

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*

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

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

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

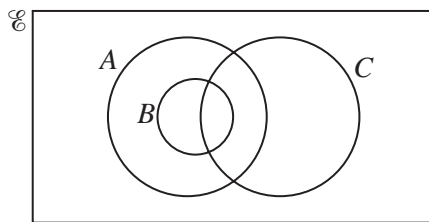
Formulae for ΔABC

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

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

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

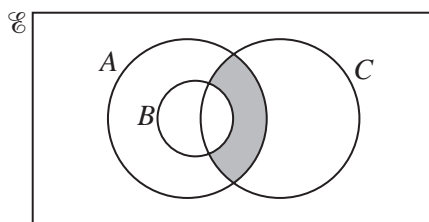
1 (a)



The diagram above shows a universal set \mathcal{C} and the three sets A , B and C .

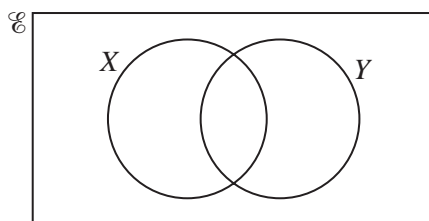
(i) Copy the above diagram and shade the region representing $(A \cap C') \cup B$. [1]

(ii)



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

(b)



The diagram shows a universal set \mathcal{C} and the sets X and Y . Show, by means of two diagrams, that the set $(X \cup Y)'$ is not the same as the set $X' \cup Y'$. [2]

2 Find the equation of the normal to the curve $y = \frac{2x+4}{x-2}$ at the point where $x = 4$. [5]

3 The straight line $3x = 2y + 18$ intersects the curve $2x^2 - 23x + 2y + 50 = 0$ at the points A and B . Given that A lies below the x -axis and that the point P lies on AB such that $AP : PB = 1 : 2$, find the coordinates of P . [6]

4 (i) Find the first three terms, in ascending powers of u , in the expansion of $(2 + u)^5$. [2]

(ii) By replacing u with $2x - 5x^2$, find the coefficient of x^2 in the expansion of $(2 + 2x - 5x^2)^5$. [4]

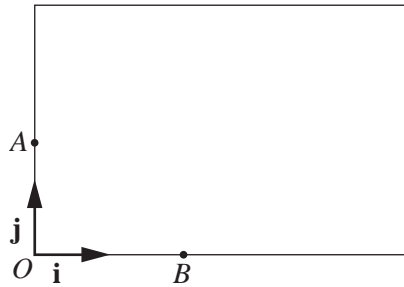
5 A curve has the equation $y = \sqrt{x} + \frac{9}{\sqrt{x}}$.

(i) Find expressions for $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. [4]

(ii) Show that the curve has a stationary value when $x = 9$. [1]

(iii) Find the nature of this stationary value. [2]

6



The diagram shows a large rectangular television screen in which one corner is taken as the origin O and \mathbf{i} and \mathbf{j} are unit vectors along two of the edges. In a game, an alien spacecraft appears at the point A with position vector $12\mathbf{j}$ cm and moves across the screen with velocity $(40\mathbf{i} + 15\mathbf{j})$ cm per second. A player fires a missile from a point B ; the missile is fired 0.5 seconds after the spacecraft appears on the screen. The point B has position vector $46\mathbf{i}$ cm and the velocity of the missile is $(k\mathbf{i} + 30\mathbf{j})$ cm per second, where k is a constant. Given that the missile hits the spacecraft,

(i) show that the spacecraft moved across the screen for 1.8 seconds before impact, [4]

(ii) find the value of k . [3]

7 (a) Use the substitution $u = 5^x$ to solve the equation $5^{x+1} = 8 + 4(5^{-x})$. [5]

(b) Given that $\log(p - q) = \log p - \log q$, express p in terms of q . [3]

8 (a) Solve, for $0 \leq x \leq 2$, the equation $1 + 5\cos 3x = 0$, giving your answer in radians correct to 2 decimal places. [3]

(b) Find all the angles between 0° and 360° such that

$$\sec y + 5\tan y = 3\cos y. \quad [5]$$

9

x	0.100	0.125	0.160	0.200	0.400
y	0.050	0.064	0.085	0.111	0.286

The table above shows experimental values of the variables x and y .

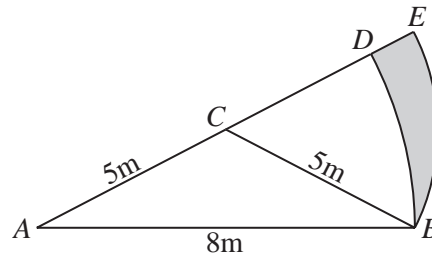
(i) On graph paper draw the graph of $\frac{1}{y}$ against $\frac{1}{x}$. [3]

Hence,

(ii) express y in terms of x , [4]

(iii) find the value of x for which $y = 0.15$. [2]

10



The diagram shows an isosceles triangle ABC in which $AB = 8\text{m}$, $BC = CA = 5\text{m}$. $ABDA$ is a sector of the circle, centre A and radius 8m . $CBEC$ is a sector of the circle, centre C and radius 5m .

(i) Show that angle BCE is 1.287 radians correct to 3 decimal places. [2]

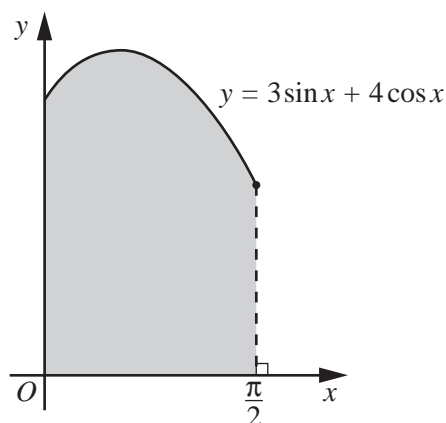
(ii) Find the perimeter of the shaded region. [4]

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

[Question 11 is printed on the next page.]

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

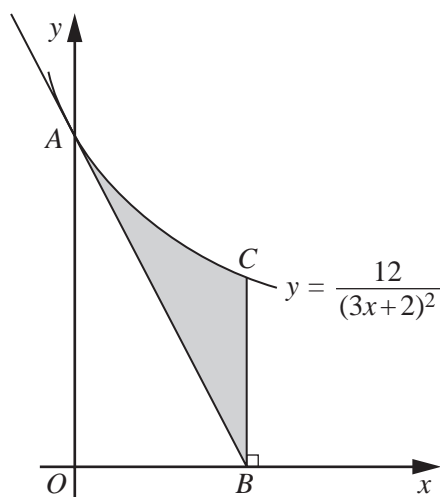
EITHER



The graph shows part of the curve $y = 3\sin x + 4\cos x$ for $0 \leq x \leq \frac{\pi}{2}$ radians.

- (i) Find the coordinates of the maximum point of the curve. [5]
- (ii) Find the area of the shaded region. [5]

OR



The diagram, which is not drawn to scale, shows part of the curve $y = \frac{12}{(3x+2)^2}$, intersecting the y -axis at A . The tangent to the curve at A meets the x -axis at B . The point C lies on the curve and BC is parallel to the y -axis.

- (i) Find the x -coordinate of B . [4]
- (ii) Find the area of the shaded region. [6]

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