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0606/11

May/June 2017

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 **12** 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 The line $y = kx - 5$, where k is a positive constant, is a tangent to the curve $y = x^2 + 4x$ at the point A .

(i) Find the exact value of k . [3]

(ii) Find the gradient of the normal to the curve at the point A , giving your answer in the form $a + b\sqrt{5}$, where a and b are constants. [2]

- 2 It is given that $p(x) = x^3 + ax^2 + bx - 48$. When $p(x)$ is divided by $x - 3$ the remainder is 6. Given that $p'(1) = 0$, find the value of a and of b . [5]

- 3 (a) Simplify $\sqrt{x^8 y^{10}} \div \sqrt[3]{x^3 y^{-6}}$, giving your answer in the form $x^a y^b$, where a and b are integers. [2]

- (b) (i) Show that $4(t-2)^{\frac{1}{2}} + 5(t-2)^{\frac{3}{2}}$ can be written in the form $(t-2)^p(qt+r)$, where p , q and r are constants to be found. [3]

- (ii) Hence solve the equation $4(t-2)^{\frac{1}{2}} + 5(t-2)^{\frac{3}{2}} = 0$. [1]

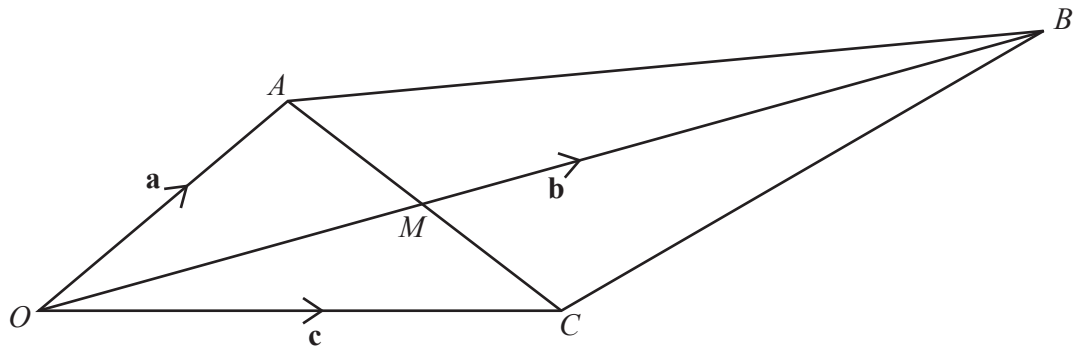
4 (a) It is given that $f(x) = 3e^{-4x} + 5$ for $x \in \mathbb{R}$.

(i) State the range of f . [1]

(ii) Find f^{-1} and state its domain. [4]

(b) It is given that $g(x) = x^2 + 5$ and $h(x) = \ln x$ for $x > 0$. Solve $hg(x) = 2$. [3]

5 (a)



The diagram shows a figure $OABC$, where $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$. The lines AC and OB intersect at the point M where M is the midpoint of the line AC .

(i) Find, in terms of $\mathbf{a}$ and $\mathbf{c}$, the vector $\overrightarrow{OM}$. [2]

(ii) Given that $OM:MB = 2:3$, find $\mathbf{b}$ in terms of $\mathbf{a}$ and $\mathbf{c}$. [2]

- (b) Vectors $\mathbf{i}$ and $\mathbf{j}$ are unit vectors parallel to the x -axis and y -axis respectively.

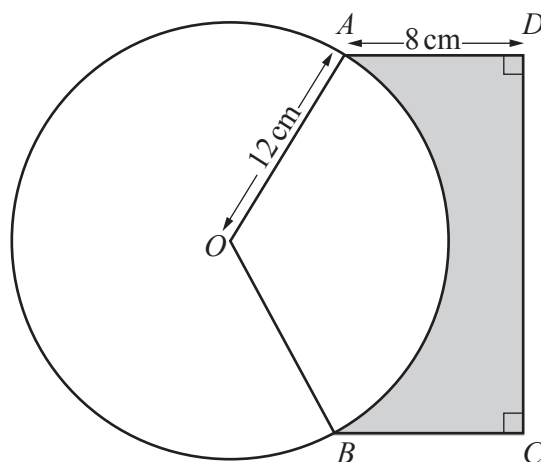
The vector $\mathbf{p}$ has a magnitude of 39 units and has the same direction as $-10\mathbf{i} + 24\mathbf{j}$.

- (i) Find $\mathbf{p}$ in terms of $\mathbf{i}$ and $\mathbf{j}$. [2]

- (ii) Find the vector $\mathbf{q}$ such that $2\mathbf{p} + \mathbf{q}$ is parallel to the positive y -axis and has a magnitude of 12 units. [3]

- (iii) Hence show that $|\mathbf{q}| = k\sqrt{5}$, where k is an integer to be found. [2]

6



The diagram shows a circle, centre O , radius 12 cm. The points A and B lie on the circumference of the circle and form a rectangle with the points C and D . The length of AD is 8 cm and the area of the minor sector AOB is 150 cm^2 .

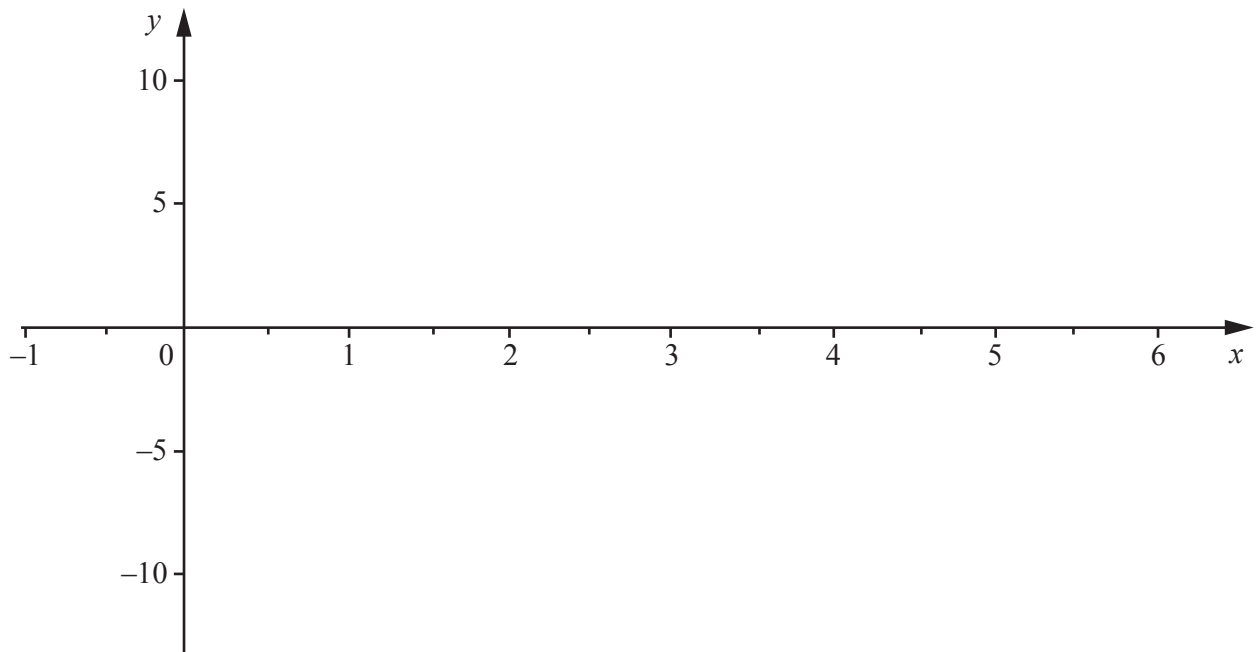
(i) Show that angle AOB is 2.08 radians, correct to 2 decimal places. [2]

(ii) Find the area of the shaded region $ADCB$. [6]

(iii) Find the perimeter of the shaded region $ADCB$. [3]

- 7 Show that the curve $y = (3x^2 + 8)^{\frac{5}{3}}$ has only one stationary point. Find the coordinates of this stationary point and determine its nature. [8]

- 8 (i) On the axes below sketch the graphs of $y = |2x - 5|$ and $9y = 80x - 16x^2$. [5]



- (ii) Solve $|2x - 5| = 4$. [3]

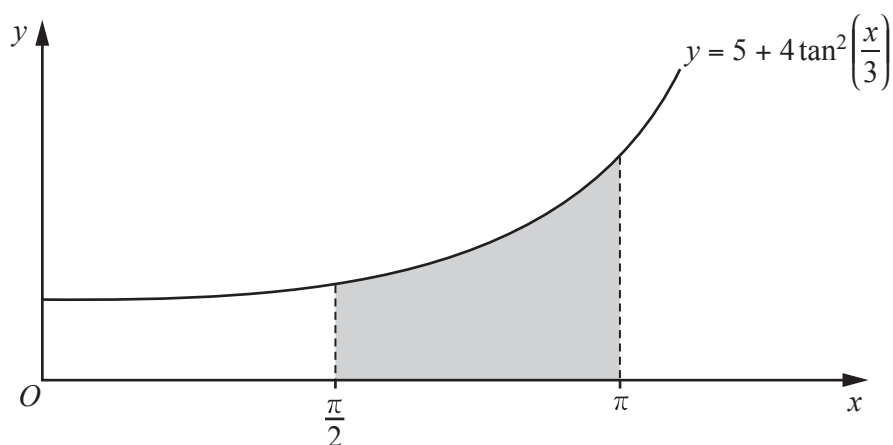
- (iii) Hence show that the graphs of $y = |2x - 5|$ and $9y = 80x - 16x^2$ intersect at the points where $y = 4$. [1]

- (iv) Hence find the values of x for which $9|2x - 5| \leq 80x - 16x^2$. [2]

9 (i) Show that $5 + 4 \tan^2\left(\frac{x}{3}\right) = 4 \sec^2\left(\frac{x}{3}\right) + 1$. [1]

(ii) Given that $\frac{d}{dx}\left(\tan\left(\frac{x}{3}\right)\right) = \frac{1}{3}\sec^2\left(\frac{x}{3}\right)$, find $\int \sec^2\left(\frac{x}{3}\right) dx$. [1]

(iii)



The diagram shows part of the curve $y = 5 + 4 \tan^2\left(\frac{x}{3}\right)$. Using the results from parts (i) and (ii), find the exact area of the shaded region enclosed by the curve, the x -axis and the lines $x = \frac{\pi}{2}$ and $x = \pi$. [5]

Question 10 is printed on the next page.

10 (a) Given that $y = \frac{e^{3x}}{4x^2 + 1}$, find $\frac{dy}{dx}$. [3]

(b) Variables x , y and t are such that $y = 4 \cos\left(x + \frac{\pi}{3}\right) + 2\sqrt{3} \sin\left(x + \frac{\pi}{3}\right)$ and $\frac{dy}{dt} = 10$.

(i) Find the value of $\frac{dy}{dx}$ when $x = \frac{\pi}{2}$. [3]

(ii) Find the value of $\frac{dx}{dt}$ when $x = \frac{\pi}{2}$. [2]

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