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0606/23

October/November 2019

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 **15** printed pages and **1** blank page.

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 $|3x+2|=x+4$. [3]

2 (i) Show that $\frac{\operatorname{cosec} x - \cot x}{1 - \cos x} = \operatorname{cosec} x$. [3]

(ii) Hence solve $\frac{\operatorname{cosec} x - \cot x}{1 - \cos x} = 2$ for $0^\circ < x < 180^\circ$. [2]

- 3 The first four terms in the expansion of $(1+ax)^5(2+bx)$ are $2+32x+210x^2+cx^3$, where a , b and c are integers. Show that $3a^2-16a+21=0$ and hence find the values of a , b and c . [8]

4 (i) Given that $y = 2x^2 - 4x - 7$, write y in the form $a(x-b)^2 + c$, where a , b and c are constants. [3]

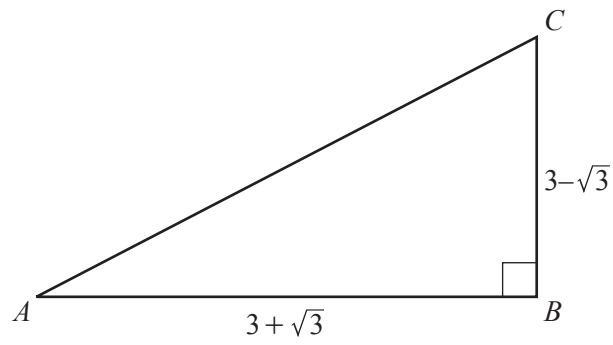
(ii) Hence write down the minimum value of y and the value of x at which it occurs. [2]

(iii) Using your answer to **part (i)**, solve the equation $2p - 4\sqrt{p} - 7 = 0$, giving your answer correct to 2 decimal places. [3]

5 **(a)** Solve $3 \cot^2\left(y - \frac{\pi}{4}\right) = 1$ for $0 < y < \pi$ radians. [4]

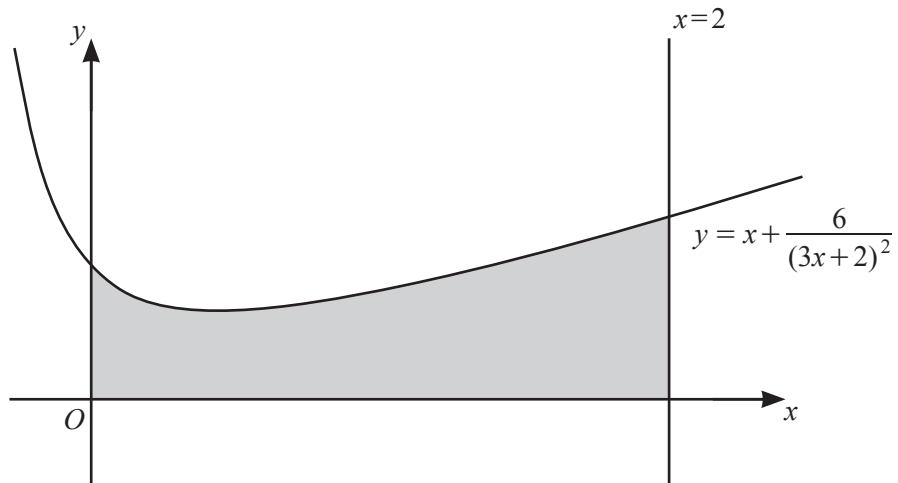
(b) Solve $7 \cot z + \tan z = 7 \operatorname{cosec} z$ for $0^\circ \leq z \leq 360^\circ$. [6]

6 Do not use a calculator in this question.



(i) Find $\tan ACB$ in the form $r + s\sqrt{3}$, where r and s are integers. [3]

(ii) Find AC in the form $t\sqrt{u}$, where t and u are integers and $t \neq 1$. [3]



The diagram shows part of the curve $y = x + \frac{6}{(3x+2)^2}$ and the line $x = 2$.

- (i) Find, correct to 2 decimal places, the coordinates of the stationary point.

[6]

- (ii) Find the area of the shaded region, showing all your working.

[4]

8 The roots of the equation $x^3 + ax^2 + bx + 24 = 0$ are 2, 3 and p , where p is an integer.

(i) Find the value of p . [1]

(ii) Show that $a = -1$ and find the value of b . [4]

Given that a curve has equation $y = x^3 - x^2 + bx + 24$ find, using your value of b ,

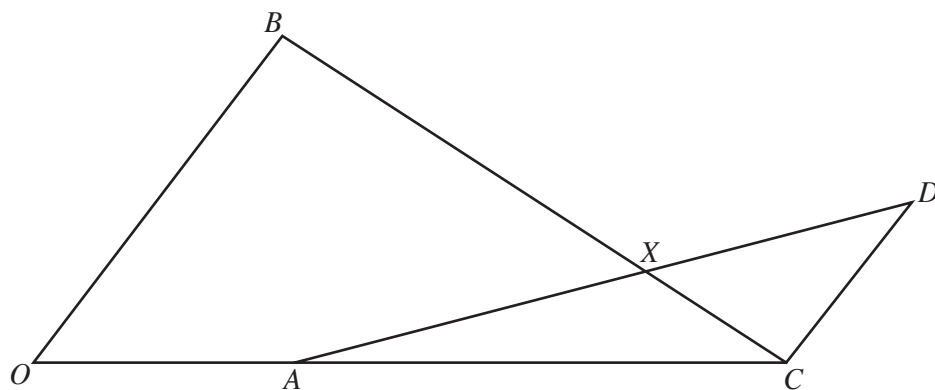
(iii) $\frac{dy}{dx}$, [1]

(iv) the integer value of x for which the gradient of the curve is 2 and the corresponding value of y . [3]

The coordinates of the point P on the curve are given by the values of x and y found in **part (iv)**.

(v) Find the equation of the tangent to the curve at P . [1]

9



The diagram shows points O, A, B, C, D and X . The position vectors of A, B , and C relative to O are $\vec{OA} = \mathbf{a}$, $\vec{OB} = 2\mathbf{b}$ and $\vec{OC} = 3\mathbf{a}$. The vector $\vec{CD} = \mathbf{b}$.

(i) Given that $\vec{AX} = \lambda \vec{AD}$, find $\vec{OX}$ in terms of $\lambda, \mathbf{a}$ and $\mathbf{b}$. [2]

(ii) Given that $\vec{BX} = \mu \vec{BC}$, find $\vec{OX}$ in terms of $\mu, \mathbf{a}$ and $\mathbf{b}$. [2]

(iii) Hence find the value of λ and of μ .

[4]

(iv) Find the ratio $\frac{AX}{XD}$.

[1]

10 The functions f and g are defined by

$$\begin{aligned} f(x) &= \ln(3x+2) \quad \text{for } x > -\frac{2}{3}, \\ g(x) &= e^{2x} - 4 \quad \text{for } x \in \mathbb{R}. \end{aligned}$$

(i) Solve $gf(x) = 5$.

[5]

(ii) Find $f^{-1}(x)$.

[2]

(iii) Solve $f^{-1}(x) = g(x)$.

[4]

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