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0606/13

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 **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*

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

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

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

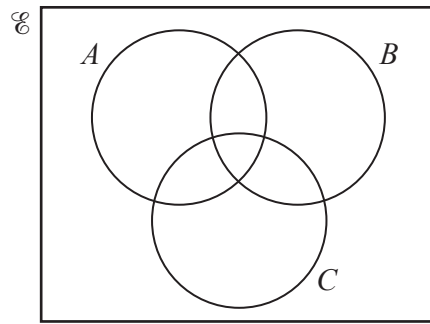
Formulae for $\triangle ABC$

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

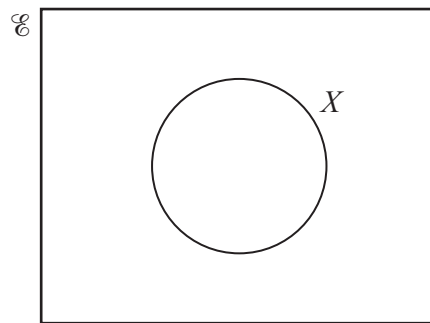
$$a^2 = b^2 + c^2 - 2bc \cos A$$

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

- 1 (a) On the Venn diagram below, shade the region which represents $(A \cap B') \cup (C \cap B')$. [1]



- (b) Complete the Venn diagram below to show the sets Y and Z such that $Z \subset X \subset Y$. [1]

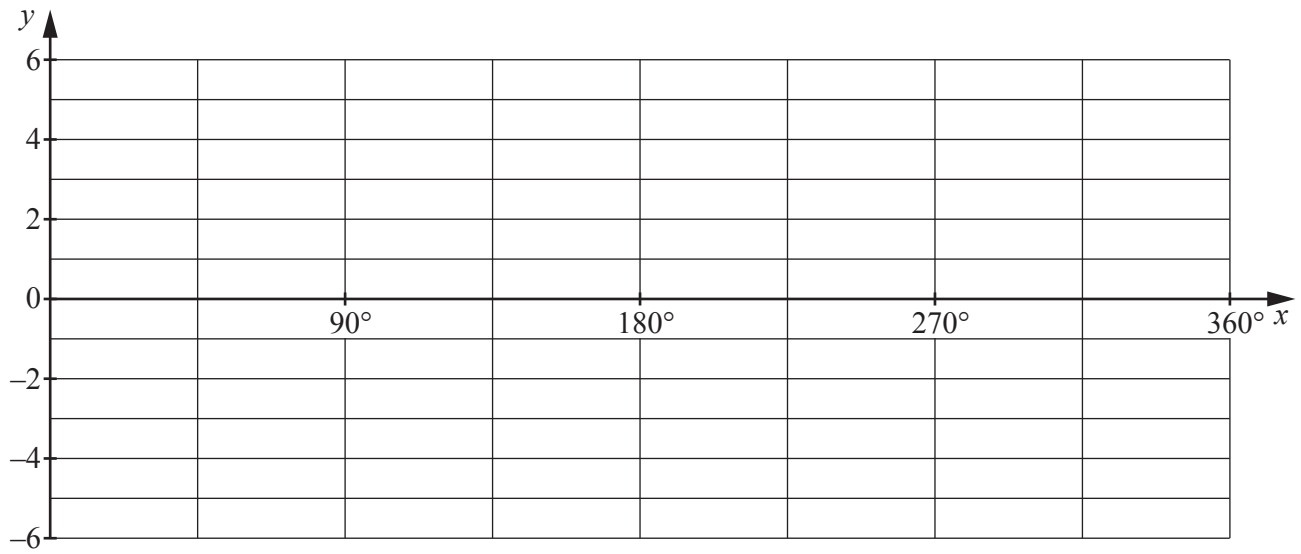


- 2 Given that $y = 3 + 4 \cos 9x$, write down

(i) the amplitude of y , [1]

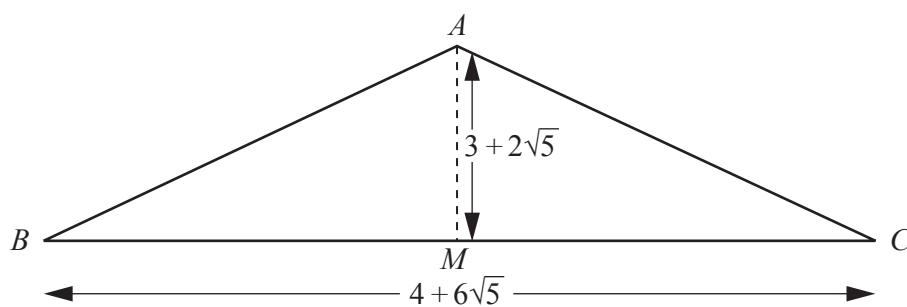
(ii) the period of y . [1]

- 3 (i) On the axes below, sketch the graph of $y = 3 \sin x - 2$ for $0^\circ \leq \theta \leq 360^\circ$. [3]



- (ii) Given that $0 \leq |3 \sin x - 2| \leq k$ for $0^\circ \leq x \leq 360^\circ$, write down the value of k . [1]

- 4 In this question, all dimensions are in centimetres.



The diagram shows an isosceles triangle ABC , where $AB = AC$. The point M is the mid-point of BC . Given that $AM = 3 + 2\sqrt{5}$ and $BC = 4 + 6\sqrt{5}$, find, **without using a calculator**,

- (i) the area of triangle ABC , [2]

- (ii) $\tan ABC$, giving your answer in the form $\frac{a + b\sqrt{5}}{c}$ where a , b and c are positive integers. [3]

- 5 The normal to the curve $y = \sqrt{4x + 9}$, at the point where $x = 4$, meets the x - and y -axes at the points A and B . Find the coordinates of the mid-point of the line AB . [7]

6 (a) Given that $\mathbf{A} = \begin{pmatrix} 3 & 1 \\ 2 & 4 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 5 & 1 \\ 2 & 4 \\ -1 & 0 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} -5 & 2 \\ 3 & 1 \end{pmatrix}$, find

(i) $\mathbf{A} + 3\mathbf{C}$, [2]

(ii) $\mathbf{BA}$. [2]

(b) (i) Given that $\mathbf{X} = \begin{pmatrix} 1 & -3 \\ 4 & -2 \end{pmatrix}$, find $\mathbf{X}^{-1}$. [2]

(ii) Hence find $\mathbf{Y}$, such that $\mathbf{XY} = \begin{pmatrix} 5 & -10 \\ 15 & 20 \end{pmatrix}$. [3]

7 (a) Show that $\frac{\tan^2 \theta + \sin^2 \theta}{\cos \theta + \sec \theta} = \tan \theta \sin \theta$. [4]

- (b) Given that $x = 3 \sin \phi$ and $y = \frac{3}{\cos \phi}$, find the numerical value of $9y^2 - x^2y^2$. [3]

- 8 It is given that $p(x) = 2x^3 + ax^2 + 4x + b$, where a and b are constants. It is given also that $2x + 1$ is a factor of $p(x)$ and that when $p(x)$ is divided by $x - 1$ there is a remainder of -12 .

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

(ii) Using your values of a and b , write $p(x)$ in the form $(2x + 1)q(x)$, where $q(x)$ is a quadratic expression. [2]

(iii) Hence find the exact solutions of the equation $p(x) = 0$. [2]

9 It is given that $\int_{-k}^k (15e^{5x} - 5e^{-5x})dx = 6$.

(i) Show that $e^{5k} - e^{-5k} = 3$. [5]

(ii) Hence, using the substitution $y = e^{5k}$, or otherwise, find the value of k . [3]

10 It is given that $y = (10x + 2)\ln(5x + 1)$.

(i) Find $\frac{dy}{dx}$. [4]

(ii) Hence show that $\int \ln(5x + 1) dx = \frac{(ax + b)}{5} \ln(5x + 1) - x + c$, where a and b are integers and c is a constant of integration. [3]

- (iii) Hence find $\int_0^{\frac{1}{5}} \ln(5x + 1) dx$, giving your answer in the form $\frac{d + \ln f}{5}$, where d and f are integers. [2]

11 A curve has equation $y = 6x - x\sqrt{x}$.

(i) Find the coordinates of the stationary point of the curve. [4]

(ii) Determine the nature of this stationary point. [2]

(iii) Find the approximate change in y when x increases from 4 to $4 + h$, where h is small. [3]

12 A particle moves in a straight line, such that its velocity, $v \text{ ms}^{-1}$, t s after passing a fixed point O , is given by $v = 2 + 6t + 3 \sin 2t$.

(i) Find the acceleration of the particle at time t . [2]

(ii) Hence find the smallest value of t for which the acceleration of the particle is zero. [2]

(iii) Find the displacement, x m from O , of the particle at time t . [5]

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