

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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Pearson

International GCSE in Further Pure Mathematics Formulae sheet

Mensuration**Surface area of sphere** $= 4\pi r^2$ **Curved surface area of cone** $= \pi r \times \text{slant height}$ **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** $(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots \quad \text{for } |x| < 1, n \in \mathbb{Q}$ **Calculus****Quotient rule (differentiation)**

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

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

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

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

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

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

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

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

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

Logarithms

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

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Answer all TEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1

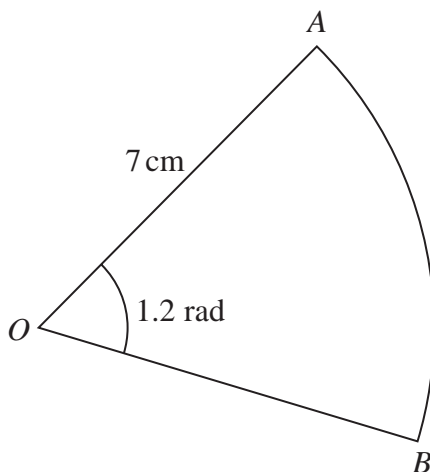


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accurately drawn

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

$$\sin(2\theta - 20)^\circ - \sqrt{3} \cos(2\theta - 20)^\circ = 0 \quad \text{for } 0 \leq \theta \leq 180 \quad (5)$$

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Question 2 continued

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(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)

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Question 3 continued

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(Total for Question 3 is 5 marks)



4

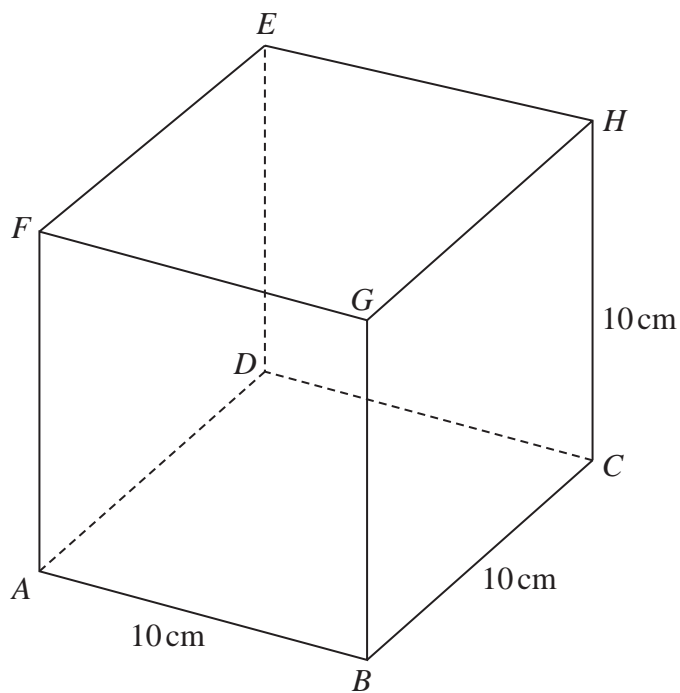
Diagram **NOT**
accurately drawn**Figure 2**

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

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Question 4 continued

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Question 4 continued

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(Total for Question 4 is 9 marks)



- 5 A particle P is moving along the x -axis. At time t seconds ($t \geq 0$) 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/s²

(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)

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Question 5 continued

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Question 5 continued

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Question 5 continued

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(Total for Question 5 is 9 marks)



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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)

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Question 6 continued

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Question 6 continued

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Question 6 continued

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(Total for Question 6 is 13 marks)



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7

$$f(x) = 2x^2 + px + q \quad \text{where } p \text{ and } q \text{ are integers}$$

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

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

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Question 7 continued

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Question 7 continued

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(Total for Question 7 is 13 marks)

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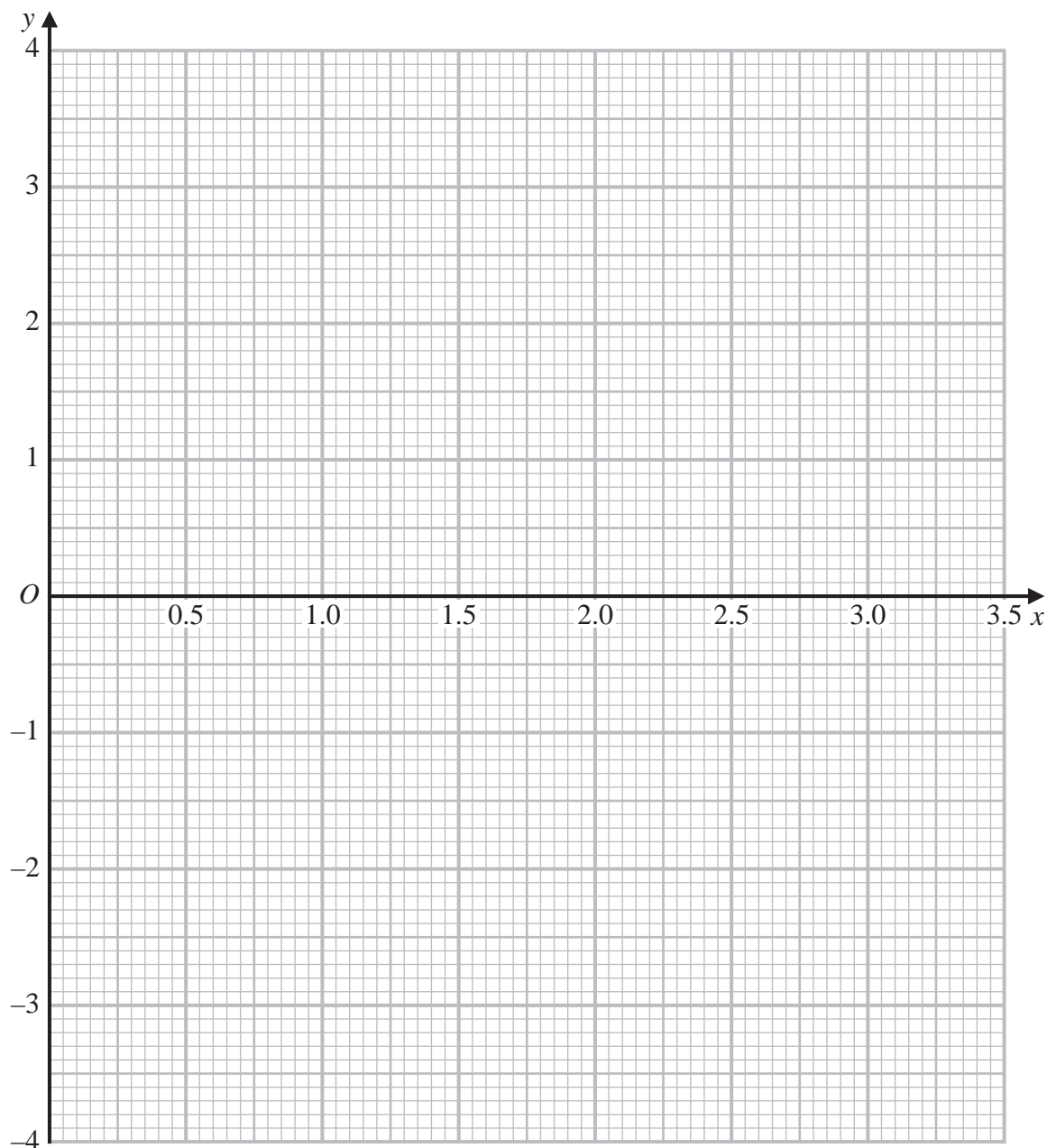
x	0	0.5	0.8	1	1.6	2	2.5	3
y			0.3	1.6			-0.8	-3.2

(2)

- (2)

(5)

Question 8 continued



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



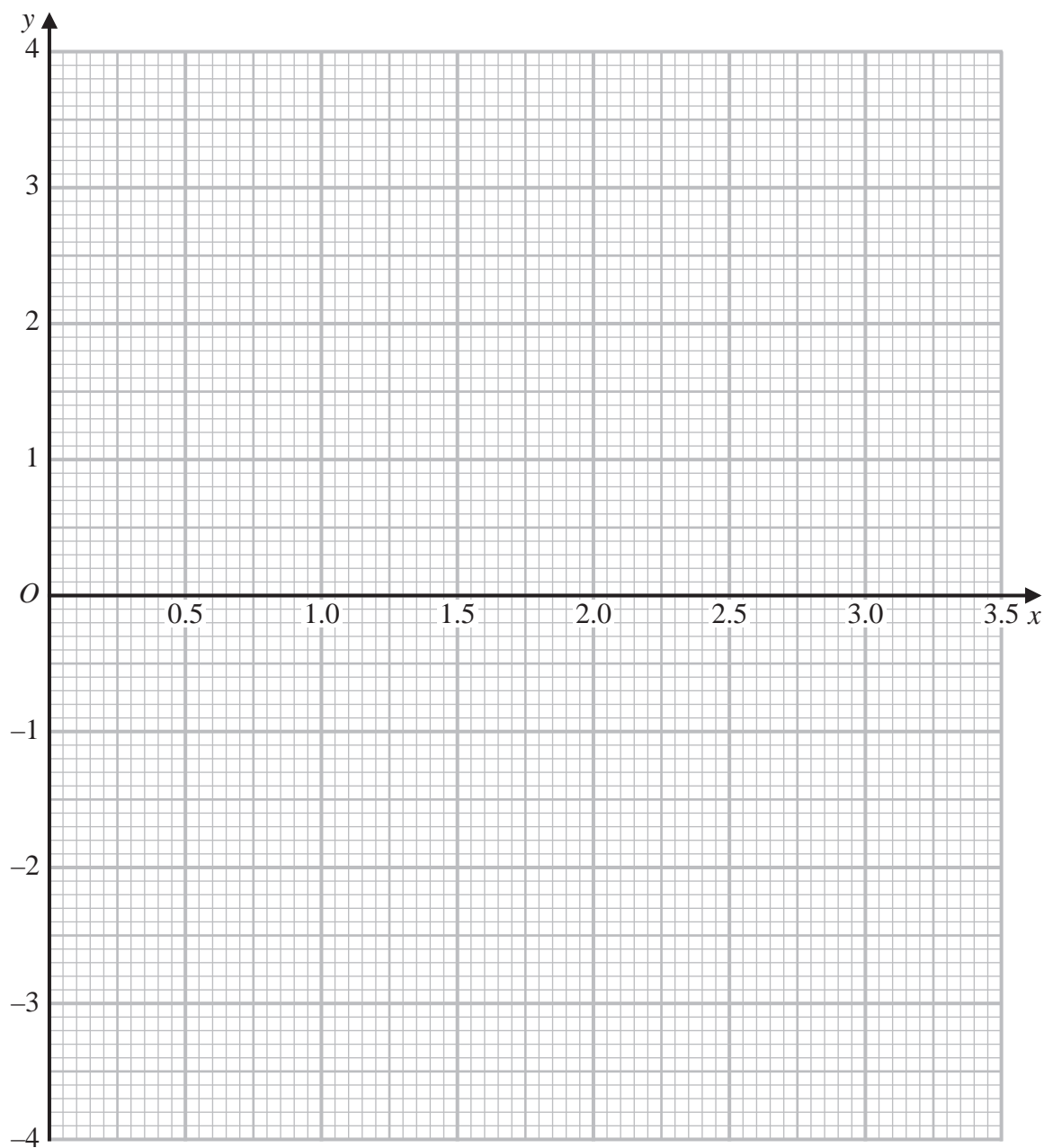
Question 8 continued

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Question 8 continued**Only use this grid if you need to redraw your graph.****(Total for Question 8 is 11 marks)**

9

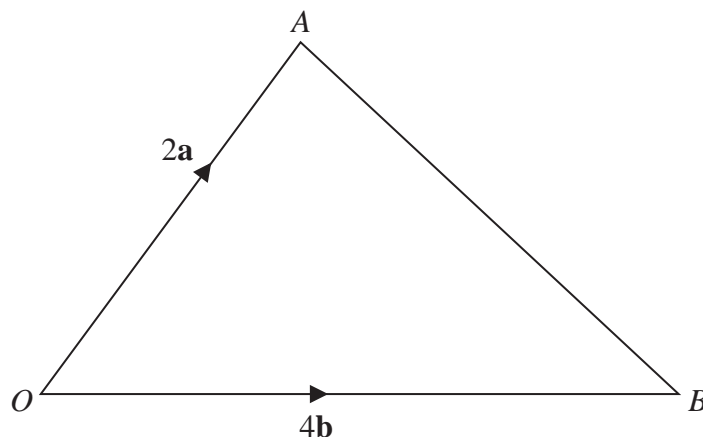
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accurately drawn

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
- \mathbf{a}
- and
- \mathbf{b}

(2)

The point P is the midpoint of AB

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

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Question 9 continued

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Question 9 continued

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(Total for Question 9 is 13 marks)



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

(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

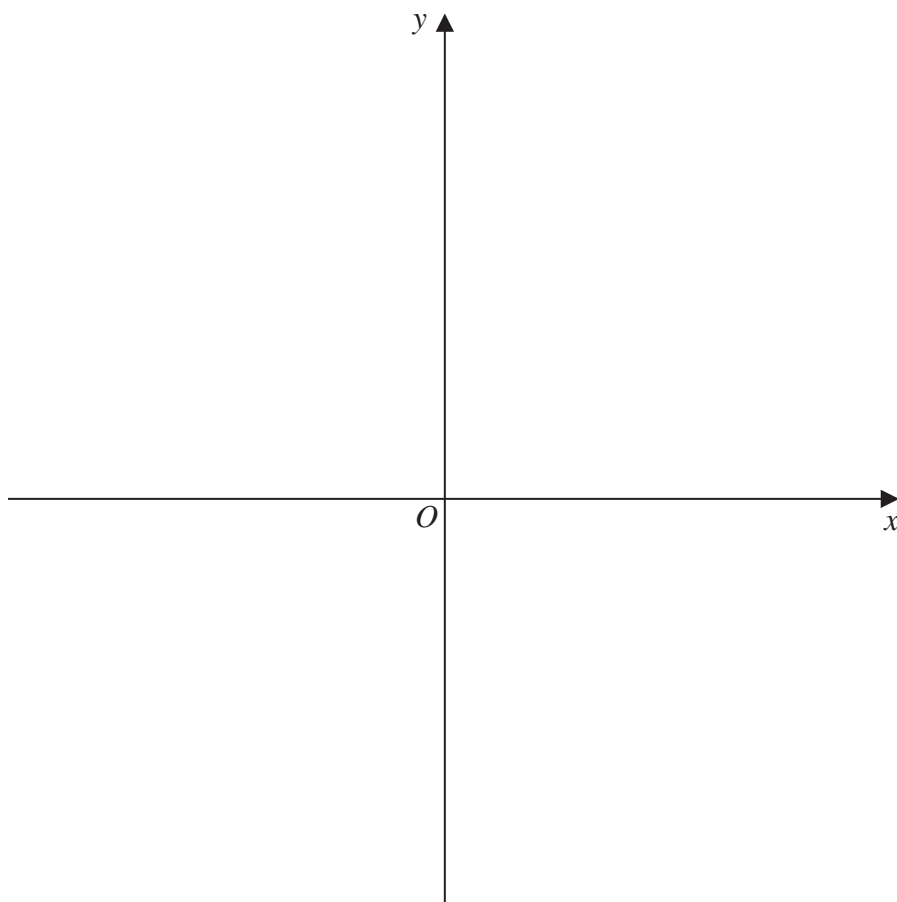
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Question 10 continued

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



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Question 10 continued

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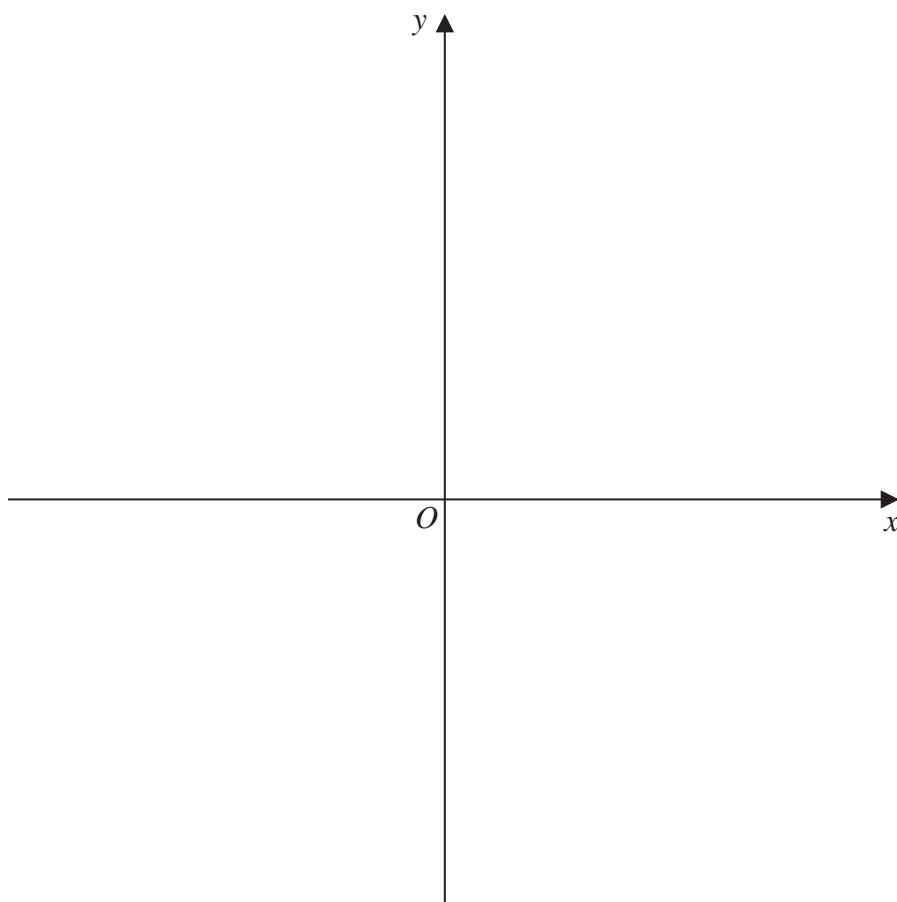
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Question 10 continued

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



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(Total for Question 10 is 18 marks)**TOTAL FOR PAPER IS 100 MARKS**