DELHI PUBLIC SCHOOL

KNOWLEDGE PARK V

MATHEMATICS

CLASS – XI

TIME ALLOWED: 3 HOURS **MAXIMUM MARKS: 80**

General Instructions:

Read the following instructions carefully and follow them:

(i) This question paper contains **38** questions. **All** questions are compulsory.
(ii) This question paper divided into **five** sections – **A, B, C, D** and **E.**
(iii) In **Section A**, Question number **1** to 18 are multiple choice questions (MCQ) and question numbers **19** and **20** are Assertion- Reason based questions of 1 mark each.
(iv) In **Section B,** Question number **21** to **25** are very short answer (VSA) type questions, carrying 2 marks each.
(v) In **Section C,** Question number **26** to **31** are short answer (SA) type questions carrying 3 marks each.
(vi) In **Section D,** Question numbers **32** to **35** are long answer (LA) type questions carrying 5 marks each.
(vii) In **Section E,** Question number **36** to **38** are **case based integrated** questions carrying 4 marks each.
(viii) Draw neat diagrams wherever required.
(ix) Use of calculator is **NOT allowed**.

SECTION A

Q1 For any two sets A and B, $A \cap (A \cup B)'$ is equal to 1

(a) $A \cap B$ (b) ϕ (c) B (d) A

Q2 If the coordinate of a point are (0,0,-4), then it lies on: 1

(a) X- axis (b) Y- axis (c) Z- axis (d) Between x- axis and y- axis

Q3 If $f(x) = \frac{x}{x-1} = \frac{1}{y}$, then f(y) = 1

(a) 1 + x (b) 1 - x (c) x - 1 (d) x

Q4 If $\cos x = \frac{1}{2}$, then $\cos 3x = ?$ 1

(a) - 1 (b) $\frac{2}{3}$ (c) $\frac{3}{2}$ (d) $\frac{1}{6}$

Q5 $(\sqrt{3}+1)^{2n} + (\sqrt{3}-1)^{2n}$ is

(a) negative real number (b) an even positive integer
(c) an odd positive integer (d) irrational number

Q6 If $R = \{(x, y): x, y \in Z, x^2 + y^2 \leq 4\}$ is a relation on Z, then domain of R is

(a) { - 2, - 1, 0, 1, 2} (b) {0, - 1, - 2} (c) { - 1, 0, 1} (d) {0, 1, 2}

Q7 If $5\cot\theta = 4$, then $\left(\frac{5\sin\theta - 3\cos\theta}{\sin\theta + 2\cos\theta}\right) = ?$

(a) 1 (b) $\frac{3}{14}$ (c) $\frac{5}{14}$ (d) $\frac{3}{4}$

Q8 If a set A has n elements then the total number of subsets of A is

(a) 2n (b) n (c) 2^n (d) n^2

Q9 The complex number z such that $\left|\frac{z-i}{z+i}\right| = 1$ lies on
(a) a circle (b) The line x = 1 (c) The x - axis (d) The line y = 1

Q10 Distance of Y – axis from the point (1,2,-3) is
(a) 2 (b) -2 (c) -3 (d) None of these

Q11 If $A = 2\sin^2 x - \cos 2x$, then A lies in the interval
(a) [- 2, 4] (b) [2, - 4] (c) [-1, 3] (d) [1, 2]

Q12 Z-Coordinate of all points on the Y – axis is
(a) -1 (b) 0 (c) 1 (d) Any number

Q13 If $z = \frac{1}{(1-i)}$, then |z| =
(a) 1 (b) $1/\sqrt{2}$ (c) $4/\sqrt{2}$ (d) $5/\sqrt{26}$

Q14 If C_r denotes ${}^nC_r$ in the expansion of $(1+x)^n$, then $C_0 + C_1 + C_2 + \ldots + C_n = ?$
(a) 2n (b) 2^n (c) $\frac{1}{3}n(2n+1)$ (d) 2^{n-1} 1

Q15 If there are 6 bowlers, 3 wicket-keepers, and 11 batsmen in all. The number of ways in which a team of 4 bowlers, 2 wicket-keepers, and 5 batsmen can be chosen.
(a) ${}^6C_4{}^3C_2{}^{11}C_5$ (b) ${}^6C_2{}^3C_4{}^{11}C_5$ (c) ${}^6C_2{}^3C_5{}^{11}C_4$ (d) ${}^6C_2{}^3C_1{}^{11}C_5$ 1

Q16 Let n (A) = m, and n (B) = n. Then the total number of non - empty relations that can be defined from A to B is
(a) m^n (b) $m^n - 1$ (c) $n^m - 1$ (d) $2^{mn} - 1$ 1

Q17 Solve the system of inequalities - $2 < 1 - 3x < 7$
(a) $-1 < x < 1$ (b) $-1 < x < 10$ (c) $-2 < x < 2$ (d) $-2 < x < 1$ 1

Q18 The smallest set A such that $A \cup \{1, 2\} = \{1, 2, 3, 5, 9\}$ is
(a) {1, 2, 5, 9} (b) {4, 5, 6} (c) {3, 5, 9} (d) {2, 3, 5}

DIRECTION: In the question number 19 and 20, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct option

Q19 **Statement A (Assertion):** Product of five consecutive natural number is divisible by 4! 1
Statement R (Reason): Product of first n natural number is (n + 1)!
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true and reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

Q20 **Statement A (Assertion):** The set A = {a, b, c, d, e, g} is finite set. 1
Statement R (Reason): The set B = {men living presently in different parts of the world} is finite set.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true and reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

SECTION- B

Q21 Write down all possible subsets of A = {1, {2, 3}}. 2

Q22 Out of 18 points in a plane, no three are in the same line except five points which are collinear. Find the number of lines that can be formed joining the point. 2

Q23 Prove that $\frac{\sin x+\sin 3x+\sin 5x}{\cos x+\cos 3x+\cos 5x} = \tan 3x$. 2

OR

The minute hand of a watch is 1.5 cm long. How far does its tip move in 40 minutes? (Use $\pi = 3.14$).

Q24 Find the value of $\left[i^{19} + \left(\frac{1}{i}\right)^{25}\right]^2$ 2

Q25 Which is larger $(1.01)^{1000000}$ or 10,000? 2

OR

Compute $(98)^5$. 2

SECTION- C

Q26 If $\sin 2A = \lambda \sin 2B$, prove that: $\frac{\tan(A+B)}{\tan(A-B)} = \frac{\lambda+1}{\lambda-1}$. 3

Q27 If $(x + iy) = \sqrt{\frac{a+ib}{c+id}}$, prove that $(x^2 + y^2)^2 = \frac{a^2+b^2}{c^2+d^2}$. 3

OR

Find all non - zero complex numbers of z satisfying $\bar{z} = iz^2$.

Q28 Solve the inequation $\frac{2x+4}{x-3} \leq 4$. 3

OR

Find all pairs of consecutive odd natural numbers, both of which are larger than 10, such that their sum is less than 40.

Q29 If $f(x) = \frac{1}{(1-x)}$ then show that $f[\, f\{f(x)\}] = x$. 3

Q30 Compute the sum of all 4 digit numbers which can be formed with the digits 1, 3, 5, 7, if each digit is used only once in each arrangement. 3

Q31 Using binomial theorem, prove that $6^n - 5n$ always leaves remainder 1 when divided by 25. 3

SECTION- D

Q32 (i) Find the domain and range of the function $f(x) = \frac{x^2-9}{x-3}$. 5

(ii) Find the domain of the function $f(x) = \frac{x^2+3x+5}{x^2+x-6}$.

Q33 If $x \cos\theta = y \cos(\theta + \frac{2\pi}{3}) = z \cos\left(\theta + \frac{4\pi}{3}\right)$, then show that $xy + yz + zx = 0$. 5

OR

Prove that: $\sin 20^o \sin 40^o \sin 80^o = \frac{\sqrt{3}}{8}$.

Q34 If $(x + iy)^{\frac{1}{3}} = a + ib$, a, b, x, y $\in R$. Find the value of $x^2 + y^2$ & show that $\frac{x}{a} + \frac{y}{b} = 4(a^2 - b^2)$. 5

Q35 How many four letter words can be made by using the letters of the word INEFFECTIVE. Also find the total number of words if we arrange all letters together. 5

OR

A bag contains six white marbles and five red marbles. Find the number of ways in which four marbles can be drawn from the bag if

(a) they can be of any colour (1)

(b) two must be white and two red (2)

(c) they must all be of the same colour. (2)

$19 + n = -25$
$n = -25 - 19$
$= -48$

SECTION- E

Q36 **Case Study – I: Read the text carefully and answer the questions:** Vijay is observing top of building and top of flag staff on building of 10m tall from a point P on the ground. The angle of elevation of the top of the flagstaff from P is B. Given that sin(A+B) = 1 and building is A and the angle of elevation of the top $\sin(A - B) = \frac{1}{2}$ where $A, B \in \left[0, \frac{\pi}{2}\right]$. 4

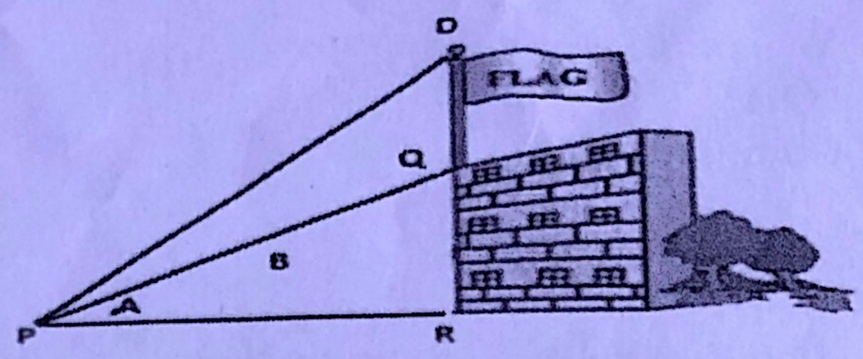
(i). What is the value of A? (1)

(ii). What is the value of tan (A + 2B) tan (2A + B)? (1)

(iii). What is the value of $\sin^2 A - \sin^2 B$? (2)

OR

What is the value of cos 2A?



Q37 **Case Study – II: Read the text carefully and answer the questions:** 4

Dr. Sharma, a chemist, needs to prepare a specific boric acid solution for his laboratory experiments. He currently has 640 litres of an 8% boric acid solution. To achieve the desired concentration, he plans to dilute this solution by adding a 2% boric acid solution. The final solution should have a boric acid concentration that is more than 4% but less than 6%.

(i) Find the volume of boric acid in 8% solution (1)

(ii) Form the inequality for given below condition in (iii) (1)

(iii) Given this scenario, determine how many litres of the 2% boric acid solution, Dr. Sharma should add to the 640 litres of the 8% boric acid solution to achieve the required concentration range. (2)

Q38 **Case Study - III: Read the text carefully and answer the questions:** 4

A pillar is to be constructed on a field. Kavita is an Engineer for that project. This was Kavita's first project after completing her Engineering. She draws the following diagram of that pillar for the approval. Consider the following diagram, where the forces in the cable are given.

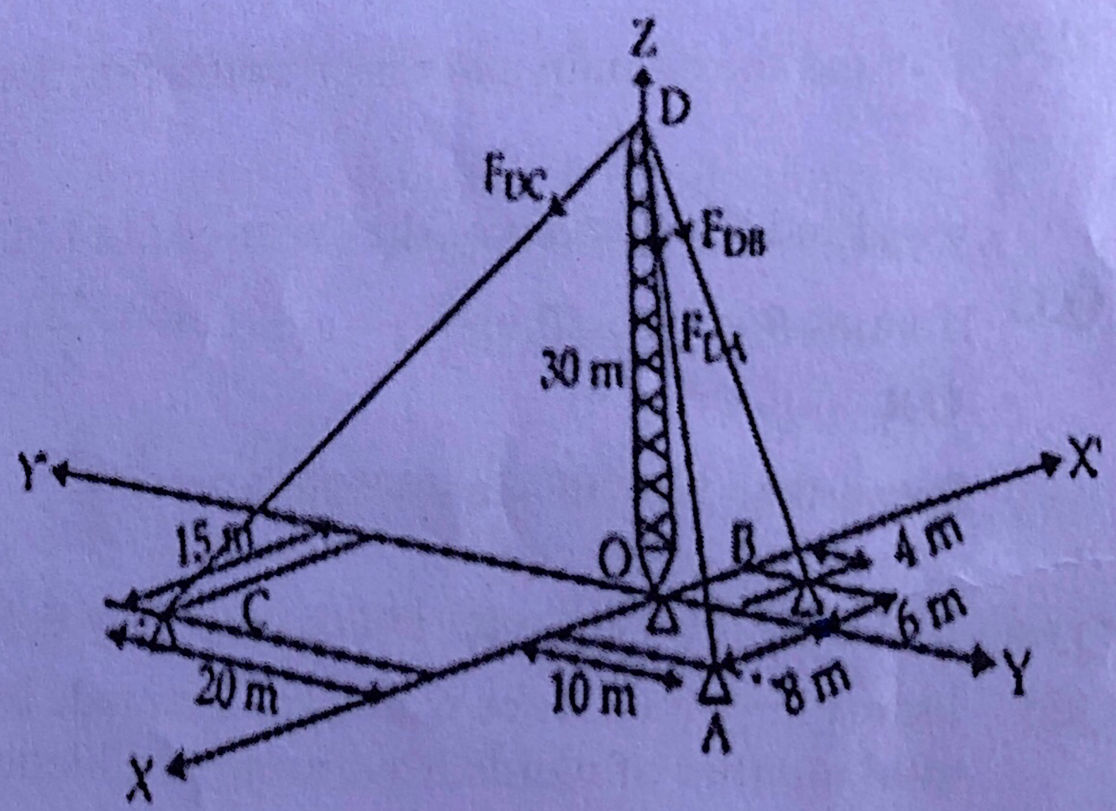
(i) Write the coordinates of A and B. (1)

(ii) Find the coordinates of the midpoint of AB (1)

(iii) Find the sum of the distances OA and OB. (2)

OR

Find the sum of the distances OC and OD. (2)



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Santosh