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4037/22

October/November 2016

2 hours

No Additional Materials are required.

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 $\triangle ABC$

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

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

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

1 Solve the equation $|4x - 3| = x$. [3]

2 **Without using a calculator**, find the integers a and b such that $\frac{a}{\sqrt{3} + 1} + \frac{b}{\sqrt{3} - 1} = \sqrt{3} - 3$. [5]

3 Solve the equation $2 \lg x - \lg \left(\frac{x+10}{2} \right) = 1$. [5]

4 The number of bacteria, N , present in a culture can be modelled by the equation $N = 7000 + 2000e^{-0.05t}$, where t is measured in days. Find

(i) the number of bacteria when $t = 10$, [1]

(ii) the value of t when the number of bacteria reaches 7500, [3]

(iii) the rate at which the number of bacteria is decreasing after 8 days. [3]

5 The curve with equation $y = x^3 + 2x^2 - 7x + 2$ passes through the point $A (-2, 16)$. Find

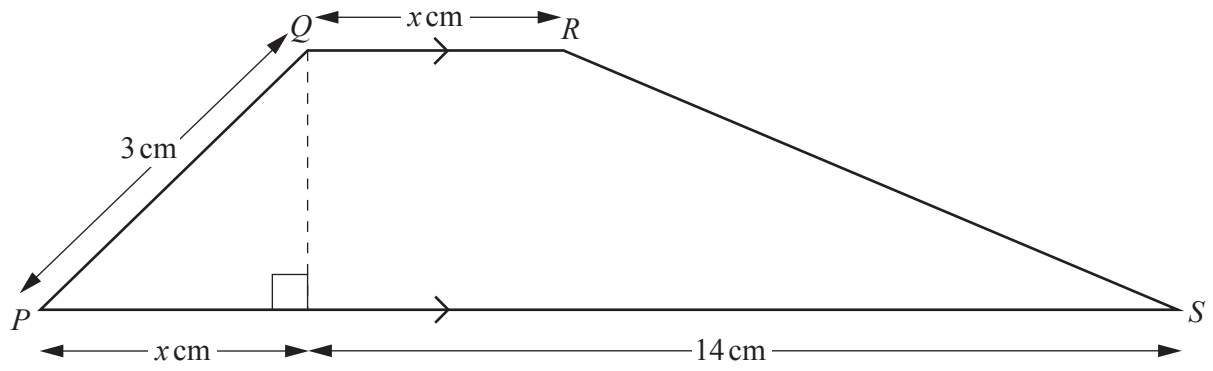
(i) the equation of the tangent to the curve at the point A , [3]

(ii) the coordinates of the point where this tangent meets the curve again. [5]

6 (i) Prove that $\frac{\cos x}{1 + \tan x} - \frac{\sin x}{1 + \cot x} = \cos x - \sin x$. [4]

(ii) Hence solve the equation $\frac{\cos x}{1 + \tan x} - \frac{\sin x}{1 + \cot x} = 3 \sin x - 4 \cos x$ for $-180^\circ < x < 180^\circ$. [4]

7



- (i) Show that the area, $A\text{ cm}^2$, of the trapezium $PQRS$ is given by $A = (7 + x)\sqrt{9 - x^2}$. [2]

- (ii) Given that x can vary, find the stationary value of A .

[7]

8 The function $f(x)$ is given by $f(x) = \frac{3x^3 - 1}{x^3 + 1}$ for $0 \leq x \leq 3$.

(i) Show that $f'(x) = \frac{kx^2}{(x^3 + 1)^2}$, where k is a constant to be determined. [3]

(ii) Find $\int \frac{x^2}{(x^3 + 1)^2} dx$ and hence evaluate $\int_1^2 \frac{x^2}{(x^3 + 1)^2} dx$. [4]

(iii) Find $f^{-1}(x)$, stating its domain.

[4]

- 9 The line $y = kx - 4$, where k is a positive constant, passes through the point $P(0, -4)$ and is a tangent to the curve $x^2 + y^2 - 2y = 8$ at the point T . Find

(i) the value of k , [5]

(ii) the coordinates of T ,

[3]

(iii) the length of TP .

[2]

- 10** The town of Cambley is 5 km east and p km north of Edwintown so that the position vector of Cambley from Edwintown is $\begin{pmatrix} 5000 \\ 1000p \end{pmatrix}$ metres. Manjit sets out from Edwintown at the same time as Raj sets out from Cambley. Manjit sets out from Edwintown on a bearing of 020° at a speed of 2.5 ms^{-1} so that her position vector relative to Edwintown after t seconds is given by $\begin{pmatrix} 2.5t \cos 70^\circ \\ 2.5t \cos 20^\circ \end{pmatrix}$ metres. Raj sets out from Cambley on a bearing of 310° at 2 ms^{-1} .

(i) Find the position vector of Raj relative to Edwintown after t seconds. [2]

Manjit and Raj meet after T seconds.

(ii) Find the value of T and of p .

[5]

Question 11 is printed on the next page.

- 11** Mr and Mrs Coldicott have 5 sons and 4 daughters. All 11 members of the family play tennis. Six members of the family enter a tennis competition where teams consist of 4 males and 2 females.

Find the number of different teams of 4 males and 2 females that could be selected if

- (i)** there are no further restrictions, [2]

- (ii)** Mr and Mrs Coldicott must both be in the team, [2]

- (iii)** either Mr or Mrs Coldicott is in the team but not both. [3]

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