



ANGEL'S PUBLIC SCHOOL

HALF YEARLY EXAMINATION

(SAMPLE PAPER)

SESSION 2026 – 27
SUBJECT : MATHEMATICS
GRADE –XII

TIME : 03 HRS

M.M:80

GENERAL INSTRUCTIONS:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there is some internal choice in some questions.
2. Section A has 18 MCQ's and 02 Assertion Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA) questions of 2 marks each.
4. Section C has 6 Short Answer (SA) questions of 3 marks each.
5. Section D has 4 Long Answer (LA) questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (04 marks each) with sub parts.

SECTION –A

This section comprises of multiple choice questions of 1 mark each

- Q1 If $f: [1, \infty) \rightarrow [2, \infty)$ is given by $f(x) = x + \frac{1}{x}$, then $f^{-1}(x)$ is
a) $\frac{x+\sqrt{x^2-4}}{2}$ b) $\frac{x}{1+x^2}$ c) $\frac{x-\sqrt{x^2-4}}{2}$ d) $1 + \sqrt{x^2 - 4}$
- Q2 If a relation R is defined on the set Z of integers as follows: $(a, b) \in R \Leftrightarrow a^2 + b^2 = 25$. Then, domain (R) is
a) {3,4,5} b) {0,3,4,5} c) {0, ± 3 , ± 4 , ± 5 } d) none of these
- Q3 The relation $R = \{(1,1), (2,2), (3,3)\}$ on the set {1,2,3} is
a) Symmetric only b) reflexive only c) an equivalence relation d) transitive only
- Q4 If $\tan^{-1} \left\{ \frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}} \right\} = \alpha$, then $x^2 =$
a) $\sin 2\alpha$ b) $\sin \alpha$ c) $\cos 2\alpha$ d) $\cos \alpha$
- Q5 If $4\cos^{-1}x + \sin^{-1}x = \pi$, then the value of x is
a) $\frac{3}{2}$ b) $\frac{1}{\sqrt{2}}$ c) $\frac{\sqrt{3}}{2}$ d) $\frac{2}{\sqrt{3}}$
- Q6 $\sin[\cot^{-1}\{\tan(\cos^{-1}x)\}]$ is equal to
a) x b) $\sqrt{1-x^2}$ c) $\frac{1}{x}$ d) none of these
- Q7 The value of $\begin{vmatrix} 5^2 & 5^3 & 5^4 \\ 5^3 & 5^4 & 5^5 \\ 5^4 & 5^5 & 5^6 \end{vmatrix}$ is
a) 5^2 b) 0 c) 5^{13} d) 5^9
- Q8 If A is a matrix of order 3×3 is such that $|A| = 4$, then the value of $|2A|$ is
a) 32 b) 8 c) 0 d) cannot able be find
- Q9 If the matrix $\begin{bmatrix} 5-x & x+1 \\ 2 & 4 \end{bmatrix}$ is a singular matrix, then what will be the value of x
a) 1 b) 4 c) 0 d) 3

- Q10 If A is a square matrix such that $A^2 = I$, then A^{-1} is equal to
 a) $A + I$ b) A c) 0 d) $2A$
- Q11 If A and B are symmetric matrices, then ABA is
 a) Symmetric matrix b) skew – symmetric matrix
 c) diagonal matrix d) scalar matrix
- Q12 The number of all possible matrices of order 3×3 with each entry 0 or 1 is
 a) 27 b) 18 c) 81 d) 512
- Q13 Let $f(x) = |x| + |x - 1|$, then
 a) $f(x)$ is continuous at $x = 0$ as well as at $x = 1$
 b) $f(x)$ is continuous at $x = 0$ but not at $x = 1$
 c) $f(x)$ is continuous at $x = 1$ but not at $x = 0$
 d) none of these
- Q14 Differential coefficient of $\sec(\tan^{-1}x)$ is
 a) $\frac{x}{1+x^2}$ b) $x\sqrt{1+x^2}$ c) $\frac{1}{\sqrt{1+x^2}}$ d) $\frac{x}{\sqrt{1+x^2}}$
- Q15 If $x^y = e^{x-y}$, then $\frac{dy}{dx}$ is
 a) $\frac{1+x}{1+\log x}$ b) $\frac{1-\log x}{1+\log x}$ c) not defined d) $\frac{\log x}{(1+\log x)^2}$
- Q16 If $x = a \cos nt - b \sin nt$, then $\frac{d^2y}{dx^2}$ is
 a) n^2x b) $-n^2x$ c) $-nx$ d) nx
- Q17 If $x = t^2, y = t^3$, then $\frac{d^2y}{dx^2}$ is
 a) $\frac{3}{2}$ b) $\frac{3}{4t}$ c) $\frac{3}{2t}$ d) $\frac{3t}{2}$
- Q18 The volume of a sphere is increasing at the rate of $0.2\text{cm}^3/\text{sec}$. The rate at which the volume of the sphere increases when the radius is 15cm is
 a) $12\pi\text{cm}^3/\text{sec}$ b) $180\pi\text{cm}^3/\text{sec}$ c) $225\pi\text{cm}^3/\text{sec}$ d) $3\pi\text{cm}^3/\text{sec}$

Assertion – Reason Based Questions

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

- (a) Both (A) and (B) are true and (R) is the correct explanation of (A).
 (b) Both (A) and (B) are true and (R) is not the correct explanation of (A).
 (c) (A) is true and (R) is false
 (d) (A) is false and (R) is true
- Q19 **Assertion (A):** The absolute maximum value of $y = x^3 - 3x + 2$ in $0 \leq x \leq 2$ is 4
Reason (R): Slope of the tangent to the curve $y = x^3 - x + 1$ is 14 at the point whose x – coordinate is 2.
- Q20 **Assertion (A):** Let the function $f(x) = x^7 + 14x^5 + 16x^3 + 30x - 560$. The equation $f(x) = 0$ has 7 real roots.
Reason (R): Above function $f(x)$ is an increasing function in x.

SECTION – B

This section comprises of very short answer type questions of 2 marks each

- Q21 Let $A = \{1,2,3\}$, $B = \{4,5,6,7\}$ and let $f = \{(1,4), (2,5), (3,6)\}$ be a function from A to B. State whether f is one – one, onto or not and why?

OR

If the function $f: R \rightarrow R$ defined by $f(x) = 3x - 4$ is bijective, then find its inverse.

- Q22 Write the value of $\begin{vmatrix} a + ib & c + id \\ -c + id & a - ib \end{vmatrix}$

- Q23 If $A = [a_{ij}]$ is a square matrix such that $a_{ij} = i^2 - j^2$, then write whether A is symmetric or skew – symmetric.

OR

Find the equation of line joining (1,2) and (3,6) using determinants.

- Q24 If $y = \sin^{-1}\left(\frac{2x}{1+x^2}\right)$, write the value of $\frac{dy}{dx}$ for $x > 1$.

- Q25 The radius of a balloon is increasing at the rate of 10cm/sec. At what rate is the surface area of the balloon increasing when the radius is 15cm?

SECTION – C

This section comprises of short answer type questions of 3 marks each

- Q26 If $\sin\left(\sin^{-1}\frac{1}{5} + \cos^{-1}x\right) = 1$, then find the value of x

- Q27 Solve $\begin{vmatrix} 1 & bc & a(b+c) \\ 1 & ca & b(c+a) \\ 1 & ab & c(a+b) \end{vmatrix}$

- Q28 If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$ and I is identity matrix, then find λ so that $A^2 - 5A - \lambda I = 0$

OR

Examine the consistency of the following system of equations: $x+2y=2$ and $2x+3y=3$

- Q29 If $y = \sqrt{\frac{1-x}{1+x}}$, prove that $(1-x^2)\frac{dy}{dx} + y = 0$

- Q30 A water tank has the shape of an inverted right circular cone with its axis vertical and vertex lower most. Its semi – vertical angle is $\tan^{-1}(0.5)$. Water is poured into it at a constant rate of 5 cubic metre per hour. Find the rate at which the level of the water is rising at the instant when the depth of water in the tank is 4m.

OR

A particle moves along the curve $6y = x^3 + 2$. Find the points on the curve at which the y – coordinate is changing 8 times as fast as the x – coordinate.

- Q31 Find the intervals in which the function f given by $f(x) = \frac{4\sin x - 2x - x\cos x}{2 + \cos x}$, $0 \leq x \leq 2\pi$ is increasing and decreasing.

SECTION – D

This section comprises of long answer type questions of 5 marks each

- Q32 Show that the relation R on the set $A = \{x \in Z: 0 \leq x \leq 12\}$, given by

$R = \{(a, b): |a - b| \text{ is a multiple of } 4\}$ is an equivalence relation. Find the set of all elements related to 1.

- Q33 Determine the product $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$ and using it to solve the system of linear equations: $x - y + z = 4, x - 2y - 2z = 9, 2x + y + 3z = 1$

OR

If $A = \begin{bmatrix} 0 & -\tan \frac{\alpha}{2} \\ \tan \frac{\alpha}{2} & 0 \end{bmatrix}$ and I is the identity of order 2, show that

$$I + A = (I - A) \begin{bmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{bmatrix}$$

- Q34 Determine the values of a , b and c for which the function $f(x) = \begin{cases} \frac{\sin(a+1)x + \sin x}{x}, & \text{for } x < 0 \\ c, & \text{for } x = 0 \\ \frac{\sqrt{x+bx^2} - \sqrt{x}}{bx^{3/2}}, & \text{for } x > 0 \end{cases}$ is continuous at $x = 0$

- Q35 Show that the semi-vertical angle of a right circular cone of maximum volume and given slant height is $\tan^{-1}\sqrt{2}$

OR

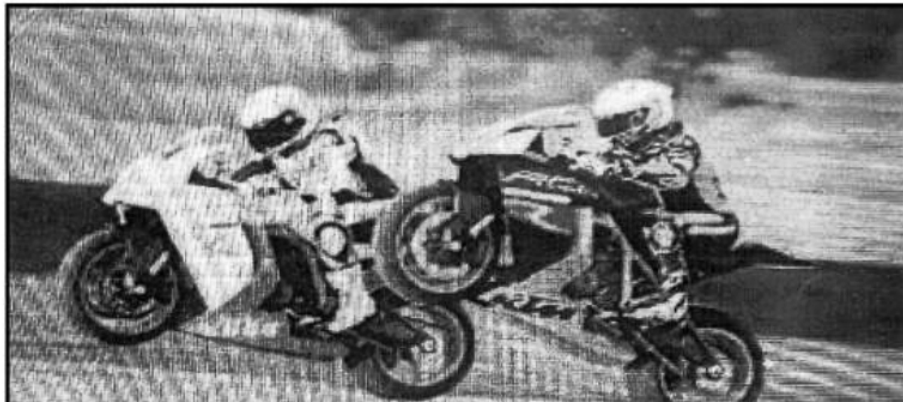
Show that the height of the cylinder of maximum volume that can be inscribed in a sphere of radius R is $\frac{2R}{\sqrt{3}}$. Also, find the maximum volume.

SECTION – E

This section comprises of 3 cases – study/passage bases questions of 4 marks each with sub – parts. The first two case – study questions have three parts (a), (b) and (c) of 1,1 and 2 respectively. The third case – study question has two sub – parts of two marks each.

- Q36 An organization conducted bike race under two different categories boys and girls. Totally there are 250 participants. Among all of them finally three from Category – 1 and two from Category – 2 were selected for the final race. Mohan forms two sets B and G with these participants for his college project.

Let $B = \{b_1, b_2, b_3\}$, $G = \{g_1, g_2\}$, where B represents the set of boys selected and G the set of girls who were selected for the final race.



Based on the above information, answer the following questions:

- How many relations are possible from B to G ?
- Among all the possible relations from B to G , how many functions can be formed from B to G ?

- (c) Let $R: B \rightarrow B$ be defined by $R = \{(x, y): x \text{ and } y \text{ are the students of same sex}\}$.
Check if R is an equivalence relation.

OR

- (c) A function $f: B \rightarrow G$ be defined by $f = \{(b_1, g_1), (b_2, g_2), (b_3, g_1)\}$. Check if f is bijective. Justify your answer.

- Q37 Mr. Sudhir and Mr. Amit decided to reward their kids on the basis of good habits practiced during their summer holidays namely daily yoga(x) and regular studies(y). Mr. Sudhir decided to give 100 chocolates for the two values to his two boys and one girl child. Mr. Amit decided to give 60 chocolates for the two values to his one boy and one girl child.

Based on the above information, answer the following questions:

- (a) Convert the given above situation into a matrix equation of the form $AX=B$
(b) Find $|A|$
(c) Find A^{-1}

OR

Determine $P = A^2 - 5A$

- Q38 A square piece of tin sheet measuring 24 cm x 24 cm is to be made into a box without top by cutting a square from each corner and folding up the flaps to form the box.

Based on the above information, answer the following questions:

- (a) Find the volume of the box
(b) Find the differentiation of the volume.

