Pleasechecktheexaminationdetailsbelowbeforeenteringyourcandidateinformation

| Candidatesurname | Othernames |
|---|---|
| | |

Centre Number | Candidate Number

# Pearson Edexcel International GCSE

**Time** 2 hours

**Paper reference** **4PM1/01R**

# Further Pure Mathematics
## PAPER 1R

**Calculators may be used.**

TotalMarks

## 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* ▶

P71818A



J:1/1/1/

P 7 1 8 1 8 A 0 1 2 8

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** Given that $\dfrac{a-\sqrt{48}}{\sqrt{3}+1}$ can be written in the form $b\sqrt{3}-9$ where $a$ and $b$ are integers,

find the value of $a$ and the value of $b$
Show your working clearly.

**(4)**

**(Total for Question 1 is 4 marks)**

**2** In $\Delta ABC$,

$$\angle BAC = 50° \qquad AB = 10\,\text{cm} \qquad BC = 9\,\text{cm}$$

Given that $\angle BCA = x°$

find the two possible values, to one decimal place, of $x$

**(3)**

**Question 2 continued**

**(Total for Question 2 is 3 marks)**

**3** An arithmetic series has first term 16 and common difference –5

The sum to $n$ terms of this series is $S_n$

Given that $S_n < -450$

find the least value of $n$

**(4)**

**Question 3 continued**

**(Total for Question 3 is 4 marks)**

**4** $O$, $A$ and $B$ are fixed points such that

$$\overrightarrow{OA} = p\mathbf{i} + 2p\mathbf{j} \qquad \overrightarrow{OB} = 5\mathbf{i} + 9p\mathbf{j}$$

Given that $\overrightarrow{AB}$ is parallel to $(\mathbf{i} - 2\mathbf{j})$

(a) find the value of $p$

**(6)**

(b) Hence find $\overrightarrow{AB}$ as a simplified expression in terms of $\mathbf{i}$ and $\mathbf{j}$

**(2)**

(c) Find a unit vector parallel to $\overrightarrow{OA}$

Give your answer in the form $\frac{\sqrt{a}}{5}(b\mathbf{i} + c\mathbf{j})$ where $a$, $b$ and $c$ are integers to be found.

**(4)**

**Question 4 continued**

**(Total for Question 4 is 12 marks)**

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

Given that $(x + 2)$ and $(x - 1)$ are both factors of $f(x)$

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

**(5)**

(b) Hence factorise $f(x)$ completely.

**(2)**

Hence, given that $h(y) = 2^{(3y + 2)} + 2^{2y} - 11(2^y) + 6$

(c) solve the equation $h(y) = 0$

Where appropriate give your answers to 3 decimal places.

**(5)**

**Question 5 continued**

**(Total for Question 5 is 12 marks)**

**6** The curve $C$ has equation $y = \dfrac{e^{(x^2+1)}}{x^2+1}$

(a) Show that $\dfrac{dy}{dx} = \dfrac{Kx^3e^{(x^2+1)}}{(x^2+1)^2}$ where $K$ is a constant whose value is to be found.

**(5)**

(b) Find an equation of the tangent to $C$ at the point on $C$ where $x = -1$
Simplify your answer.

**(5)**

**Question 6 continued**

**(Total for Question 6 is 10 marks)**

**7** A particle $P$ is moving along the $x$-axis. At time $t$ seconds $(t \geqslant 0)$ the velocity of $P$ is $v$ m/s where

$$v = t^2 - 10t + 28$$

(a) Find the velocity of $P$ when $t = 1$

**(1)**

Given that the distance of $P$ from the origin is 24 m when $t = 3$

(b) find the distance of $P$ from the origin when $t = 5$

**(5)**

(c) Find the acceleration of $P$ when $t = 9$

**(2)**

(d) (i) Show that there are no values of $t$ for which $P$ is instantaneously at rest.

(ii) Find the least magnitude of the velocity of $P$

**(3)**

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

**Question 7 continued**

**Question 7 continued**

**Question 7 continued**

**(Total for Question 7 is 11 marks)**

**8**

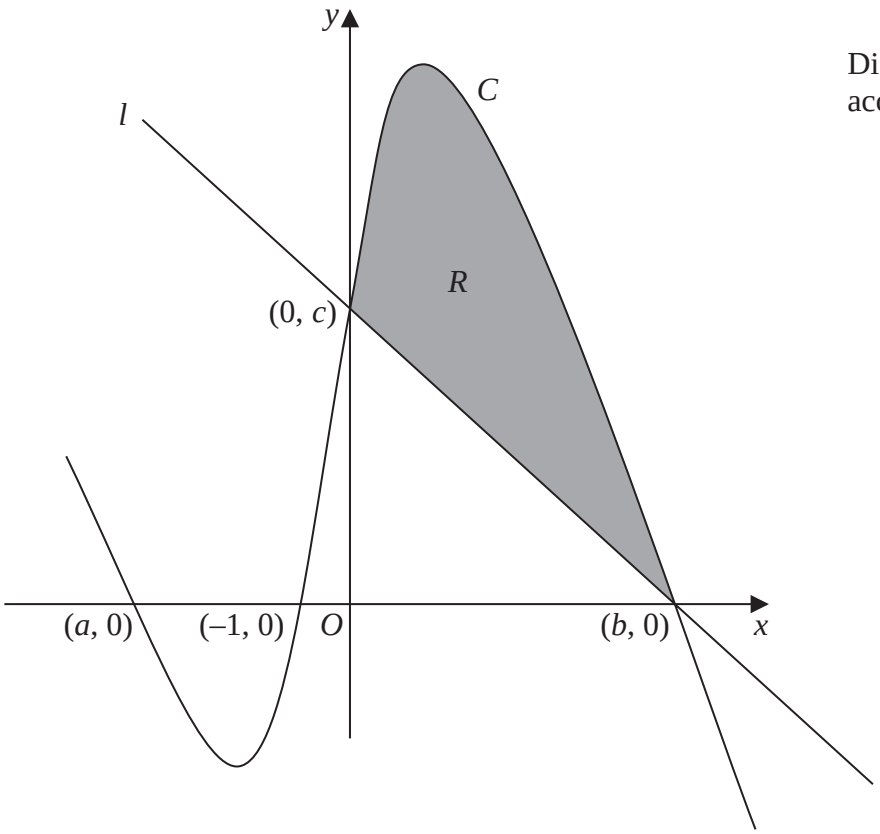


Diagram **NOT** accurately drawn

**Figure 1**

Figure 1 shows part of the curve $C$ with equation $y = f(x)$

The curve $C$ passes through the points with coordinates

$$(a, 0), (-1, 0), (b, 0) \text{ and } (0, c)$$

Given that $f'(x) = 17 + 2x - 3x^2$

(a) show that the equation of $C$ is $y = 15 + 17x + x^2 - x^3$

**(4)**

(b) Find the value of $a$, the value of $b$ and the value of $c$

**(6)**

The straight line $l$ intersects $C$ at the points with coordinates $(b, 0)$ and $(0, c)$

The region $R$, shown shaded in Figure 1, is bounded by $l$ and $C$

(c) Use algebraic integration to find the exact area of region $R$

**(5)**

**Question 8 continued**

**Question 8 continued**

**Question 8 continued**

**(Total for Question 8 is 15 marks)**

**9**

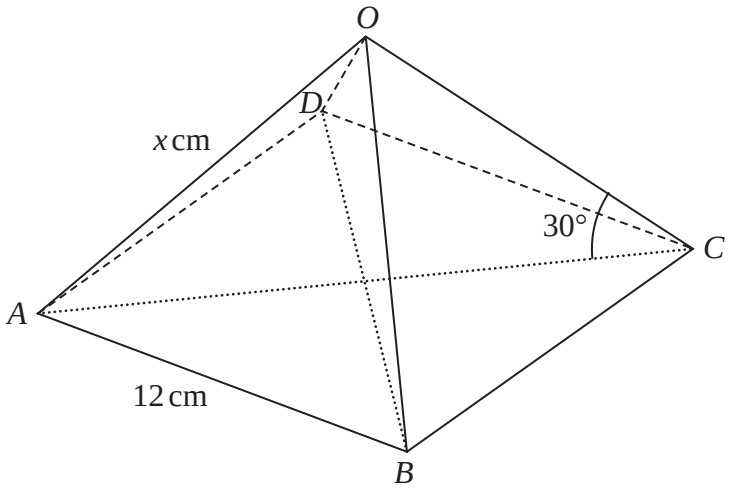


Diagram **NOT** accurately drawn

**Figure 2**

Figure 2 shows the right pyramid $OABCD$ with a square base $ABCD$ of side 12 cm.

$$OA = OB = OC = OD = x \text{ cm} \quad \text{and} \quad \angle OAC = \angle ODB = \angle OCA = \angle OBD = 30°$$

(a) Find the exact length of $AC$

**(2)**

(b) Show that $x = 4\sqrt{6}$

**(2)**

(c) Find the total surface area, to the nearest $\text{cm}^2$, of the pyramid.

**(5)**

(d) Find the size of the obtuse angle, to the nearest degree, between the plane $OAB$ and the plane $OBC$

**(4)**

**Question 9 continued**

**Question 9 continued**

**Question 9 continued**

**(Total for Question 9 is 13 marks)**

**10** Using formulae from page 2

(a) show that $\cos(A - B) - \cos(A + B) = 2\sin A \sin B$

**(2)**

(b) Hence show that $\cos 5\theta - \cos 9\theta = 2\sin 7\theta \sin 2\theta$

**(1)**

(c) Solve the equation

$$\cos 5\theta - \cos 9\theta = \sqrt{3}\sin 7\theta \quad \text{for} \quad 0 < \theta \leqslant \frac{1}{3}\pi$$

Give your solutions in terms of $\pi$

**(7)**

(d) Using calculus and showing your working, evaluate

$$\int_0^{\frac{\pi}{7}} 8\sin 7x \cos 2x \tan 2x \, \mathrm{d}x$$

Give your answer to 3 decimal places.

**(6)**

**Question 10 continued**

**Question 10 continued**

**(Total for Question 10 is 16 marks)**

**TOTAL FOR PAPER IS 100 MARKS**