Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number | Candidate Number

Friday 10 January 2020

Morning (Time: 2 hours) | Paper Reference **4PM1/01R**

Further Pure Mathematics

Paper 1R

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 0 4 7 5 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 ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Given that $\frac{a+\sqrt{3}}{2-\sqrt{3}} = 11 + b\sqrt{3}$ where a and b are integers,

find the value of a and the value of b.

(4)

(Total for Question 1 is 4 marks)

2 $f(x) = 7 + 4x - x^2$

(a) Write $f(x)$ in the form $a - b(x + c)^2$ where a, b and c are integers to be found.

(3)

(b) Hence, or otherwise, find

(i) the maximum value of $f(x)$

(ii) the value of x for which this maximum occurs.

(2)

Question 2 continued

(Total for Question 2 is 5 marks)

3 Given that $y = e^{2x}(x^2 + 1)$

(a) find $\frac{dy}{dx}$

(3)

The straight line l is the tangent to the curve with equation $y = e^{2x}(x^2 + 1)$ at the point on the curve where $x = 0$

(b) Find an equation for l in the form $y = mx + c$

(3)

Question 3 continued

(Total for Question 3 is 6 marks)

4 $f(x) = 2x^3 + ax^2 + bx + 18$ where a and b are constants

When $f'(x)$ is divided by $(x - 2)$ the remainder is 5

Given that $(x - 2)$ is a factor of $f(x)$

(a) find the value of a and the value of b.

(6)

(b) Express $f(x)$ as a product of linear factors.

(3)

(c) Hence use algebra to solve the equation $f(x) = 0$

(2)

Question 4 continued

(Total for Question 4 is 11 marks)

5 (a) Show that $\log_4 32 = \frac{5}{2}$

(2)

(b) Hence, or otherwise, find the exact solutions of the equation

$$\log_2 x - \log_4 32 + \frac{1}{4} \log_x 16 = 0$$

(7)

Question 5 continued

(Total for Question 5 is 9 marks)

6 (a) Complete the table of values for

$$y = x - \frac{3}{x^2}$$

giving your answers to one decimal place where appropriate.

x	0.5	1	1.5	2	3	4	5	6
y	–11.5			1.3	2.7			5.9

(2)

(b) On the grid opposite, draw the graph of $y = x - \frac{3}{x^2}$ for $0.5 \leqslant x \leqslant 6$

(2)

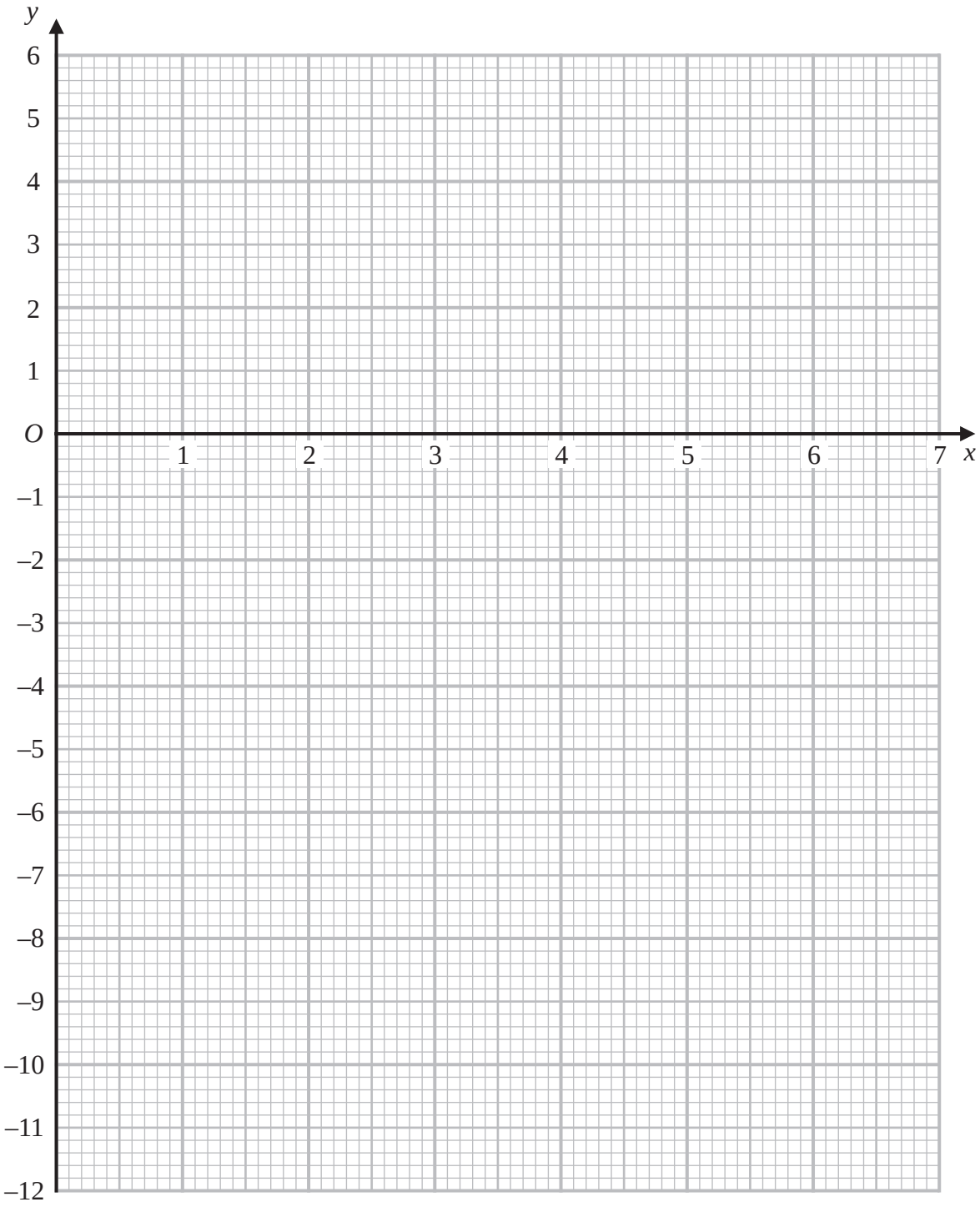
(c) By drawing a suitable straight line on the grid, obtain estimates, to one decimal place, of each of the two roots of the equation

$$2x^3 - 6x^2 + 3 = 0$$

in the interval $0.5 \leqslant x \leqslant 6$

(5)

Question 6 continued

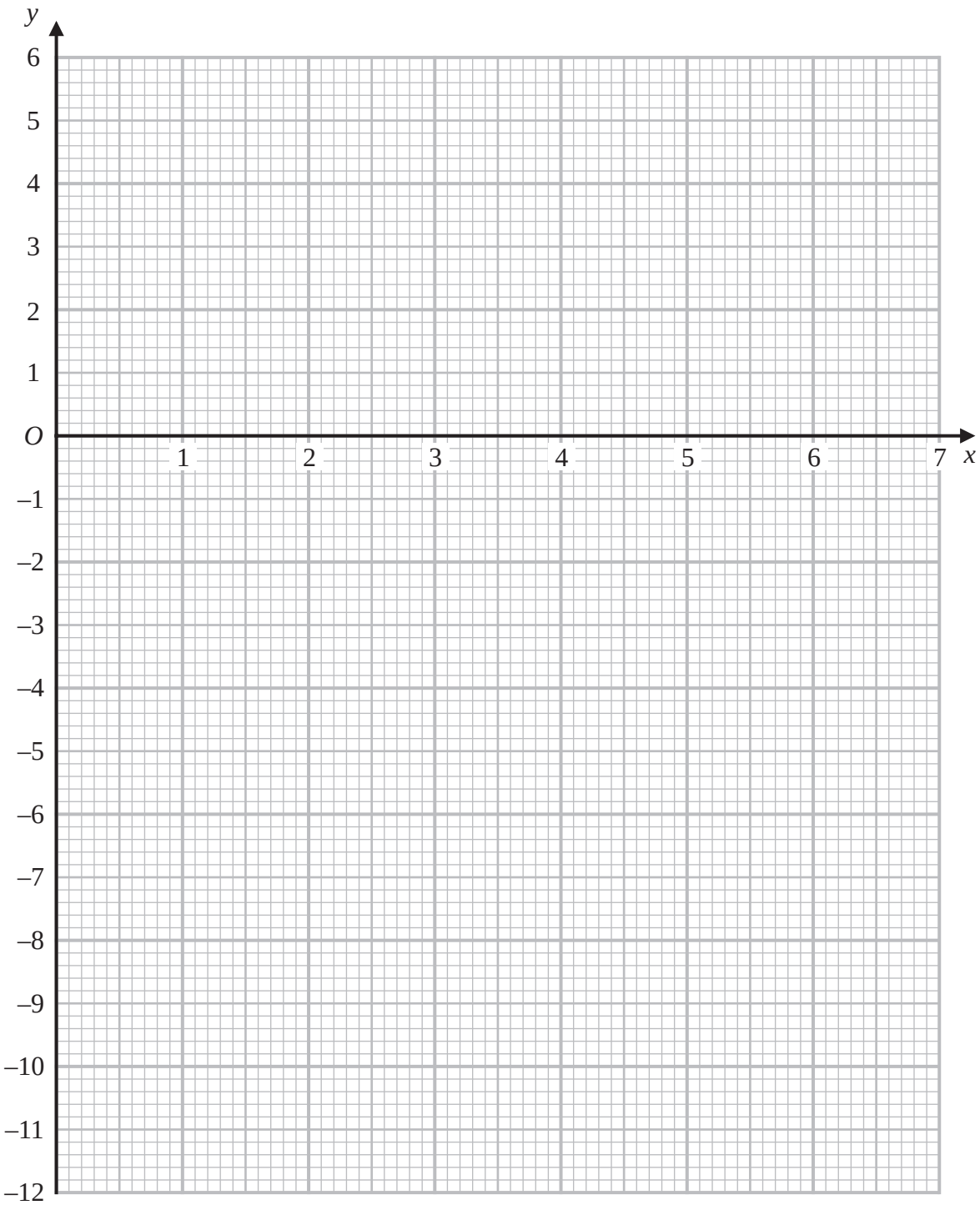


Turn over for a spare grid if you need to redraw your graph.

Question 6 continued

Question 6 continued

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



(Total for Question 6 is 9 marks)

7 An arithmetic series P has first term a, common difference d and nth term u_n

Given that $u_5 = 4x + 6$ and that $u_8 = 7x + 3$

(a) (i) show that $d = x - 1$

(ii) find the value of a

(4)

Given further that $u_9 = 42$

(b) find the value of x

(2)

The sum of the first n terms of P is S_n

(c) Find the value of n for which $S_{(n+1)} = 12u_n + 18$

(5)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 11 marks)

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

At time t seconds, P is at the point with coordinates $(x, 0)$.

Given that at time $t = 0$, P is at the point with coordinates $(5, 0)$, find the maximum value of x, justifying that this is a maximum value.

(8)

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 8 marks)

9 The line l_1 with equation $y + 2x - 4 = 0$ passes through the point P with coordinates $(a, 6)$ and the point Q with coordinates $(3, b)$.

(a) Find the value of a and the value of b.

(2)

The line l_2 passes through point P and is perpendicular to l_1

The point R, with coordinates (e, f) lies on l_2 such that $PR = 6\sqrt{5}$

(b) Find the two possible pairs of values of e and f.

(8)

Given that $e < 0$,

(c) find the area of triangle PQR.

(3)

The points P, Q and R lie on a circle C.

(d) Find the coordinates of the centre of C.

(2)

Question 9 continued

Question 9 continued

Question 9 continued

(Total for Question 9 is 15 marks)

10

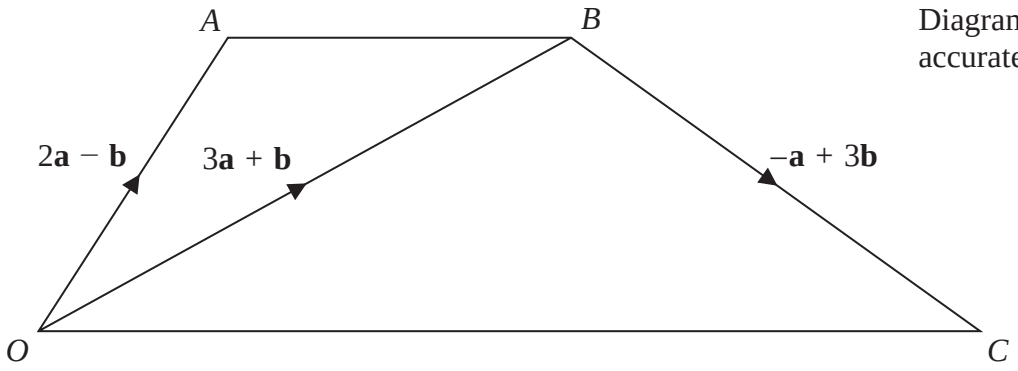


Diagram **NOT** accurately drawn

Figure 1

Figure 1 shows quadrilateral $OABC$ with

$$\overrightarrow{OA} = 2\mathbf{a} - \mathbf{b} \qquad \overrightarrow{OB} = 3\mathbf{a} + \mathbf{b} \qquad \overrightarrow{BC} = -\mathbf{a} + 3\mathbf{b}$$

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

(2)

(b) Prove that $\overrightarrow{OC}$ is parallel to $\overrightarrow{AB}$

(2)

The diagonals, OB and AC, intersect at the point X.

(c) Using a vector method find the ratio $AX : XC$

(7)

Question 10 continued

Question 10 continued

Question 10 continued

(Total for Question 10 is 11 marks)

11

Diagram **NOT** accurately drawn

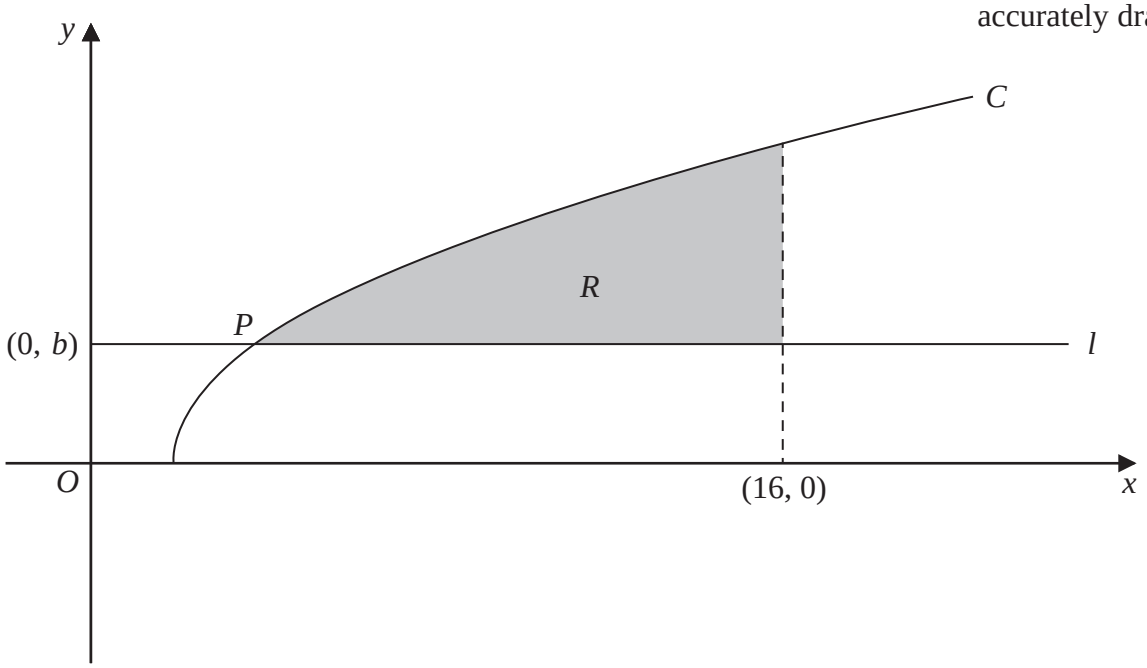


Figure 2

Figure 2 shows part of the curve C with equation $y = \sqrt{x - 2}$
Figure 2 also shows the straight line l with equation $y = b$ for $x > 0$ where $b > 0$

Given that C and l intersect at the point P with coordinates (a, b), where $2 < a < 16$

(a) show that $b^2 = a - 2$

(2)

The finite region R bounded by C, the straight line with equation $x = 16$ and l, shown shaded in Figure 2, is rotated through 360° about the x-axis to form a solid S.

Given that the volume of the solid formed is 50π

(b) use algebraic integration to find the value of a and the value of b.

(9)

Question 11 continued

Question 11 continued

Question 11 continued

Question 11 continued

(Total for Question 11 is 11 marks)

TOTAL FOR PAPER IS 100 MARKS