www.dynamicpapers.com

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 **4PM1/01**

Further Pure Mathematics
PAPER 1



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 ▶

P66310A

©2022 Pearson Education Ltd.

L:1/1/1/

P 6 6 3 1 0 A 0 1 3 6

Pearson

www.dynamicpapers.com

International GCSE in Further Pure Mathematics Formulae shee

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

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

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

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

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

Logarithms

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

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Answer all ELEVEN questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Using calculus find the exact value of $\int_{\frac{\pi}{4}}^{\frac{\pi}{3}} \cos 4\theta \, \mathrm{d}\theta$

Give your answer in the form $-\frac{\sqrt{a}}{b}$ where a is a prime number and b is an integer.

(4)

(Total for Question 1 is 4 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

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

Given that $f(x)$ can be written in the form $f(x) = a(x + b)^2 + c$ where a, b and c are integers,

(a) find the value of a, the value of b and the value of c

(3)

(b) Hence find the set of values of x for which $f(x) - 37 > 0$

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 2 continued

(Total for Question 2 is 7 marks)

www.dynamicpapers.com

3 A geometric series G has first term a and common ratio r

The 2nd term of G is $\frac{5}{16}$ and the 5th term of G is $\frac{135}{1024}$

(a) Find

(i) the value of r

(ii) the value of a

(5)

Given that G is convergent with sum to infinity S

(b) find the exact value of S

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 3 continued

(Total for Question 3 is 7 marks)

www.dynamicpapers.com

4 (a) On the grid opposite, draw the line with equation

(i) $y = 2x - 4$ (ii) $2x + 3y = 12$ (iii) $y + 2x + 2 = 0$

(

(b) Show, by shading on the grid, the region R defined by the inequalities

$y \geqslant 2x - 4$ $2x + 3y \leqslant 12$ $y + 2x + 2 \geqslant 0$

(1)

For all points in R, with coordinates (x, y)

$$P = x - 2y$$

(c) find the least value of P

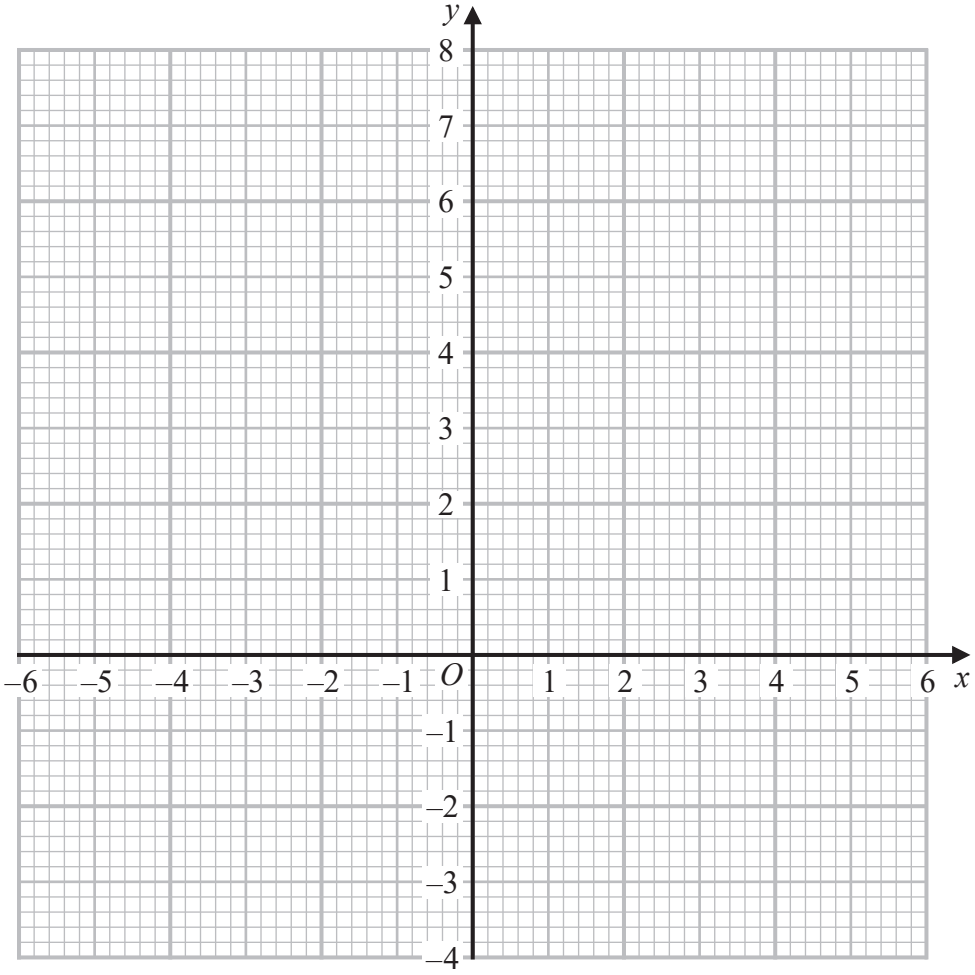
(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 4 continued



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

www.dynamicpapers.com

Question 4 continued

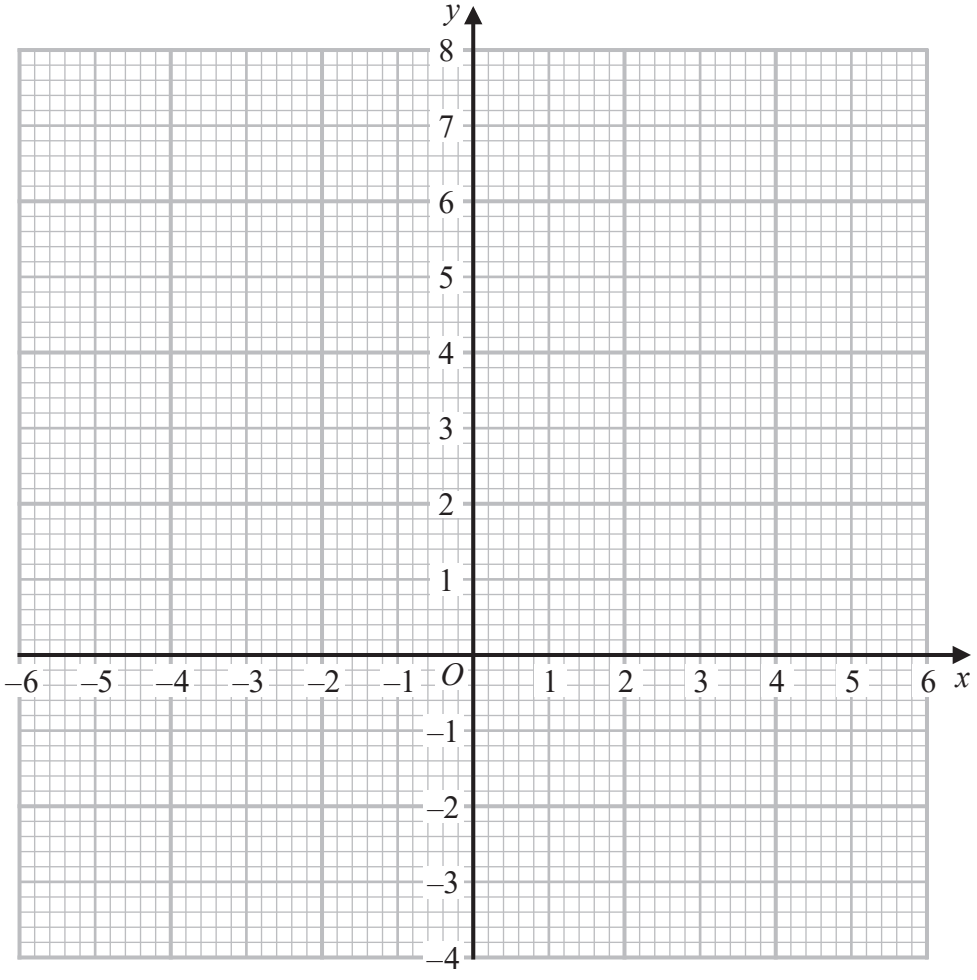
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 4 continued

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



(Total for Question 4 is 8 marks)

www.dynamicpapers.com

5 $f(x) = ax^3 + 5bx^2 + 8ax - 4b$ where a and b are integers

Given that

$(x + 2)$ is a factor of $f(x)$

and that

when $f(x)$ is divided by $(x + 3)$ the remainder is 21

(a) show that $a = 2$ and find the value of b

(5)

(b) Use algebra to solve the equation $f(x) = 0$

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 5 continued

(Total for Question 5 is 9 marks)

www.dynamicpapers.com

6 In triangle ABC, $AC = x$ cm, $AB = (x + 3)$ cm and $\angle ABC = 30°$

Given that $\angle ACB = \theta°$ where $0 < \theta < 90$

(a) show that

(i) $\sin\theta° = \dfrac{x + 3}{2x}$

(ii) $\cos\theta° = \dfrac{\sqrt{3x^2 - 6x - 9}}{2x}$

(5)

Given that the size of $\angle BAC$: the size of $\angle ABC = 7 : 2$

(b) find the exact value of x

Give your answer in the form $a + a\sqrt{b}$ where a and b are prime numbers.

(5)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 6 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 6 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 6 continued

(Total for Question 6 is 10 marks)

www.dynamicpapers.com

7 (a) Write down the value of $\log_2 16$

1)

Given that $4 + 2\log_4 x = \log_2 y$

(b) show that $y = 16x$

(4)

(c) Hence solve the equation $4 + 2\log_4 x = \log_2(4x + 5)$

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 7 continued

(Total for Question 7 is 8 marks)

www.dynamicpapers.com

8

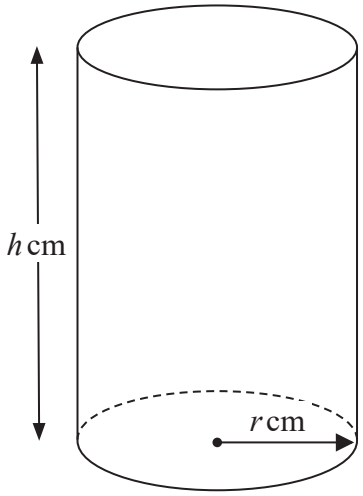


Diagram **NOT** accurately drawn

Figure 1

A solid right circular cylinder has base radius r cm and height h cm as shown in Figure 1.

The cylinder has a volume of $90\pi\,\text{cm}^3$ and a total surface area of $S\,\text{cm}^2$

(a) Show that $S = 2\pi r^2 + \dfrac{180\pi}{r}$

(3)

Given that r can vary,

(b) use calculus to find, to 3 significant figures, the value of r for which S is a minimum, justifying that this value of r gives a minimum value of S

(5)

(c) Find, to 3 significant figures, the minimum value of S

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 8 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 8 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 8 continued

(Total for Question 8 is 10 marks)

www.dynamicpapers.com

9 (a) Expand $\frac{1}{\sqrt{1-2x}}$ in ascending powers of x up to and including the term in x^3

Simplify each term as far as possible.

(3)

(b) Show that $\frac{1}{\sqrt{0.96}} = \frac{5\sqrt{6}}{12}$

Show all your working clearly.

(2)

(c) Express $\frac{1}{5\sqrt{6}-12}$ in the form $\frac{a\sqrt{6}}{c} + b$ where a, b and c are integers.

Show all your working clearly.

(2)

Using the expansion you found in part (a) with a suitable value of x

(d) find an estimate, to 5 decimal places, of $\frac{9}{5\sqrt{6}-12}$

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 9 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 9 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 9 continued

(Total for Question 9 is 11 marks)

www.dynamicpapers.com

10 The equation of the line L_1 is $y - 2x - 6 = 0$

The point P with coordinates $(2, a)$ lies on L_1

(a) Find the value of a

(1)

The line L_2 is perpendicular to L_1 and passes through P

(b) Show that an equation of L_2 is $x + 2y - 22 = 0$

(4)

Line L_1 crosses the x-axis at the point A and line L_2 crosses the x-axis at the point B

The point C has coordinates (m, n) such that $m > 0$ and $n < 0$

The length of AC is $5\sqrt{2}$ and the gradient of BC is $\frac{1}{4}$

(c) Find the value of m and the value of n

(9)

(d) Find the area of quadrilateral $ACBP$

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 10 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

Question 10 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 10 continued

(Total for Question 10 is 17 marks)

www.dynamicpapers.com

11 Given that

$$y = \frac{e^{4x}}{32}(8x^2 - 4x + 1)$$

(a) show that $\frac{dy}{dx} = x^2e^{4x}$

(5)

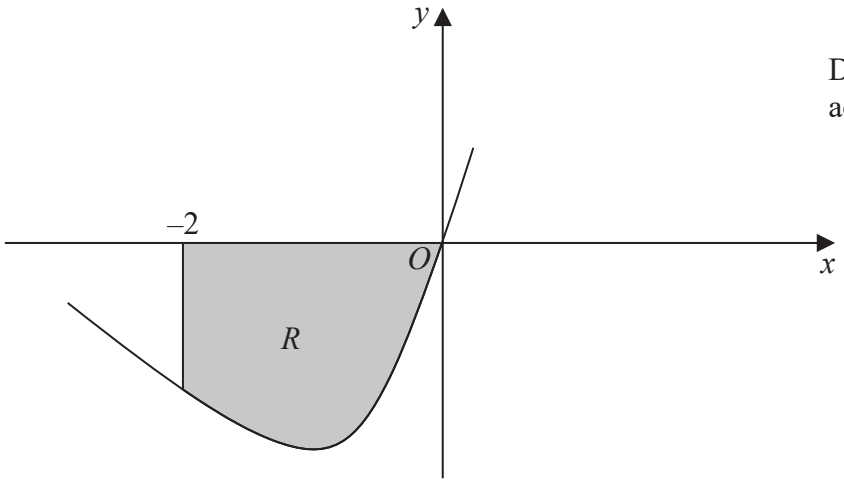


Diagram **NOT** accurately drawn

Figure 2

Figure 2 shows part of the curve C with equation $y = 3xe^{2x}$

The finite region R bounded by C, the straight line with equation $x = -2$ and the x-axis, shown shaded in Figure 2, is rotated though 360° about the x-axis.

(b) Using part (a), find the volume, to 2 significant figures, of the solid formed.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 11 continued

www.dynamicpapers.com

Question 11 continued

(Total for Question 11 is 9 marks)

TOTAL FOR PAPER IS 100 MARKS

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

www.dynamicpapers.com

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE