

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 Variables x and y are such that $y = \sin x + e^{-x}$. Use differentiation to find the approximate change in y as x increases from $\frac{\pi}{4}$ to $\frac{\pi}{4} + h$, where h is small. [4]

2 **DO NOT USE A CALCULATOR IN THIS QUESTION.**

The point $(1 - \sqrt{5}, p)$ lies on the curve $y = \frac{10 + 2\sqrt{5}}{x^2}$. Find the exact value of p , simplifying your answer. [5]

- 3 Find the values of k for which the line $y = x - 3$ intersects the curve $y = k^2x^2 + 5kx + 1$ at two distinct points. [6]

- 4 The three roots of $p(x) = 0$, where $p(x) = 2x^3 + ax^2 + bx + c$ are $x = \frac{1}{2}$, $x = n$ and $x = -n$, where a , b , c and n are integers. The y -intercept of the graph of $y = p(x)$ is 4. Find $p(x)$, simplifying your coefficients. [5]

5 Solutions to this question by accurate drawing will not be accepted.

The points A and B are $(4, 3)$ and $(12, -7)$ respectively.

(a) Find the equation of the line L , the perpendicular bisector of the line AB . [4]

(b) The line parallel to AB which passes through the point $(5, 12)$ intersects L at the point C . Find the coordinates of C . [4]

- 6 (a) Find the equation of the tangent to the curve $2y = \tan 2x + 7$ at the point where $x = \frac{\pi}{8}$.

Give your answer in the form $ax - y = \frac{\pi}{b} + c$, where a , b and c are integers. [5]

- (b) This tangent intersects the x -axis at P and the y -axis at Q . Find the length of PQ . [2]

7 Giving your answer in its simplest form, find the exact value of

(a) $\int_0^4 \frac{10}{5x+2} dx,$ [4]

(b) $\int_0^{\ln 2} (e^{4x+2})^2 dx.$ [5]

- 8 (a) Solve $3 \cot^2 x - 14 \operatorname{cosec} x - 2 = 0$ for $0^\circ < x < 360^\circ$. [5]

- (b) Show that $\frac{\sin^4 y - \cos^4 y}{\cot y} = \tan y - 2 \cos y \sin y$. [4]

9 (a) Solve the equation $\frac{9^{5x}}{27^{x-2}} = 243$. [3]

(b) $\log_a \sqrt{b} - \frac{1}{2} = \log_b a$, where $a > 0$ and $b > 0$.

Solve this equation for b , giving your answers in terms of a . [5]

- 10 (a)** The first 5 terms of a sequence are given below.

4 -2 1 -0.5 0.25

- (i)** Find the 20th term of the sequence. [2]

- (ii)** Explain why the sum to infinity exists for this sequence and find the value of this sum. [2]

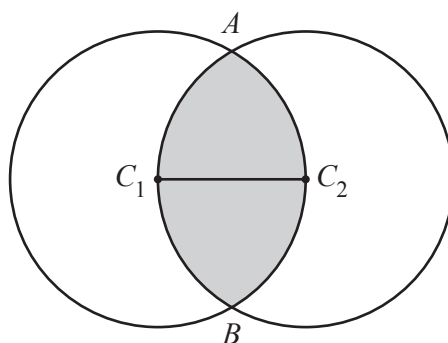
(b) The tenth term of an arithmetic progression is 15 times the second term. The sum of the first 6 terms of the progression is 87.

(i) Find the common difference of the progression. [4]

(ii) For this progression, the n th term is 6990. Find the value of n . [3]

Question 11 is printed on the next page.

11



The circles with centres C_1 and C_2 have equal radii of length r cm. The line C_1C_2 is a radius of both circles. The two circles intersect at A and B .

(a) Given that the perimeter of the shaded region is 4π cm, find the value of r . [4]

(b) Find the exact area of the shaded region. [4]

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