


Please check the examination details below before entering your candidate information

Candidate surname	Other names
<b>Pearson Edexcel</b>	Centre Number
<b>International GCSE</b>	Candidate Number
<b>Thursday 18 June 2020</b>	
Morning (Time: 2 hours)	Paper Reference <b>4PM1/02</b>
<b>Further Pure Mathematics</b>	
<b>Paper 2</b>	
	
<b>Calculators may be used.</b>	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 =  $\pi r \times$  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** $(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots$  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 TEN questions.**

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

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

- 1** A particle  $P$  is moving in a straight line. At time  $t$  seconds,  $t \geq 0$ , the displacement,  $s$  metres, of  $P$  from a fixed point  $O$  of the line is given by

$$s = 3 + 8t + t^2 - \frac{1}{3}t^3$$

Find the distance of  $P$  from  $O$  when  $P$  is instantaneously at rest.

(4)

(Total for Question 1 is 4 marks)



- 2 The region enclosed by the curve with equation  $y = e^{3x}$ , the  $x$ -axis, the  $y$ -axis and the line with equation  $x = 3$  is rotated through  $360^\circ$  about the  $x$ -axis.

Use algebraic integration to find, in terms of  $\pi$  and  $e$ , the volume of the solid generated.

(4)

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**Question 2 continued**

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**(Total for Question 2 is 4 marks)**



3 (a) Expand

$$(1 + px)^{-5} \quad p \neq 0$$

in ascending powers of  $x$ , up to and including the term in  $x^4$   
Give each term in its simplest form.

(3)

The coefficient of  $x^r$  in the expansion is  $c_r$

Given that  $c_4 = 2c_3$

(b) find the value of  $p$ .

(2)

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**Question 3 continued**

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



4 (i) Solve the equation  $16\log_r 4 = \log_4 r$  (2)

(ii) Solve the equation  $\log_5 9 + \log_5 12 + \log_5 15 + \log_5 18 = 1 + \log_5 x + \log_5 x^2$  (5)

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**Question 4 continued**

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



5 (a) Show that  $\sum_{r=1}^n (3r + 5) = \frac{1}{2}n(3n + 13)$  (3)

(b) Hence evaluate  $\sum_{r=35}^{50} (3r + 5)$  (2)

Given that  $\sum_{r=1}^n (3r + 5) = 385$

(c) find the value of  $n$ . (3)

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**Question 5 continued**

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



6

$$f(x) = 4x^2 - 3x - 5$$

The equation  $f(x) = 0$  has roots  $\alpha$  and  $\beta$

Without solving the equation  $f(x) = 0$

- (a) form an equation, with integer coefficients, that has roots  $\frac{2\alpha}{\beta}$  and  $\frac{2\beta}{\alpha}$  (6)

$$g(x) = 4x^2 + px + q \quad \text{where } p \text{ and } q \text{ are constants}$$

Given that the equation  $g(x) = 0$  has roots  $3\alpha + \beta$  and  $\alpha + 3\beta$

- (b) find the value of  $p$  and the value of  $q$  (5)

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**Question 6 continued**

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**Question 6 continued**

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**(Total for Question 6 is 11 marks)**



7 A geometric series has first term  $(x - 3)$ , second term  $(x + 1)$  and third term  $(4x - 2)$ .

(a) Find the two possible values of  $x$ .

(5)

Given that  $x < 1$ ,

(b) show that the series is convergent.

(2)

The sum to infinity of the series is  $S$ .

(c) Find the value of  $S$ .

(2)

The sum of the first  $n$  terms of the series is  $S_n$

Given that  $\frac{S}{S_n} = \frac{256}{255}$

(d) find the value of  $n$ .

(3)

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**Question 7 continued**

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**Question 7 continued**

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**(Total for Question 7 is 12 marks)**



8 The curve  $C_1$  has equation  $y = 5e^{-2x} + 4$

The curve  $C_2$  has equation  $y = e^{2x}$

The curves  $C_1$  and  $C_2$  intersect at the point  $A$ .

(a) Find the exact coordinates of  $A$ .

(4)

The tangent at  $A$  to  $C_1$  intersects the  $x$ -axis at the point  $B$ .

(b) Show that the  $x$  coordinate of  $B$  is  $\frac{1}{2}(5 + \ln 5)$

(5)

The tangent at  $A$  to  $C_2$  intersects the  $x$ -axis at the point  $D$ .

(c) Find the area of  $\triangle ABD$ .

(6)

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**Question 8 continued**

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**Question 8 continued**

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



9 A curve  $C$  has equation

$$y = \frac{2 + 4x - x^2}{2x + 1} \quad x \neq -\frac{1}{2}$$

(a) Write the equation of  $C$  in the form  $ax^2 + (by - 4)x + (y - c) = 0$ , where  $a$ ,  $b$  and  $c$  are integers whose values are to be found.

(3)

(b) Hence show that  $x$  is real when  $y \leq 2$  and when  $y \geq 3$

(4)

(c) Find the coordinates of the stationary points on  $C$ .

(6)

(d) Sketch  $C$  showing clearly

(i) the exact coordinates of the points where  $C$  crosses the  $x$ -axis,

(ii) the asymptote to  $C$  that is parallel to the  $y$ -axis,

(iii) the coordinates of the stationary points.

(5)

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**Question 9 continued**

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**Question 9 continued**

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**(Total for Question 9 is 18 marks)**



10 (a) Show that

$$\cos(A + B) + \cos(A - B) = 2 \cos A \cos B \quad (2)$$

(b) Hence show that

$$\cos P + \cos Q = 2 \cos \frac{P + Q}{2} \cos \frac{P - Q}{2} \quad (3)$$

(c) Solve, for  $0 \leq \theta \leq \frac{\pi}{2}$ , the equation

$$\cos 5\theta + \cos 7\theta = 0$$

Give each solution in terms of  $\pi$  (4)

(d) Show that

$$\cos 8x + 2 \cos 6x + \cos 4x = 4 \cos 6x \cos^2 x \quad (3)$$

(e) Use calculus to find the exact value of

$$\int_0^{\frac{\pi}{3}} \cos 6x \cos^2 x \, dx \quad (4)$$

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**Question 10 continued**

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**Question 10 continued**

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