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4037/12

May/June 2019

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*

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

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

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

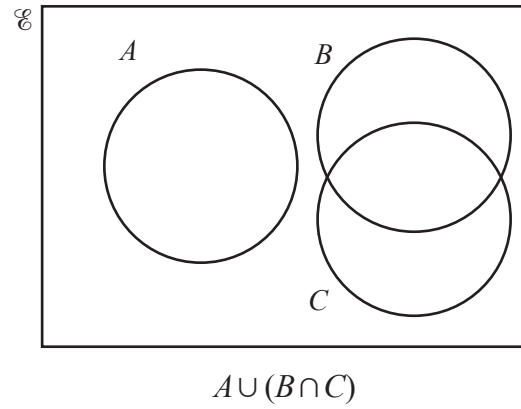
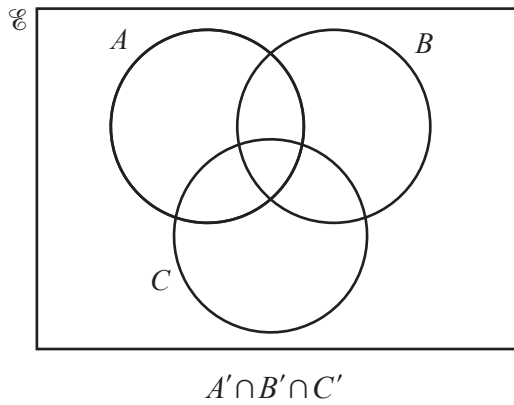
Formulae for $\triangle ABC$

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

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

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

- 1 (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]

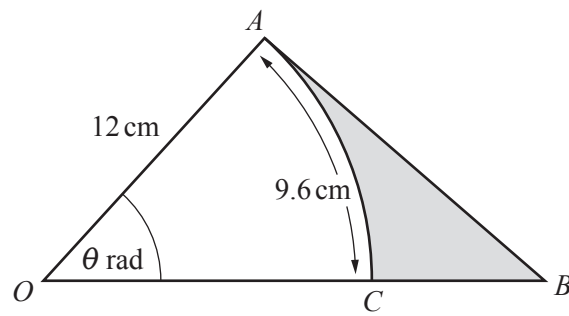
(ii) At the instant when $\frac{dB}{dt} = 1200$, show that $e^{4t} - 3e^{2t} - 4 = 0$. [3]

(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 θ . [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° . There is a wind blowing at 120 km h^{-1} from the west. The plane can fly at 650 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 km , find the time it will take the pilot to fly from A to B . [4]

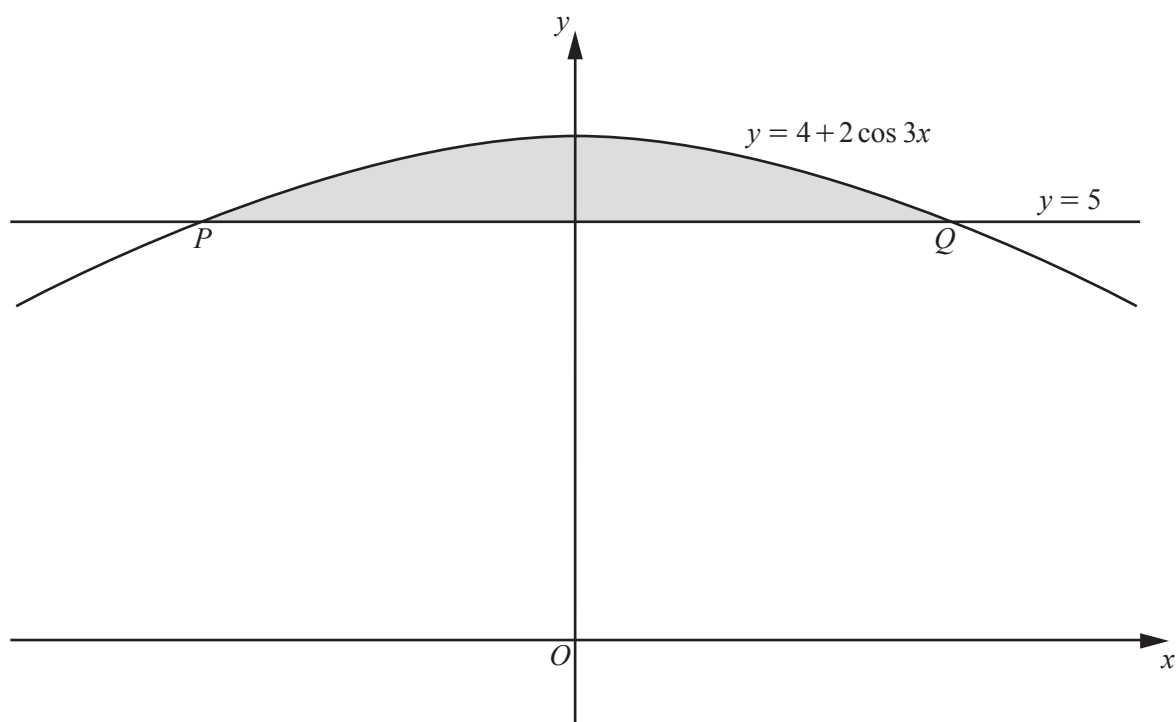
8 When e^y is plotted against $\frac{1}{x}$, a straight line graph passing through the points (2, 20) and (4, 8) is obtained.

(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 .

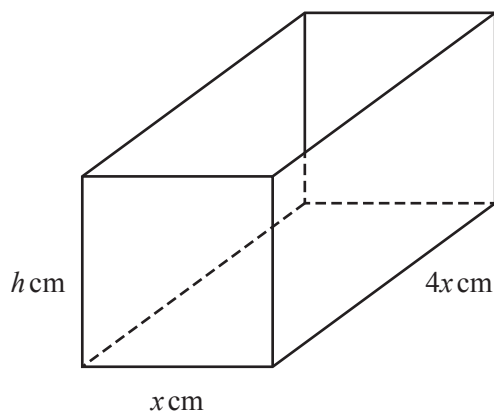
- (i) Find, in terms of π , the x -coordinate of P and of Q .

[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 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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