Model Question of HSC Examination 2015
Subject : Higher Mathematics Fist Paper

Time : 3 Hours   **Full Marks — 75**

[The figure in the right margin indicate the full works.]

Part - A(Algebra)

1. Answer any **two** of the following questions : $5 \times 2 = 10$

a. If $A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & 3 \\ 1 & -1 & 1 \end{bmatrix}$, (i) find A^3

(ii) find $A^3 - 2A^2 + A - 2I$, where $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

b. Show that, $\begin{vmatrix} 1 & 1 & 1 \\ 1 & p & p^2 \\ 1 & p^2 & p^4 \end{vmatrix} = p(p-1)^2(p^2-1)$

c. Show that, $\begin{vmatrix} a+b+2c & a & b \\ c & b+c+2a & b \\ c & a & c+a+2b \end{vmatrix} = 2(a+b+c)^3$

2. Answer any **one** of the following questions: $5 \times 1 = 5$

a. How many different arrangements can be made of all the letters of the word 'MILLENNIUM'? In how many of them M stands first and last?

b. How many permutations and combinations can be made from the letters of the word 'PROFESSOR' taken 4 at a time?

Part - B (Geometry)

3. Answer any **one** of the following questions : $5 \times 1 = 5$

a. If $\vec{A} = \hat{i} + 2\hat{j} - 3\hat{k}$ and $\vec{B} = 3\hat{i} - \hat{j} + 2\hat{k}$, show that the vectors $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$ are perpendicular to each other.

b. Prove by using vector that the diagonals of a rhombus bisect each other at right angles.

4. Answer any **three** of the following questions: $5 \times 3 = 15$

a. The distance of any point of a set from the point (2, 0) is three times its distance from the line $x = 0$. Find the equation of the locus.

b. $A(1, 1)$, $B(3, 4)$ and $C(5, -2)$ are the vertices of a triangle ABC. Find the equation of the straight line joining the middle points of AB and AC.

c. Show that the area of the triangle formed by the straight lines $x = a$, $y = b$, $y = mx$ is $\frac{1}{2|m|}(b - ma)^2$ sq.units.

d. The centre of a circle lies on the straight line $2x - y = 3$ and it passes through the points $(3, -2)$

Part - C (Trigonometry)

5. Answer any **two** of the following questions : $5 \times 2 = 10$

a. If $\sin 2\alpha = k \sin 2\theta$, show that $\tan(\alpha - \theta) = \frac{k-1}{k+1} \tan(\alpha + \theta)$

b. Solve with the help of a graph : $\sin 2x - \sin x = 0$, $0 \leq x \leq 2\pi$

c. Draw the graph of the function $y = \cos 2x$, when $0 \leq x \leq 2\pi$

6. Answer any **two** of the following questions : $5 \times 2 = 10$

a. show that, $2 \cos\frac{\pi}{16} = \sqrt{2 + \sqrt{2 + \sqrt{2}}}$

b. If $A + B + C = \pi$, prove that $\sin 2A - \sin 2B + \sin 2C = 4 \cos A \sin B \cos C$

c. $a^4 + b^4 + c^4 = 2c^2(a^2 + b^2)$, show that $C = 45°$ or $135°$.

Part - D (Calculus)

7. Answer any **one** of the following questions : $5 \times 1 = 5$

a. If $f(x) = \frac{1-x}{1+x}$ then prove that $f(\cos\theta) = \tan^2\frac{\theta}{2}$.

b. Let **R** be the set of real number $A, B \subseteq \mathbf{R}$, $f : A \to B$ defined by $f(x) = \frac{x-3}{2x+1}$

(i) Find the domain and range of the function
(ii) Find $f^{-1}(x)$.

8. Answer any **three** of the following questions : $5 \times 3 = 15$

a. $\displaystyle\lim_{x \to 0} \frac{1 - \sin x}{\cos x}$

b. If $y = px^2 + qx^{-\frac{1}{2}}$, prove that, $2x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} = 2y$

c. Find the integral of the following (any two)

(i) $\int \frac{dx}{\sqrt{5 - 4x^2}}$

(ii) $\int \tan x \, dx$

(iii) $\int_0^{\frac{\pi}{4}} \frac{1}{1 + \sin x} dx$

d. Find the area bounded by the circle $x^2 + y^2 = 16$

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1. (a) (i) $\begin{bmatrix} 24 & 14 & 34 \\ 18 & 8 & 26 \\ 4 & 0 & 6 \end{bmatrix}$; (ii) $\begin{bmatrix} 5 & 15 & 10 \\ 10 & 0 & 15 \\ 5 & -5 & 5 \end{bmatrix}$

2. (a) 226800, 5040
   (b) 738, 48

4. (a) $y^2 - 8x^2 - 4x + 4 = 0$
   (b) $6x + 2y - 17 = 0$
   (d) $x^2 + y^2 + 3x + 12y + 2 = 0$

5. (b) $0, \frac{\pi}{3}, \pi, \frac{5\pi}{3}, 2\pi$

7. (b) (i) Domain $= \mathbf{R} - \left\{-\frac{1}{2}\right\}$, Range $= \mathbf{R} - \left\{\frac{1}{2}\right\}$

(ii) $\frac{x+3}{1-2x}$

8. (a) 1

(c) (i) $\frac{1}{2} \sin^{-1}\frac{2x}{\sqrt{5}}$; (ii) $\ln|\sec x| + c$; (iii) $2 - \sqrt{2}$

(d) 16π sq. units.

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Ian Pickup

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