

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*

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

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

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

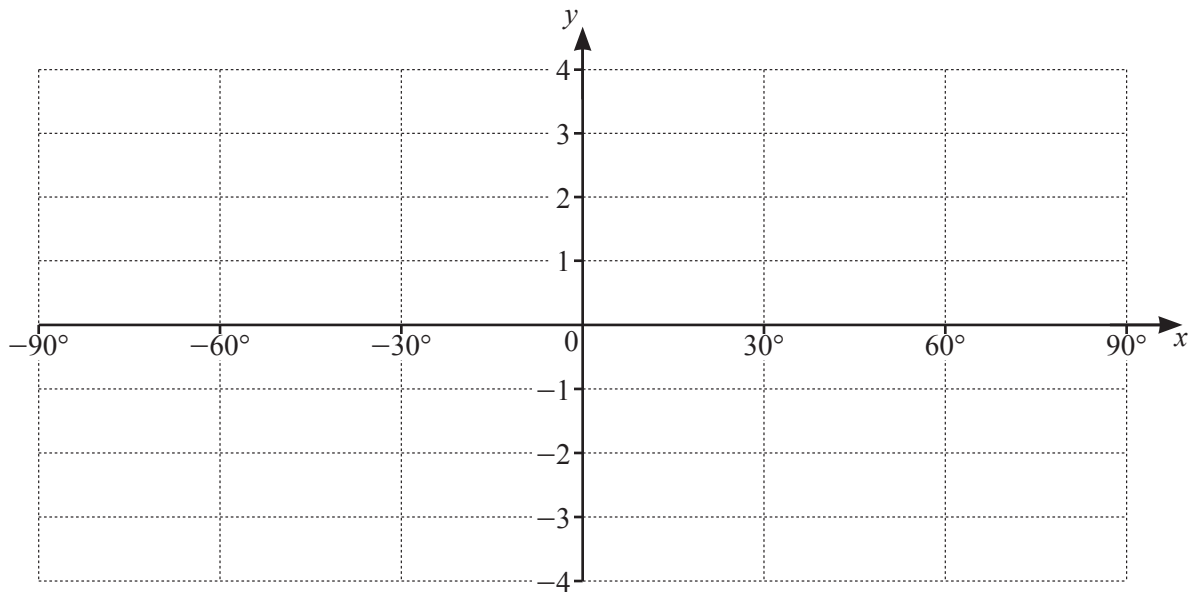
Formulae for $\triangle ABC$

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

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

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

- 1 (i) On the axes below, sketch the graph of $y = 2 \cos 3x - 1$ for $-90^\circ \leq x \leq 90^\circ$.



[3]

- (ii) Write down the amplitude of $2 \cos 3x - 1$.

[1]

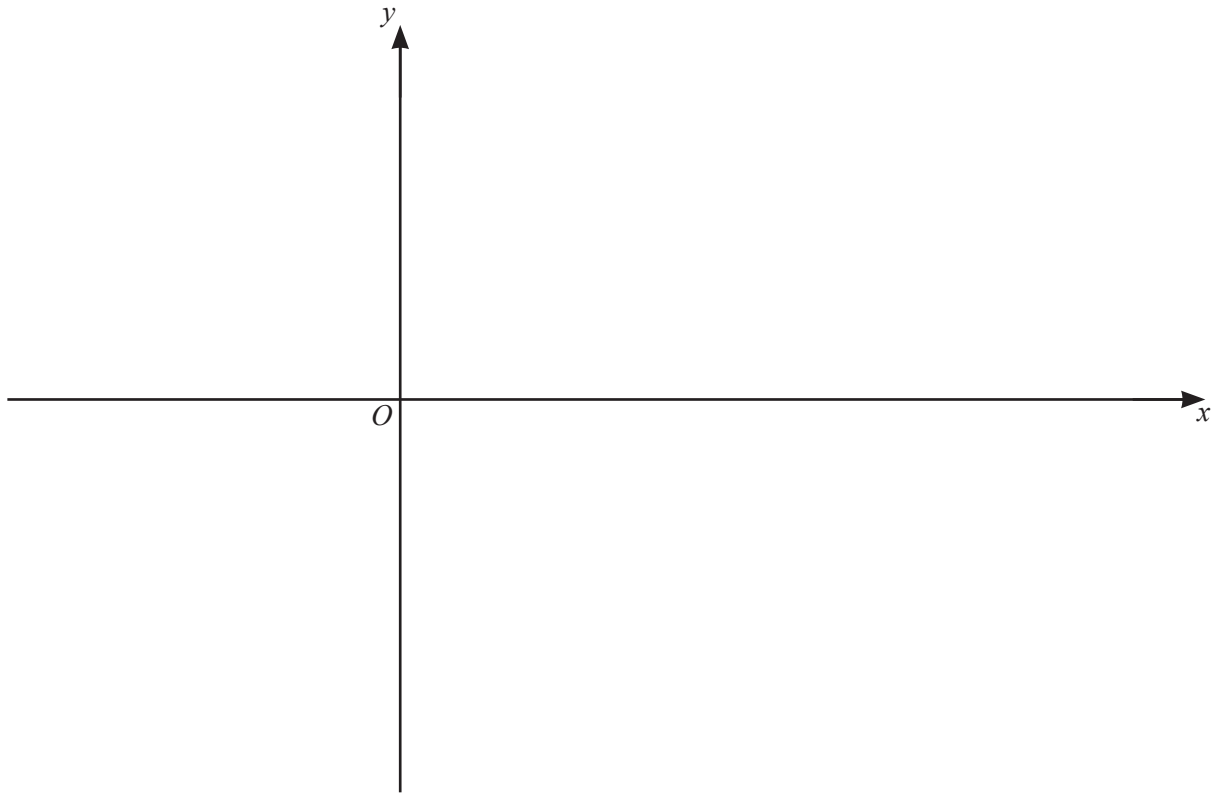
- (iii) Write down the period of $2 \cos 3x - 1$.

[1]

- 2 When $\lg y^2$ is plotted against x , a straight line is obtained passing through the points $(5, 12)$ and $(3, 20)$. Find y in terms of x , giving your answer in the form $y = 10^{ax+b}$, where a and b are integers. [5]

- 3 The first three terms in the expansion of $\left(1 - \frac{x}{7}\right)^{14} (1 - 2x)^4$ can be written as $1 + ax + bx^2$. Find the value of each of the constants a and b . [6]

- 4 (i) On the axes below, sketch the graph of $y = |2x^2 - 9x - 5|$ showing the coordinates of the points where the graph meets the axes. [4]



- (ii) Find the values of k for which $|2x^2 - 9x - 5| = k$ has exactly 2 solutions. [3]

- 5 (a)** It is given that $f : x \mapsto \sqrt{x}$ for $x \geq 0$,
 $g : x \mapsto x + 5$ for $x \geq 0$.

Identify each of the following functions with one of f^{-1} , g^{-1} , fg , gf , f^2 , g^2 .

(i) $\sqrt{x+5}$ [1]

(ii) $x-5$ [1]

(iii) x^2 [1]

(iv) $x+10$ [1]

- (b)** It is given that $h(x) = a + \frac{b}{x^2}$ where a and b are constants.

(i) Why is $-2 \leq x \leq 2$ not a suitable domain for $h(x)$? [1]

(ii) Given that $h(1) = 4$ and $h'(1) = 16$, find the value of a and of b . [2]

6 (a) Write $\frac{\sqrt{p}\left(\frac{qp}{r}\right)^2}{p^{-1}\sqrt[3]{qr}}$ in the form $p^a q^b r^c$, where a , b and c are constants. [3]

(b) Solve $\log_7 x + 2 \log_x 7 = 3$. [4]

7 It is given that $y = (1 + e^{x^2})(x + 5)$.

(i) Find $\frac{dy}{dx}$. [3]

(ii) Find the approximate change in y as x increases from 0.5 to $0.5 + p$, where p is small. [2]

(iii) Given that y is increasing at a rate of 2 units per second when $x = 0.5$, find the corresponding rate of change in x . [2]

- 8 (a) Five teams took part in a competition in which each team played each of the other 4 teams. The following table represents the results after all the matches had been played.

Team	Won	Drawn	Lost
A	2	1	1
B	1	3	0
C	1	1	2
D	0	1	3
E	3	0	1

Points in the competition were awarded to the teams as follows

4 for each match won, 2 for each match drawn, 0 for each match lost.

- (i) Write down two matrices whose product under matrix multiplication will give the total number of points awarded to each team. [2]

- (ii) Evaluate the matrix product from **part (i)** and hence state which team was awarded the most points. [2]

(b) It is given that $\mathbf{A} = \begin{pmatrix} 1 & -1 \\ 2 & 4 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 5 & 0 \\ 1 & -2 \end{pmatrix}$.

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

[2]

(ii) Hence find the matrix $\mathbf{C}$ such that $\mathbf{AC} = \mathbf{B}$.

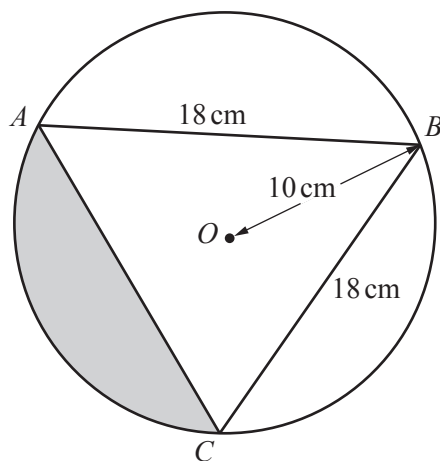
[3]

- 9 A solid circular cylinder has a base radius of r cm and a height of h cm. The cylinder has a volume of $1200\pi \text{ cm}^3$ and a total surface area of $S \text{ cm}^2$.

(i) Show that $S = 2\pi r^2 + \frac{2400\pi}{r}$. [3]

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

10



The diagram shows a circle centre O , radius 10 cm. The points A , B and C lie on the circumference of the circle such that $AB = BC = 18$ cm.

(i) Show that angle $AOB = 2.24$ radians correct to 2 decimal places. [3]

(ii) Find the perimeter of the shaded region. [5]

Continuation of working space for Question 10(ii).

(iii) Find the area of the shaded region.

[3]

Question 11 is printed on the next page.

- 11 A curve is such that $\frac{d^2y}{dx^2} = 2(3x-1)^{-\frac{2}{3}}$. Given that the curve has a gradient of 6 at the point (3, 11), find the equation of the curve. [8]

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