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0606/12

February/March 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 **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 $\triangle ABC$

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

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

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

- 1** The remainder obtained when the polynomial $p(x) = x^3 + ax^2 - 3x + b$ is divided by $x + 3$ is twice the remainder obtained when $p(x)$ is divided by $x - 2$. Given also that $p(x)$ is divisible by $x + 1$, find the value of a and of b . [5]

2 A curve has equation $y = 4 + 5 \sin 3x$.

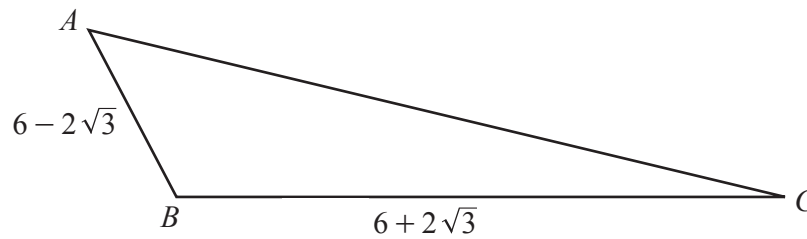
(i) Find $\frac{dy}{dx}$. [2]

(ii) Hence find the equation of the tangent to the curve $y = 4 + 5 \sin 3x$ at the point where $x = \frac{\pi}{3}$. [3]

3 Do not use a calculator in this question.

- (a) Simplify $\frac{(3 + 2\sqrt{5})(6 - 2\sqrt{5})}{(4 - \sqrt{5})}$, giving your answer in the form $a + b\sqrt{5}$, where a and b are integers. [3]

- (b) In this part, all lengths are in centimetres.



The diagram shows the triangle ABC with $AB = 6 - 2\sqrt{3}$ and $BC = 6 + 2\sqrt{3}$. Given that $\cos ABC = -\frac{1}{2}$, find the length of AC in the form $c\sqrt{d}$, where c and d are integers. [3]

4 It is given that $y = \frac{\ln(4x^2 - 1)}{x + 2}$.

(i) Find the values of x for which y is not defined. [2]

(ii) Find $\frac{dy}{dx}$. [3]

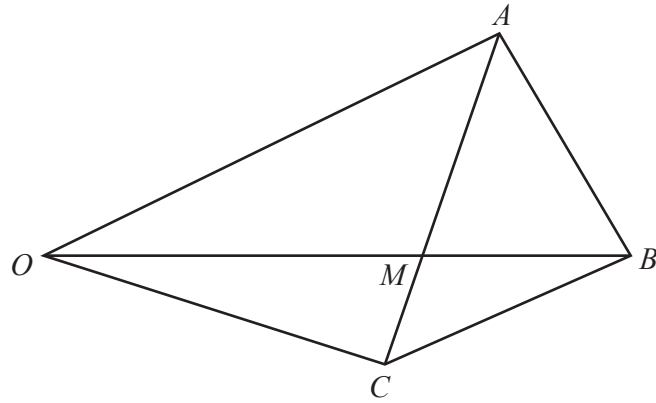
(iii) Hence find the approximate increase in y when x increases from 2 to $2 + h$, where h is small. [2]

- 5 The first 3 terms in the expansion of $(2 + ax)^n$ are equal to $1024 - 1280x + bx^2$, where n , a and b are constants.

(i) Find the value of each of n , a and b . [5]

(ii) Hence find the term independent of x in the expansion of $(2 + ax)^n \left(x - \frac{1}{x}\right)^2$. [3]

6



The diagram shows the quadrilateral $OABC$ such that $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{OC} = \mathbf{c}$. It is given that $AM:MC = 2:1$ and $OM:MB = 3:2$.

(i) Find $\overrightarrow{AC}$ in terms of $\mathbf{a}$ and $\mathbf{c}$. [1]

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

(iii) Find $\overrightarrow{OM}$ in terms of $\mathbf{b}$. [1]

(iv) Find $5\mathbf{a} + 10\mathbf{c}$ in terms of $\mathbf{b}$.

[2]

(v) Find $\overrightarrow{AB}$ in terms of $\mathbf{a}$ and $\mathbf{c}$, giving your answer in its simplest form.

[2]

7 (a) Find the values of a for which $\det \begin{pmatrix} 2a & 1 \\ 4a & a \end{pmatrix} = 6 - 3a$. [3]

(b) It is given that $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 2 & 0 \\ -3 & 5 \end{pmatrix}$.
(i) Find $\mathbf{A}^{-1}$. [2]

(ii) Hence find the matrix $\mathbf{C}$ such that $\mathbf{AC} = \mathbf{B}$. [3]

(c) Find the 2×2 matrix $\mathbf{D}$ such that $4\mathbf{D} + 3\mathbf{I} = \mathbf{O}$. [1]

- 8 A particle P , moving in a straight line, passes through a fixed point O at time $t = 0$ s. At time t s after leaving O , the displacement of the particle is x m and its velocity is v ms⁻¹, where $v = 12e^{2t} - 48t$, $t \geq 0$.

(i) Find x in terms of t . [4]

(ii) Find the value of t when the acceleration of P is zero. [3]

(iii) Find the velocity of P when the acceleration is zero. [2]

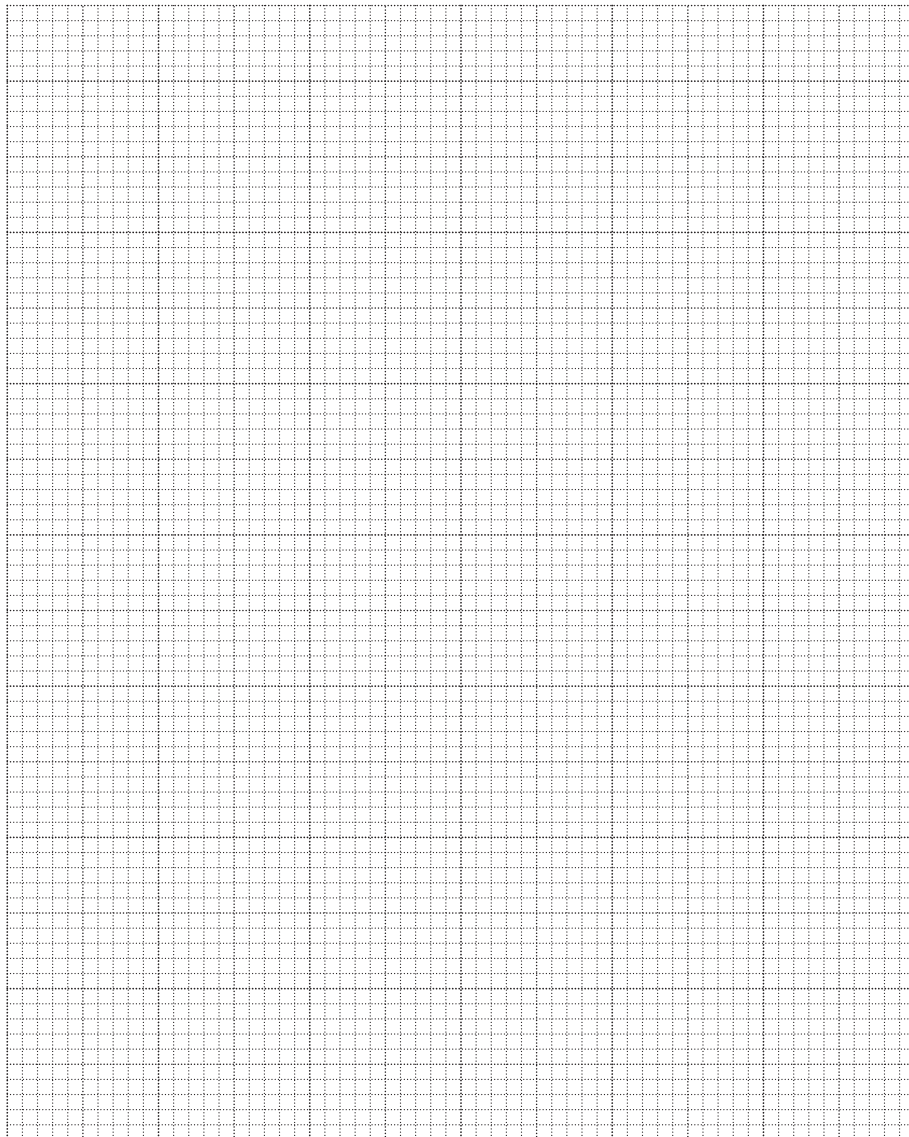
- 9 The table shows values of the variables x and y .

x	2	4	6	8	10
y	736	271	100	37	13

The relationship between x and y is thought to be of the form $y = Ae^{bx}$, where A and b are constants.

- (i) Transform this relationship into straight line form. [1]

- (ii) Hence, by plotting a suitable graph, show that the relationship $y = Ae^{bx}$ is correct. [2]



(iii) Use your graph to find the value of A and of b .

[4]

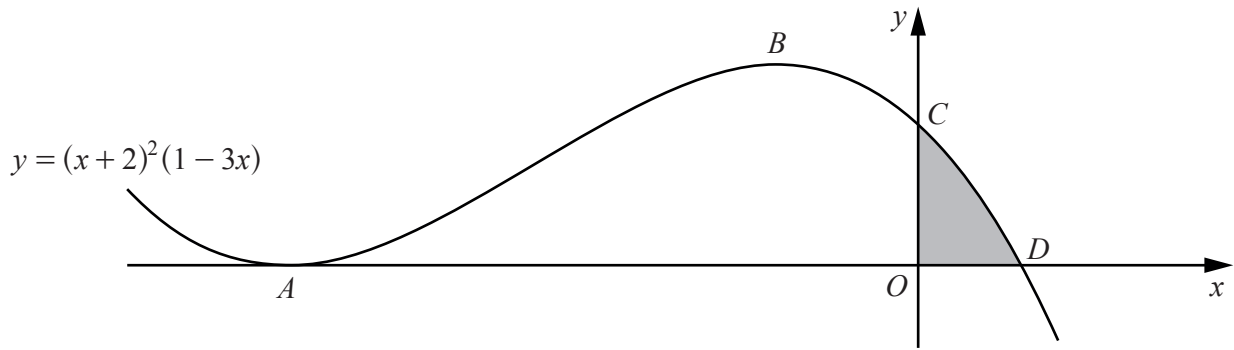
(iv) Estimate the value of x when $y = 500$.

[2]

(v) Estimate the value of y when $x = 5$.

[2]

10



The diagram shows the graph of $y = (x + 2)^2(1 - 3x)$. The curve has a minimum at the point A , a maximum at the point B and intersects the y -axis and the x -axis at the points C and D respectively.

(i) Find the x -coordinate of A and of B .

[5]

(ii) Write down the coordinates of C and of D .

[2]

(iii) Showing all your working, find the area of the shaded region.

[5]

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