

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 function f is defined by $f: x \mapsto e^{x-1}$, where $x > 0$.

(i) State the range of f . [1]

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

(iii) State the domain of f^{-1} . [1]

2 (i) Find the first four terms, in ascending powers of x , in the expansion of $\left(2 - \frac{x}{2}\right)^6$. [4]

(ii) Find the coefficient of x^3 in the expansion of $(1+x)^2 \left(2 - \frac{x}{2}\right)^6$. [2]

3 The table shows experimental values of the variables x and y which are related by the equation

$$y = \frac{a}{x^2} + \frac{b}{x}, \text{ where } a \text{ and } b \text{ are constants.}$$

x	2	4	6	8	10
y	6.24	2.82	1.79	1.33	1.05

(i) Using graph paper, plot x^2y against x and draw a straight line graph. [3]

(ii) Use your graph to estimate the value of a and of b . [4]

4 Find the coordinates and the nature of the stationary points of the curve $y = x^3 + 3x^2 - 45x + 60$. [7]

5 Relative to an origin O , the position vectors of points A and B are $\begin{pmatrix} 7 \\ 24 \end{pmatrix}$ and $\begin{pmatrix} 10 \\ 20 \end{pmatrix}$ respectively. Find

(i) the length of \overrightarrow{OA} , [2]

(ii) the length of \overrightarrow{AB} . [2]

Given that ABC is a straight line and that the length of \overrightarrow{AC} is equal to the length of \overrightarrow{OA} , find

(iii) the position vector of the point C . [3]

6 (i) Given that $y = x\sqrt{4x+12}$, show that $\frac{dy}{dx} = \frac{k(x+2)}{\sqrt{4x+12}}$, where k is a constant to be found. [4]

(ii) Hence evaluate $\int_{-2}^6 \frac{3x+6}{\sqrt{4x+12}} dx$. [3]

- 7 (i) Using graph paper, draw the curve $y = \sin 2x$ for $0^\circ \leq x \leq 360^\circ$. [3]
- In order to solve the equation $1 + \sin 2x = 2\cos x$ another curve must be added to your diagram.
- (ii) Write down the equation of this curve and add this curve to your diagram. [3]
- (iii) State the number of values of x which satisfy the equation $1 + \sin 2x = 2\cos x$ for $0^\circ \leq x \leq 360^\circ$. [1]

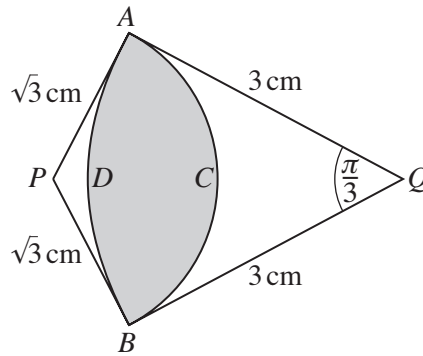
- 8 It is given that $\mathbf{A} = \begin{pmatrix} 2 & -1 \\ 4 & 3 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 1 & -3 \\ 2 & 0 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$. Find
- (i) \mathbf{AB} , [2]
- (ii) \mathbf{BC} , [2]
- (iii) \mathbf{A}^{-1} , and hence find the matrix \mathbf{X} such that $\mathbf{AX} = \mathbf{B}$. [4]

- 9 A particle moves in a straight line so that, t seconds after passing through a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by $v = \frac{20}{(2t + 4)^2}$. Find
- (i) the velocity of the particle at O , [1]
- (ii) the acceleration of the particle when $t = 3$, [3]
- (iii) the distance travelled by the particle in the first 8 seconds. [4]

- 10 (a) Solve $\lg(7x - 3) + 2 \lg 5 = 2 + \lg(x + 3)$. [4]
- (b) Use the substitution $u = 3^x$ to solve the equation $3^{x+1} + 3^{2-x} = 28$. [5]

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

EITHER

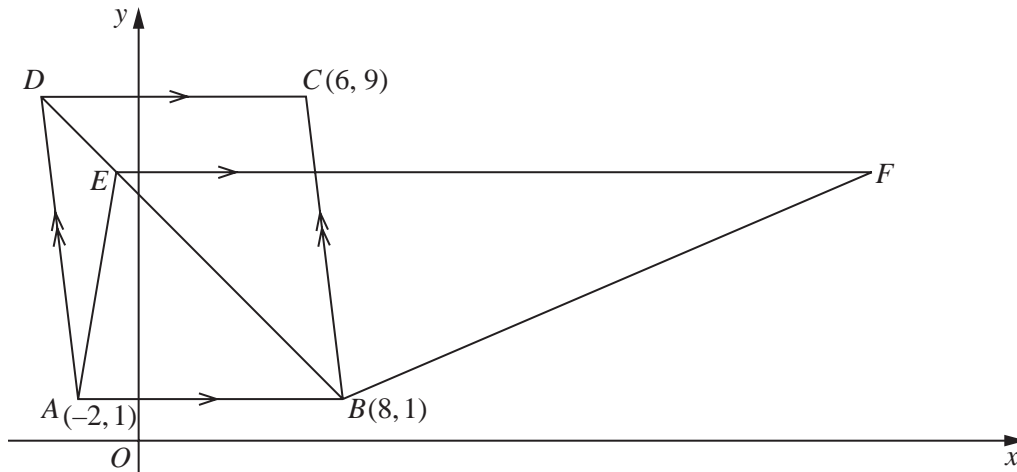


In the diagram, ACB is an arc of a circle with centre P , and ADB is an arc of a circle with centre Q . Angle $AQB = \frac{\pi}{3}$, $AQ = BQ = 3$ cm and $AP = BP = \sqrt{3}$ cm.

- (i) Show that angle $APB = \frac{2\pi}{3}$. [2]
- (ii) Find the perimeter of the shaded region. [3]
- (iii) Find the area of the shaded region. [5]

OR

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



The diagram shows a parallelogram with vertices $A(-2, 1)$, $B(8, 1)$, $C(6, 9)$ and D .

- (i) Find the coordinates of D . [2]

The point E lies on the diagonal DB such that $DE = \frac{1}{4}DB$.

- (ii) Find the coordinates of E . [2]

The point F is such that EF is parallel to AB .

The area of trapezium $AEFB$ is $1\frac{1}{2} \times$ (the area of parallelogram $ABCD$).

- (iii) Find the coordinates of F . [6]

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