

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*

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

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

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

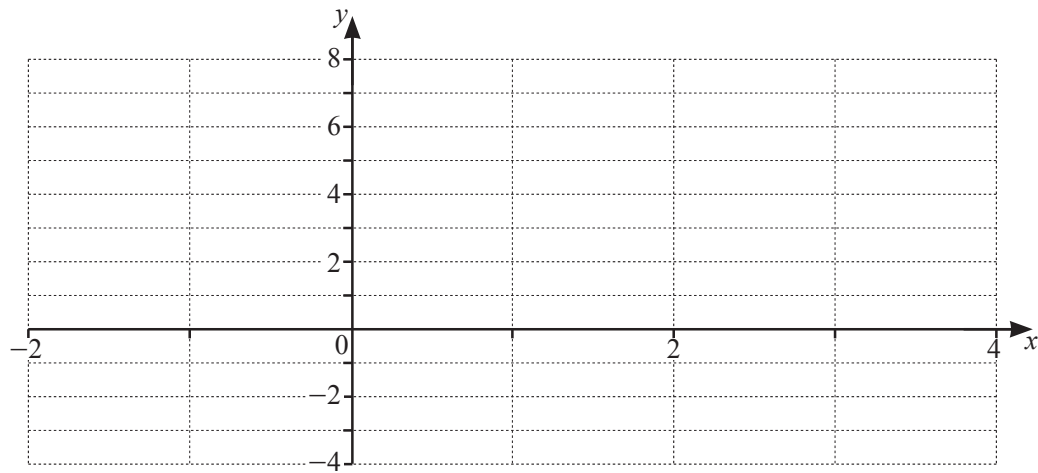
Formulae for ΔABC

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

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

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

- 1 (i) On the axes below, draw the graph of $y = |2x - 3|$.

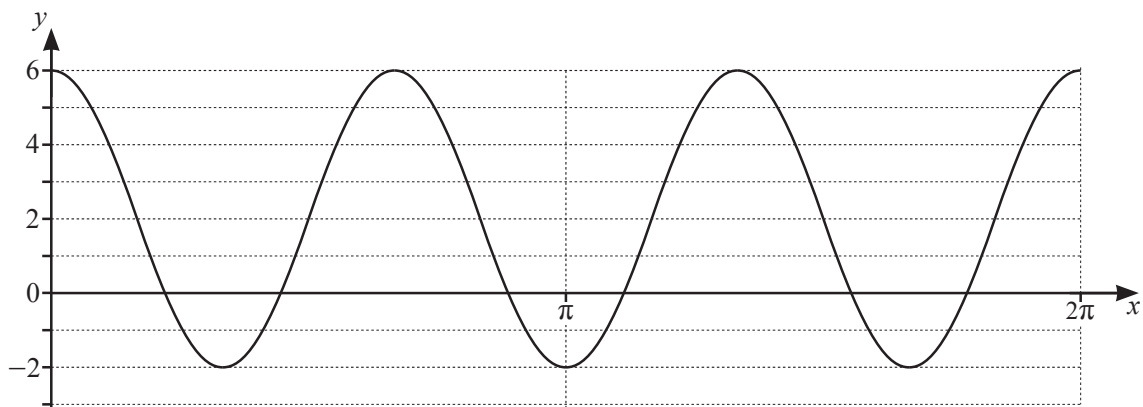


[2]

- (ii) Solve the equation $7 - |2x - 3| = 0$.

[3]

2



The figure shows part of the graph of $y = p + q \cos rx$. Find the value of each of the integers p , q and r .

 $p =$ $q =$ $r =$

[3]

3 (a) Solve $e^{2x+1} = 3e^{4-3x}$. [3]

(b) Solve $\lg(y-6) + \lg(y+15) = 2$. [5]

4 Do not use a calculator in this question.

Solve the following simultaneous equations, giving your answers for both x and y in the form $a + b\sqrt{2}$, where a and b are integers.

$$2x + y = 5$$

$$3x - \sqrt{2}y = 7 \quad [5]$$

- 5 A particle is moving in a straight line such that t seconds after passing a fixed point O its displacement, s m, is given by $s = 3 \sin 2t + 4 \cos 2t - 4$.

(i) Find expressions for the velocity and acceleration of the particle at time t . [3]

(ii) Find the first time when the particle is instantaneously at rest. [3]

(iii) Find the acceleration of the particle at the time found in **part (ii)**. [2]

6 Do not use a calculator in this question.

The curve $xy = 11x + 5$ cuts the line $y = x + 10$ at the points A and B . The mid-point of AB is the point C . Show that the point C lies on the line $x + y = 11$. [7]

- 7 (a) (i) Use the factor theorem to show that $2x - 1$ is a factor of $p(x)$, where $p(x) = 4x^3 + 9x - 5$. [1]

- (ii) Write $p(x)$ as a product of linear and quadratic factors. [2]

(b) (i) Show that $13 \tan x \sec x - 4 \sin x - 5 \sec^2 x = 0$ can be written as $4 \sin^3 x + 9 \sin x - 5 = 0$. [3]

(ii) Using your answers to **part (a)(ii)** and **part (b)(i)** solve the equation

$$13 \tan x \sec x - 4 \sin x - 5 \sec^2 x = 0 \quad \text{for } 0 < x < 2\pi \text{ radians.} \quad [4]$$

8 The equation of a curve is given by $y = xe^{-2x}$.

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

(ii) Find the exact coordinates of the stationary point on the curve $y = xe^{-2x}$. [2]

- (iii) Find, in terms of e , the equation of the tangent to the curve $y = xe^{-2x}$ at the point $\left(1, \frac{1}{e^2}\right)$. [2]

- (iv) Using your answer to **part (i)**, find $\int xe^{-2x} dx$. [3]

9 Given that $\mathbf{A} = \begin{pmatrix} 5 & 2 \\ -9 & -3 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 2 & 1 \\ 6 & 5 \end{pmatrix}$, find

(i) $\mathbf{A}^{-1}$, [2]

(ii) $\mathbf{B}^2$, [2]

(iii) the matrix $\mathbf{C}$, where $\mathbf{B}^{-1}\mathbf{C} + \mathbf{A} = \mathbf{B}$, [3]

(iv) the matrix $\mathbf{D}$, where $\mathbf{B}^{-2}\mathbf{D}\mathbf{A} = \mathbf{I}$.

[3]

- 10 (i) Expand $(3+x)^4$ evaluating each coefficient. [3]

In the expansion of $\left(x - \frac{p}{x}\right)(3+x)^4$ the coefficient of x is zero.

- (ii) Find the value of the constant p . [2]

- (iii) Hence find the term independent of x . [1]

- (iv) Show that the coefficient of x^2 is 90. [2]

- 11** A plane, which can travel at a speed of 300 km h^{-1} in still air, heads due north. The plane is blown off course by a wind so that it travels on a bearing of 010° at a speed of 280 km h^{-1} .

(i) Find the speed of the wind. [3]

(ii) Find the direction of the wind as a bearing correct to the nearest degree. [3]

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