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0606/12

February/March 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 **14** printed pages and **2** blank 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 (a) It is given that $\mathcal{E} = \{x : 0 < x < 35, x \in \mathbb{R}\}$ and sets A and B are such that

$$A = \{\text{multiples of } 5\} \text{ and } B = \{\text{multiples of } 7\}.$$

- (i) Find $n(A \cap B)$. [1]

- (ii) Find $n(A \cup B)$. [1]

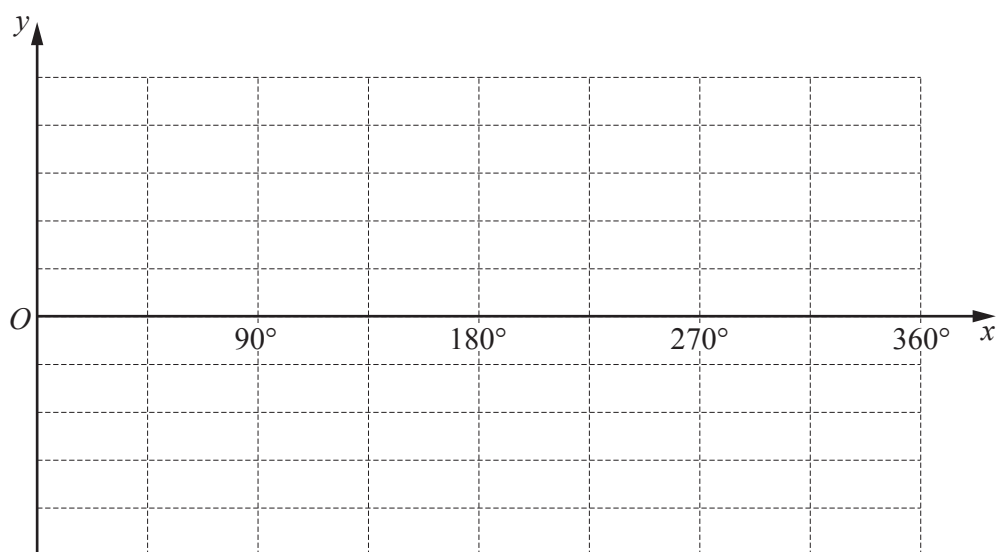
- (b) It is given that sets X , Y and Z are such that

$$X \cap Y = Y, \quad X \cap Z = Z \quad \text{and} \quad Y \cap Z = \emptyset.$$

On the Venn diagram below, illustrate sets X , Y and Z . [3]



- 2 (i) On the axes below sketch, for $0^\circ \leq x \leq 360^\circ$, the graph of $y = 1 + 3 \cos 2x$. [3]



- (ii) Write down the coordinates of the point where this graph first has a minimum value. [1]

- 3 The first three terms in the expansion of $\left(a + \frac{x}{4}\right)^5$ are $32 + bx + cx^2$. Find the value of each of the constants a , b and c . [5]

4 (a) It is given that $\mathbf{A} = \begin{pmatrix} 1 & -3 \\ 2 & 4 \end{pmatrix}$.

(i) Find $\mathbf{A}^{-1}$. [2]

(ii) Using your answer to part (i), find the matrix $\mathbf{M}$ such that $\mathbf{AM} = \begin{pmatrix} -1 & -5 \\ 4 & 2 \end{pmatrix}$. [3]

(b) $\mathbf{X}$ is $\begin{pmatrix} a & -1 \\ 2 & -3 \end{pmatrix}$ and $\mathbf{Y}$ is $\begin{pmatrix} 2 & 1 \\ 4 & 3a \end{pmatrix}$, where a is a constant.

Given that $\det \mathbf{X} = 4 \det \mathbf{Y}$, find the value of a . [2]

5 (i) Show that $\operatorname{cosec} \theta - \sin \theta = \cot \theta \cos \theta$.

[3]

(ii) Hence solve the equation $\operatorname{cosec} \theta - \sin \theta = \frac{1}{3} \cos \theta$, for $0 \leq \theta \leq 2\pi$ radians.

[4]

- 6 (a)** The letters of the word THURSDAY are arranged in a straight line. Find the number of different arrangements of these letters if
- (i)** there are no restrictions, [1]
 - (ii)** the arrangement must start with the letter T and end with the letter Y, [1]
 - (iii)** the second letter in the arrangement must be Y. [1]
- (b)** 7 children have to be divided into two groups, one of 4 children and the other of 3 children. Given that there are 3 girls and 4 boys, find the number of different ways this can be done if
- (i)** there are no restrictions, [1]
 - (ii)** all the boys are in one group, [1]
 - (iii)** one boy and one girl are twins and must be in the same group. [3]

- 7 (a) A vector $\mathbf{v}$ has a magnitude of 102 units and has the same direction as $\begin{pmatrix} 8 \\ -15 \end{pmatrix}$. Find $\mathbf{v}$ in the form $\begin{pmatrix} a \\ b \end{pmatrix}$, where a and b are integers. [2]

- (b) Vectors $\mathbf{c} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $\mathbf{d} = \begin{pmatrix} p - q \\ 5p + q \end{pmatrix}$ are such that $\mathbf{c} + 2\mathbf{d} = \begin{pmatrix} p^2 \\ 27 \end{pmatrix}$. Find the possible values of the constants p and q . [6]

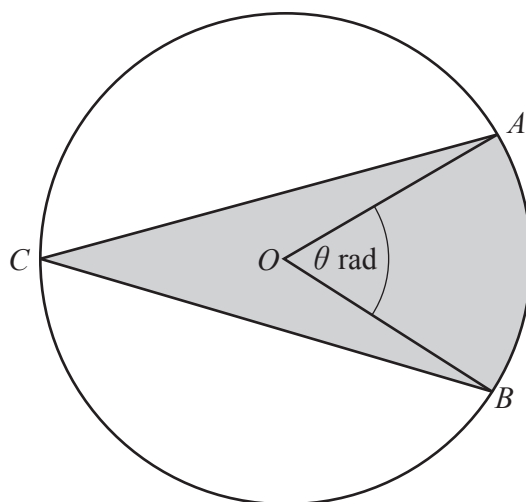
8 A curve is such that $\frac{d^2y}{dx^2} = 4 \sin 2x$. The curve has a gradient of 5 at the point where $x = \frac{\pi}{2}$.

(i) Find an expression for the gradient of the curve at the point (x, y) . [4]

The curve passes through the point $P\left(\frac{\pi}{12}, -\frac{1}{2}\right)$.

(ii) Find the equation of the curve. [4]

(iii) Find the equation of the normal to the curve at the point P , giving your answer in the form $y = mx + c$, where m and c are constants correct to 3 decimal places. [3]



The diagram shows a circle, centre O , radius 10 cm. Points A , B and C lie on the circumference of the circle such that $AC = BC$. The area of the minor sector AOB is $20\pi \text{ cm}^2$ and angle AOB is θ radians.

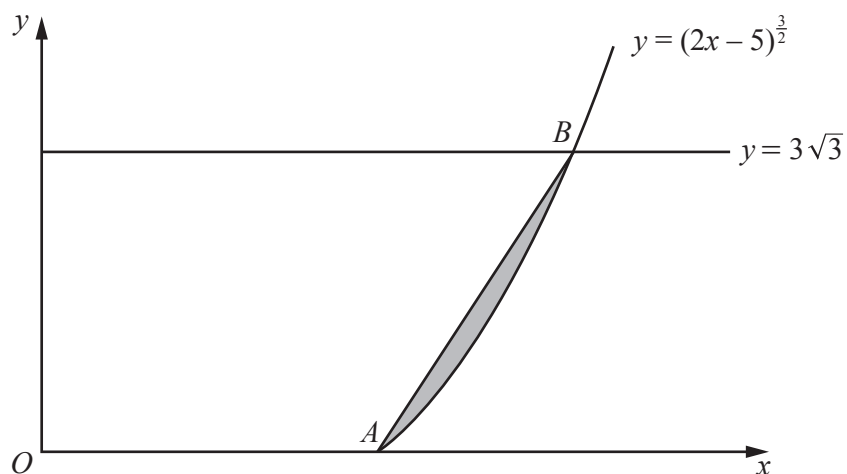
(i) Find the value of θ in terms of π . [2]

(ii) Find the perimeter of the shaded region. [4]

(iii) Find the area of the shaded region.

[3]

10



The diagram shows part of the curve $y = (2x - 5)^{\frac{3}{2}}$ and the line $y = 3\sqrt{3}$. The curve meets the x -axis at the point A and the line $y = 3\sqrt{3}$ at the point B . Find the area of the shaded region enclosed

by the line AB and the curve, giving your answer in the form $\frac{p\sqrt{3}}{20}$, where p is an integer. You must show all your working. [8]

Question 11 is printed on the next page.

- 11** It is given that $y = Ae^{bx}$, where A and b are constants. When $\ln y$ is plotted against x a straight line graph is obtained which passes through the points $(1.0, 0.7)$ and $(2.5, 3.7)$.

(i) Find the value of A and of b . [6]

(ii) Find the value of y when $x = 2$. [2]

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