

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*

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

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

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

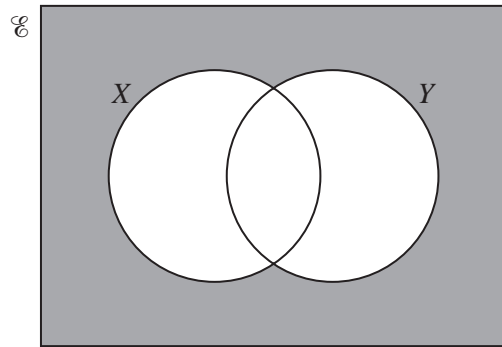
Formulae for ΔABC

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

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

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

1 (a)



Express, in set notation, the set represented by the shaded region. [1]

(b) In a class of 30 students, 17 are studying politics, 14 are studying economics and 10 are studying both of these subjects.

(i) Illustrate this information using a Venn diagram. [1]

Find the number of students studying

(ii) neither of these subjects, [1]

(iii) exactly one of these subjects. [1]

2 Given that $\mathbf{A} = \begin{pmatrix} 7 & 6 \\ 3 & 4 \end{pmatrix}$, find \mathbf{A}^{-1} and hence solve the simultaneous equations

$$7x + 6y = 17,$$

$$3x + 4y = 3.$$

[4]

3 Sketch the graph of $y = |x^2 - 8x + 12|$. [4]

4 Find the coefficient of x^4 in the expansion of

(i) $(1 + 2x)^6$, [2]

(ii) $\left(1 - \frac{x}{4}\right)(1 + 2x)^6$. [3]

5 Two variables, x and y , are related by the equation

$$y = 6x^2 + \frac{32}{x^3}.$$

(i) Obtain an expression for $\frac{dy}{dx}$. [2]

(ii) Use your expression to find the approximate change in the value of y when x increases from 2 to 2.04. [3]

6 The function f is defined by $f(x) = 2 + \sqrt{x-3}$ for $x \geq 3$. Find

(i) the range of f , [1]

(ii) an expression for $f^{-1}(x)$. [2]

The function g is defined by $g(x) = \frac{12}{x} + 2$ for $x > 0$. Find

(iii) $gf(12)$. [2]

7 Given that $\log_p X = 9$ and $\log_p Y = 6$, find

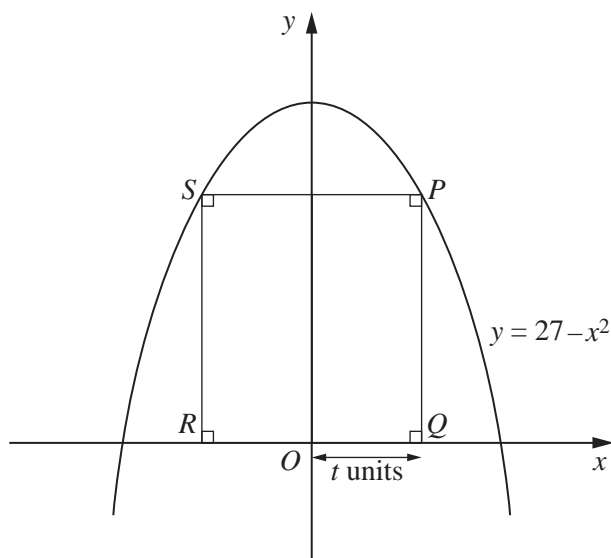
(i) $\log_p \sqrt{X}$, [1]

(ii) $\log_p \left(\frac{1}{X}\right)$, [1]

(iii) $\log_p (XY)$, [2]

(iv) $\log_Y X$. [2]

8



The diagram shows part of the curve $y = 27 - x^2$. The points P and S lie on this curve. The points Q and R lie on the x -axis and $PQRS$ is a rectangle. The length of OQ is t units.

- (i) Find the length of PQ in terms of t and hence show that the area, A square units, of $PQRS$ is given by

$$A = 54t - 2t^3. \quad [2]$$

- (ii) Given that t can vary, find the value of t for which A has a stationary value. [3]

- (iii) Find this stationary value of A and determine its nature. [3]

- 9 A musician has to play 4 pieces from a list of 9. Of these 9 pieces 4 were written by Beethoven, 3 by Handel and 2 by Sibelius. Calculate the number of ways the 4 pieces can be chosen if

- (i) there are no restrictions, [2]

- (ii) there must be 2 pieces by Beethoven, 1 by Handel and 1 by Sibelius, [3]

- (iii) there must be at least one piece by each composer. [4]

- 10 The line $2x + y = 12$ intersects the curve $x^2 + 3xy + y^2 = 176$ at the points A and B . Find the equation of the perpendicular bisector of AB . [9]

- 11 (a) Find all the angles between 0° and 360° which satisfy

(i) $2\sin x - 3\cos x = 0$, [3]

(ii) $2\sin^2 y - 3\cos y = 0$. [5]

- (b) Given that $0 \leq z \leq 3$ radians, find, correct to 2 decimal places, all the values of z for which $\sin(2z + 1) = 0.9$. [3]

12 Answer only **one** of the following two alternatives.

EITHER

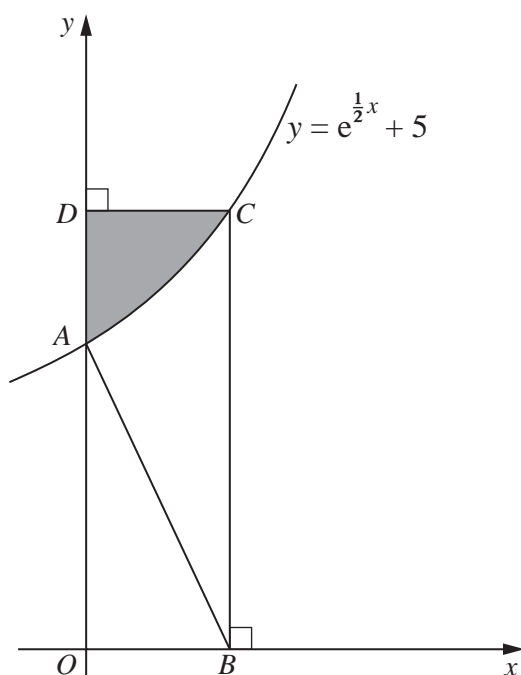
The point $P(0, 5)$ lies on the curve for which $\frac{dy}{dx} = e^{\frac{1}{2}x}$. The point Q , with x -coordinate 2, also lies on the curve.

(i) Find, in terms of e , the y -coordinate of Q . [5]

The tangents to the curve at the points P and Q intersect at the point R .

(ii) Find, in terms of e , the x -coordinate of R . [5]

OR



The diagram shows part of the curve $y = e^{\frac{1}{2}x} + 5$ crossing the y -axis at A . The normal to the curve at A meets the x -axis at B .

(i) Find the coordinates of B . [4]

The line through B , parallel to the y -axis, meets the curve at C . The line through C , parallel to the x -axis, meets the y -axis at D .

(ii) Find the area of the shaded region. [6]

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