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0606/12

October/November 2018

2 hours

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

You are reminded of the need for clear presentation in your answers.

The total number of marks for this paper is 80.

This document consists of **16** printed pages.

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 $\binom{n}{r} = \frac{n!}{(n-r)!r!}$.

2. TRIGONOMETRY*Identities*

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

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

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

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

1 Solve $1 + \sqrt{2} \sin(x + 50^\circ) = 0$ for $-180^\circ \leq x \leq 180^\circ$.

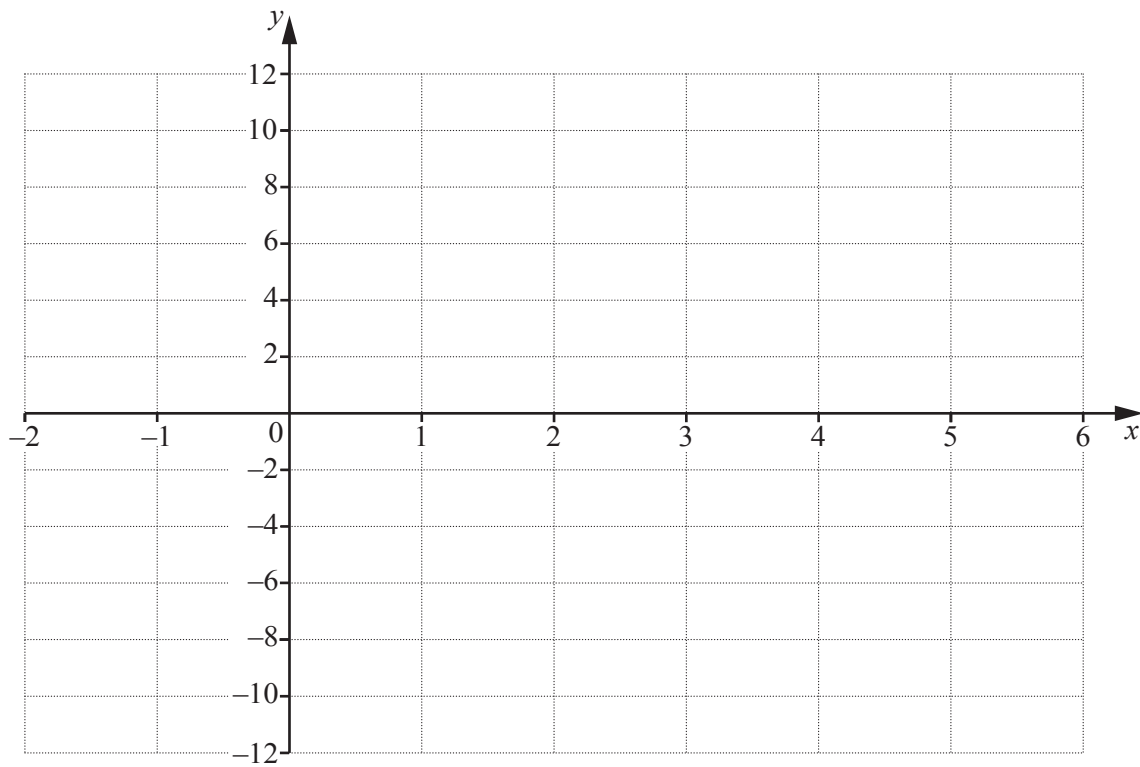
[4]

- 2 Find the equation of the curve which has a gradient of 4 at the point $(0, -3)$ and is such that

$$\frac{d^2y}{dx^2} = 5 + e^{2x}.$$

[5]

- 3 (i) On the axes below, sketch the graph of $y = |6 - 3x|$, showing the coordinates of the points where the graph meets the coordinate axes. [2]



- (ii) Solve $|6 - 3x| = 2$. [3]

- (iii) Hence find the values of x for which $|6 - 3x| > 2$. [1]

4 $y = x^3 \ln(2x + 1)$

- (i) Find the value of $\frac{dy}{dx}$ when $x = 0.3$. You must show all your working. [4]

- (ii) Hence find the approximate increase in y when x increases from 0.3 to $0.3 + h$, where h is small. [1]

- 5 The 7th term in the expansion of $(a + bx)^{12}$ in ascending powers of x is $924x^6$. It is given that a and b are positive constants.

(i) Show that $b = \frac{1}{a}$. [2]

The 6th term in the expansion of $(a + bx)^{12}$ in ascending powers of x is $198x^5$.

(ii) Find the value of a and of b . [4]

6 (i) Find $\frac{d}{dx}(5x^2 - 125)^{\frac{2}{3}}$. [2]

(ii) Using your answer to part (i), find $\int x(5x^2 - 125)^{-\frac{1}{3}} dx$. [2]

(iii) Hence find $\int_6^{10} x(5x^2 - 125)^{-\frac{1}{3}} dx$. [2]

- 7 (a) The vector $\mathbf{v}$ has a magnitude of 39 units and is in the same direction as $\begin{pmatrix} -12 \\ 5 \end{pmatrix}$. Write $\mathbf{v}$ in the form $\begin{pmatrix} a \\ b \end{pmatrix}$, where a and b are constants. [2]

- (b) Vectors $\mathbf{p}$ and $\mathbf{q}$ are such that $\mathbf{p} = \begin{pmatrix} r+s \\ r+6 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} 5r+1 \\ 2s-1 \end{pmatrix}$, where r and s are constants. Given that $2\mathbf{p} + 3\mathbf{q} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$, find the value of r and of s . [4]

8

$$\mathbf{A} = \begin{pmatrix} a & 3 \\ 4 & a+4 \end{pmatrix}$$

(i) Find the values of the constant a for which $\mathbf{A}^{-1}$ does not exist. [3]

(ii) Given that $a = 4$, find $\mathbf{A}^{-1}$. [2]

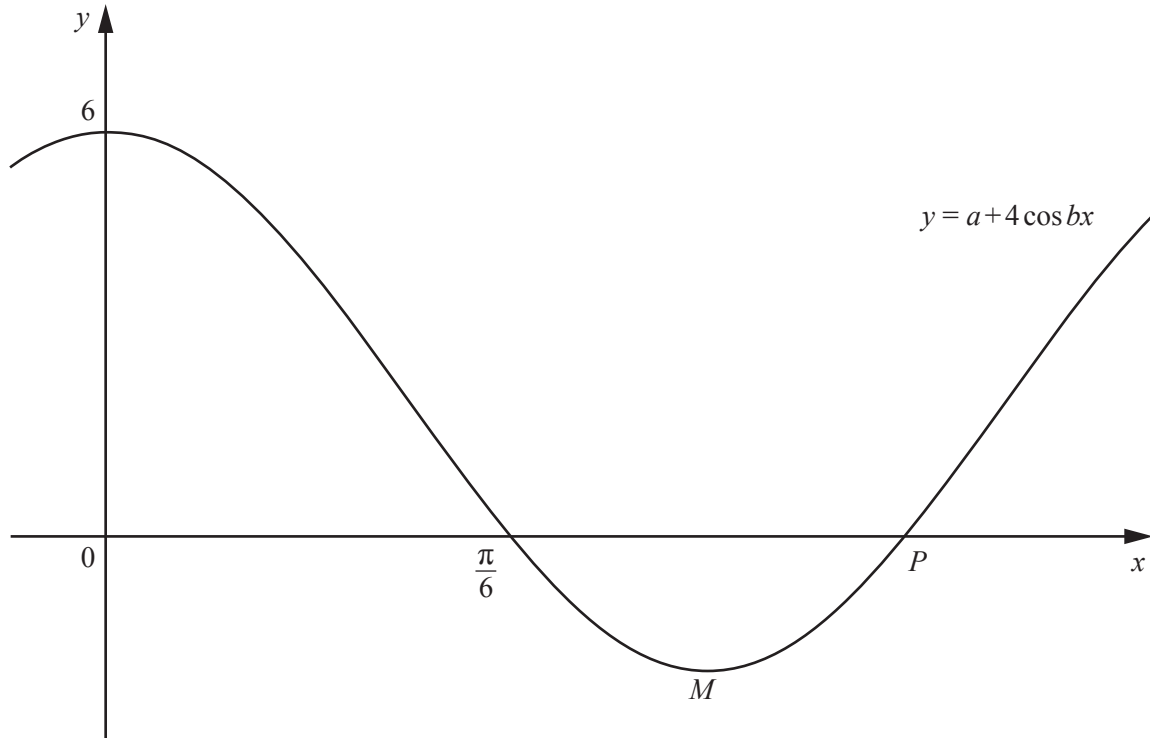
(iii) Hence find the matrix $\mathbf{B}$ such that $\mathbf{AB} = \begin{pmatrix} 2 & 3 \\ 4 & -5 \end{pmatrix}$. [3]

9 The polynomial $p(x) = ax^3 + bx^2 + cx - 9$ is divisible by $x + 3$. It is given that $p'(0) = 36$ and $p''(0) = 86$.

(i) Find the value of each of the constants a , b and c . [6]

(ii) Using your values of a , b and c , find the remainder when $p(x)$ is divided by $2x - 1$. [2]

10



The diagram shows part of the curve $y = a + 4 \cos bx$, where a and b are positive constants. The curve meets the y -axis at the point $(0, 6)$ and the x -axis at the point $(\frac{\pi}{6}, 0)$. The curve meets the x -axis again at the point P and has a minimum at the point M .

- (i) Find the value of a and of b .

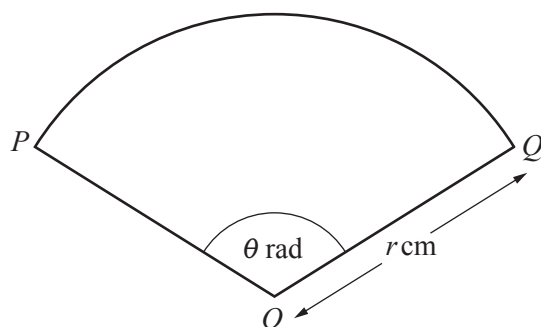
[3]

Using your values of a and b find,

(ii) the exact coordinates of P , [2]

(iii) the exact coordinates of M . [2]

11



The diagram shows the sector OPQ of a circle, centre O , radius r cm, where angle $POQ = \theta$ radians. The perimeter of the sector is 10 cm.

- (i) Show that area, A cm², of the sector is given by $A = \frac{50\theta}{(2+\theta)^2}$. [5]

It is given that θ can vary and A has a maximum value.

- (ii) Find the maximum value of A .

[5]

Question 12 is printed on the next page.

- 12 The line $y = 2x + 5$ intersects the curve $y + xy = 5$ at the points A and B . Find the coordinates of the point where the perpendicular bisector of the line AB intersects the line $y = x$. [9]

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