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ADDITIONAL MATHEMATICS

0606/13

Paper 1

May/June 2021

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY*Identities*

$$\begin{aligned} \sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A \end{aligned}$$

Formulae for $\triangle ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2}bc \sin A$$

- 1 Find the possible values of the constant k such that the equation $kx^2 + 4kx + 3k + 1 = 0$ has two different real roots. [4]

2 (a) Find $\frac{d}{dx}(x^2 e^{3x})$. [3]

(b) (i) Find $\frac{d}{dx}(3x^2 + 4)^{\frac{1}{3}}$. [2]

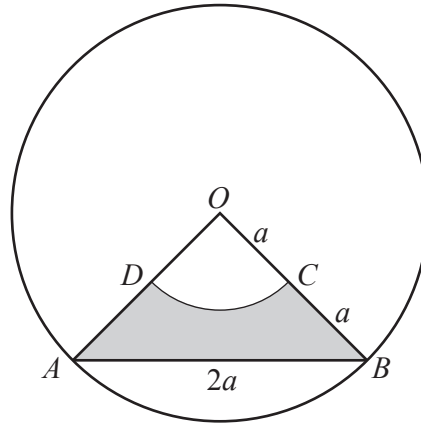
(ii) Hence find $\int_0^2 x(3x^2 + 4)^{-\frac{2}{3}} dx$. [3]

- 3 Solve the equation $\operatorname{cosec}^2\theta + 2\cot^2\theta = 2\cot\theta + 9$, where θ is in radians and $-\frac{\pi}{2} < \theta < \frac{\pi}{2}$. [5]

- 4 (a) Find the first three non-zero terms in the expansion of $\left(2 - \frac{x^2}{4}\right)^6$ in ascending powers of x . Simplify each term. [3]

- (b) Hence find the term independent of x in the expansion of $\left(2 - \frac{x^2}{4}\right)^6 \left(3 - \frac{1}{x^2}\right)^2$. [3]

- 5 When e^y is plotted against x^2 a straight line graph passing through the points (2.24, 5) and (4.74, 10) is obtained. Find y in terms of x . [5]



The diagram shows a circle, centre O , radius $2a$. The points A and B lie on the circumference of the circle. The points C and D are the mid-points of the lines OB and OA respectively. The arc DC is part of a circle centre O . The chord AB is of length $2a$.

(a) Find angle AOB , giving your answer in radians in terms of π . [1]

(b) Find, in terms of a and π , the perimeter of the shaded region $ABCD$. [2]

(c) Find, in terms of a and π , the area of the shaded region $ABCD$. [3]

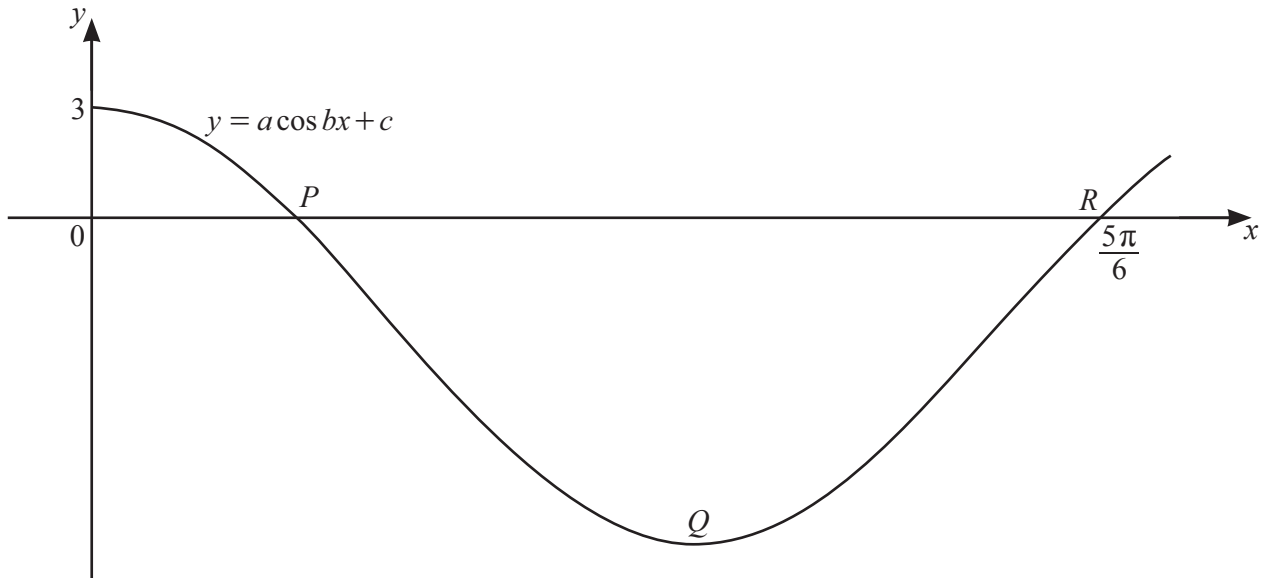
7 (a) A committee of 8 people is to be formed from 5 teachers, 4 doctors and 3 police officers. Find the number of different committees that could be chosen if

(i) all 4 doctors are on the committee, [2]

(ii) there are at least 2 teachers on the committee. [3]

(b) Given that ${}^n P_5 = 6 \times {}^{n-1} P_4$, find the value of n . [3]

8



The graph shows the curve $y = a \cos bx + c$, for $0 \leq x \leq 2.8$, where a , b and c are constants and x is in radians. The curve meets the y -axis at $(0, 3)$ and the x -axis at the point P and point $R\left(\frac{5\pi}{6}, 0\right)$.

The curve has a minimum at point Q . The period of $a \cos bx + c$ is π radians.

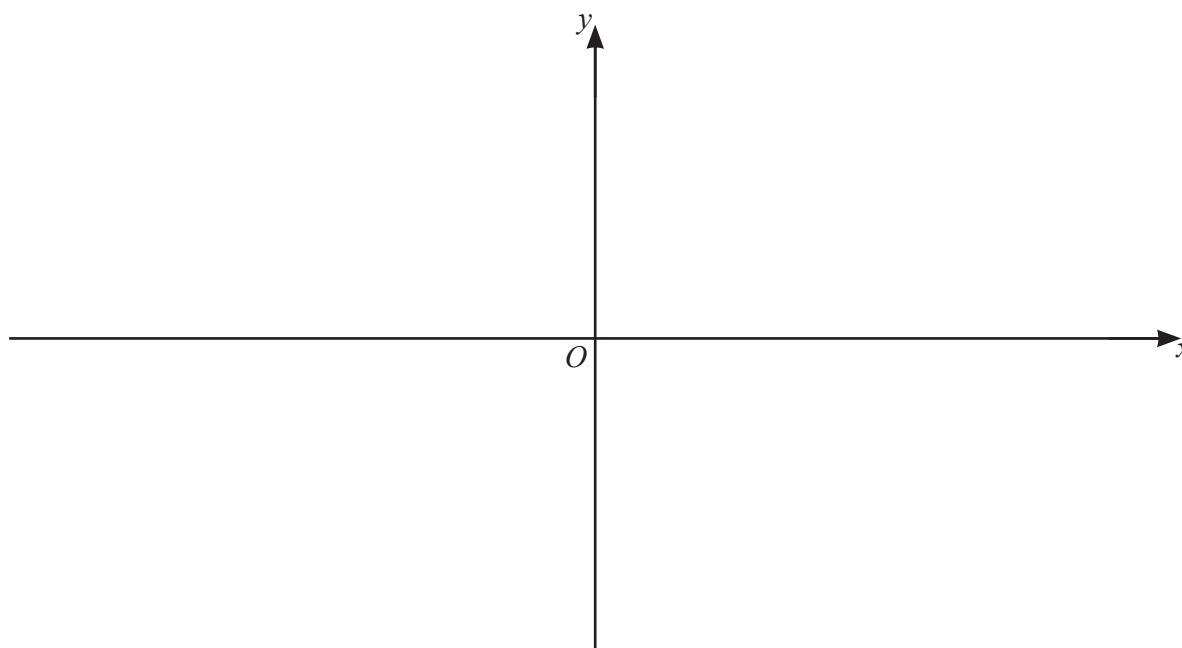
(a) Find the value of each of a , b and c . [4]

(b) Find the coordinates of P . [1]

(c) Find the coordinates of Q . [2]

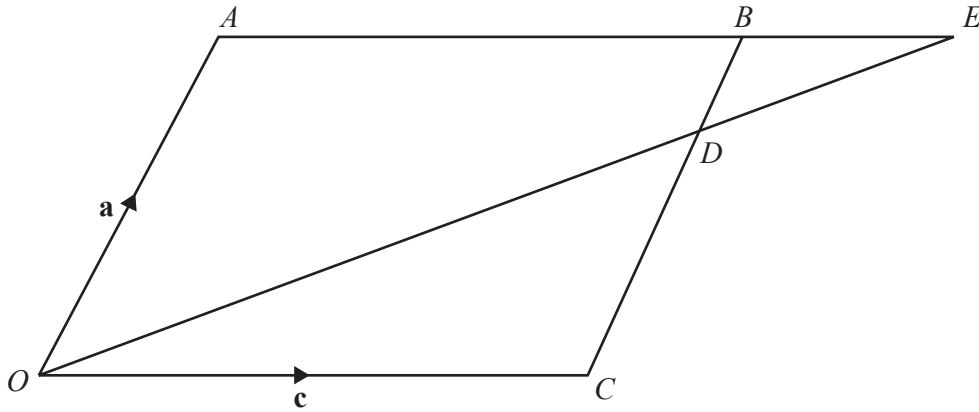
- 9 (a) Show that the equation of the curve $y = (x^2 - 4)(x - 2)$ can be written as $y = x^3 + ax^2 + bx + 8$, where a and b are integers. Hence find the exact coordinates of the stationary points on the curve. [4]

- (b) On the axes, sketch the graph of $y = |(x^2 - 4)(x - 2)|$, stating the intercepts with the coordinate axes. [4]



- (c) Find the possible values of the constant k for which $|(x^2 - 4)(x - 2)| = k$ has exactly 4 different solutions. [2]

10



The diagram shows the parallelogram $OABC$, such that $\vec{OA} = \mathbf{a}$ and $\vec{OC} = \mathbf{c}$. The point D lies on CB such that $CD : DB = 3 : 1$. When extended, the lines AB and OD meet at the point E . It is given that $\vec{OE} = h\vec{OD}$ and $\vec{BE} = k\vec{AB}$, where h and k are constants.

(a) Find \vec{DE} in terms of \mathbf{a} , \mathbf{c} and h .

[4]

(b) Find \overrightarrow{DE} in terms of \mathbf{a} , \mathbf{c} and k . [1]

(c) Hence find the value of h and of k . [4]

- 11 The line $x + 2y = 10$ intersects the two lines satisfying the equation $|x + y| = 2$ at the points A and B .
- (a) Show that the point $C(-5, 20)$ lies on the perpendicular bisector of the line AB . [8]

- (b) The point D also lies on this perpendicular bisector. M is the mid-point of AB . The distance CD is three times the distance of CM . Find the possible coordinates of D . [4]

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