

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 Solve the following inequality.

$$(2x + 3)(x - 4) > (3x + 4)(x - 1)$$

[5]

- 2 The tangent to the curve $y = ax^2 - 5x + 2$ at the point where $x = 2$ has equation $y = 7x + b$. Find the values of the constants a and b . [5]

- 3 Solve the equation $\lg(2x - 1) + \lg(x + 2) = 2 - \lg 4$. [5]

4 The line $y = kx + 6$ intersects the curve $y = x^3 - 4x^2 + 3kx + 2$ at the point where $x = 2$.

(a) Find the value of k . [2]

(b) Show that, for this value of k , the line cuts the curve only once. [4]

5 (a) Show that $\frac{\cos x}{1 - \sin x} + \frac{1 - \sin x}{\cos x} = 2 \sec x$. [4]

(b) Hence solve the equation $\frac{\cos \frac{\theta}{2}}{1 - \sin \frac{\theta}{2}} + \frac{1 - \sin \frac{\theta}{2}}{\cos \frac{\theta}{2}} = 8 \cos^2 \frac{\theta}{2}$ for $-360^\circ < \theta < 360^\circ$. [4]

- 6 The first four terms in ascending powers of x in the expansion $(3 + ax)^4$ can be written as $81 + bx + cx^2 + \frac{3}{2}x^3$. Find the values of the constants a , b and c . [6]

- 7 Given that ${}^nC_4 = 13 \times {}^nC_2$, find the value of nC_8 . [5]

- 8 (a) Particle A starts from the point with position vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ and travels with speed 26 ms^{-1} in the direction of the vector $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$. Find the position vector of A after t seconds. [3]

- (b) At the same time, particle B starts from the point with position vector $\begin{pmatrix} 67 \\ -18 \end{pmatrix}$. It travels with speed 20 ms^{-1} at an angle of α above the positive x -axis, where $\tan \alpha = \frac{3}{4}$. Find the position vector of B after t seconds. [4]

- (c) Hence find the time at which A and B meet, and the position where this occurs. [3]

9 The equation of a curve is $y = kxe^{-2x}$, where k is a constant.

(a) Find $\frac{dy}{dx}$. [2]

(b) Find the coordinates of the stationary point on the curve $y = 10xe^{-2x}$. [3]

(c) Use your answer to **part (a)** to find $\int 4xe^{-2x} dx$. [3]

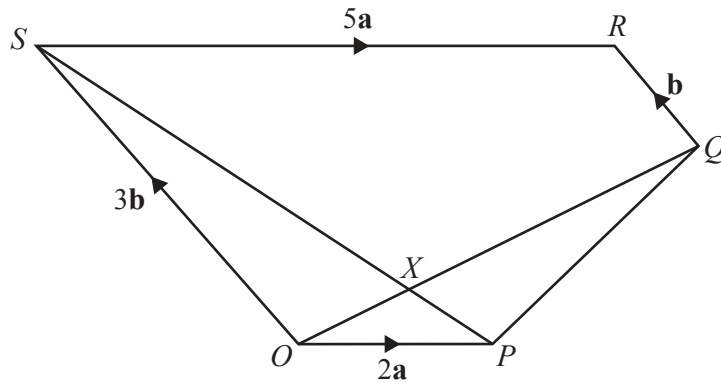
(d) Find the exact value of $\int_0^1 4xe^{-2x} dx$. [2]

- 10 (a) The third term of an arithmetic progression is 10 and the sum of the first 8 terms is 116. Find the first term and common difference. [5]

(b) Find the sum of nineteen terms of the progression, starting with the twelfth term.

[4]

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In the vector diagram, $\vec{OP} = 2\mathbf{a}$, $\vec{SR} = 5\mathbf{a}$, $\vec{OS} = 3\mathbf{b}$ and $\vec{QR} = \mathbf{b}$.

(a) Given that $\vec{PX} = \lambda\vec{PS}$, write \vec{OX} in terms of \mathbf{a} , \mathbf{b} and λ . [3]

(b) Given that $\vec{OX} = \mu\vec{OQ}$, write \vec{OX} in terms of \mathbf{a} , \mathbf{b} and μ . [2]

(c) Find the values of λ and μ .

[4]

(d) Write down the value of $\frac{OX}{OQ}$.

[1]

(e) Find the value of $\frac{PX}{XS}$.

[1]

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