

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel International GCSE

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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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

$(1 + x)^n = 1 + nx + \frac{n(n - 1)}{2!}x^2 + \dots + \frac{n(n - 1)\dots(n - r + 1)}{r!}x^r + \dots$  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 ELEVEN questions.**

**Write your answers in the spaces provided.**

**You must write down all the stages in your working.**

- 1** An arithmetic series has 5th term 16 and 100th term 301

Find the sum of the first 50 terms of the series.

(5)

(Total for Question 1 is 5 marks)



2 A particle  $P$  is moving along a straight line, which passes through the fixed point  $O$ .

At time  $t$  seconds ( $t \geq 0$ ), the velocity,  $v$  m/s, of  $P$  is given by

$$v = t^2 - 3t + 4$$

At time  $t$  seconds the acceleration of  $P$  is  $a \text{ m/s}^2$

- (a) Find an expression for  $a$  in terms of  $t$

(2)

The displacement of  $P$  from  $O$  is 7 m when  $t = 2$

- (b) Find the exact displacement of  $P$  from  $O$  when  $t = 4$

(5)



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**Question 2 continued**

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**(Total for Question 2 is 7 marks)**

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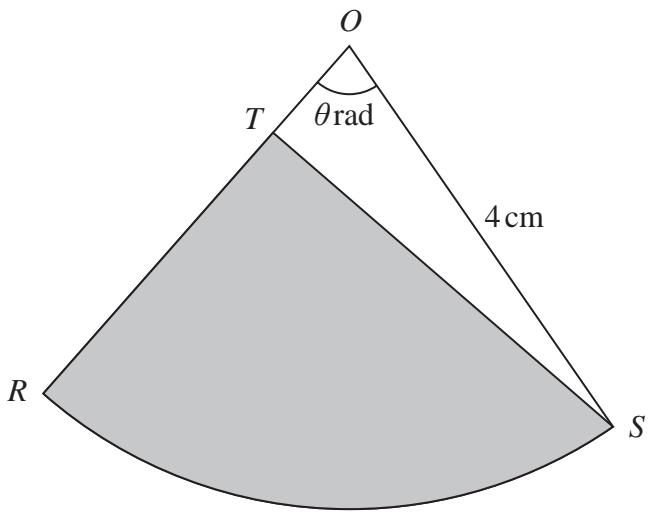


Diagram **NOT**  
accurately drawn

**Figure 1**

Figure 1 shows sector  $ORS$  of a circle with centre  $O$  and radius 4 cm.  
The size of angle  $ROS$  is  $\theta$  radians.

The area of sector  $ORS$  is  $2\pi \text{ cm}^2$

- (a) Find the exact value of  $\theta$  (2)

- (b) Find the perimeter, in cm to 3 significant figures, of the sector  $ORS$ . (2)

The point  $T$  lies on  $OR$  such that  $OT : TR = 1 : 3$

The region shown shaded in Figure 1 is bounded by the line  $TR$ , the line  $TS$  and the arc  $RS$  of the sector.

The area of this region is  $A \text{ cm}^2$

- (c) Find the exact value of  $A$  (2)

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**Question 3 continued**

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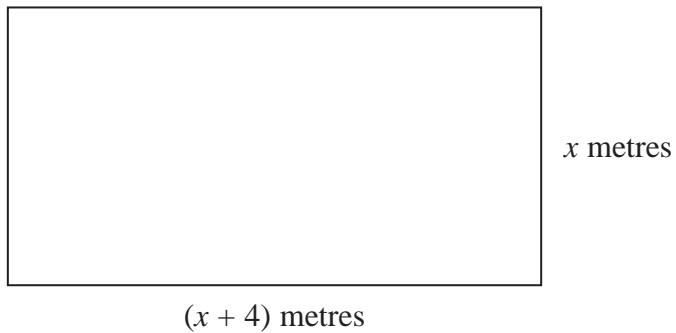


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**Figure 2**

Figure 2 shows a rectangle with width  $x$  metres and length  $(x + 4)$  metres.

The perimeter of the rectangle is  $P$  metres and the area of the rectangle is  $A \text{ m}^2$

(a) Find, in terms of  $x$ , an expression for

- (i)  $P$       (ii)  $A$

(2)

The perimeter of the rectangle has to be less than 30 metres.

The area of the rectangle has to be greater than  $12 \text{ m}^2$

(b) Find the set of possible values for  $x$

Give your answer in the form  $a < x < b$

(5)



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**Question 4 continued**

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**(Total for Question 4 is 7 marks)**

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## 5 Differentiate with respect to $x$

$$(a) \ e^{4x} (6x + 2)^{\frac{3}{2}}$$

Give your answer in the form  $e^{4x}(\sqrt{6x+2})(Ax+B)$  where  $A$  and  $B$  are integers.

(5)

$$(b) \frac{\sin 3x}{(2x - 4)^3}$$

(3)



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**Question 5 continued**

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**(Total for Question 5 is 8 marks)**

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6 Given that  $\frac{a + \sqrt{5}}{\sqrt{5} - 2} = 11 + 5\sqrt{5}$

- (a) without using a calculator, find the value of  $a$   
Show your working clearly.

(2)

Triangle  $PQR$  is such that

$$PR = (x + 3) \text{ cm} \quad QR = x \text{ cm} \quad \text{angle } QPR = 30^\circ \quad \text{angle } PQR = 45^\circ$$

- (b) Show that  $x = 3 + 3\sqrt{2}$

(3)

Given that  $\sin 105^\circ = \frac{\sqrt{6} + \sqrt{2}}{4}$  and that the area of triangle  $PQR$  is  $A \text{ cm}^2$

- (c) find the exact value of  $A$  in the form  $\frac{9}{8}(p\sqrt{6} + q\sqrt{2} + r\sqrt{3} + s)$

where  $p, q, r$  and  $s$  are integers.

(3)

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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 8 marks)**

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- 7 A curve  $C$  has equation  $y = \log_{10}(x + 2)$

(a) Using the axes below, sketch the graph of  $C$ .

Label the coordinates of the points of intersection of  $C$  with the coordinate axes.

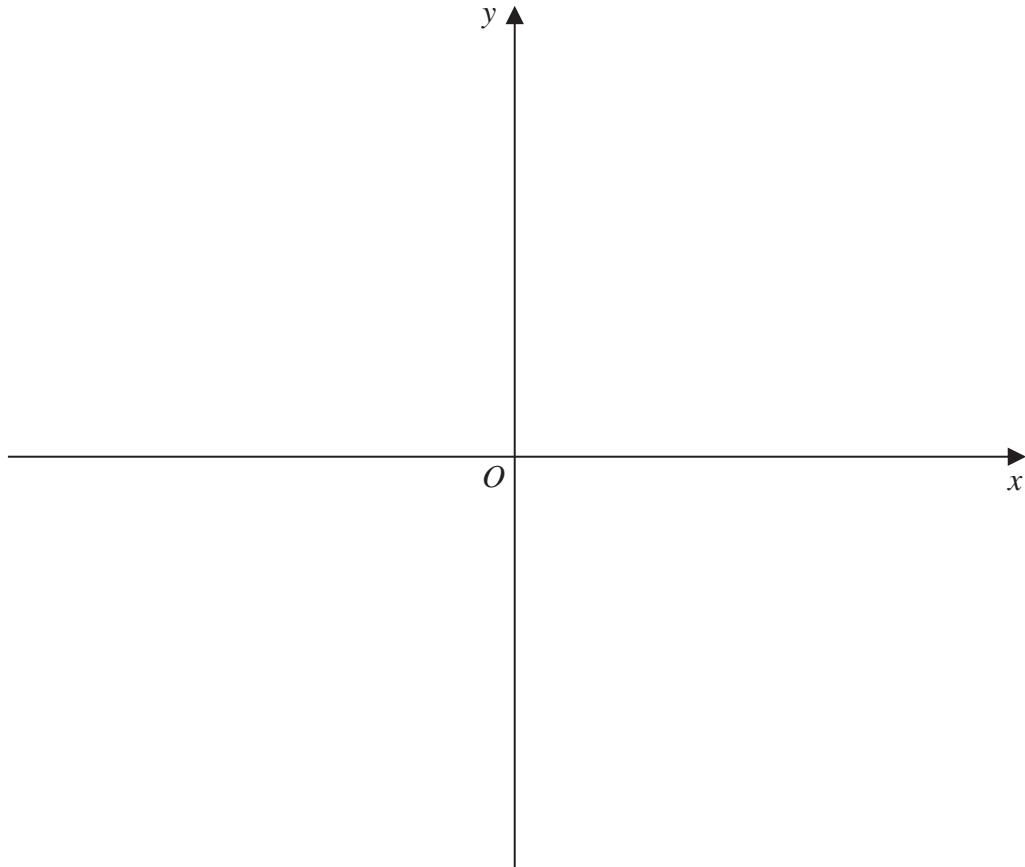
(2)

(b) Solve the equation  $2(\log_a 4 + \log_a 16) = 1$

(3)

(c) Solve the equation  $5\log_q 16 + 4\log_2 q = 24$

(6)



**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 11 marks)**

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- 8 (a) Using the binomial expansion, or otherwise, find the complete expansion of

$$(x + y)^3$$

(1)

The quadratic equation

$$2x^2 + 3x + 4 = 0$$

has roots  $\alpha$  and  $\beta$

- (b) Without solving the equation, find the value of

$$\alpha^3 + \beta^3$$

(4)

- (c) Hence, form a quadratic equation with integer coefficients that has roots

$$\frac{\alpha}{\beta^2} \text{ and } \frac{\beta}{\alpha^2}$$

(5)



**Question 8 continued**

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## **Question 8 continued**

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**Question 8 continued**

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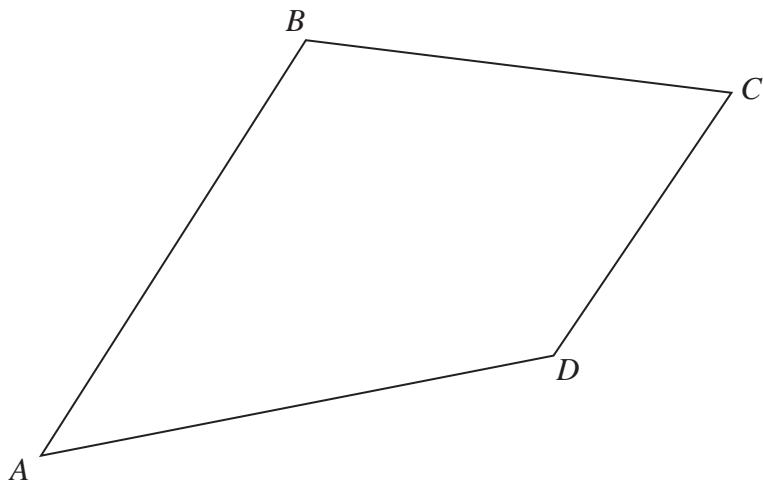


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accurately drawn

**Figure 3**

Figure 3 shows quadrilateral  $ABCD$  such that

$$\overrightarrow{AD} = 2\mathbf{a} + \mathbf{b} \quad \overrightarrow{BC} = \frac{1}{3}\mathbf{b} \quad \overrightarrow{BD} = -4\mathbf{a} - \mathbf{b}$$

- (a) Prove that  $\overrightarrow{AB}$  is parallel to  $\overrightarrow{DC}$  (4)

The diagonals,  $AC$  and  $BD$ , of the quadrilateral intersect at the point  $Y$ .

- (b) Using a vector method, find  $\overrightarrow{AY}$  as a simplified expression in terms of  $\mathbf{a}$  and  $\mathbf{b}$  (6)



**Question 9 continued**

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## **Question 9 continued**

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**Question 9 continued**

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**10** Using suitable results for  $\sin(A + B)$  and  $\sin(A - B)$  from the formulae page,

(a) show that  $2 \sin 4x \cos x = \sin 5x + \sin 3x$

(3)

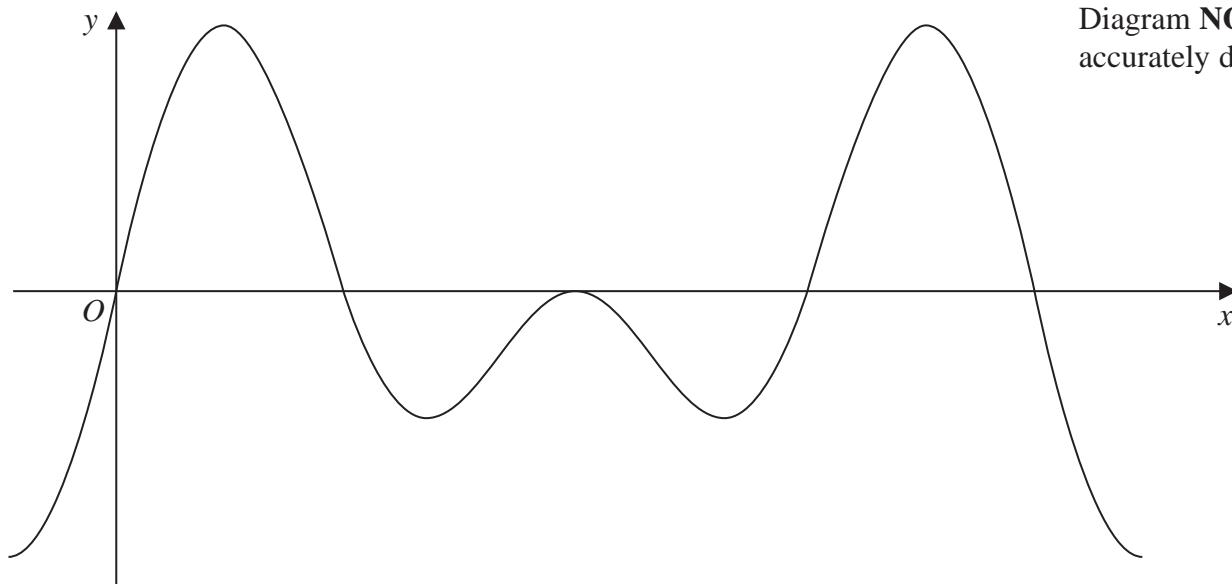


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**Figure 4**

Figure 4 shows part of a sketch of the curve  $y = 6 \sin 4x \cos x$

(b) Using calculus, find the total area bounded by the curve and the  $x$ -axis between

$$x = 0 \text{ and } x = \frac{\pi}{2}$$

Give your answer to 3 significant figures.

(8)



**Question 10 continued**

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## **Question 10 continued**

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**Question 10 continued**

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**(Total for Question 10 is 11 marks)**

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- 11** An equation of the straight line  $l$  is  $y - 3x = 3$

The point  $A$  on  $l$  lies on the  $y$ -axis.

The point  $B$  on  $l$  has coordinates  $(10, b)$ , where  $b$  is an integer.

The point  $C$  divides  $AB$  in the ratio  $2:3$

The straight line  $k$  passes through  $C$  and is perpendicular to  $l$

- (a) Show that an equation of  $k$  is

$$3y + x - 49 = 0 \quad (6)$$

The point  $D$  with coordinates  $(p, q)$ , where  $q$  is positive, is such that  $AD$  is parallel to  $k$  and the length of  $AD$  is  $12\sqrt{10}$

- (b) Find the coordinates of  $D$

(6)

The point  $E$  lies on  $k$  such that  $DE$  is parallel to the  $y$ -axis.

The point  $F$  lies on  $l$  such that  $DF$  is parallel to the  $y$ -axis.

- (c) Find the exact area of triangle  $ECF$ .

(5)



**Question 11 continued**

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**Question 11 continued**

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**Question 11 continued**

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**Question 11 continued**

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**(Total for Question 11 is 17 marks)**

**TOTAL FOR PAPER IS 100 MARKS**

