

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 Given that $f(x) = 2x^3 - 7x^2 + 7ax + 16$ is divisible by $x - a$, find

(i) the value of the constant a , [2]

(ii) the remainder when $f(x)$ is divided by $2x + 1$. [2]

2

Team \ Place	1st	2nd	3rd	4th
Harriers	6	3	1	2
Strollers	3	2	4	3
Road Runners	2	5	5	0
Olympians	1	2	2	7

The table shows the results achieved by four teams in twelve events of an athletics match. In each event, 1st place scores 5 points, 2nd place scores 3 points, 3rd place scores 2 points and 4th place scores 1 point.

(i) Write down two matrices whose product shows the total number of points scored by each team. [2]

(ii) Evaluate this product of matrices. [2]

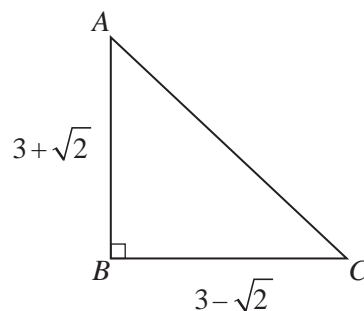
3 Find the values of k for which the equation $x^2 - 2(2k + 1)x + (k + 2) = 0$ has two equal roots. [4]

4 Solve the simultaneous equations

$$x + 3y = 13,$$

$$x^2 + 3y^2 = 43. \quad [5]$$

5



The diagram shows a triangle ABC , where angle B is a right angle, the length of $AB = 3 + \sqrt{2}$ and the length of $BC = 3 - \sqrt{2}$.

(i) Find the length of AC in the form \sqrt{k} , where k is an integer. [2]

(ii) Find $\tan A$ in the form $\frac{a + b\sqrt{2}}{c}$, where a , b and c are integers. [3]

- 6 Set A is such that $A = \{x : 3x^2 - 10x - 8 \leq 0\}$.
- (i) Find the set of values of x which define the set A . [3]
- Set B is such that $B = \{x : 7 - 2x \leq 1\}$.
- (ii) Find the set of values of x which define the set $A \cap B$. [2]
- 7 A committee of 8 people is to be selected from 7 teachers and 6 students. Find the number of different ways in which the committee can be selected if
- (i) there are no restrictions, [2]
- (ii) there are to be more teachers than students on the committee. [4]
- 8 The number, N , of bacteria present in an experiment, t minutes after measurements begin, is given by $N = 1000e^{-kt}$, where k is a constant.
- (i) State the number of bacteria when $t = 0$. [1]
- When $t = 0$, the number of bacteria is decreasing at the rate of 20 per minute. Find
- (ii) the value of k , [3]
- (iii) the time taken for the number of bacteria to decrease by 50%. [3]
- 9 Differentiate, with respect to x ,
- (i) $(1 - 2x)^{20}$, [2]
- (ii) $x^2 \ln x$, [3]
- (iii) $\frac{\tan(2x + 1)}{x}$. [3]
- 10 A curve has equation $y = 3x^3 - 2x^2 + 2x$.
- (i) Show that the equation of the tangent to the curve at the point where $x = 1$ is
- $$y = 7x - 4. \quad [4]$$
- (ii) Find the coordinates of the point where this tangent meets the curve again. [5]

- 11 (a) Show that $\tan\theta + \cot\theta = \operatorname{cosec}\theta \sec\theta$. [3]
- (b) Solve the equation
- (i) $\tan x = 3 \sin x$ for $0^\circ < x < 360^\circ$, [4]
- (ii) $2\cot^2 y + 3 \operatorname{cosec} y = 0$ for $0 < y < 2\pi$ radians. [5]

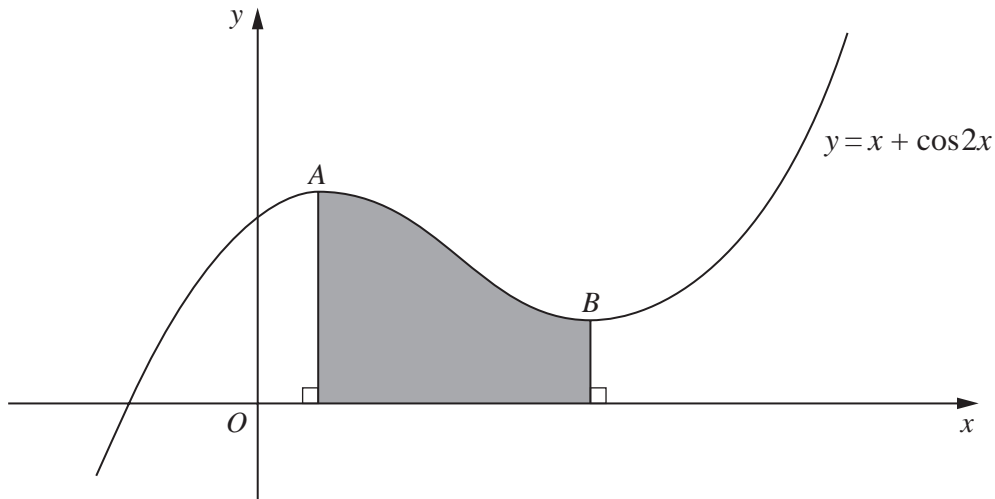
12 Answer only **one** of the following two alternatives.

EITHER

A solid circular cylinder has radius r cm and height h cm. The volume of the cylinder is 1000 cm^3 .

- (i) Find an expression for h in terms of r . [2]
- (ii) Hence show that the total surface area, $A \text{ cm}^2$, of the cylinder is given by
- $$A = 2\pi r^2 + \frac{2000}{r}. \quad [2]$$
- (iii) Given that r varies, find, correct to 2 decimal places, the value of r when A has a stationary value. [4]
- (iv) Find this stationary value of A and determine its nature. [3]

OR



The diagram shows part of the curve $y = x + \cos 2x$. The curve has a maximum point at A and a minimum point at B .

- (i) Find the x -coordinate of the point A and of the point B . [6]
- (ii) Find, in terms of π , the area of the shaded region. [5]

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