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0606/11

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 **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*

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

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

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

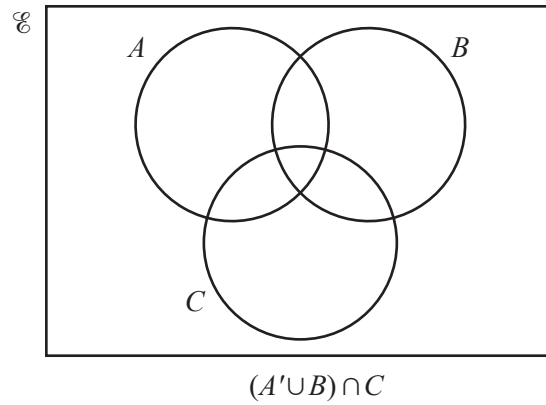
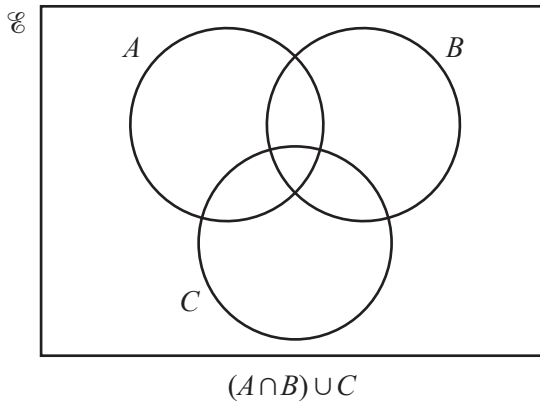
Formulae for $\triangle ABC$

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

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

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

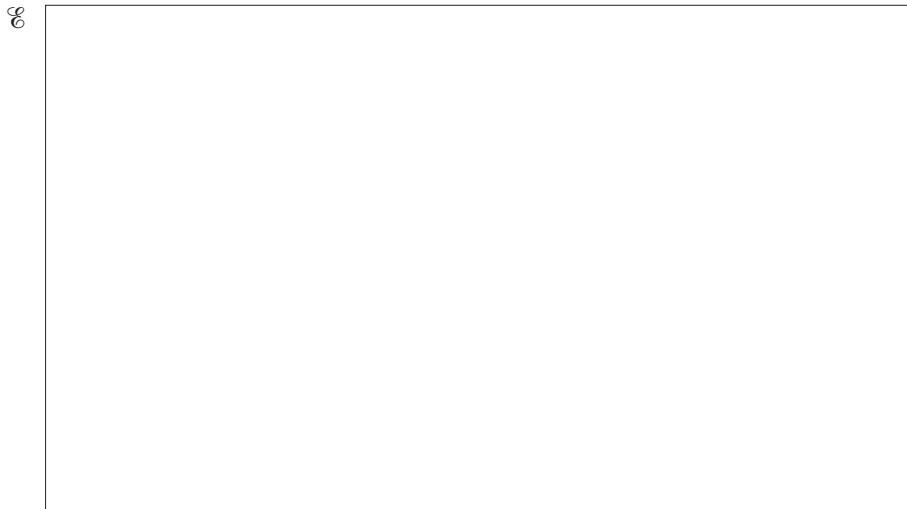
- 1 (a) On the Venn diagrams below, shade the region indicated.



[2]

- (b) On the Venn diagram below, draw sets P , Q and R such that

$$P \subset R, \quad Q \subset R \quad \text{and} \quad P \cap Q = \emptyset.$$

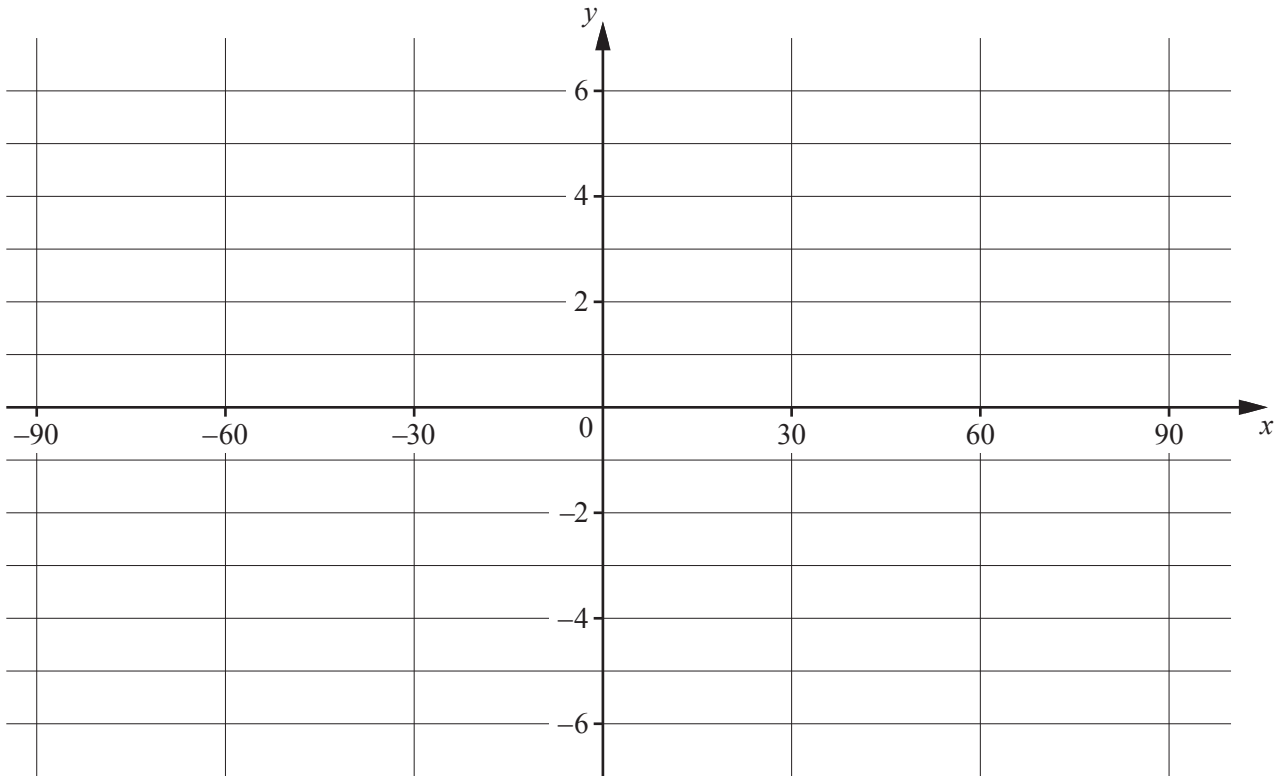


[2]

2 (i) Write down the amplitude of $4 \sin 3x - 1$. [1]

(ii) Write down the period of $4 \sin 3x - 1$. [1]

(iii) On the axes below, sketch the graph of $y = 4 \sin 3x - 1$ for $-90^\circ \leq x^\circ \leq 90^\circ$.



[3]

3 The polynomial $p(x) = (2x - 1)(x + k) - 12$, where k is a constant.

(i) Write down the value of $p(-k)$. [1]

When $p(x)$ is divided by $x + 3$ the remainder is 23.

(ii) Find the value of k . [2]

(iii) Using your value of k , show that the equation $p(x) = -25$ has no real solutions. [3]

- 4 (i) The first 3 terms, in ascending powers of x , in the expansion of $(2 + bx)^8$ can be written as $a + 256x + cx^2$. Find the value of each of the constants a , b and c . [4]

- (ii) Using the values found in **part (i)**, find the term independent of x in the expansion of $(2 + bx)^8 \left(2x - \frac{3}{x}\right)^2$. [3]

5 A particle P is moving with a velocity of 20 ms^{-1} in the same direction as $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$.

(i) Find the velocity vector of P .

[2]

At time $t = 0 \text{ s}$, P has position vector $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ relative to a fixed point O .

(ii) Write down the position vector of P after $t \text{ s}$.

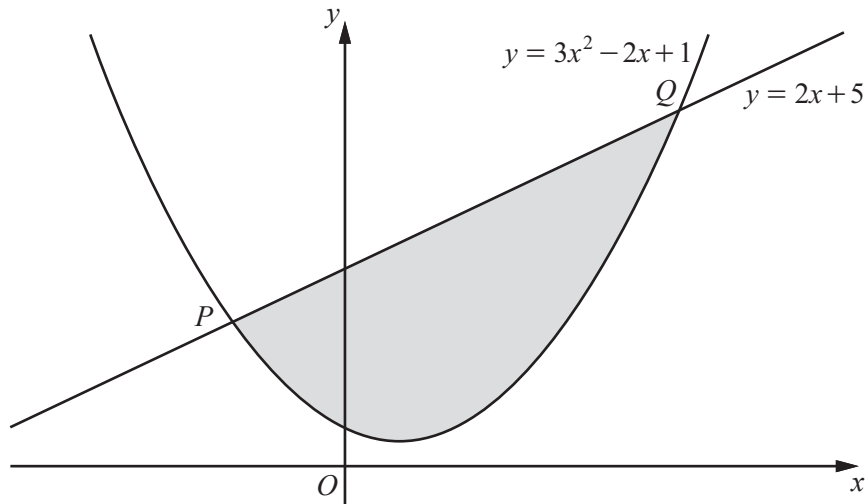
[2]

A particle Q has position vector $\begin{pmatrix} 17 \\ 18 \end{pmatrix}$ relative to O at time $t = 0 \text{ s}$ and has a velocity vector $\begin{pmatrix} 8 \\ 12 \end{pmatrix} \text{ ms}^{-1}$.

(iii) Given that P and Q collide, find the value of t when they collide and the position vector of the point of collision.

[3]

6



The diagram shows the curve $y = 3x^2 - 2x + 1$ and the straight line $y = 2x + 5$ intersecting at the points P and Q . Showing all your working, find the area of the shaded region. [8]

7 **(a)** Solve $\log_3 x + \log_9 x = 12$.

[3]

(b) Solve $\log_4(3y^2 - 10) = 2\log_4(y - 1) + \frac{1}{2}$.

[5]

8 It is given that $f(x) = 5e^x - 1$ for $x \in \mathbb{R}$.

(i) Write down the range of f . [1]

(ii) Find f^{-1} and state its domain. [3]

It is given also that $g(x) = x^2 + 4$ for $x \in \mathbb{R}$.

(iii) Find the value of $fg(1)$. [2]

(iv) Find the exact solutions of $g^2(x) = 40$.

[3]

9 In this question all lengths are in centimetres.

A closed cylinder has base radius r , height h and volume V . It is given that the total surface area of the cylinder is 600π and that V , r and h can vary.

(i) Show that $V = 300\pi r - \pi r^3$. [3]

(ii) Find the stationary value of V and determine its nature. [5]

- 10** When $\lg y$ is plotted against x^2 a straight line graph is obtained which passes through the points $(2, 4)$ and $(6, 16)$.

(i) Show that $y = 10^{A+Bx^2}$, where A and B are constants. [4]

(ii) Find y when $x = \frac{1}{\sqrt{3}}$. [2]

(iii) Find the positive value of x when $y = 2$. [3]

11 It is given that $y = (x^2 + 1)(2x - 3)^{\frac{1}{2}}$.

(i) Show that $\frac{dy}{dx} = \frac{Px^2 + Qx + 1}{(2x - 3)^{\frac{1}{2}}}$, where P and Q are integers. [5]

- (ii) Hence find the equation of the normal to the curve $y = (x^2 + 1)(2x - 3)^{\frac{1}{2}}$ at the point where $x = 2$, giving your answer in the form $ax + by + c = 0$, where a , b and c are integers. [4]

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