

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 $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

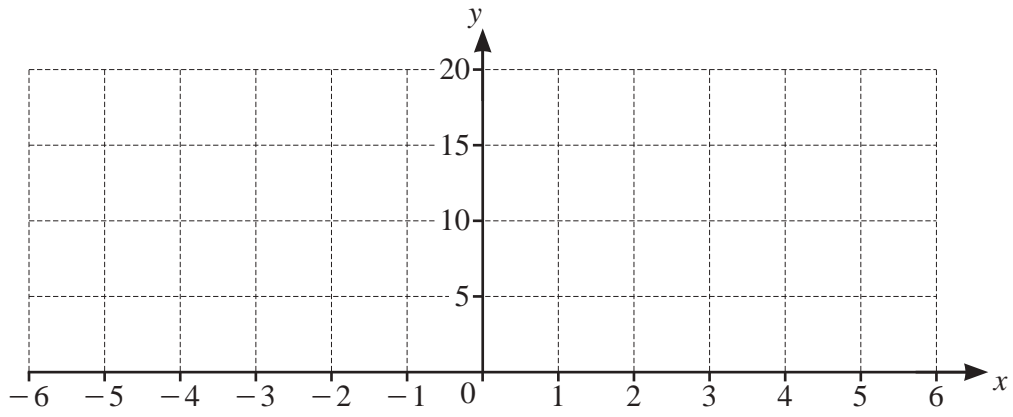
2. TRIGONOMETRY*Identities*

$$\begin{aligned} \sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A \end{aligned}$$

Formulae for $\triangle ABC$

$$\begin{aligned} \frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A \end{aligned}$$

1



- (a) On the axes, draw the graphs of $y = 5 + |3x - 2|$ and $y = 11 - x$. [4]
- (b) Using the graphs, or otherwise, solve the inequality $11 - x < 5 + |3x - 2|$. [2]

2 (a) Expand $(2 - 3x)^4$, evaluating all of the coefficients.

[4]

(b) The sum of the first three terms in ascending powers of x in the expansion of $(2 - 3x)^4 \left(1 + \frac{a}{x}\right)$ is $\frac{32}{x} + b + cx$, where a , b and c are integers. Find the values of each of a , b and c . [4]

3 (a) Show that $\frac{1}{\sec x - 1} + \frac{1}{\sec x + 1} = 2 \cot x \operatorname{cosec} x$. [4]

(b) Hence solve the equation $\frac{1}{\sec x - 1} + \frac{1}{\sec x + 1} = 3 \sec x$ for $0^\circ < x < 360^\circ$. [4]

4 (a) Find the x -coordinates of the stationary points on the curve $y = 3 \ln x + x^2 - 7x$, where $x > 0$. [5]

(b) Determine the nature of each of these stationary points. [3]

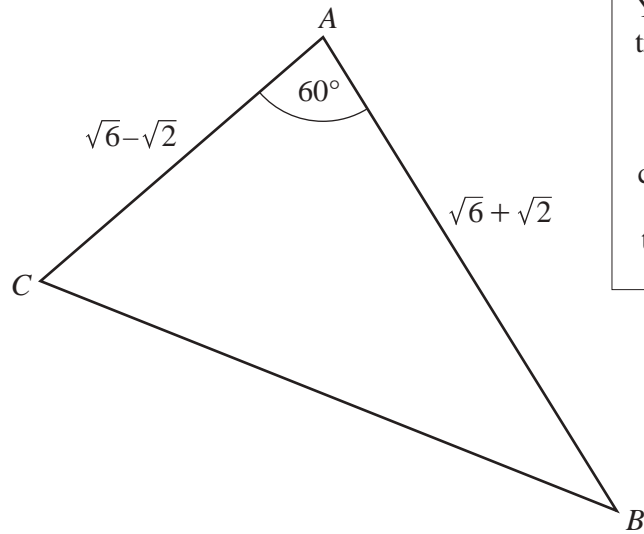
5 (a) Solve the following simultaneous equations.

$$\begin{aligned}e^x + e^y &= 5 \\ 2e^x - 3e^y &= 8\end{aligned}\quad [5]$$

(b) Solve the equation $e^{(2t-1)} = 5e^{(5t-3)}$. [4]

6 DO NOT USE A CALCULATOR IN THIS QUESTION.

All lengths in this question are in centimetres.



You may use the following trigonometrical ratios.

$$\sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$\cos 60^\circ = \frac{1}{2}$$

$$\tan 60^\circ = \sqrt{3}$$

The diagram shows triangle ABC with $AC = \sqrt{6} - \sqrt{2}$, $AB = \sqrt{6} + \sqrt{2}$ and angle $CAB = 60^\circ$.

(a) Find the exact length of BC .

[3]

(b) Show that $\sin ACB = \frac{\sqrt{6} + \sqrt{2}}{4}$.

[2]

(c) Show that the perpendicular distance from A to the line BC is 1.

[2]

7 It is given that $\frac{d^2y}{dx^2} = e^{2x} + \frac{1}{(x+1)^2}$ for $x > -1$.

(a) Find an expression for $\frac{dy}{dx}$ given that $\frac{dy}{dx} = 2$ when $x = 0$. [3]

(b) Find an expression for y given that $y = 4$ when $x = 0$. [3]

8 Variables x and y are such that when \sqrt{y} is plotted against $\log_2(x+1)$, where $x > -1$, a straight line is obtained which passes through $(2, 10.4)$ and $(4, 15.4)$.

(a) Find \sqrt{y} in terms of $\log_2(x+1)$. [4]

(b) Find the value of y when $x = 15$. [1]

(c) Find the value of x when $y = 25$.

[3]

- 9 (a) Find the equation of the normal to the curve $y = x^3 + x^2 - 4x + 6$ at the point (1, 4). [5]

(b) **DO NOT USE A CALCULATOR IN THIS PART OF THE QUESTION.**

Find the exact x -coordinate of each of the two points where the normal cuts the curve again. [5]

- 10 (a) The first three terms of an arithmetic progression are x , $5x - 4$ and $8x + 2$. Find x and the common difference. [4]

(b) The first three terms of a geometric progression are y , $5y - 4$ and $8y + 2$.

(i) Find the two possible values of y .

[4]

(ii) For each of these values of y , find the corresponding value of the common ratio.

[2]

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