

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 $u_n = ar^{n-1}$

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

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

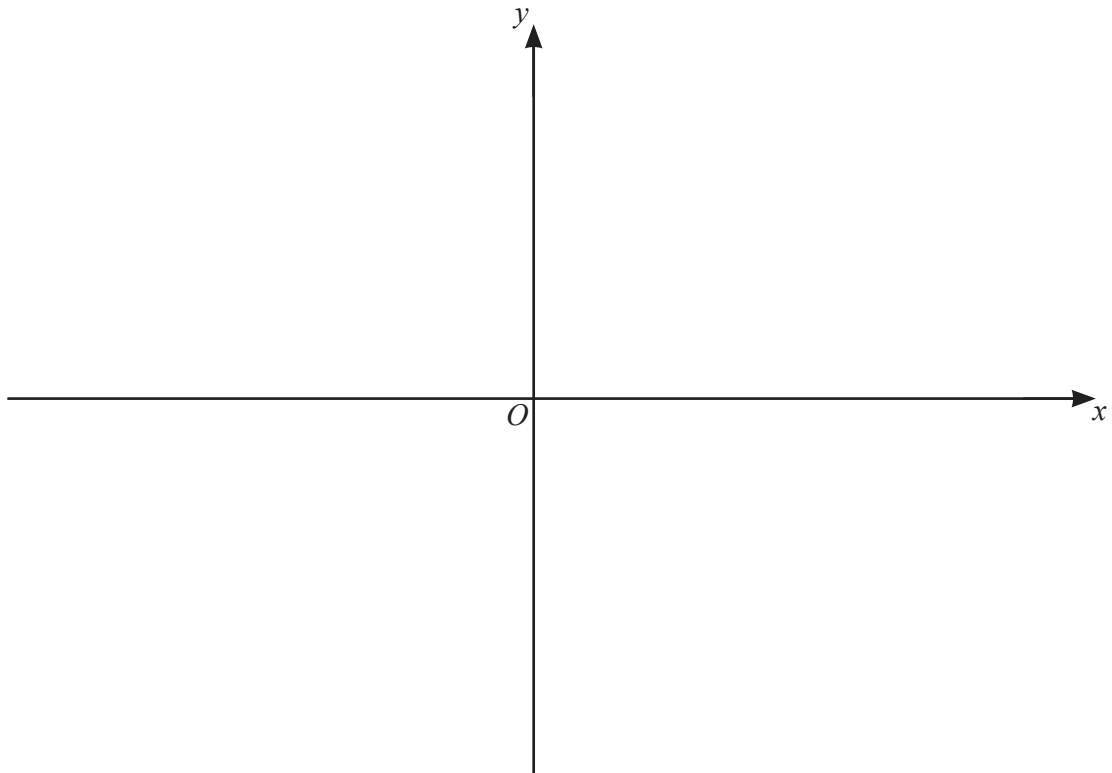
2. TRIGONOMETRY*Identities*

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

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, sketch the graph of $y = -\frac{1}{5}(x+2)(2x-1)(x+5)$, stating the intercepts with the axes. [3]



- (b) Hence solve the inequality $-\frac{1}{5}(x+2)(2x-1)(x+5) \geq 0$. [2]

2 DO NOT USE A CALCULATOR IN THIS QUESTION.

The polynomial p is such that $p(x) = 6x^3 - 35x^2 + 34x + 45$.

(a) Find $p(x)$ in the form $(2x - 5)q(x) + r$, where $q(x)$ is a polynomial and r is a constant. [3]

(b) Hence write the expression $p(x) - 5$ as a product of linear factors. [2]

(c) Hence write down the solutions of the equation $p(x) = 5$. [1]

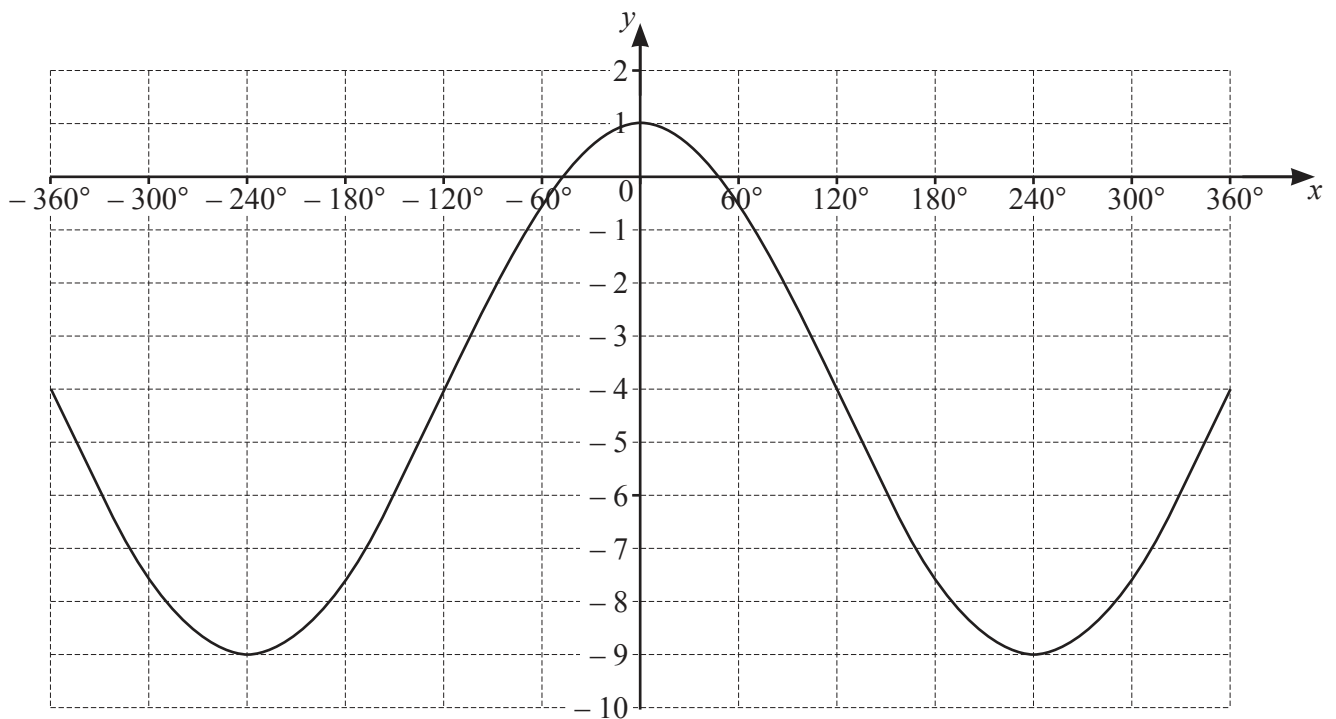
- 3 (a) Write $1 + \lg(x^2 - 1) - 2 \lg(x - 1)$, where $x > 1$, as a single logarithm to base 10. Give your answer in its simplest form. [4]

- (b) Solve the equation $4 \log_5(x + 1) = 9 \log_{(x+1)} 5$, giving your answers in the form $a + b\sqrt{c}$, where a , b and c are constants. [5]

- 4 (a) The first three terms, in ascending powers of x , in the expansion of $(3+px)^n$ are $243 + 810x + qx^2$, where n , p and q are constants. Find the values of n , p and q . [5]

- (b) Find the term independent of y in the expansion of $\left(2y - \frac{1}{3y^2}\right)^6$. Give your answer in exact form. [2]

- 5 (a) The diagram shows the graph of $y = a \cos bx + c$, for $-360^\circ \leq x \leq 360^\circ$, where a , b and c are constants. Find the values of a , b and c . [3]



- (b) The line $y = p$ is a tangent to the curve $y = 3 - 2 \sin 6\theta$. Write down the possible values of p . [2]

6 Find $\int_2^4 \left(\frac{2}{2x-3} - \frac{3}{(3x-5)^2} \right) dx$, giving your answer in exact form. [4]

7 Given that $2 + \cot \theta = 3x$ and $\sin \theta = \sqrt{y}$, find y in terms of x . [3]

- 8 Solve the equation $4 \sin^2\left(2\alpha - \frac{\pi}{3}\right) = 1$ for $-\frac{\pi}{2} \leq \alpha \leq \frac{\pi}{2}$. Give your answers in terms of π . [5]

- 9 (a) Solve the following simultaneous equations.

$$e^{x+y} \times e^{3x-2y} = 1$$

$$x^2y = 256 \quad [5]$$

- (b) Solve the equation $10e^{(2x-1)} - 11 = 6e^{(1-2x)}$, giving your answer in exact form. [4]

10 In this question, all distances are in metres and time, t , is in seconds.

A particle P is at a fixed point O at time $t = 0$.

The velocity, v , of P is given by $v = 3 \sin 2t$ for $t \geq 0$.

(a) Find the exact value of t for which the velocity is zero for the first time after P leaves O . [2]

(b) Find an expression, in terms of t , for the displacement of P from O at time t . [4]

(c) Find the distance travelled by P for $0 \leq t \leq \pi$.

[3]

- 11 The tangent to the curve $y = (3x - 1)^{\frac{1}{3}}$ at the point where $x = 3$ meets the coordinate axes at the points A and B . The point with coordinates (a, a) lies on the perpendicular bisector of the line AB . Find the exact value of a . [10]

Continuation of working space for Question 11.

Question 12 is printed on the next page.

12 (a) It is given that $y = \frac{\ln 3x}{x^2}$ for $x > 0$.

Find $\frac{dy}{dx}$. Give your answer in the form $\frac{A + B \ln 3x}{x^3}$, where A and B are integers. [4]

(b) Hence find $\int \frac{\ln 3x}{x^3} dx$. [4]

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