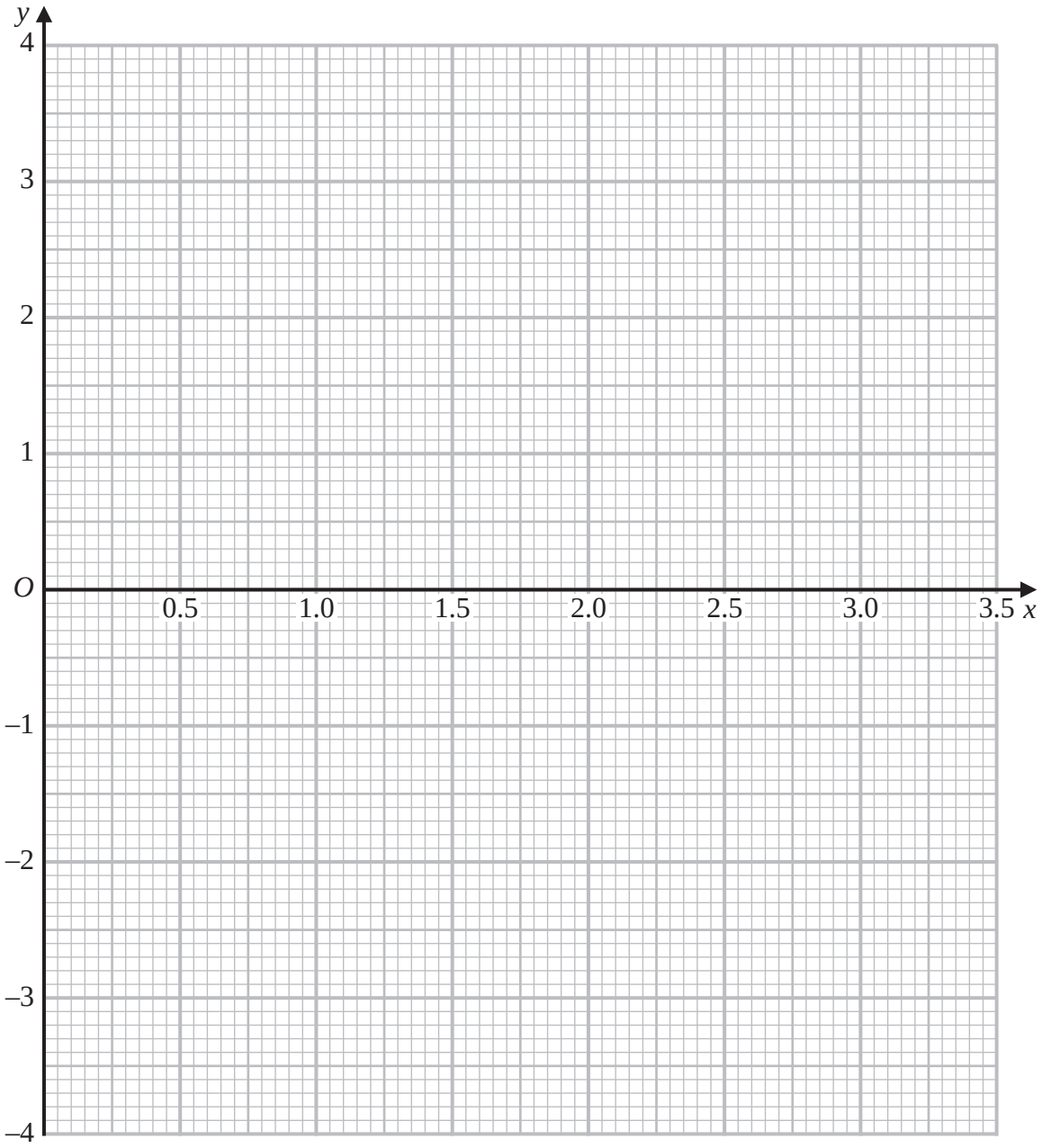


Turn over for a spare grid if you need to redraw your graph.

Question 8 continued

Question 8 continued

Only use this grid if you need to redraw your graph.



(Total for Question 8 is 11 marks)

9

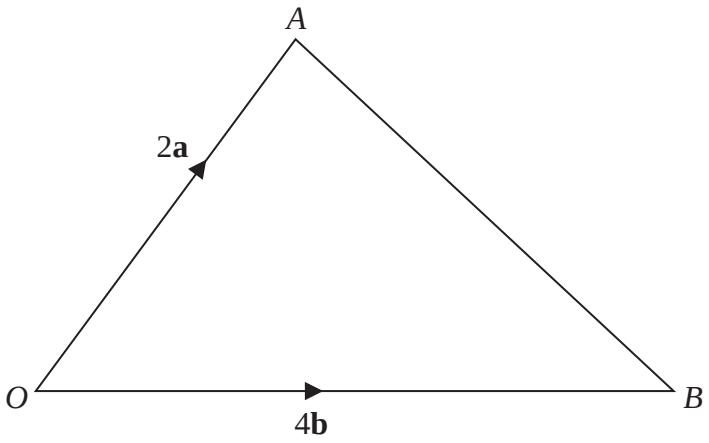


Diagram **NOT** accurately drawn

Figure 3

Figure 3 shows the triangle OAB with

$$\overrightarrow{OA} = 2\mathbf{a} \text{ and } \overrightarrow{OB} = 4\mathbf{b}$$

(a) Find $\overrightarrow{AB}$ in terms of **a** and **b**

(2)

The point P is the midpoint of AB

(b) Find $\overrightarrow{OP}$ as a simplified expression in terms of **a** and **b**

(2)

The point Q lies on OP such that $OQ : QP = 3 : 1$

(c) Find $\overrightarrow{AQ}$ as a simplified expression in terms of **a** and **b**

(3)

The point R lies on OB such that AQR is a straight line.

(d) Find in its simplest form the ratio $OR : RB$

(6)

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Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 13 marks)

10 The curve C has equation $y = \dfrac{2x-1}{x+4}$ $\quad x \neq -4$

(a) Write down an equation of the asymptote to C that is

(i) parallel to the x-axis,

(ii) parallel to the y-axis.

(2)

(b) Find the coordinates of the points of intersection of C with the coordinate axes.

(2)

(c) Using the axes on the opposite page, sketch C, showing clearly the asymptotes and the coordinates of the points of intersection of C with the coordinate axes.

(3)

The line with equation $y = x + k_1$ is the tangent to C at the point P

The line with equation $y = x + k_2$ is the tangent to C at the point Q

Given that the x coordinate of P is greater than the x coordinate of Q

(d) using calculus, find the coordinates of

(i) P

(ii) Q

(8)

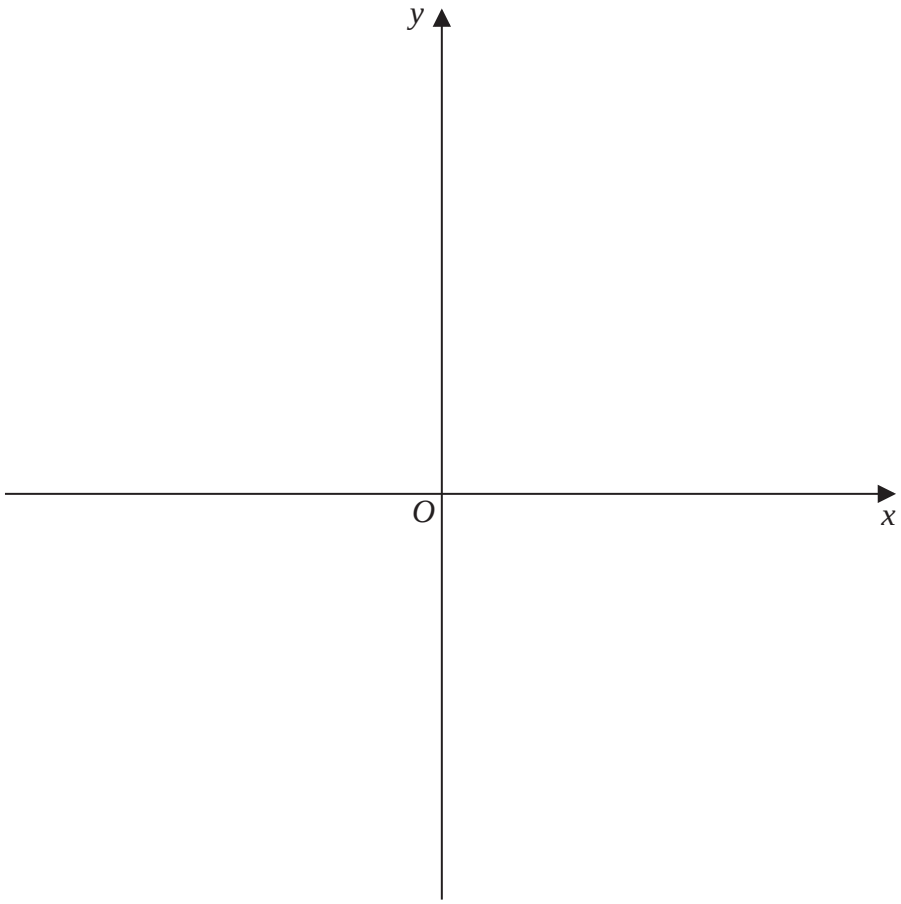
(e) Hence find the value of

(i) k_1

(ii) k_2

(3)

Question 10 continued

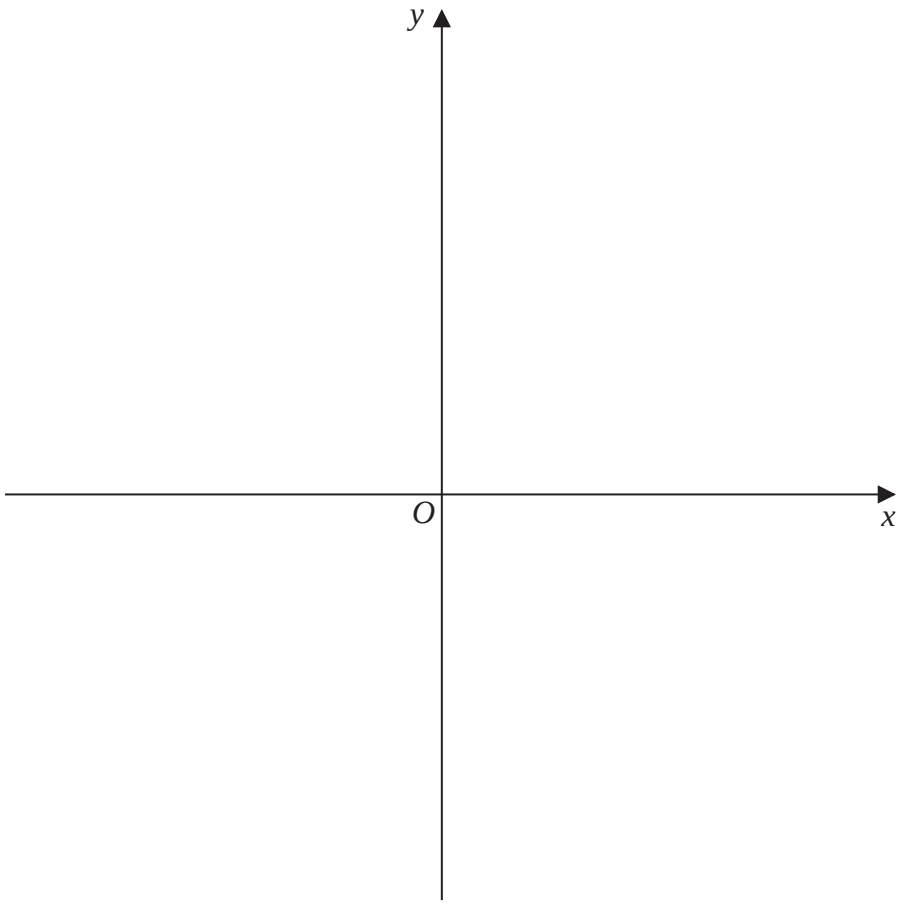


Turn over for spare axes if you need to redraw your sketch.

Question 10 continued

Question 10 continued

Only use these axes if you need to redraw your sketch.



Question 10 continued

(Total for Question 10 is 18 marks)

TOTAL FOR PAPER IS 100 MARKS