

BHATNAGAR INTERNATIONAL SCHOOL
PASHIM VIHAR
Class XI 2025-26
Mid-term Examination
Subject- Mathematics (041)
Set - A

Time: 3 Hours

Maximum Marks: 80

General Instructions:

1. This question paper contains five sections A, B, C, D and E. Each section is compulsory.
2. Section - A carries 20 marks weightage, Section - B carries 10 marks weightage, Section - C carries 18 marks weightage, Section - D carries 20 marks weightage and Section - E carries 3 case-based with total weightage of 12 marks.
Section - A:
3. It comprises of 20 MCQs of 1 mark each.
Section - B:
4. It comprises of 5 VSA type questions of 2 marks each.
Section - C:
5. It comprises of 6 SA type of questions of 3 marks each.
Section - D:
6. It comprises of 4 LA type of questions of 5 marks each.
Section - E:
7. It has 3 case studies. Each case study comprises of 3 case-based questions, where 2 VSA type questions are of 1 mark each and 1 SA type question is of 2 marks.

SECTION - A

1. If $P = \{3, 6, 9, 12, 15, 18, 21\}$, $Q = \{4, 8, 12, 16, 20\}$, $R = \{2, 4, 6, 8, 10, 12, 14, 16\}$, $S = \{5, 10, 15, 20\}$, the value of $S - P$ is
- a) $\{5, 10, 20\}$ b) $\{15, 10, 20\}$ c) $\{5, 3, 6, 20\}$ d) $\{10, 20\}$
2. Find x and y if: $(x - y, x + y) = (6, 10)$
- a) $x = 8, y = -2$ b) $x = 8, y = 2$ c) $x = -8, y = -2$ d) $x = -8, y = 2$
3. The value of $\tan 1^\circ \tan 2^\circ \tan 3^\circ \dots \tan 89^\circ$ is
- a) 0 b) 1 c) $\frac{1}{2}$ d) Not defined
4. If $-3 \leq 4 - \frac{7x}{2} \leq 18$ then x belongs to
- a) $[4, 2]$ b) $[-4, 2]$ c) $(-4, 2]$ d) $[-4, 2]$
5. The value of $(z+3)(\bar{z}+3)$ is equivalent to
- a) $|z+3|^2$ b) $|z-3|$ c) z^2+3 d) None of these
6. The set $(A \cap B)' \cup (B \cap C)$ is equal to
- a) $A' \cup B \cup C$ b) $A' \cup B$ c) $A' \cup C'$ d) $A' \cap B$
7. There are 10 lamps in a hall. Each one of them can be switched on independently. The number of ways in which the hall can be illuminated are
- a) 1024 b) 1023 c) 20 d) 19
8. What is the range of greatest integer function?
- a) $\mathbb{R}$ b) $\mathbb{R}^+$ c) $\mathbb{R}^-$ d) $\mathbb{Z}$

✓ 9. If ${}^nC_{12} = {}^nC_8$, then n is equal to

- a) 20 b) 12 c) 6 d) 30

✓ 10. The minimum value of $4^x + 4^{1-x}$, $x \in \mathbb{R}$, is

- a) 2 b) 4 c) 1 d) 0

✓ 11. The domain and range of the function f given by $f(x) = 2 - |x - 5|$ is

- a) Domain = $\mathbb{R}^+$, Range = $(-\infty, 1]$ b) Domain = $\mathbb{R}$, Range = $(-\infty, 2]$
c) Domain = $\mathbb{R}$, Range = $(-\infty, 2)$ d) Domain = $\mathbb{R}^+$, Range = $(-\infty, 2]$

✓ 12. Ravi obtained 70 and 75 marks in first two unit tests. The minimum marks he should get in the third test to have an average of at least 60 marks is

- a) 45 b) 40 c) 30 d) 35

✓ 13. The multiplicative inverse of complex number $4 - 3i$ is

- a) $-\frac{4}{25} - i\frac{3}{25}$ b) $\frac{4}{25} - i\frac{3}{25}$ c) $\frac{4}{25} + i\frac{3}{25}$ d) $-\frac{4}{25} + i\frac{3}{25}$

✓ 14. The 12th term of a G.P. whose 8th term is 192 and the common ratio is 2 is

- a) 3072 b) 1536 c) 6144 d) 3076

✓ 15. Out of 18 points in a plane, no three are in the same line except five points which are collinear. The number of lines that can be formed joining the point.

- a) 154 b) 143 c) 155 d) 144

✓ 16. If $\sin \theta$ and $\cos \theta$ are the roots of the equation $ax^2 - bx + c = 0$, then a , b and c satisfy the relation.

- a) $a^2 + b^2 + 2ac = 0$ b) $a^2 - b^2 + 2ac = 0$ c) $a^2 + c^2 + 2ab = 0$ d) $a^2 - b^2 - 2ac = 0$

✓ 17. For a, b, c to be in G.P. the value of $\frac{a-b}{b-c}$ is equal to

- a) $\frac{a}{b}$ b) ab c) $\frac{b}{a}$ d) ac

✓ 18. If $|x - 1| > 5$, then

- a) $x \in (-4, 6)$ b) $x \in (-\infty, -4) \cup (6, \infty)$ c) $x \in [-4, 6]$ d) $x \in (-\infty, -4) \cup (6, \infty)$

Followings are Assertion (A) - Reason (R) based questions (from Q19 to 20).

Read the following statements carefully to mark the correct option out of the options given below.

- (a) A is true, R is true; R is a correct explanation for A.
(b) A is true, R is true; R is not a correct explanation for A.
(c) A is true, R is false.
(d) A is false, R is true.

✓ 19. **Assertion (A):** If W is the set of whole numbers and N is the set of natural numbers, then $W - N = \{ \}$.
Reason (R): $A - B$ is the set of elements of A which are not in B .

✓ 20. **Assertion (A):** The ratio of the radii of two circles at the centre of which two equal arcs subtend angles of 30° and 70° is 21:10.

Reason (R): Number of radians in an angle subtended at the centre of a circle by an arc is equal to the ratio of the length of the arc to the radius of the circle.

SECTION - B

1. Write the following sets in the roster form:

a) $B = \{x \mid x^2 = x, x \in \mathbb{R}\}$

b) $F = \{x \mid x^4 - 5x^2 + 6 = 0, x \in \mathbb{R}\}$

2. Show that $\tan 3x \tan 2x \tan x = \tan 3x - \tan 2x - \tan x$

3. If $A = \{-1, 1\}$, find $A \times A \times A$.

4. If $x - iy = \sqrt{\frac{a - ib}{c - id}}$, prove that $(x^2 + y^2)^2 = \frac{a^2 + b^2}{c^2 + d^2}$

5. Three married couples are to be seated in a row having six seats in a cinema hall. If spouses are to be seated next to each other, in how many ways can they be seated? Find also the number of ways of their seating if all the ladies sit together and all the men sit together.

OR

6. If the letters of the word SURITI are arranged in all possible ways as listed in dictionary, then what is the rank of the word SURITI?

SECTION - C

7. A solution of 8% boric acid is to be diluted by adding a 2% boric acid solution to it. The resulting mixture is to be more than 4% but less than 6% boric acid. If we have 640 litres of the 8% solution, how many litres of the 2% solution will have to be added?

8. Find the sum to n terms of the sequence $0.6 + 0.66 + 0.666 + \dots$

OR

9. The sum of two numbers is 6 times their geometric mean, show that numbers are in the ratio $(3 + 2\sqrt{2}) : (3 - 2\sqrt{2})$.

10. In how many of the distinct permutations of the letters in MISSISSIPPI do the four I's not come together?

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

12. If $|z + 1| = z + 2(1 + i)$, then find z .

OR

If $a = \cos \theta + i \sin \theta$, prove that $\frac{1+a}{1-a} = i \cot \frac{\theta}{2}$.

13. If $x \cos \alpha = y \cos(\alpha + \frac{2\pi}{3}) = z \cos(\alpha + \frac{4\pi}{3})$, then find the value of $xy + yz + zx$.

SECTION - D

14. Find the domain and range of the following functions:

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

b) $g(x) = \frac{1}{\sqrt{9-x^2}}$

15. Prove that $\sin^3 x + \sin^3(\frac{2\pi}{3} + x) + \sin^3(\frac{4\pi}{3} + x) = -\frac{3}{4} \sin 3x$

16. Let S be the sum, P the product and R the sum of reciprocals of n terms in a G.P. Prove that $P^2 R^n = S^n$.

36. Solve for x : $\frac{|x+3|+x}{x+2} > 1$

OR

37. Solve the following system of inequalities: $\frac{2x+1}{7x-1} > 5, \frac{x+7}{x-8} > 2$

SECTION - E

38. CASE STUDY-1

With the Real component of z , $\text{Re}(z) = a$, and the Imaginary part of z , $\text{Im}(z) = b$, a complex number z can be expressed in the form $z = a + bi$. Two complex numbers $Z_1 = a + ib$ and $Z_2 = c + id$ are said to be equal if $a = c$ and $b = d$.

Based on the above information, answer the following questions. Show steps to support your answers.

a) If $(3a - 6) + 2ib = -(6b + (6 + a)i)$, what are the real values of a and b ? (1)

b) If $\left(\frac{1-i}{1+i}\right)^{100} = a + ib$, determine values of a and b . (1)

c) If $\frac{(1+i)^2}{2-i} = x + iy$, find the value of $x + y$. (2)

39. CASE STUDY-2

In a group of 50 students, the number of students studying French, English, Sanskrit was found to be as follows:

French = 17, English = 13, Sanskrit = 15, French and English = 09,

English and Sanskrit = 4, French and Sanskrit = 5, English, French and Sanskrit = 3.

Based on the above information, answer the following questions. Show steps to support your answers.

Find the number of students who study:

a) French only (1)

b) at least one of the three languages (2)

c) French and Sanskrit but not English (1)

40. CASE STUDY-3

In mathematics, a **combination** is a way of selecting items from a collection where the order of selection does not matter. Suppose we have a set of three numbers P , Q and R . Then in how many ways we can select two numbers from each set, is defined by combination.

A group consisting of 4 girls and 7 boys goes to a picnic. They decide to play a game which requires a team of five members.



Based on the above information, answer the following questions. Show steps to support your answers.

a) In how many ways can a team be selected if the team has no girl? (1)

b) In how many ways can a team be selected if the team has at least three boys? (2)

c) In how many ways can a team be selected if the team has at least three girls? (1)