

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 Express $\frac{8-3\sqrt{2}}{4+3\sqrt{2}}$ in the form $a+b\sqrt{2}$, where a and b are integers. [3]

2 A committee of 5 people is to be selected from 6 men and 4 women. Find

(i) the number of different ways in which the committee can be selected, [1]

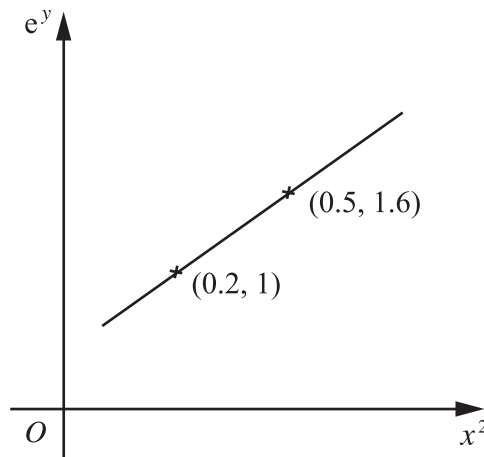
(ii) the number of these selections with more women than men. [4]

3 The line $y = 3x + k$ is a tangent to the curve $x^2 + xy + 16 = 0$.

(i) Find the possible values of k . [3]

(ii) For each of these values of k , find the coordinates of the point of contact of the tangent with the curve. [2]

4 Variables x and y are such that, when e^y is plotted against x^2 , a straight line graph passing through the points $(0.2, 1)$ and $(0.5, 1.6)$ is obtained.



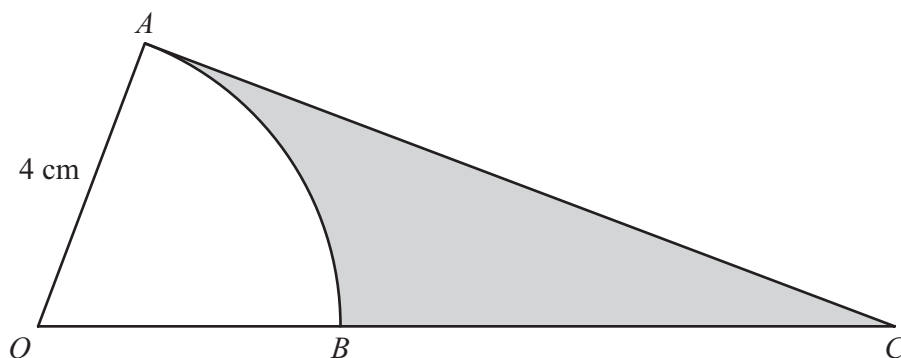
(i) Find the value of e^y when $x = 0$. [2]

(ii) Express y in terms of x . [3]

5 Variables x and y are connected by the equation $y = \frac{x}{\tan x}$. Given that x is increasing at the rate of 2 units per second, find the rate of increase of y when $x = \frac{\pi}{4}$. [5]

6 Solve the equation $x^2(2x + 3) = 17x - 12$. [6]

7



The diagram shows a sector OAB of a circle, centre O , radius 4 cm. The tangent to the circle at A meets the line OB extended at C . Given that the area of the sector OAB is 10 cm^2 , calculate

- (i) the angle AOB in radians, [2]
 (ii) the perimeter of the shaded region. [4]

- 8 (i) Given that $\log_9 x = a \log_3 x$, find a . [1]
 (ii) Given that $\log_{27} y = b \log_3 y$, find b . [1]
 (iii) Hence solve, for x and y , the simultaneous equations

$$\begin{aligned} 6 \log_9 x + 3 \log_{27} y &= 8, \\ \log_3 x + 2 \log_9 y &= 2. \end{aligned}$$

[4]

- 9 A curve is such that $\frac{dy}{dx} = 2 \cos\left(2x - \frac{\pi}{2}\right)$. The curve passes through the point $\left(\frac{\pi}{2}, 3\right)$.
- (i) Find the equation of the curve. [4]
 (ii) Find the equation of the normal to the curve at the point where $x = \frac{3\pi}{4}$. [4]

10 In this question, \mathbf{i} is a unit vector due east and \mathbf{j} is a unit vector due north.

At 0900 hours a ship sails from the point P with position vector $(2\mathbf{i} + 3\mathbf{j})$ km relative to an origin O . The ship sails north-east with a speed of $15\sqrt{2}$ km h⁻¹.

- (i) Find, in terms of \mathbf{i} and \mathbf{j} , the velocity of the ship. [2]
- (ii) Show that the ship will be at the point with position vector $(24.5\mathbf{i} + 25.5\mathbf{j})$ km at 1030 hours. [1]
- (iii) Find, in terms of \mathbf{i} , \mathbf{j} and t , the position of the ship t hours after leaving P . [2]

At the same time as the ship leaves P , a submarine leaves the point Q with position vector $(47\mathbf{i} - 27\mathbf{j})$ km. The submarine proceeds with a speed of 25 km h⁻¹ due north to meet the ship.

- (iv) Find, in terms of \mathbf{i} and \mathbf{j} , the velocity of the ship relative to the submarine. [2]
- (v) Find the position vector of the point where the submarine meets the ship. [2]

11 Solve the equation

- (i) $3 \sin x + 5 \cos x = 0$ for $0^\circ < x < 360^\circ$, [3]
- (ii) $3 \tan^2 y - \sec y - 1 = 0$ for $0^\circ < y < 360^\circ$, [5]
- (iii) $\sin(2z - 0.6) = 0.8$ for $0 < z < 3$ radians. [4]

[Question 12 is printed on the next page.]

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

EITHER

A curve has equation $y = (x^2 - 3)e^{-x}$.

- (i) Find the coordinates of the points of intersection of the curve with the x -axis. [2]
- (ii) Find the coordinates of the stationary points of the curve. [5]
- (iii) Determine the nature of these stationary points. [3]

OR

A particle moves in a straight line such that its displacement, s m, from a fixed point O at a time t s, is given by

$$s = \ln(t + 1) \quad \text{for } 0 \leq t \leq 3,$$

$$s = \frac{1}{2}\ln(t - 2) - \ln(t + 1) + \ln 16 \quad \text{for } t > 3.$$

Find

- (i) the initial velocity of the particle, [2]
- (ii) the velocity of the particle when $t = 4$, [2]
- (iii) the acceleration of the particle when $t = 4$, [2]
- (iv) the value of t when the particle is instantaneously at rest, [2]
- (v) the distance travelled by the particle in the 4th second. [2]

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