



Delhi Public School, Howrah

PERIODIC TEST - I (2025 - 2026)

Class - XI

Care must be taken not to write anything on the question paper. All the questions must be attempted in the correct sequence.

Time: 3 Hours

Subject:- Mathematics (Code 041)

F.M. 80

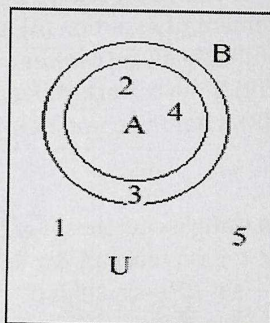
General Instructions:

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

SECTION A

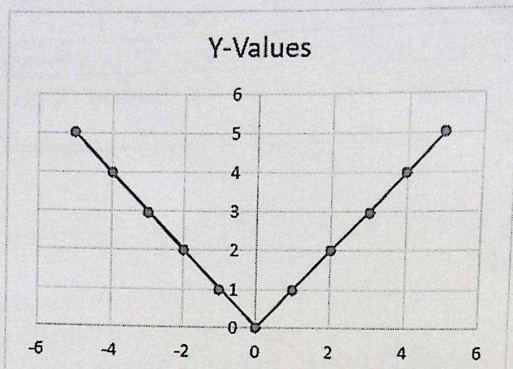
(All Questions are compulsory. No internal choice is provided in this section)

- 1) If the number of elements in set A is 5 and in set B is 7, then maximum number of elements in $A \cup B$ is:
A) 12 B) 35 C) 7 D) 5
- 2) Let $A = \{1, 2, 3\}$ and $P(A)$ be its power set. How many elements of $P(A)$ contain the element 2?
A) 7 B) 6 C) 5 D) 4
- 3) Which of the following is set representing B but not A?



- A) $\{\}$ B) $\{2\}$ C) $\{2, 3\}$ D) $\{3\}$
- 4) If $P(A)$ contains 8 elements, and $A \cap B = \emptyset$, then the number of elements in $B \cup A$ is:
A) 3 B) cannot be determined C) 5 D) depends on B
- 5) Let A and B be two finite sets, then the number of functions from A to B is
A) $n(A) \cdot n(B)$ B) $2^{n(A) \cdot n(B)}$ C) $\{n(A)\}^{n(B)}$ D) $\{n(B)\}^{n(A)}$
- 6) If $(4a - 2, b + 4) = (3a - 1, 5)$, then a and b are
A) $a = 1, b = 1$ B) $a = 2, b = 1$ C) $a = 1, b = 2$ D) $a = 2, b = 2$
- 7) The domain of the function $f(x) = \frac{x}{x^2 + 3x + 2}$ is
A) $[-2, -1]$ B) $\mathbb{R} - \{1, 2\}$ C) $\mathbb{R} - \{-1, -2\}$ D) $\mathbb{R} - \{2\}$
- 8) For any two sets X and Y, $X \cap (X \cup Y)'$ is equal to
A) X B) Y C) $\emptyset$ D) $X \cap Y$
- 9) Evaluate: $\frac{1}{i^{25}} + i^{18}$.
A) i B) 1 C) (-2) D) -i
- 10) Number of solutions of the equation $z^2 + |z|^2 = 0$ is
A) 1 B) 2 C) 3 D) infinitely many
- 11) If z is a complex number, then
A) $|z^2| > |z|^2$ B) $|z^2| = |z|^2$ C) $|z^2| < |z|^2$ D) $|z^2| \geq |z|^2$
- 12) Number of proper subsets of a set containing 4 elements is
A) 16 B) 15 C) 32 D) None of these

- 13) A wheel makes 450 revolutions per hour. The number of radians through which it turns in one second is
 A) $\frac{\pi}{4}$ B) $\frac{\pi}{2}$ C) $\frac{\pi}{6}$ D) $\frac{\pi}{3}$
- 14) Which function is shown in graph?



- A) Constant Function B) Modulus function C) Signum function D) None of these
- 15) The value of $\cos 130^\circ \cos 40^\circ + \sin 130^\circ \sin 40^\circ$ is
 A) 0 B) 1 C) -1 D) Undefined
- 16) Which of the following is correct?
 A) $\sin 1^\circ > \sin 1$ B) $\sin 1^\circ < \sin 1$ C) $\sin 1^\circ = \sin 1$ D) $\sin 1^\circ = \frac{\pi}{180} \sin 1$
- 17) The value of $\operatorname{cosec}(-750^\circ)$ is
 A) $\frac{2}{\sqrt{3}}$ B) -2 C) 2 D) $-\frac{2}{\sqrt{3}}$
- 18) $\forall n \in N, 3 \cdot 5^{2n+1} + 2^{3n+1}$ is divisible by
 A) 19 B) 17 C) 23 D) 25

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 (R) are true and (R) is the correct explanation of (A).
 (B) Both (A) and (R) are true but (R) is not the correct explanation of (A).
 (C) (A) is true but (R) is false.
 (D) (A) is false but (R) is true.

- 19) Assertion (A): Additive inverse of a complex number $(-\sqrt{2} - 3i)$ is $(-\sqrt{2} + 3i)$.
 Reason (R): For a complex number $x + iy$, real part is x and imaginary part is iy .
- 20) Assertion (A): The value of $\sin 50^\circ - \sin 70^\circ + \sin 10^\circ$ is 0.
 Reason (R): $\sin x - \sin y = 2 \cos \frac{x+y}{2} \sin \frac{y-x}{2}$.

SECTION B

(All Questions are compulsory. In case of internal Choice, attempt any one question only)

- 21) a) If $P(A) = P(B)$, then show that $A = B$.

OR

- b) Let A and B be two sets. If $A \cap X = B \cap X = \emptyset$ and $A \cup X = B \cup X$ for some set X, then show that $A = B$.

- 22) a) Find the value of $\tan 15^\circ$.

OR

- b) Prove: $\frac{\sin x - \sin y}{\cos x + \cos y} = \tan \frac{x-y}{2}$.

- 23) Find the domain of the function f given by $f(x) = \frac{1}{\sqrt{4-x^2}}$.

- 24) Solve the following quadratic equation: $x^2 + x + \frac{1}{\sqrt{2}} = 0$.

- 25) Find the modulus of $\left[\frac{1+i}{1-i} - \frac{1-i}{1+i} \right]$.

SECTION C

(All Questions are compulsory. In case of internal Choice, attempt any one question only)

- 26) Two finite sets have m and n elements respectively. The total number of subsets of first set is 56 more than the total number of subsets of the second set. Find the values of m and n .

27) a) Convert the complex number $z = \frac{2(i-1)}{1+\sqrt{3}i}$ in the polar form.

b) Evaluate: $(1+i)^6 + (1-i)^3$

OR

28) Find the range of the functions: (a) $f(x) = \frac{|x-4|}{x-4}$

(b) $f(x) = 1 + 3 \cos 2x$

29) Is $g = \{(1, 1), (2, 3), (3, 5), (4, 7)\}$ a function? Justify. If this is described by the relation, $g(x) = \alpha x + \beta$, then what values should be assigned to α and β ?

30) Prove that $\tan x + \tan\left(\frac{\pi}{3} + x\right) - \tan\left(\frac{\pi}{3} - x\right) = 3 \tan 3x$.

31) a) If $\sin x = \frac{3}{5}$, $\cos y = \frac{-12}{13}$, where x and y both lie in the second quadrant, find the value of $\sin(x+y)$.

OR

b) If $a \cos 2\theta + b \sin 2\theta = c$ has $\tan \alpha$ and $\tan \beta$ as its roots, then prove that $\tan \alpha + \tan \beta = \frac{2b}{a+c}$.

SECTION D

(All Questions are compulsory. In case of internal Choice, attempt any one question only)

32) a) If $\tan \frac{\alpha}{2}$ and $\tan \frac{\beta}{2}$ are the roots of the quadratic equation $8x^2 - 26x + 15 = 0$, then find the value of $\cos(\alpha + \beta)$.

OR

b) If $\sin x + \sin y = a$, $\cos x + \cos y = b$, then show that $\cos(x-y) = \frac{a^2+b^2-2}{2}$.

33) In a town of 10,000 families, it was found that 40 % families buy newspaper A, 20 % families buy newspaper B, 10 % families buy newspaper C, 5 % families buy A and B, 3 % buy B and C and 4 % buy A and C. If 2 % families buy all the three newspapers. Find the following:

(a) The number of families which buy newspaper A only.

(b) The number of families which buy newspaper C only.

(c) The number of families which buy none of A, B and C.

34) Prove that $\frac{1}{1.2.3} + \frac{1}{2.3.4} + \frac{1}{3.4.5} + \dots + \frac{1}{n(n+1)(n+2)} = \frac{n(n+3)}{4(n+1)(n+2)}$.

35) a) (i) If $\cos \theta = \frac{\cos \phi - e}{1 - e \cos \phi}$, prove that $\tan^2 \frac{\theta}{2} = \frac{1+e}{1-e} \tan^2 \frac{\phi}{2}$.

(ii) Find the range of the function $5 \sin x - 12 \cos x + 7$.

OR

b) (i) Show that $\cos \frac{2\pi}{7} + \cos \frac{4\pi}{7} + \cos \frac{6\pi}{7} = \frac{-1}{2}$.

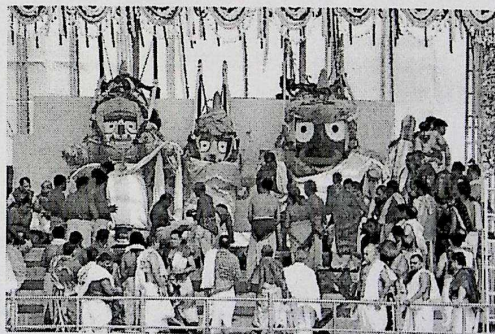
(ii) Find the minimum value of $3 \cos x + 4 \sin x + 8$.

SECTION E

(This section comprises of 3 source-based questions (Case Studies) of 4 marks each)

36) Case study - I:

During the annual Snan Yatra of Lord Jagannath in Puri, the massive 3.5-ton chariots of the deities are transported up a specially constructed inclined plane (ramp) to the elevated Snana Mandapa. Engineers observed that for optimal mechanical advantage and safety, the angle of elevation θ of the ramp must maintain specific trigonometric ratio. This year, the angle of elevation θ was such that $\sin \theta = \frac{3}{5}$, $\theta \in (0, 2\pi)$. To ensure uniform force distribution across support chains, trigonometric modelling was used to predict the structural tension behaviour as the angle doubled and tripled due to slope variations near the top of the ramp. Based on the above information, answer the following questions:



i) Assume due to elevation variation, a segment of the ramp follows angle 2θ . Compute the value of $\cos 2\theta \sin^2 \theta + \sin 2\theta \cos^2 \theta$. 1

ii) Given θ is such that $\sin \theta = \frac{3}{5}$, find the value of the expression: $\frac{\cos 3\theta + \cos \theta}{\cos 2\theta}$. 1

iii) If another ramp is built on the opposite side of the Mandapa at angle ϕ such that $\phi = \theta + \frac{\pi}{6}$,

then find the exact value of $\cos(\phi + \theta)$.

2

OR

- iv) In the same Snan Yatra, suppose a second ramp is inclined at $B = 30^\circ$, then find the value of $\sin^2(\theta + B)$.

2

37) Case study - II:

During the grand Durga Puja festival organized by the "Shakti Cultural Society," three categories of volunteers were involved:

- Set A: Volunteers managing pandal decorations
- Set B: Volunteers handling prasad distribution
- Set C: Volunteers assisting in crowd control

There were 200 total volunteers. The following data was collected:

- 95 participated in decoration (A)
- 85 participated in prasad distribution (B)
- 75 helped in crowd control (C)
- 40 were part of both A and B
- 30 were part of both B and C
- 25 were part of both A and C
- 15 were active in all three activities ($A \cap B \cap C$)

Based on this information, answer the following questions.

- i) How many volunteers took part in only decoration? 1
- ii) How many volunteers were involved in at least one of the three activities? 1
- iii) a) How many volunteers were involved in only one activity? 2

OR

- iii) b) How many volunteers were not involved in any of the three activities? 2

38) Case study - III:

At a high-tech pet shelter, each animal is fitted with a smart collar that tracks their position on a 2D field using complex numbers. The shelter represents the field using the Argand plane, where the position of any pet is represented by a complex number $z = x + iy$. One day, two pets wandered off. The dog was at position $z_D = 3 + 3i$. The cat was at position $z_C = 4 + 4\sqrt{3}i$. To analyse their movement, the shelter uses the polar form of complex numbers, $z = r(\cos \theta + i \sin \theta)$ where $r = |z|$ is the modulus (distance from origin), and θ is the amplitude (argument, direction angle from the positive x-axis). Based on the above information, answer the following questions:

- i) What is the modulus of the dog's position $z_D = 3 + 3i$? 1
- ii) What is the amplitude (argument) of the cat's position? 1
- iii) a) If both the dog and cat move one step by rotating 90° anticlockwise about the origin, what is the polar form of the new position of the dog? 2

OR

- iii) (b) After analysing the animals' behaviour, the shelter decides to send both pets back in a straight line towards the origin at the same speed. Who will reach the origin first and how many units will each travel? 2

