

Please check the examination details below before entering your candidate information

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| Candidate surname    |                      |                      |                      |                      | Other names          |                      |                      |                      |  |
| Centre Number        |                      |                      |                      |                      | Candidate Number     |                      |                      |                      |  |
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**Pearson Edexcel International GCSE**

**Friday 26 May 2023**

Afternoon (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 ►

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## 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 heightVolume 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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2

$$y = (\sin 2x) \sqrt{3 + 2x}$$

Show that  $\frac{dy}{dx} = \frac{\sin 2x + (A + Bx) \cos 2x}{\sqrt{3 + 2x}}$  where  $A$  and  $B$  are integers to be found.

(5)

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**Question 2 continued**

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**(Total for Question 2 is 5 marks)**



**Question 3 continued**

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**(Total for Question 3 is 5 marks)**

- 4 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  $v = 2t^2 - 16t + 30$

(a) Find the acceleration, in  $\text{m/s}^2$ , of  $P$  when  $t = 5$

(2)

$P$  comes to instantaneous rest at the points  $M$  and  $N$  at times  $t_1$  seconds and  $t_2$  seconds where  $t_2 > t_1$

(b) Find the exact distance  $MN$

(8)

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**Question 4 continued**

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**(Total for Question 4 is 10 marks)**



## 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 11 marks)**

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6 Solve the equation

$$\log_2 x^3 + \log_4 x^2 - 3\log_x 2 = 0$$

giving your answers to 3 significant figures.

(8)

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**Question 6 continued**

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**(Total for Question 6 is 8 marks)**

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7 The equation of a curve is  $y = \sqrt{\frac{e^{4x}}{2x-3}}$

When  $x$  is increased to  $(x + \delta x)$ ,  $y$  increases to  $(y + \delta y)$  where  $\delta x$  and  $\delta y$  are small.

(a) Show that  $\delta y \approx \frac{e^{2x}(4x-7)}{(2x-3)^{\frac{3}{2}}} \delta x$  (7)

Given that  $x = 2.5$

(b) find an estimate, to 2 significant figures, of the value of  $\delta y$  when the value of  $x$  increases by 0.2% (3)

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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 10 marks)**

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8

$$f'(x) = 18x^2 - 2x + 13$$

Given that  $(2x - 1)$  is a factor of  $f(x)$

show that the curve with equation  $y = f(x)$  has only one intersection with the  $x$ -axis.

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**Question 8 continued**

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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)**



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10  $O, A$  and  $B$  are fixed points such that

$$\vec{OA} = (b + 1)\mathbf{i} + b\mathbf{j}$$

$$\vec{AB} = 3\mathbf{i}$$

The unit vector parallel to  $\vec{OB}$  is  $\frac{\sqrt{17}}{34} [(3a + 2)\mathbf{i} + b\mathbf{j}]$

Given that  $a$  and  $b$  are constants where  $a > 0$  and  $b > 0$

find the exact value of

(i)  $a$

(ii)  $b$

(10)

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**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 10 marks)**

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**Question 11 continued**

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**Question 11 continued**

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**(Total for Question 11 is 14 marks)****TOTAL FOR PAPER IS 100 MARKS**