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0606/12

May/June 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 **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*

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

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

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

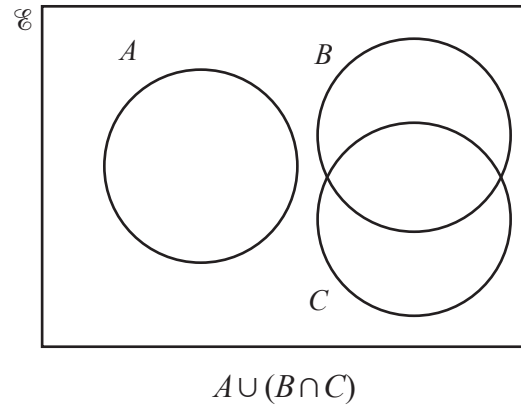
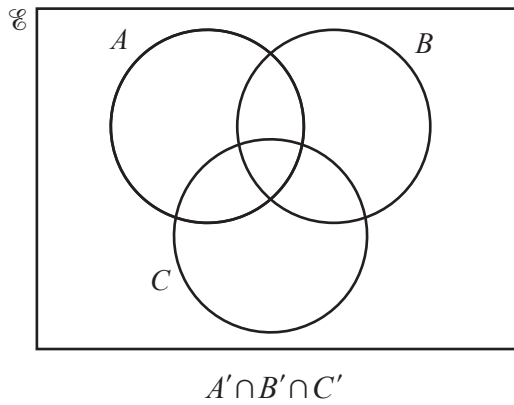
*Formulae for  $\triangle ABC$* 

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

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

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

- 1 (a) On the Venn diagrams below, shade the region indicated.



[2]

- (b)
- $$\mathcal{E} = \{x : 0^\circ \leq x \leq 360^\circ\}$$
- $$P = \{x : \cos 2x = 0.5\}$$
- $$Q = \{x : \sin x = 0.5\}$$

Find  $P \cap Q$ .

[3]

**2 Do not use a calculator in this question.**

Find the coordinates of the points of intersection of the curve  $y = (2x + 3)^2(x - 1)$  and the line  $y = 3(2x + 3)$ .

[5]

3 The number,  $B$ , of a certain type of bacteria at time  $t$  days can be described by  $B = 200e^{2t} + 800e^{-2t}$ .

(i) Find the value of  $B$  when  $t = 0$ . [1]

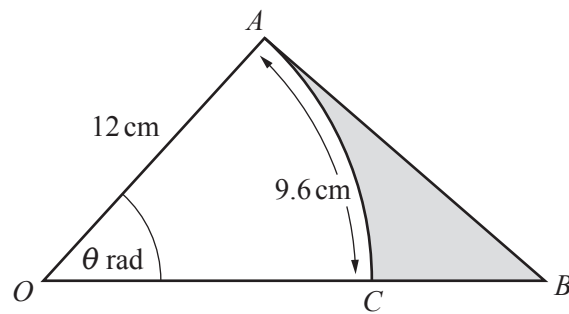
(ii) At the instant when  $\frac{dB}{dt} = 1200$ , show that  $e^{4t} - 3e^{2t} - 4 = 0$ . [3]

(iii) Using the substitution  $u = e^{2t}$ , or otherwise, solve  $e^{4t} - 3e^{2t} - 4 = 0$ . [2]

- 4 (a) Given that  $\frac{(pr^2)^{\frac{3}{2}}\sqrt{qr}}{q^2(pr^2)^{-1}}$  can be written in the form  $p^a q^b r^c$ , find the value of each of the constants  $a$ ,  $b$  and  $c$ . [3]

- (b) Solve 
$$\begin{aligned} 3x^{\frac{1}{2}} - y^{-\frac{1}{2}} &= 4, \\ 4x^{\frac{1}{2}} + 3y^{-\frac{1}{2}} &= 14. \end{aligned}$$
 [3]

5



The diagram shows the right-angled triangle  $OAB$ . The point  $C$  lies on the line  $OB$ . Angle  $OAB = \frac{\pi}{2}$  radians and angle  $AOB = \theta$  radians.  $AC$  is an arc of the circle, centre  $O$ , radius 12 cm and  $AC$  has length 9.6 cm.

(i) Find the value of  $\theta$ . [2]

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

- 6 (a) Eight books are to be arranged on a shelf. There are 4 mathematics books, 3 geography books and 1 French book.
- (i) Find the number of different arrangements of the books if there are no restrictions. [1]
- (ii) Find the number of different arrangements if the mathematics books have to be kept together. [3]
- (iii) Find the number of different arrangements if the mathematics books have to be kept together and the geography books have to be kept together. [3]



(b) A team of 6 players is to be chosen from 8 men and 4 women. Find the number of different ways this can be done if

(i) there are no restrictions, [1]

(ii) there is at least one woman in the team. [2]

- 7 A pilot wishes to fly his plane from a point  $A$  to a point  $B$  on a bearing of  $055^\circ$ . There is a wind blowing at  $120 \text{ km h}^{-1}$  from the west. The plane can fly at  $650 \text{ km h}^{-1}$  in still air.

(i) Find the direction in which the pilot must fly his plane in order to reach  $B$ . [4]

(ii) Given that the distance between  $A$  and  $B$  is  $1250 \text{ km}$ , find the time it will take the pilot to fly from  $A$  to  $B$ . [4]

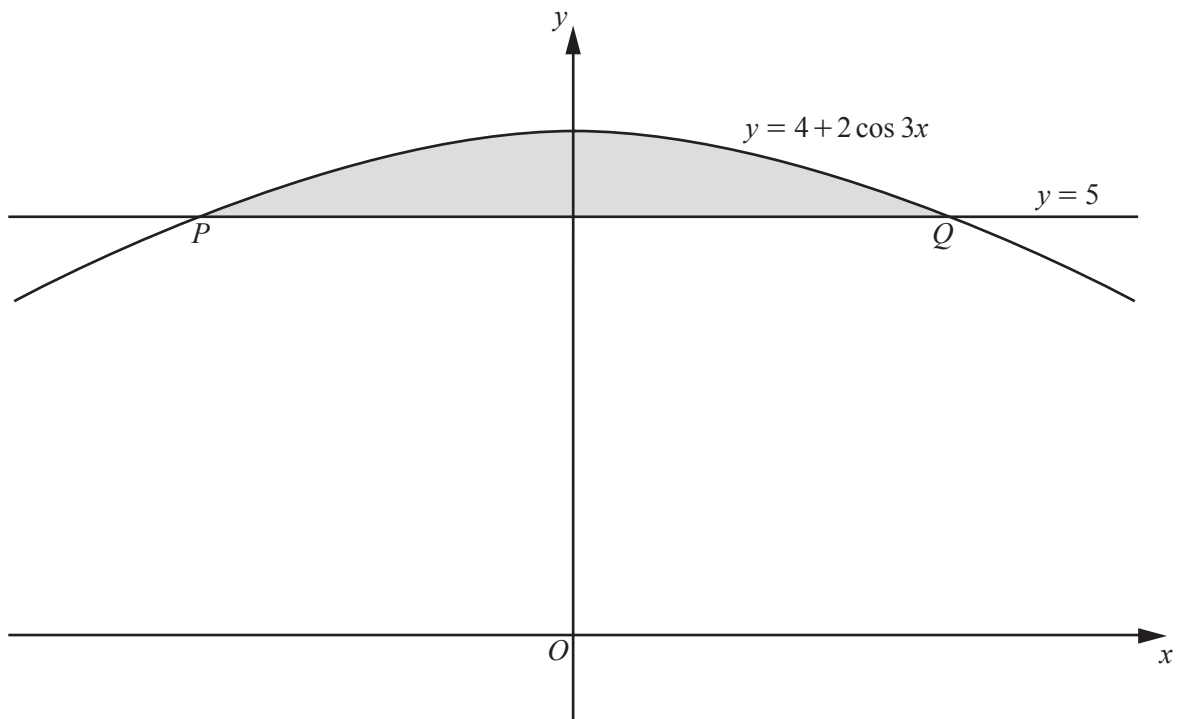
8 When  $e^y$  is plotted against  $\frac{1}{x}$ , a straight line graph passing through the points (2, 20) and (4, 8) is obtained.

(i) Find  $y$  in terms of  $x$ . [5]

(ii) Hence find the positive values of  $x$  for which  $y$  is defined. [1]

(iii) Find the exact value of  $y$  when  $x = 3$ . [1]

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



The diagram shows the curve  $y = 4 + 2 \cos 3x$  intersecting the line  $y = 5$  at the points  $P$  and  $Q$ .

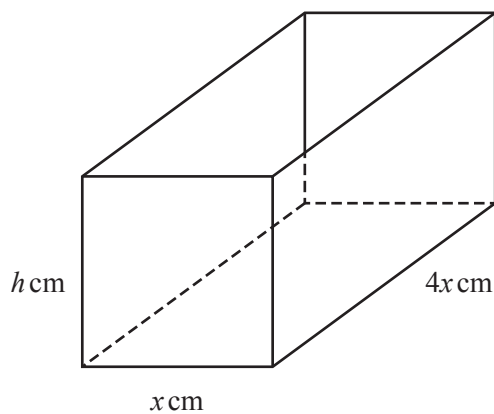
- (i) Find, in terms of  $\pi$ , the  $x$ -coordinate of  $P$  and of  $Q$ .

[3]

- (ii) Find the exact area of the shaded region. You must show all your working.

[6]

10



The diagram shows an open container in the shape of a cuboid of width  $x \text{ cm}$ , length  $4x \text{ cm}$  and height  $h \text{ cm}$ . The volume of the container is  $800 \text{ cm}^3$ .

- (i) Show that the external surface area,  $S \text{ cm}^2$ , of the open container is such that  $S = 4x^2 + \frac{2000}{x}$ . [4]

- (ii) Given that  $x$  can vary, find the stationary value of  $S$  and determine its nature. [5]

**Question 11 is printed on the next page.**

- 11 The normal to the curve  $y = (x-2)(3x+1)^{\frac{2}{3}}$  at the point where  $x = \frac{7}{3}$ , meets the  $y$ -axis at the point  $P$ . Find the exact coordinates of the point  $P$ . [7]

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