

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*

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

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

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

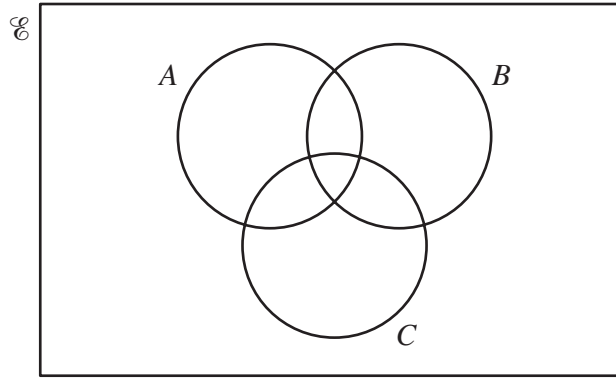
Formulae for ΔABC

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

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

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

1



(i) Copy the Venn diagram above and shade the region that represents $A \cup (B \cap C)$. [1]

(ii) Copy the Venn diagram above and shade the region that represents $A \cap (B \cup C)$. [1]

(iii) Copy the Venn diagram above and shade the region that represents $(A \cup B \cup C)'$. [1]

2 Find the set of values of x for which $(2x + 1)^2 > 8x + 9$. [4]

3 Prove that $\frac{\sin A}{1 + \cos A} + \frac{1 + \cos A}{\sin A} \equiv 2 \operatorname{cosec} A$. [4]

4 A function f is such that $f(x) = ax^3 + bx^2 + 3x + 4$. When $f(x)$ is divided by $x - 1$, the remainder is 3. When $f(x)$ is divided by $2x + 1$, the remainder is 6. Find the value of a and of b . [5]

5 Given that $\mathbf{a} = 5\mathbf{i} - 12\mathbf{j}$ and that $\mathbf{b} = p\mathbf{i} + \mathbf{j}$, find

(i) the unit vector in the direction of \mathbf{a} , [2]

(ii) the values of the constants p and q such that $q\mathbf{a} + \mathbf{b} = 19\mathbf{i} - 23\mathbf{j}$. [3]

6 (i) Solve the equation $2t = 9 + \frac{5}{t}$. [3]

(ii) Hence, or otherwise, solve the equation $2x^{\frac{1}{2}} = 9 + 5x^{-\frac{1}{2}}$. [3]

7 (i) Express $4x^2 - 12x + 3$ in the form $(ax + b)^2 + c$, where a , b and c are constants and $a > 0$. [3]

(ii) Hence, or otherwise, find the coordinates of the stationary point of the curve $y = 4x^2 - 12x + 3$. [2]

(iii) Given that $f(x) = 4x^2 - 12x + 3$, write down the range of f . [1]

- 8 A curve is such that $\frac{d^2y}{dx^2} = 4e^{-2x}$. Given that $\frac{dy}{dx} = 3$ when $x = 0$ and that the curve passes through the point $(2, e^{-4})$, find the equation of the curve. [6]

- 9 (i) Find, in ascending powers of x , the first 3 terms in the expansion of $(2 - 3x)^5$. [3]

The first 3 terms in the expansion of $(a + bx)(2 - 3x)^5$ in ascending powers of x are $64 - 192x + cx^2$.

- (ii) Find the value of a , of b and of c . [5]

- 10 (a) Functions f and g are defined, for $x \in \mathbb{R}$, by

$$f(x) = 3 - x,$$

$$g(x) = \frac{x}{x+2}, \text{ where } x \neq -2.$$

- (i) Find $fg(x)$. [2]

- (ii) Hence find the value of x for which $fg(x) = 10$. [2]

- (b) A function h is defined, for $x \in \mathbb{R}$, by $h(x) = 4 + \ln x$, where $x > 1$.

- (i) Find the range of h . [1]

- (ii) Find the value of $h^{-1}(9)$. [2]

- (iii) On the same axes, sketch the graphs of $y = h(x)$ and $y = h^{-1}(x)$. [3]

- 11 Solve the equation

- (i) $\tan 2x - 3 \cot 2x = 0$, for $0^\circ < x < 180^\circ$, [4]

- (ii) $\operatorname{cosec} y = 1 - 2\cot^2 y$, for $0^\circ \leq y \leq 360^\circ$, [5]

- (iii) $\sec(z + \frac{\pi}{2}) = -2$, for $0 < z < \pi$ radians. [3]

12 Answer only **one** of the following two alternatives.

EITHER

A curve has equation $y = \frac{x^2}{x+1}$.

- (i) Find the coordinates of the stationary points of the curve. [5]

The normal to the curve at the point where $x = 1$ meets the x -axis at M . The tangent to the curve at the point where $x = -2$ meets the y -axis at N .

- (ii) Find the area of the triangle MNO , where O is the origin. [6]

OR

A curve has equation $y = e^{x-2} - 2x + 6$.

- (i) Find the coordinates of the stationary point of the curve and determine the nature of the stationary point. [6]

The area of the region enclosed by the curve, the positive x -axis, the positive y -axis and the line $x = 3$ is $k + e - e^{-2}$.

- (ii) Find the value of k . [5]

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