

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 $u_n = ar^{n-1}$

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

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

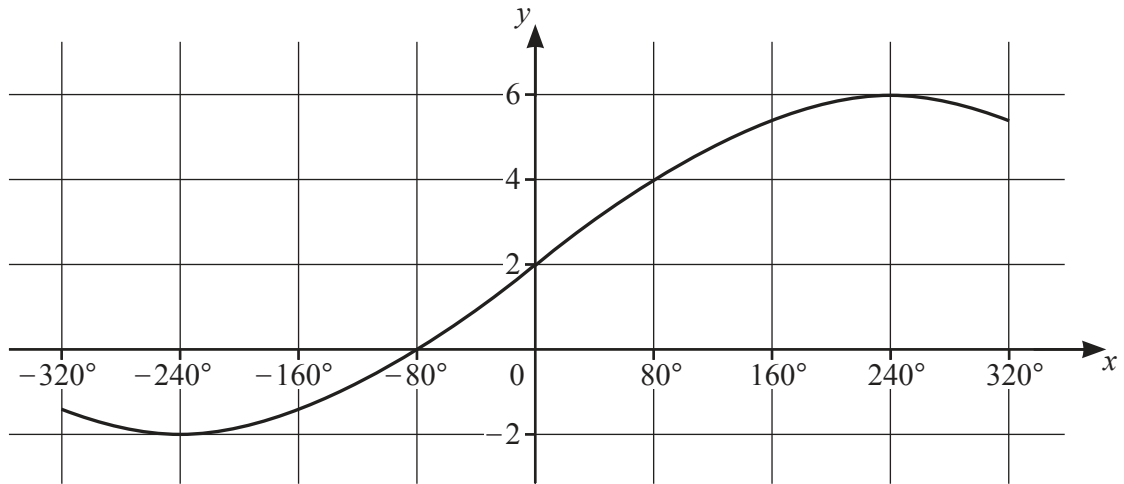
2. TRIGONOMETRY*Identities*

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

Formulae for $\triangle ABC$

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

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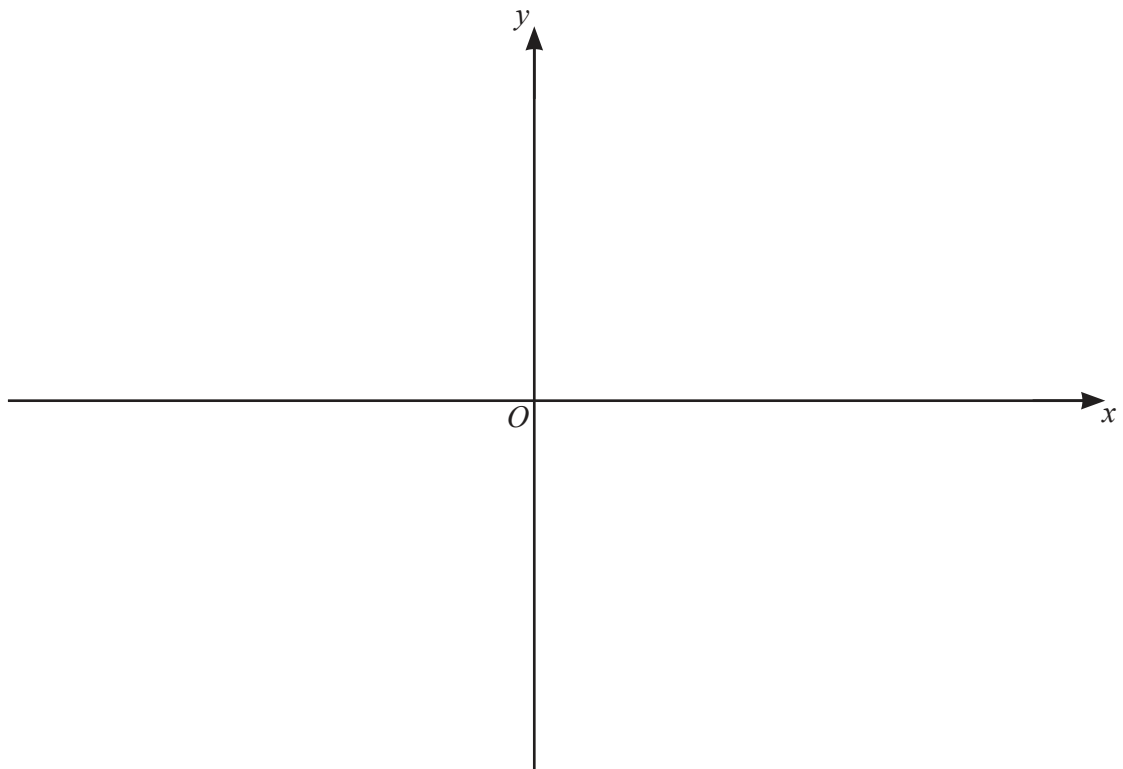


The diagram shows the graph of $y = a \sin bx + c$, for $-320^\circ \leq x \leq 320^\circ$, where a , b and c are constants. Find the values of a , b and c . [3]

- 2 Solve the equation $3(2^{2x+1}) - 11(2^x) + 3 = 0$, giving your answers correct to 2 decimal places. [4]

- 3 (a) Find the coordinates of the stationary points on the curve $y = (2x + 1)^2(x - 3)$. [4]

- (b) On the axes, sketch the graph of $y = (2x + 1)^2(x - 3)$, stating the intercepts with the axes. [3]



- (c) Write down the values of k for which the equation $(2x+1)^2(x-3) = k$ has exactly one solution. [2]

- 4 Find $\int_0^2 (1 + e^{2x})^2 dx$, giving your answer in exact form. [5]

- 5 When e^{2y} is plotted against x^3 , a straight line graph that passes through the points (2, 5) and (6.4, 7.2) is obtained.

(a) Find y in terms of x . [4]

(b) Find the values of x for which y exists. [2]

6 It is given that $y = \frac{\ln(2x^2 + 1)}{x + 2}$, $x \neq -2$.

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

(b) Given that x increases from 1 to $1 + h$, where h is small, find the approximate corresponding change in y . [2]

(c) When $x = 1$, the rate of change in y is 3 units per second. Find the corresponding rate of change in x . [2]

- 7 (a) A 6-digit number is to be formed using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The 6-digit number cannot start with 0. Each digit can be used at most once in any 6-digit number. Find how many of these 6-digit numbers are divisible by 5. [3]
- (b) The number of combinations of $(n + 1)$ objects taken 13 at a time is equal to 16 times the number of combinations of n objects taken 12 at a time. Find the value of n . [3]

- 8 The line L is the normal to the curve $y = 3(5x+6)^{\frac{1}{2}}$ at the point where $x = 2$. The point $(-2, k)$, where k is a constant, lies on L . Find the exact value of k . [7]

- 9 In this question, all lengths are in metres, and time, t , is in seconds.

A particle P moves in a straight line such that, t seconds after leaving a fixed point O , its displacement, s , is given by $s = 4t - 4 \cos 2t + 4$.

- (a) Find the velocity, v , of P at time t . [2]

- (b) On the axes, sketch the velocity–time graph for P for $0 \leq t \leq \pi$, stating the intercepts with the axes in exact form. [5]



(c) Find the acceleration of P at time t .

[1]

(d) Find the times when the acceleration of P is zero for $0 \leq t \leq \pi$. Give your answers in terms of π .
[2]

- 10 (a) In an arithmetic progression, the first term is a and the common difference is d . The sum of the first three terms of this arithmetic progression is 42. The product of the first three terms of this arithmetic progression is -6720 .

(i) Show that $a(a+2d) = -480$. [3]

(ii) Hence, given that a is positive, find the values of a and d . [4]

- (b) In a geometric progression, the 3rd term is $\frac{e^{4x}}{4}$ and the 10th term is $\frac{e^{11x}}{512}$. Find the first term and the common ratio. [5]

- 11 Solve the following simultaneous equations, giving your answers in exact form.

$$8 \log_3 x + 12 \log_{81} y = 5$$

$$4 \log_9 x + 3 \log_3 y = 2$$

[6]

- 12 Solve the equation $\sec\left(3\theta - \frac{\pi}{2}\right) = 2$ for $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$. Give your answers in exact form. [5]

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