


Please check the examination details below before entering your candidate information

Candidate surname					Other names						
Pearson Edexcel International GCSE		Centre Number					Candidate Number				
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<h1>Monday 20 January 2020</h1>											
Morning (Time: 2 hours)					Paper Reference 4PM1/02						
<h2>Further Pure Mathematics</h2> <h3>Level 2</h3> <h3>Paper 2</h3>											
											
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**

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2 + \dots + \frac{n(n-1)\dots(n-r+1)}{r!}x^r + \dots \quad \text{for } |x| < 1, n \in \mathbb{Q}$$

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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Answer all ELEVEN questions.**Write your answers in the spaces provided.****You must write down all the stages in your working.**

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

$$s = t^3 + 4t^2 - 27t + 4$$

Find the value of t at the instant when the velocity of P is 8 m/s.

(4)

(Total for Question 1 is 4 marks)



P 5 9 9 3 9 A 0 3 3 6

2 Find the set of values of x for which

(a) $3 + 2x \leq x + 2$

(1)

(b) $8x^2 + 10x < 3$

(4)

(c) **both** $3 + 2x \leq x + 2$ **and** $8x^2 + 10x < 3$

(1)

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Question 2 continued

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(Total for Question 2 is 6 marks)



3

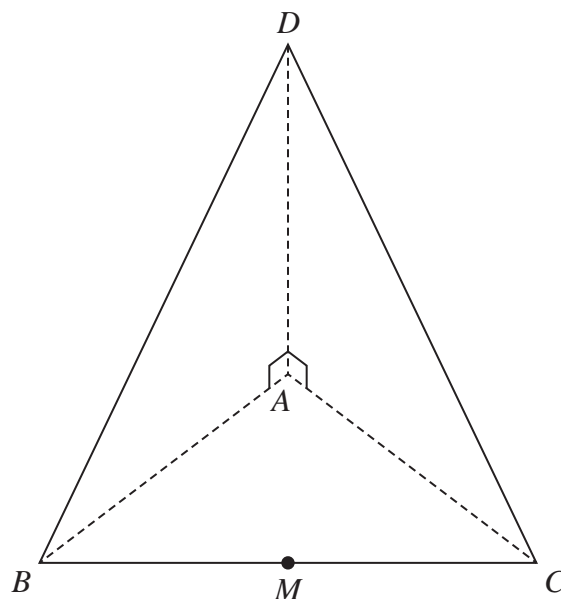
Diagram **NOT**
accurately drawn**Figure 1**

Figure 1 shows a triangular pyramid $ABCD$.

The base, ABC , of the pyramid is a horizontal isosceles triangle with $AB = AC = 10\text{ cm}$ and $BC = 16\text{ cm}$. The midpoint of BC is M .

The face BCD of the pyramid is an isosceles triangle with $BD = CD = 26\text{ cm}$ and D is vertically above A .

$$\angle BAD = \angle CAD = 90^\circ$$

(a) Calculate the length, in cm, of AM .

(2)

Calculate, in degrees to the nearest degree,

(b) the size of $\angle BCD$,

(3)

(c) the size of the angle between the planes BCA and BCD .

(4)

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Question 3 continued

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Question 3 continued

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Question 3 continued

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(Total for Question 3 is 9 marks)



- 4 The points A , B , C and D are the vertices of a quadrilateral $ABCD$ such that

$$\overrightarrow{AB} = 7\mathbf{i} + p\mathbf{j} \quad \overrightarrow{AC} = 11\mathbf{i} - p\mathbf{j} \quad \overrightarrow{AD} = 4\mathbf{i} - 2p\mathbf{j}$$

- (a) Show that, for all values of p , $ABCD$ is a parallelogram.

(3)

Given that $|\overrightarrow{BD}| = 3\sqrt{10}$

- (b) find the possible values of p .

(3)

Given that $p > 0$

- (c) find a unit vector which is parallel to \overrightarrow{BD} .

(1)

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Question 4 continued

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Question 4 continued

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Question 4 continued

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(Total for Question 4 is 7 marks)

P 5 9 9 3 9 A 0 1 3 3 6

5 Given that α and β are such that $\alpha + \beta = \frac{7}{2}$ and $\alpha\beta = 2$

(a) form a quadratic equation with integer coefficients that has roots α and β , (2)

(b) form a quadratic equation with integer coefficients that has roots $\frac{\alpha}{\beta}$ and $\frac{\beta}{\alpha}$. (6)

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Question 5 continued

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(Total for Question 5 is 8 marks)

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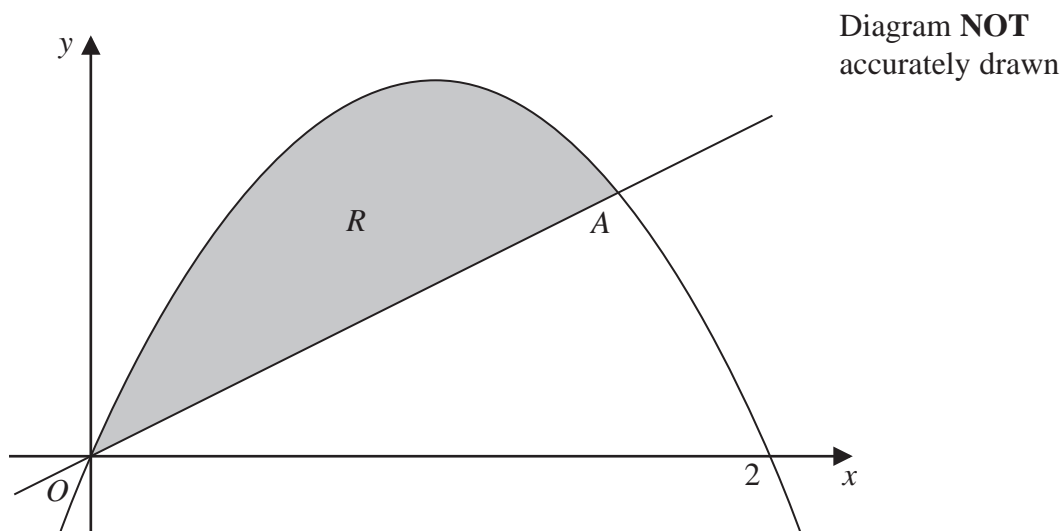


Figure 2

The region R , shown shaded in Figure 2, is bounded by the curve with equation $y = 2x - x^2$ and the line with equation $2y - x = 0$

The curve and the line intersect at the origin O and the point A .

- (a) Show that the point A has coordinates $\left(\frac{3}{2}, \frac{3}{4}\right)$. (2)

The region R is rotated through 360° about the x -axis.

- (b) Use algebraic integration to find, in terms of π , the volume of the solid formed. (6)

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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 The 7th term of a geometric series is 192 and the 8th term of this geometric series is 1152

(a) Find, as a fraction in its simplest form, the 4th term of this geometric series.

(3)

A different geometric series G has a common ratio r and n th term t_n

Given that $t_3 = 24$ and $t_2 + t_3 + t_4 = -36$

(b) show that r satisfies the equation

$$2r^2 + 5r + 2 = 0$$

(5)

Given further that G is convergent with sum to infinity S ,

(c) find the value of S .

(4)

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Question 7 continued

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Question 7 continued

(Total for Question 7 is 12 marks)



P 5 9 9 3 9 A 0 2 3 3 6

8 Given that $y = e^{3x} \sin 2x$

show that $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 13y = 0$

(8)

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Question 8 continued

Area for writing answers to Question 8 continued.



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Question 8 continued

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Question 8 continued

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(Total for Question 8 is 8 marks)

P 5 9 9 3 9 A 0 2 7 3 6

9 A curve C has equation

$$y = \frac{qx - 2}{x - p} \quad x \neq p$$

The curve crosses the y -axis at the point A .

The line l with equation $y = x + 2$ is the normal to C at A .

(a) (i) Show that $p = 1$

(ii) Find the value of q .

(7)

(b) Using the axes on the opposite page, sketch C , showing clearly the asymptotes and the coordinates of the points where C crosses the coordinate axes.

(5)

The line l meets C again at the point D .

(c) Find the x coordinate of D .

(4)

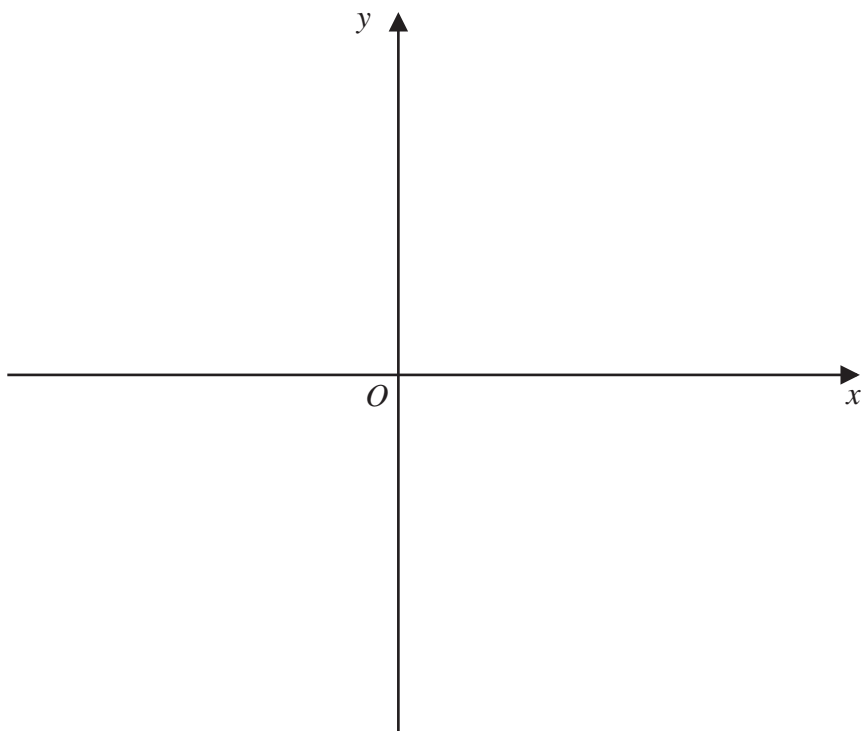
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Question 9 continued



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Question 9 continued

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Question 9 continued**(Total for Question 9 is 16 marks)**

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10 The volume of a sphere is increasing at a constant rate of $40\text{ cm}^3/\text{s}$.

Find the rate of increase, in cm^2/s , of the surface area of the sphere at the instant when the radius is 4 cm.

(9)

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Question 10 continued

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(Total for Question 10 is 9 marks)



11 (a) Express the equation

$$3 \sin(A - B) = \sin(A + B)$$

in the form $\tan A = k \tan B$, giving the value of the integer k .

(4)

(b) Given that $\theta \neq \frac{(2n+1)\pi}{2}$ where $n \in \mathbb{Z}$,

show that $\frac{\cos^4 \theta - \sin^4 \theta}{\cos^2 \theta} = 1 - \tan^2 \theta$

(3)

(c) Using the exact values of $\sin x^\circ$, $\cos x^\circ$ and $\tan x^\circ$ for $x = 30, 45, 60$

show that

(i) $\cos 15^\circ = \frac{\sqrt{6} + \sqrt{2}}{4}$

(2)

(ii) $\tan 255^\circ = \frac{3 + \sqrt{3}}{3 - \sqrt{3}}$

(4)

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Question 11 continued

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(Total for Question 11 is 13 marks)

TOTAL FOR PAPER IS 100 MARKS

