

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 $\triangle ABC$

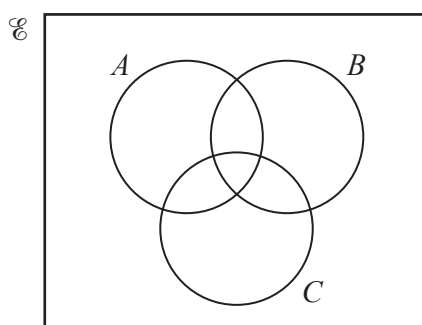
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

1 On the Venn diagrams below, shade the regions indicated.

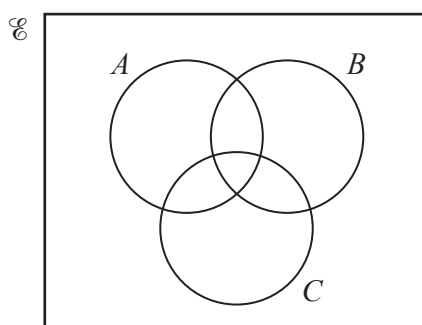
(i)



$$A \cap (B \cup C)$$

[1]

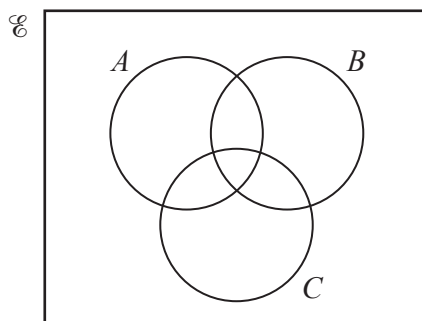
(ii)



$$A \cup (B \cap C)$$

[1]

(iii)



$$(A \cup B)' \cap C$$

[1]

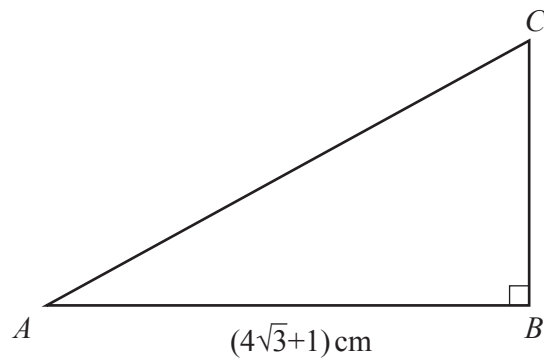
2 Solve $2 \cos^2\left(3x - \frac{\pi}{4}\right) = 1$ for $0 \leq x \leq \frac{\pi}{3}$. [4]

- 3 (a) Matrices **A** and **B** are such that $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ 4 & 3 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 3 & 8 & 1 \\ 6 & 0 & 2 \end{pmatrix}$. Find **AB**. [2]

- (b) Given that matrix $\mathbf{X} = \begin{pmatrix} 4 & 6 \\ 2 & -8 \end{pmatrix}$, find the integer value of m and of n such that $\mathbf{X}^2 = m\mathbf{X} + n\mathbf{I}$, where **I** is the identity matrix. [5]

- (c) Given that matrix $\mathbf{Y} = \begin{pmatrix} a & 2 \\ 3 & a \end{pmatrix}$, find the values of a for which $\det \mathbf{Y} = 0$. [2]

4 You are not allowed to use a calculator in this question.



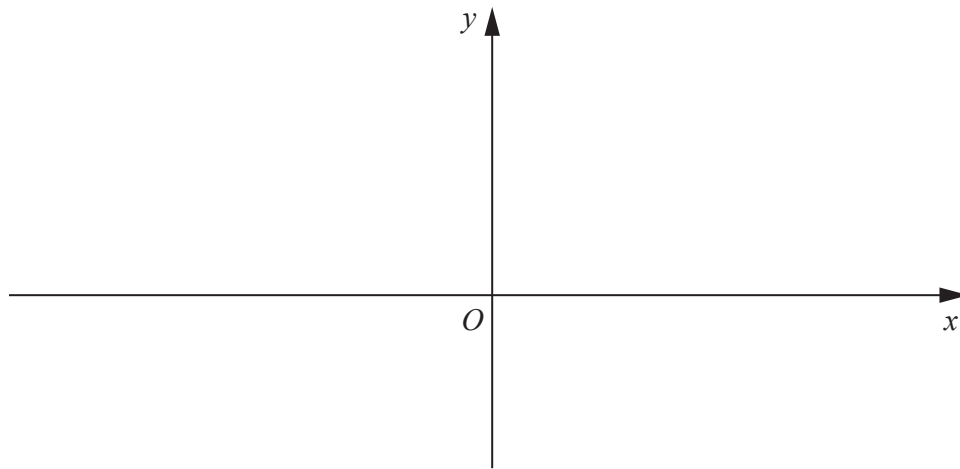
The diagram shows triangle ABC with side $AB = (4\sqrt{3} + 1)$ cm. Angle B is a right angle. It is given that the area of this triangle is $\frac{47}{2}$ cm².

(i) Find the length of the side BC in the form $(a\sqrt{3} + b)$ cm, where a and b are integers. [3]

(ii) Hence find the length of the side AC in the form $p\sqrt{2}$ cm, where p is an integer. [2]

- 5 Find the equation of the normal to the curve $y = 5 \tan x - 3$ at the point where $x = \frac{\pi}{4}$. [5]

- 6 (i) On the axes below, sketch the graph of $y = |x^2 - 4x - 12|$ showing the coordinates of the points where the graph meets the axes. [3]



- (ii) Find the coordinates of the stationary point on the curve $y = |x^2 - 4x - 12|$. [2]

- (iii) Find the values of k such that the equation $|x^2 - 4x - 12| = k$ has only 2 solutions. [2]

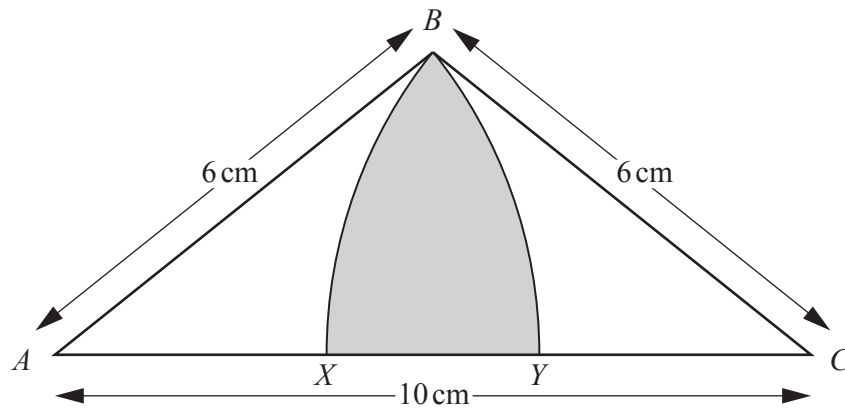
- 7 A curve, showing the relationship between two variables x and y , is such that $\frac{d^2y}{dx^2} = 6 \cos 3x$. Given that the curve has a gradient of $4\sqrt{3}$ at the point $\left(\frac{\pi}{9}, -\frac{1}{3}\right)$, find the equation of the curve. [6]

- 8 (a) Given that the first 4 terms in the expansion of $(2 + kx)^8$ are $256 + 256x + px^2 + qx^3$, find the value of k , of p and of q . [3]

- (b) Find the term that is independent of x in the expansion of $\left(x - \frac{2}{x^2}\right)^9$. [3]

- 9 (a) Five different books are to be arranged on a shelf. There are 2 Mathematics books and 3 History books. Find the number of different arrangements of books if
- (i) the Mathematics books are next to each other, [2]
- (ii) the Mathematics books are not next to each other. [2]
- (b) To compete in a quiz, a team of 5 is to be chosen from a group of 9 men and 6 women. Find the number of different teams that can be chosen if
- (i) there are no restrictions, [1]
- (ii) at least two men must be on the team. [3]

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The diagram shows an isosceles triangle ABC such that $AC = 10$ cm and $AB = BC = 6$ cm. BX is an arc of a circle, centre C , and BY is an arc of a circle, centre A .

(i) Show that angle $ABC = 1.970$ radians, correct to 3 decimal places. [2]

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

(iii) Find the area of the shaded region.

[3]

- 11** The line $x - y + 2 = 0$ intersects the curve $2x^2 - y^2 + 2x + 1 = 0$ at the points A and B . The perpendicular bisector of the line AB intersects the curve at the points C and D . Find the length of the line CD in the form $a\sqrt{5}$, where a is an integer. [10]

Question 12 is printed on the next page.

12 (a) Given that $2^{2x-1} \times 4^{x+y} = 128$ and $\frac{9^{2y-x}}{27^{y-4}} = 1$, find the value of each of the integers x and y . [4]

(b) Solve $2(5)^{2z} + 5^z - 1 = 0$. [4]

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