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0606/22

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 **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*

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

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

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

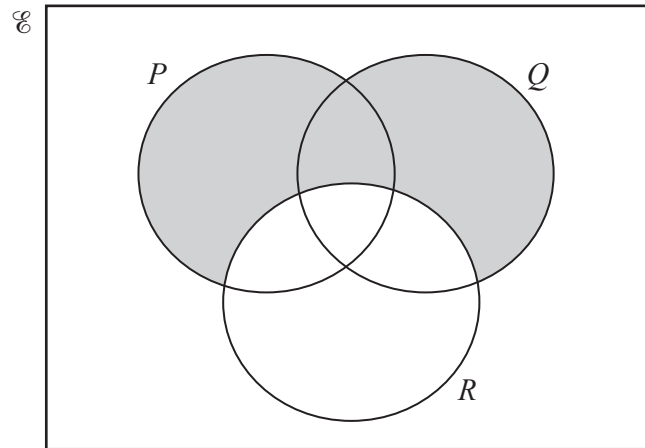
Formulae for $\triangle ABC$

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

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

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

1 (a)



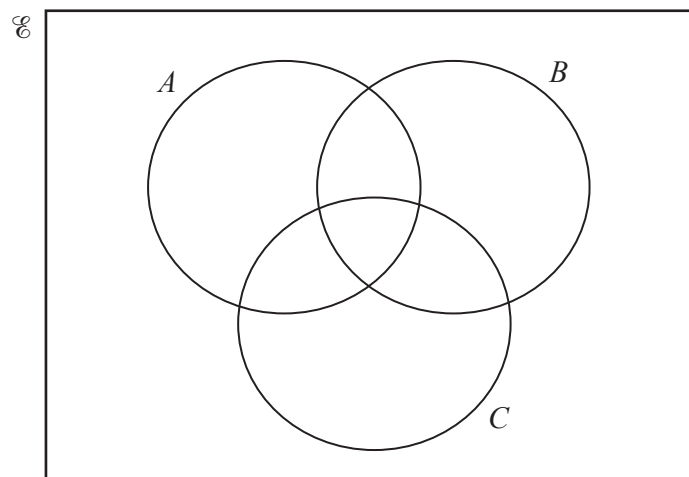
Using set notation, write down the set represented by the shaded region.

[1]

- (b) $\mathcal{E} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
 $A = \{x: x \text{ is a prime number}\}$
 $B = \{x: x \text{ is an even number}\}$
 $C = \{1, 2, 3, 4, 8\}$

(i) Complete the Venn diagram to show the elements of each set.

[3]



(ii) Write down the value of $n((A \cup B \cup C)')$.

[1]

- 2 Determine the set of values of k for which the equation $(3 - 2k)x^2 + (2k - 3)x + 1 = 0$ has no real roots. [5]

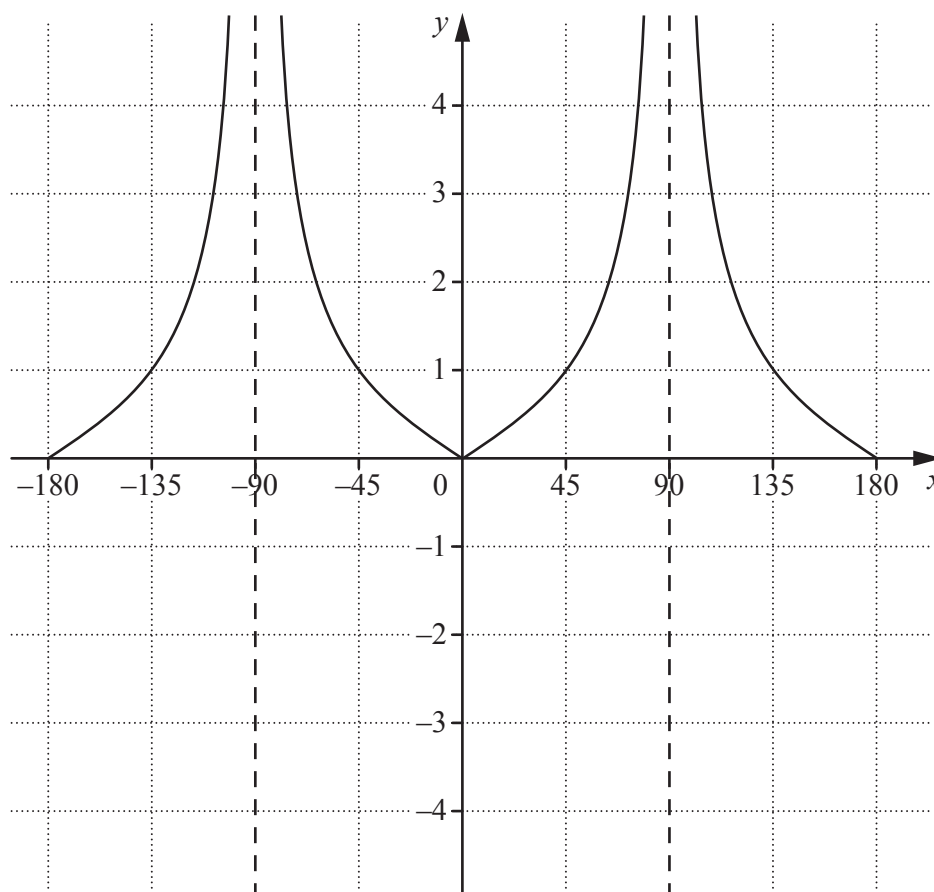
- 3 A group of five people consists of two women, Alice and Betty, and three men, Carl, David and Ed.
- (i) Three of these five people are chosen at random to be a chairperson, a treasurer and a secretary. Find the number of ways in which this can be done if the chairperson and treasurer are both men. [2]

These five people sit in a row of five chairs. Find the number of different possible seating arrangements if

- (ii) David must sit in the middle, [1]
- (iii) Alice and Carl must sit together. [2]

- 4 (a) (i) State the amplitude of $15\sin 2x - 5$. [1]
- (ii) State the period of $15\sin 2x - 5$. [1]

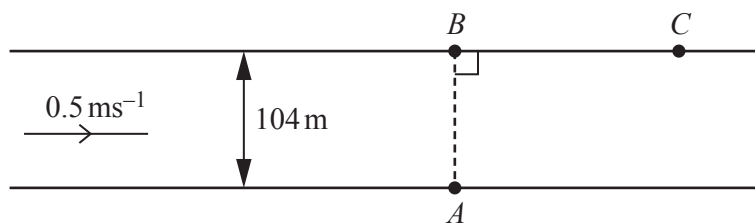
(b)



The diagram shows the graph of $y = |f(x)|$ for $-180^\circ \leq x^\circ \leq 180^\circ$, where $f(x)$ is a trigonometric function.

- (i) Write down two possible expressions for the trigonometric function $f(x)$. [2]
- (ii) State the number of solutions of the equation $|f(x)| = 1$ for $-180^\circ \leq x^\circ \leq 180^\circ$. [1]

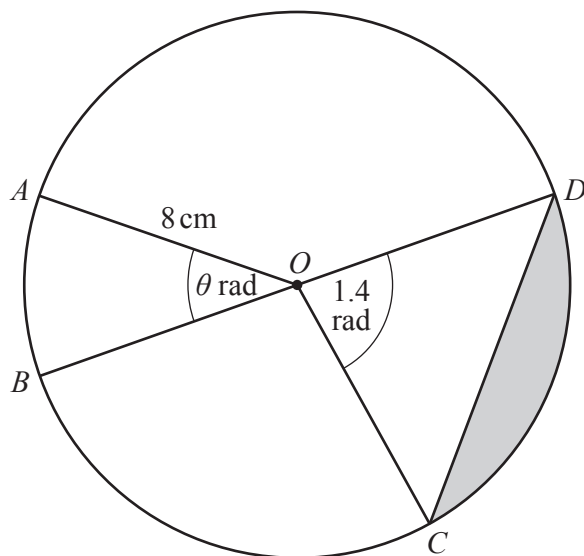
5



A river is 104 metres wide and the current flows at 0.5 ms^{-1} parallel to its banks. A woman can swim at 1.6 ms^{-1} in still water. She swims from point A and aims for point B which is directly opposite, but she is carried downstream to point C . Calculate the time it takes the woman to swim across the river and the distance downstream, BC , that she travels. [4]

6 (i) Differentiate $1 + \tan\left(\frac{x}{3}\right)$ with respect to x . [2]

(ii) Hence find $\int \sec^2\left(\frac{x}{3}\right) dx$. [2]



The diagram shows a circle with centre O and radius 8 cm . The points A , B , C and D lie on the circumference of the circle. Angle $AOB = \theta$ radians and angle $COD = 1.4$ radians. The area of sector AOB is 20 cm^2 .

(i) Find angle θ . [2]

(ii) Find the length of the arc AB . [2]

(iii) Find the area of the shaded segment. [3]

8 (a) Solve the following equations.

(i) $5e^{3x+4} = 14$ [2]

(ii) $\lg(2y - 7) + \lg y = 2 \lg 3$ [4]

(b) Write $\frac{\log_2 p - \log_2 q}{(\log_2 r)(\log_r 2)}$ as a single logarithm to base 2. [2]

9 Solutions to this question by accurate drawing will not be accepted.

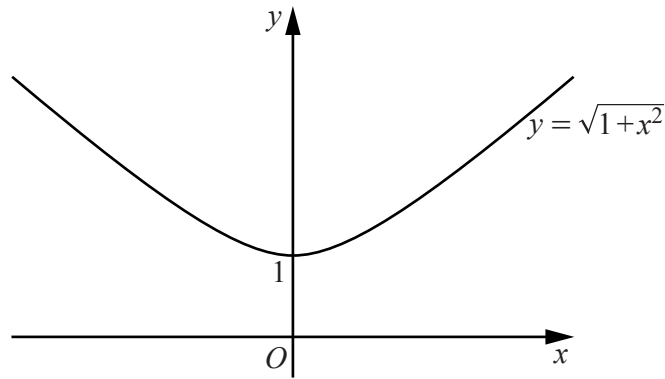
P is the point $(8, 2)$ and Q is the point $(11, 6)$.

- (i)** Find the equation of the line L which passes through P and is perpendicular to the line PQ . [3]

The point R lies on L such that the area of triangle PQR is 12.5 units^2 .

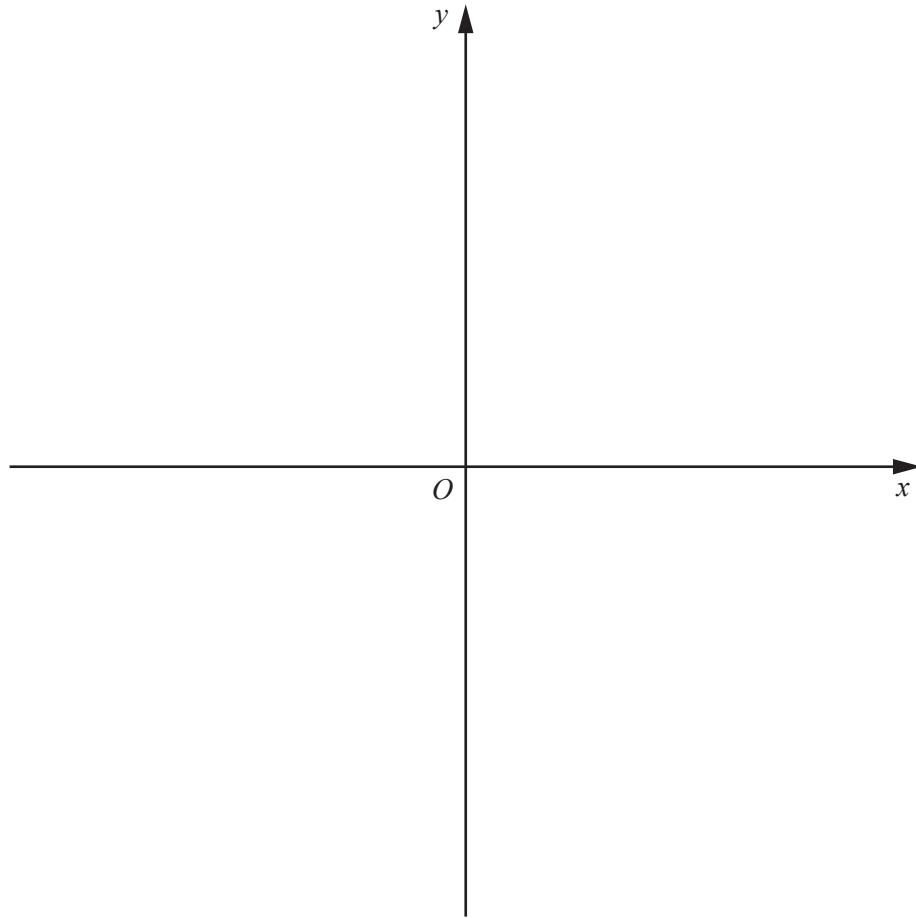
- (ii)** Showing all your working, find the coordinates of each of the two possible positions of point R . [6]

- 10 (a)** The function f is defined by $f(x) = \sqrt{1+x^2}$, for all real values of x . The graph of $y = f(x)$ is given below.



- (i)** Explain, with reference to the graph, why f does not have an inverse. [1]
- (ii)** Find $f^2(x)$. [2]
- (b)** The function g is defined, for $x > k$, by $g(x) = \sqrt{1+x^2}$ and g has an inverse.
- (i)** Write down a possible value for k . [1]
- (ii)** Find $g^{-1}(x)$. [2]

- (c) The function h is defined, for all real values of x , by $h(x) = 4e^x + 2$. Sketch the graph of $y = h(x)$. Hence, on the same axes, sketch the graph of $y = h^{-1}(x)$. Give the coordinates of any points where your graphs meet the coordinate axes. [4]



11 (a) (i) Show that $\frac{(1 - \sin A)(1 + \sin A)}{\sin A \cos A} = \cot A$. [2]

(ii) Hence solve $\frac{(1 - \sin 3x)(1 + \sin 3x)}{\sin 3x \cos 3x} = \frac{1}{2}$ for $0^\circ \leq x \leq 180^\circ$. [4]

- (b) Solve $10 \tan^2 y - \sec y - 1 = 0$ for $0 \leq y \leq 2\pi$ radians. [5]

- 12** The volume, V , and surface area, S , of a sphere of radius r are given by $V = \frac{4}{3}\pi r^3$ and $S = 4\pi r^2$ respectively.

The volume of a sphere increases at a rate of 200 cm^3 per second. At the instant when the radius of the sphere is 10 cm , find

- (i) the rate of increase of the radius of the sphere, [4]

- (ii) the rate of increase of the surface area of the sphere. [3]

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