SUN TUITION CENTER -9629216361

HALF YEARLY / PUBLIC MODEL QUESTION PAPER -2022

MODEL -I

Time Allowed: 3 Hours **HIGHER SECONDARY FIRST YEAR** **Maximum Marks: 90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.
(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$
(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. The range of the function $f(x) = |\lfloor x\rfloor - x|, x \in R$ is
(1) [0, 1] (2) [0, ∞) (3) [0, 1) (4) (0, 1)

2. If 3 is the logarithm of 343, then the base is
(1) 5 (2) 7 (3) 6 (4) 9

3. Let $f_k(x) = \frac{1}{k}[\sin^k x + \cos^k x]$ where $x \in R$ and $k \geq 1$. Then $f_4(x) - f_6(x) =$
(1)$\frac{1}{4}$ (2) $\frac{1}{12}$ (3)$\frac{1}{6}$ (4)$\frac{1}{3}$

4. In 3 fingers, the number of ways four rings can be worn is ………ways.
(1) $4^3 - 1$ (2) 3^4 (3) 68 (4) 64

5. The n^{th} term of the sequence 1,2,4,7,11,⋯is
(1) $n^3 + 3n^2 + 2n$ (2) $n^3 - 3n^2 + 3n$ (3) $\frac{n(n+1)(n+2)}{3}$ (4)$\frac{n^2-n+2}{2}$

6. The equation of the line with slope 2 and the length of the perpendicular from the origin equal to √5 is
(1) x -2y = √5 (2) 2x - y = √5 (3) 2x - y =5 (4) x -2y−5=0

7. A root of the equation $\begin{vmatrix} 3-x & -6 & 3 \\ -6 & 3-x & 3 \\ 3 & 3 & -6-x \end{vmatrix} = 0$ is
(1) 6 (2) 3 (3) 0 (4) -6

8. If $\vec{a}, \vec{b}$ are the position vectors of A and B then which one of the following points whose position vector lies on AB is
(1)$\vec{a} + \vec{b}$ (2) $\frac{2\vec{a}-\vec{b}}{2}$ (3) $\frac{2\vec{a}+\vec{b}}{3}$ (4) $\frac{\vec{a}-\vec{b}}{3}$

9. $\lim_{x\to\infty}\left(\frac{x^2+5x+3}{x^2+x+3}\right)^x$ *is*
(1)e^4 (2)e^2 (3)e^3 (4) 1

10. If $pv = 81$, then $\frac{dp}{dv}$ at $v = 9$ is
(1)1 (2)-1 (3)2 (4)-2

11. $\int \frac{e^{6\log x} - e^{5\log x}}{e^{4\log x} - e^{3\log x}} dx$is
(1) $x + c$ (2) $\frac{x^3}{3} + c$ (3) $\frac{3}{x^3} + c$ (4) $\frac{1}{x^2} + c$

12. Let A and B be two events such that $P(\overline{A \cap B}) = \frac{1}{6}$, $P(A \cap B) = \frac{1}{4}$and $P(\bar{A}) = \frac{1}{4}$. Then the events A and B are
(1) Equally likely but not independent (2) Independent but not equally likely
(3) Independent and equally likely (4) Mutually inclusive and dependent

13. The range of the function $\frac{1}{1-2\sin x}$is
(1)$(-\infty, -1) \cup \left(\frac{1}{3}, \infty\right)$ (2) $\left(-1, \frac{1}{3}\right)$ (3) $\left[-1, \frac{1}{3}\right]$ (4) $(-\infty, -1] \cup \left[\frac{1}{3}, \infty\right)$.

14. The value of $\log_3 11 \cdot \log_{11} 13 \cdot \log_{13} 15 \cdot \log_{15} 27$is
(1) 1 (2) 2 (3) 3 (4) 4

15. The number of five digit telephone numbers having at least one of their digits repeated is
(1) 90000 (2) 9000 (3) 30240 (4) 69760.

16. Which one of the following is not true about the matrix $\begin{bmatrix}1 & 0 & 30\\0 & 0 & 0\\0 & 0 & 5\end{bmatrix}$?

(1) a scalar matrix (2) a diagonal matrix

(3) an upper triangular matrix (4) a lower triangular matrix

17. The value of $\overrightarrow{AB}+\overrightarrow{BC}+\overrightarrow{CA}$ is

(1) $\overrightarrow{AD}$ (2) $\overrightarrow{CA}$ (3) $\vec{0}$ (4) $-\overrightarrow{AD}$

18. $\lim\limits_{n\to\infty}\frac{tan^{-1}x}{x}$ is

(1)1 (2)0 (3)∞ (4)$-\infty$

19. The number of points in R in which the function f(x) = $|x-4|+|x-9|+sinx$ is not differentiable is

(1)2 (2)2 (3)1 (4)4

20. $\int x^2\cos x\,dx$is

(1) $x^2\sin x+2x\cos x-2\sin x+c$ (2) $x^2\sin x-2x\cos x-2\sin x+c$

(3) $-x^2\sin x+2x\cos x+2\sin x+c$ (4) $-x^2\sin x-2x\cos x+2\sin x+c$

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7\ X\ 2=14$

(ii) Question number **30** is compulsory.

21. Three coins are tossed simultaneously, what is the probability of getting (i) exactly one head (ii) at least one head (iii) atmost one head?

22. Integrate:$sec^2 x+18\cos 2x+10\sec(5x+3)\tan(5x+3)$

23. Compute: $\lim\limits_{x\to1}\frac{\sqrt{x}-1}{x-1}$.

24. If A is a 3 × 4 matrix and B is a matrix such that both $A^T B$ and BA^T are defined, what is the order of the matrix B?

25. Let X = {a, b, c, d} and R = {(a, a),(b, b),(a, c)}. Write down the minimum number of ordered pairs to be included to R to make it (i) reflexive (ii) symmetric (iii) transitive (iv) equivalence

26. Simplify: (i)$(125)^{\frac{2}{3}}$ (ii) $16^{\frac{-3}{4}}$

27. Prove that (b + c) cos A + (c + a) cos B + (a + b) cos C = a + b + c.

28. If $\frac{1}{7!}+\frac{1}{8!}=\frac{A}{9!}$ then find the value of A.

29. Find the coefficient of x^{15} in $\left(x^2+\frac{1}{x^3}\right)^{10}$

30. The length of the perpendicular drawn from the origin to a line is 12 and makes an angle 30°with positive direction of the x-axis. Find the equation of the line.

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7\ X\ 3=21$

(ii) Question number **40** is compulsory.

31. A fruit shop keeper prepares 3 different varieties of gift packages.

Pack-I contains 6 apples, 3 oranges and 3 pomegranates.

Pack-II contains 5 apples, 4 oranges and 4 pomegranates and

Pack –III contains 6 apples, 6 oranges and 6 pomegranates.

The cost of an apple, an orange and a pomegranate respectively are Rs 30, Rs 15 and Rs 45. What is the cost of preparing each package of fruits?

32. Show that the vectors $5\hat{\imath}+6\hat{\jmath}+7\hat{k}$,$7\hat{\imath}-8\hat{\jmath}+9\hat{k}$ and $3\hat{\imath}+20\hat{\jmath}+5\hat{k}$ are coplanar.

33. A main road in a City has 4 crossroads with traffic lights. Each traffic light opens or closes the traffic with the probability of 0.4 and 0.6 respectively. Determine the probability of

(i) a car crossing the first crossroad without stopping

(ii) a car crossing first two crossroads without stopping

(iii) a car crossing all the crossroads, stopping at third cross.

(iv) a car crossing all the crossroads, stopping at exactly one cross.

34. Show that the function $\begin{cases}\frac{x^3-1}{x-1}, & if\ x\neq1\\3, & if\ x=1\end{cases}$ is continuous on $(-\infty,\infty)$

35. Differentiate y = $\frac{x^{\frac{3}{4}}\sqrt{x^2+1}}{(3x+2)^5}$

36. Integrate: $\frac{\cos 2x-\cos 2\alpha}{\cos x-\cos\alpha}$

37. Find the range of the function $f(x) = \frac{1}{1-3\cos x}$

38. Find all values of x that satisfies the inequality $\frac{2x-3}{(x-2)(x-4)} < 0$

39. Find the value of $\sqrt{3}$ cosec 20° – sec 20°

40. If the roots of the equation (q−r)x^2 +(r−p)x + p−q =0are equal, then show that p,q and rare in AP.

SECTION-D

Note: Answer **all** the questions. $7X\,5 = 35$

41. (A) Verify that det(AB) = (det$A$) (det$B$) for $A = \begin{bmatrix}4 & 3 & -2\\ 1 & 0 & 7\\ 2 & 3 & -5\end{bmatrix}$ and $B = \begin{bmatrix}1 & 3 & 3\\ -2 & 4 & 0\\ 9 & 7 & 5\end{bmatrix}$

(OR)

(B) Prove that $\sqrt[3]{x^3+7}$ - $\sqrt[3]{x^3+4}$ is approximately equal to $\frac{1}{x^2}$ when x is large.

42. (A) Integrate: (i) $\frac{e^x}{e^x-1}$ (ii) $\frac{e^x-e^{-x}}{e^x+e^{-x}}$ (iii) $e^{2x}\sin x$ (iv) $e^x(\tan x+\log\sec x)$ (v) $cosec^2\,(5x-7)$

(OR)

(B) Find $p\ and\ q$, if the following equation represents a pair of perpendicular lines

$6x^2+5xy-py^2\ +7x\ +\ qy-5=0$

43. (A) Prove that the medians of a triangle are concurrent.

(OR)

(B) Evaluate: $\lim_{x\to 0}\frac{\sqrt{1+\sin x}-\sqrt{1-\sin x}}{\tan x}$

44. (A) Prove that using the Mathematical induction

$\sin(\alpha) + \sin(\alpha + \frac{\pi}{6}) + \sin(\alpha + \frac{2\pi}{6}) + \cdots + \sin(\alpha\ +\ \frac{(n-1)\pi}{6}) = \frac{\sin\left(\alpha+\frac{(n-1)\pi}{12}\right)x\sin(\frac{n\pi}{12})}{\sin\left(\frac{\pi}{12}\right)}$.

(OR)

(B) Prove that $\frac{\cot(180°+\theta)\sin(90°-\theta)\cos(-\theta)}{\sin(270°+\theta)\tan(-\theta)\mathrm{cosec}(360°+\theta)} = \cos^2\theta\ \cot\theta$.

45. (A) A simple cipher takes a number and codes it, using the function f(x)=3x−4. Find the inverse of this function, determine whether the inverse is also a function and verify the symmetrical property about the line y = x (by drawing the lines).

(OR)

(B) State and prove the quadratic equation formula .

46. (A) (i) If y = $(cos^{-1}x)^2$, prove that (1-x^2)$\frac{d^2y}{dx^2} - x\frac{dy}{dx} - 2 = 0$. Hence find y_2 when x = 0.

(ii) If sin y = x sin(a+y) , then prove that $\frac{dy}{dx} = \frac{sin^2(a+y)}{sina}$, a$\neq n\pi$.

(OR)

(B) Find the principal value of

(i) $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

(ii) $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(iii) $\mathrm{cosec}^{-1}(-1)$

(iv) $\sec^{-1}(-\sqrt{2})$.

(v) $\tan^{-1}(\sqrt{3})$.

47. (A) A ball is thrown vertically upward from the ground with an initial velocity of 39.2 m/sec. If the only forceconsidered is that attributed to the acceleration due to gravity, find (i) how long will it take for the ball to strike the ground? (ii) the speed with which will it strike the ground? and (iii) how high the ball will rise?

(OR)

(B) There are two identical urns containing respectively 6 black and 4 red balls, 2 black and 2 red balls. An urn is chosen at random and a ball is drawn from it. (i) find the probability that the ball is black (ii) if the ball is black, what is the probability that it is from the first urn?

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HALF YEARLY / PUBLIC MODEL QUESTION PAPER -2022

MODEL-2

Time Allowed: 3 Hours **HIGHER SECONDARY FIRST YEAR** **Maximum Marks: 90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$

(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. If A = {(*x*, *y*) : *y* = *sin x*, *x* ∈ R} and B = {(*x*, *y*) : *y* = *cos x*, *x* ∈ R} then A ∩ B contains
(1) no element (2) infinitely many elements
(3) only one element (4) cannot be determined.

2. Find a so that the sum and product of the roots of the equation $2x^2 + (a - 3)x + 3a - 5=0$ are equal is
(1) 1 (2) 2 (3) 0 (4) 4

3. In a triangle ABC, $\sin^2 A + \sin^2 B + \sin^2 C = 2$, then the triangle is
(1) equilateral triangle (2) isosceles triangle
(3) right triangle (4) scalene triangle.

4. $nC_x=nC_y$ if and only if ________
(1) x=y (2)x+y=0 (3)x+y=n (4)both (1) and (2)

5. The n^{th} term of the sequence 1,2,4,7,11,⋯is
(1) $n^3 +3n^2 +2n$ (2) $n^3 -3n^2 +3n$ (3) $\frac{n(n+1)(n+2)}{3}$ (4) $\frac{n^2-n+2}{2}$

6. The y-intercept of the straight line passing through (1,3) and perpendicular to 2x−3y +1=0is
(1) $\frac{3}{2}$ (2) $\frac{9}{2}$ (3) $\frac{2}{3}$ (4) $\frac{2}{9}$

7. If $\vec{a} = \vec{\imath} + 2\vec{\jmath} + 2\vec{k}$, $|\vec{b}| = 5$ and the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{6}$, then the area of the triangle formed by these two vectors as two sides is
(1) $\frac{7}{4}$ (2) $\frac{15}{4}$ (3) $\frac{3}{4}$ (4) $\frac{17}{4}$

8. The order of the matrix A which satisfies A $\begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\end{bmatrix} = \begin{bmatrix}-7 & -8 & -9\\2 & 4 & 6\end{bmatrix}$ is
1) 1 X 3 (2) 3 X 1 (3) 2 X 2 (4) 3 X 2

9. A letter is taken at random from the letters of the word 'ASSISTANT' and another letter is taken at random from the letters of the word 'STATISTICS'. The probability that the selected letters are the same is
(1) $\frac{7}{45}$ (2) $\frac{17}{90}$ (3) $\frac{29}{90}$ (4) $\frac{19}{90}$

10. The probability of two events A and B are 0.3 and 0.6 respectively. The probability that both A and B occur simultaneously is 0.18. The probability that neither A nor B occurs is
(1) 0.1 (2) 0.72 (3) 0.42 (4) 0.28

11. If $A = \begin{bmatrix}1 & -1\\2 & -1\end{bmatrix}, B = \begin{bmatrix}a & 1\\b & -1\end{bmatrix}$ and $(A + B)^2 = A^2 + B^2$, then the value of a and b are
(1) $a = 4, b = 1$ (2) $a = 1, b = 4$ (3) $a = 0, b = 4$ (4) $a = 2, b = 4$

12. The vector of magnitude 5 and parallel to the vector whose direction ratios are 2,3,6 are
(1) $\frac{2}{7}, \frac{3}{7}, \frac{6}{7}$ (2) $\frac{2\hat{\imath}+3\hat{\jmath}+6\hat{k}}{7}$ (3) $\frac{5}{7}(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$ (4) $\pm\frac{5}{7}(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$

13. If G is the centroid of a triangle ABC then $\overrightarrow{GA} + \overrightarrow{GB} + \overrightarrow{GC} =$
(1) $\vec{0}$ (2) $\vec{a}$ (3) $\vec{b}$ (4) $\vec{c}$

14. The number of points in R in which the function f(x) = $|x - 1| + |x - 3| + \sin x$ is not differentiable is
(1) 3 (2) 2 (3) 1 (4) 4

15. If pv = 81 then $\frac{dp}{dv}$ at v = 9 is
(1) 1 (2) -1 (3) 2 (4) -2

16. If $\int \frac{3^{\frac{1}{x}}}{x^2} dx = k\left(3^{\frac{1}{x}}\right) + c$ then the value of k is
(1) log 3 (2) −log 3 (3) $\frac{-1}{\log 3}$ (4) $\frac{1}{\log 3}$

17. Let a function f be defined by f(x) = $\frac{x-|x|}{x}$ for x $\neq 0$ and f(0) = 2 then f is

(1) continuous nowhere (2) continuous everywhere

(3) continuous for all except x = 1 (4) continuous for all x except x = 0

18. If a and b are the real roots of the equation $x^2 - kx + c = 0$, then the distance between the points $(a, 0)$ and $(b, 0)$ is

(1) $\sqrt{k^2 - 4c}$ (2) $\sqrt{4k^2 - c}$ (3) $\sqrt{4c - k^2}$ (4) $\sqrt{k - 8c}$

19. Number of sides of a polygon having 44 diagonals is······

(1) 4 (2) 4! (3) 11 (4) 22

20. If f(x) = $x tan^{-1}x$, then $f'(x)$ is

(1) $1+\frac{\pi}{4}$ (2) $\frac{1}{2}+\frac{\pi}{4}$ (3) $\frac{1}{2}-\frac{\pi}{4}$ (4) 2

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7 X 2 = 14$

(ii) Question number **30** is compulsory.

21. If n(A) = 10 and n(A ∩ B)=3, find n((A ∩ B)' ∩ A)
22. A quadratic polynomial has one of its zeros $1 + \sqrt{5}$ and it satisfies $p(1) = 2$. Find the quadratic polynomial.
23. Prove that cos(A + B) cos C − cos(B + C) cos A = sin B sin(C − A).
24. Find the value of n, if the sum to n terms of the series $\sqrt{3} + \sqrt{75} + \sqrt{243} + \cdots$ is $435\sqrt{3}$
25. Find the family of straight lines (i) Perpendicular (ii) Parallel to 3x +4y−12 = 0.
26. Show that $\begin{vmatrix} 4-x & 4+x & 4+x \\ 4+x & 4-x & 4+x \\ 4+x & 4+x & 4-x \end{vmatrix} = 0$
27. For any vector $\vec{r}$,prove that $\vec{r} = (\vec{r}.\hat{\imath})\hat{\imath} + (\vec{r}.\hat{\jmath})\hat{\jmath} + (\vec{r}.\hat{k})\hat{k}$.
28. Find the derivative of f(x) = sin x°
29. Integrate $\frac{cosx}{sin^2x}$
30. If A and B are independent then prove that $\bar{A}$ *and* $\bar{B}$ are also independent.

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7 X 3 = 21$

(ii) Question number **40** is compulsory.

31. A die is rolled once. If it shows an odd number, then find the probability of getting 3.
32. Integrate $\frac{xsin^{-1}x}{\sqrt{1-x^2}}$
33. If x = a $(\theta + sin\theta)$, y = a(1-cosθ) then prove that at $\theta = \frac{\pi}{2}, y'' = \frac{1}{a}$.
34. Examine the continuity of e^xtanx
35. If $\vec{a}$ and $\vec{b}$ are unit vectors and θ is the angle between them, show that

$\sin\frac{\theta}{2} = \frac{1}{2}|\vec{a} - \vec{b}|$

36. Show that $\begin{vmatrix} 1 & 1 & 1 \\ x & y & z \\ x^2 & y^2 & z^2 \end{vmatrix}$ = (x-y)(y-z)(z-x).
37. A line is drawn perpendicular to 5x = y+7. Find the equation of the line if the area of the triangle formed by this line with co-ordinate axes is 10 sq. units.
38. If the letters of the word TABLE are permuted in all possible ways and the words thus formed are arranged in the dictionary order (alphabetical order), find the ranks of the words (i) TABLE, (ii) BLEAT
39. Construct a cubic polynomial function having zeros at $x = \frac{2}{5}, 1 + \sqrt{3}$ such that $f(0) = -8$
40. In a ΔABC, if a = 12 cm, b = 8 cm and C = 30°, then show that its area is 24 sq.cm.

SECTION-D

Note: Answer **all** the questions. $7X\ 5 = 35$

41. A) If *f* : R → R is defined by *f(x)=3x – 5*, prove that *f* is a bijection and find its inverse.

(OR)

B) Resolve into Partial fractions: $\frac{2x}{(x^2+1)(x-1)}$.

42. A) . If θ + φ = α and tan θ = *k* tan φ, then prove that sin(θ − φ) = $\frac{k-1}{k+1}$ sin α.

(OR)

B) There are 11 points in a plane. No three of these lies in the same straight line except 4 points, which are collinear. Find, (i) the number of straight lines that can be obtained from the pairs of these points? (ii) The number of triangles that can be formed for which the points are their vertices?

43. A) Prove that $\sqrt{\frac{1-x}{1+x}}$ is approximately equal to 1− x + $\frac{x^2}{2}$ when x is very small.

(OR)

B) Show that the equation $2x^2-xy-3y^2-6x+19y-20 = 0$ represents a pair of intersecting lines. Show further that the angle between them is $\tan^{-1}(5)$.

44. A) If $\begin{vmatrix} a & b & a\alpha+b \\ b & c & b\alpha+c \\ a\alpha+b & b\alpha+c & 0 \end{vmatrix} = 0$, prove that a,b,c are in G.P. or α is a root of ax^2+bx+c=0.

(OR)

B) Find the area of the triangle whose vertices are A(3,-1,2) , B(1,-1,-3) and C(4,-3,1).

45. A) Evaluate $\lim_{x\to 0}\frac{\tan x-\sin x}{x^3}$

(OR)

B) Find y'' if $x^4 + y^4 = 16$.

46.A) Integrate $\frac{x+1}{x^2-3x+1}$

(OR)

B) The chances of A,B and C becoming manager of a certain company are 5:3:2. The probabilities that the office canteen will be improved if A,B and C become managers are 0.4, 0.5 and 0.3 respectively.(i) Find the probability that the office canteen has been improved (ii) If the office canteen has been improved, what is the probability that B was appointed as the manager?

47. A) Integrate $\frac{x^3}{(x-1)(x-2)}$

(OR)

B) Differentiate $(2x+1)^5(x^3-x+1)^4$.

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MODEL-3

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Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.
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SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$
(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. Let A and B be subsets of the universal set N, the set of natural numbers. Then $A' \cup [(A \cap B) \cup B']$ is
   (1) A (2) A' (3) B (4) N
2. The function $f: R \to R$ is defined by $f(x) = sin\, x + cos\, x$ is
   (1) an odd function (2) neither an odd function nor an even function
   (3) an even function (4) both odd function and even function.
3. The value of $\log_{\sqrt{2}} 512$ is
   (1) 16 (2) 18 (3) 9 (4) 12
4. The number of roots of $(x + 3)^4 + (x + 5)^4 = 16$ is
   (1) 4 (2) 2 (3) 3 (4) 0
5. Let $f_k(x) = \frac{1}{k}[\sin^k x + \cos^k x]$ where $x \in R$ and $k \geq 1$. Then $f_4(x) - f_6(x) =$
   (1) $\frac{1}{4}$ (2) $\frac{1}{12}$ (3) $\frac{1}{6}$ (4) $\frac{1}{3}$
6. A wheel is spinning at 2 radians/second. How many seconds will it take to make 10 complete rotations?
   (1) 10π seconds (2) 20π seconds (3) 5π seconds (4) 15π seconds
7. There are 10 points in a plane and 4 of them are collinear. The number of straight lines joining any two points is
   (1) 45 (2) 40 (3) 39 (4) 38
8. The sum up to n terms of the series $\sqrt{2}+\sqrt{8}+\sqrt{18}+\sqrt{32}+\cdots$ is
   (1) $\frac{n(n+1)}{2}$ (2) 2n (n + 1) (3) $\frac{n(n+1)}{\sqrt{2}}$ (4) 1
9. The y-intercept of the straight line passing through (1,3) and perpendicular to 2x−3y +1=0is
   (1) $\frac{3}{2}$ (2) $\frac{9}{2}$ (3) $\frac{2}{3}$ (4) $\frac{2}{9}$
10. The value of the determinant of $A = \begin{bmatrix} 0 & a & -b \\ -a & 0 & c \\ b & -c & 0 \end{bmatrix}$ is
   (1) -2abc (2) abc (3) 0 (4) $a^2 + b^2 + c^2$
11. If $\lambda\hat{\imath} + 2\lambda\hat{\jmath} + 2\lambda\hat{k}$ is a unit vector then the value of λ is
   (1) $\frac{1}{3}$ (2) $\frac{1}{4}$ (3) $\frac{1}{9}$ (4) $\frac{1}{2}$
12. $\lim_{x\to 0} \frac{e^{\sin x}-1}{x}$
   (1) 1 (2) e (3) $\frac{1}{e}$ (4) 0
13. If y = mx+c and f(0) = $f'(0)$= 1, then f(2) is
   (1)1 (2)2 (3)3 (4)-3
14. If $\int \frac{3^{\frac{1}{x}}}{x^2} dx = k\left(3^{\frac{1}{x}}\right) + c$, then the value of k is
   (1) $\log 3$ (2) $-\log 3$ (3) $-\frac{1}{log\, 3}$ (4) $\frac{1}{log\, 3}$
15. If X and Y are two events such that P(X/Y)= ½ , P(Y/X) = 1/3 , and P(X∩Y) = 1/6, then P(XUY) is
   (1) 1/3 (2) 2/5 (3) 1/6 (4) 2/3
16. If y = e^{sinx} then dy/dx is
   (1) y sinx (2) y cosx (3) y tanx (4) none of these
17. The sum of squares of the direction sines of any vector is
   (1) 0 (2) 1 (3) 2 (4)5
18. If the elements of a column are multiplied with corresponding cofactors of any other column then their sum is
   (1) 0 (2) 1 (3) 2 (4)5

19.If n(A) = 1 then it is called

(1) null set (2) singleton set (3) finite set (4) both (2) & (3)

20. The number of positive integers greater than 7000 and less than 8000 which are divisible by 5 without repetition of digits is

(1) 112 (2) 114 (3) 110 (4)1001

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7 X 2 = 14$

(ii) Question number **30** is compulsory.

21. Prove that the relation "friendship" is not an equivalence relation on the set of all people in Chennai.

22. Write $f(x) = x^2 + 5x + 4$ in completed square form.

23. Prove that cos 5θ = 16 $\cos^5\theta$ – 20 $\cos^3\theta$ + 5 cos θ.

24. Find the expansion of $(2x + 3)^5$.

25. Find the equations of the straight lines, making the y- intercept of 7 and angle between the line and the y-axis is 30°.

26. Find x, y, a, and b if $\begin{bmatrix} 3x+4y & 6 & x-2y \\ a+b & 2a-b & -3 \end{bmatrix} = \begin{bmatrix} 2 & 6 & 4 \\ 5 & -5 & -3 \end{bmatrix}$.

27. Find the value or values of m for which m $(\hat{i} + \hat{j} + \hat{k})$ is a unit vector.

28. Find y'' if y = $\frac{1}{x}$

29. Find the probability of getting the number 9 , when a usual die is rolled.

30. Evaluate $\int \sqrt{4-x^2}dx$

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7 X 3 = 21$

(ii) Question number **40** is compulsory.

31. Find the range of the function f(x) = $\frac{1}{1-3\cos x}$.

32. Find the square root of $7 - 4\sqrt{3}$

33. If the sides of a ΔABC are a = 4, b = 6 and c = 8, then show that 4 cos B + 3 cos C = 2.

34. By the principle of mathematical induction, prove that, for all integers n ≥ 1, 1+2+3+⋯+ n = $\frac{n(n+1)}{2}$

35. If the area of the triangle with vertices (- 3, 0), (3, 0) and (0, k) is 9 square units, find the values of k .

36. Show that the points (4,-3,1) , (2,-4,5) and (1,-1,0) form a right angled triangle.

37. Evaluate: $\lim_{x\to 0} \frac{3^x-1}{\sqrt{x+1}-1}$

38. Differentiate: y=$\sqrt{x+\sqrt{x}}$

39. If for two events A and B,P(A) = ¾, P(B)=2/5 and AUB=S (sample space), find the conditional probability P(A / B).

40. Find the nearest point on the line $3x + 4y = 12$ from the origin.

SECTION-D

Note: Answer **all** the questions. $7X 5 = 35$

41. A) If f : R → R is defined by f(x)=2x – 3 prove that f is a bijection and find its inverse.

(OR)

B) An advertising executive is studying television viewing habits of married men and women during prime time hours. Based on the past viewing records he has determined that during prime time wives are watching television 60% of the time. It has also been determined that when the wife is watching television, 40% of the time the husband is also watching. When the wife is not watching the television, 30% of the time the husband is watching the television. Find the probability that (i) the husband is watching the television during the prime time of television (ii) if the husband is watching the television, the wife is also watching the television

42. A) Resolve into partial fractions: $\frac{2x^2+5x-11}{x^2+2x-3}$

(OR)

B) Using Factor Theorem, prove that $\begin{vmatrix} 1 & x^2 & x^3 \\ 1 & y^2 & y^3 \\ 1 & z^2 & z^3 \end{vmatrix} = (x-y)(y-z)(z-x)(xy+yz+zx)$

43. A) If cot θ (1 + sin θ) =4m and cot θ (1 – sin θ) =4n, then prove that $(m^2 - n^2)^2$ = mn.

(OR)

B) State and prove Napier's formula.

44. A) Find the number of strings of 5 letters that can be formed with the letters of the word PROPOSITION.

(OR)

B) Prove that $\sqrt{\frac{1-x}{1+x}}$ is approximately equal to $1-x+\frac{x^2}{2}$ when x is very small.

45. A) Find the derivative of $tan^{-1}\left(\frac{\cos x+\sin x}{cosx-\sin x}\right)$

(OR)

B) If $y = \tan^{-1}\left(\frac{1+x}{1-x}\right)$, find y'

46. A) Evaluate: $\int \frac{2x+3}{\sqrt{x^2+x+1}}dx$

(OR)

B) Evaluate: $\int \frac{1}{\sqrt{x+1}+\sqrt{x}}\,dx$.

47. A) Prove that the straight lines joining the origin to the points of intersection of $3x^2 + 5xy - 3y^2 + 2x + 3y = 0$ and $3x - 2y - 1 = 0$ are at right angles.

(OR)

B) Prove that a quadrilateral is a parallelogram iff its diagonals bisect each other

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HALF YEARLY / PUBLIC MODEL QUESTION PAPER -2022

MODEL-4

Time Allowed: 3 Hours **HIGHER SECONDARY FIRST YEAR** **Maximum Marks: 90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$

(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. Let R be the set of all real numbers. Consider the following subsets of the plane $R \times R: S = \{(x, y) : y = x + 1 \text{ and } 0 < x < 2\}$ and $T = \{(x, y) : x - y \text{ is an integer }\}$. Then which of the following is true?

(1) T is an equivalence relation but S is not an equivalence relation.
(2) Neither S nor T is an equivalence relation
(3) Both S and T are equivalence relation
(4) S is an equivalence relation but T is not an equivalence relation.

2. Given that x, y and b are real numbers $x < y$, b > 0, then

(1) xb < yb (2) xb > yb (3) xb ≤ yb (4) x b ≥ y b

3. $\frac{\sin(A-B)}{\cos A \cos B} + \frac{\sin(B-C)}{\cos B \cos C} + \frac{\sin(C-A)}{\cos C \cos A}$ is

(1) sin A + sin B + sin C (2) 1 (3) 0 (4) cos A + cos B + cos C

4. The product of r consecutive positive integers is divisible by

(1) r! (2) (r−1)! (3) (r + 1)! (4) r^r.

5. If S_n denotes the sum of n terms of an AP whose common difference is d, the value of $S_n - 2S_{n-1} + S_{n-2}$ is

(1) d (2) 2d (3) 4d (4) d^2.

6. If the equation of the base opposite to the vertex (2, 3) of an equilateral triangle is x + y = 2, then the length of a side is

(1) $\sqrt{\frac{3}{2}}$ (2) 6 (3) $\sqrt{6}$ (4) $3\sqrt{2}$

7. If A and B are symmetric matrices of order ,where n (A ≠ B), then

(1) A + B is skew-symmetric (2) A + B is symmetric
(3) A + B is a diagonal matrix (4) A + B is a zero matrix

8. A vector $\overrightarrow{OP}$ makes an angle 60° and 45° with the positive direction of X and Y axes respectively.Then the angle between $\overrightarrow{OP}$ and the Z axis is

(1) 45° (2) 60° (3) 90° (4) 30°

9. $\lim_{x\to\infty} \frac{\sqrt{x^2-1}}{2x+1} =$

(1) 1 (2) 0 (3) − 1 (4) $\frac{1}{2}$

10. $\frac{d}{dx}\left(e^{x+5\log x}\right)$ is

(1) $e^x.x^4(x+5)$ (2) $e^x.x(x+5)$ (3) $e^x + \frac{5}{x}$ (4) $e^x - \frac{5}{x}$

11. $\int \frac{\sec x}{\sqrt{\cos 2x}}\, dx$ is

(1) $tan^{-1}(\sin x) + c$ (2) $2\, sin^{-1}(\tan x) + c$
(3) $tan^{-1}(\cos x) + c$ (4) $sin^{-1}(\tan x) + c$

12. A bag contains 6 green, 2 white, and 7 black balls. If two balls are drawn simultaneously, then the probability that both are different colours is

(1) $\frac{68}{105}$ (2) $\frac{71}{105}$ (3) $\frac{64}{105}$ (4) $\frac{73}{105}$

13. A matrix which both symmetric and skew – symmetric is

(1) zero matric (2) row matric (3) column matric (4) scalar matric

14. The sum of the square of the direction cosines of $\vec{r}$ is

(1) 1 (2) 0 (3) 2 (4) 3

15. Does $f(x) = \lim_{x\to n}[x]$ exists?

(1) n (2) $n-1$ (3) $n-2$ (4) $n+1$

16. Test of $f(x) = x^{\frac{1}{3}}$ is

(1) $x = 0$ (2) $x = 1$ (3) $x = 2$ (4) $x = -1$

17. Integration of $\frac{1}{4-x^2}$ is

(1) $\frac{1}{4} log \left|\frac{2+x}{2-x}\right|$ (2) $log \left|\frac{2+x}{2-x}\right|$ (3) $\frac{1}{4} log \left|\frac{2-x}{2+x}\right|$ (4) $log \left|\frac{2-x}{2+x}\right|$

18. Probability of impossible event is

(1) 0 (2) 1 (3) 2 (4) *none of these*

19. Two sets A and B are disjoint

(1) A (2) B (3) ∅ (4) $A \cap B = A \cup B$

20. $|x - a| = rn$ iff $r \geq 0$ and

(1) $x - a = r$ (2) $x - a = 0$ (3) $x + a = r$ (4) $x - a = \pm r$

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7 X 2 = 14$

(ii) Question number **30** is compulsory.

21. If X = {1, 2, 3,... 10} and A = {1, 2, 3, 4, 5}, find the number of sets B ⊆ X such that A – B = {4}

22. If the equations $x^2 - ax + b = 0$ and $x^2 - ex + f = 0$ have one root in common and if the second equation has equal roots, then prove that $ae = 2(b + f)$.

23. Prove that $(sec\, A - cosec\, A)\,(1 + tan\, A + cot\, A) = tan\, A\, sec\, A - cot\, A\, cosec\, A.$

24. Find the number of ways of arranging the letters of the word RAMANUJAN so that the relative positions of vowels and consonants are not changed.

25. Write the nth term of the sequence $\frac{3}{1^2 2^2}, \frac{5}{2^2 3^2}, \frac{7}{3^2 4^2}, \ldots$ as a difference of two terms.

26. Find the equation of the straight line parallel to $5x - 4y + 3 = 0$ and having x-intercept 3.

27. Definition of triangle law of addition.

28. Calculate $\lim_{x \to 2} \frac{|x|}{x}$.

29. Defintion of Anti Derivative.

30. Find the matrix A such that $\begin{bmatrix} 2 & -1 \\ 1 & 0 \\ -3 & 4 \end{bmatrix} A^T = \begin{bmatrix} -1 & -8 & -10 \\ 1 & 2 & -5 \\ 9 & 22 & 15 \end{bmatrix}$.

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7 X 3 = 21$

(ii) Question number **40** is compulsory.

31. A town has 2 fire engines operating independently. The probability that a fire engine is available when needed is 0.96. (i) What is the probability that a fire engine is available when needed?

(ii) What is the probability that neither is available when needed?

32. Do the limits of following exist as $x \to 0$? State reasons for your answer? $\frac{x|x|}{\sin|x|}$

33. If f is differentiable at a point $x = x_0$, then f is continuous at x_0

34. If GM and HM denote the geometric mean and the harmonic mean of two nonnegative numbers, then GM ≥ HM. The equality holds if and only if the two numbers are equal.

35. An exam paper contains 8 questions, 4 in Part A and 4 in Part B. Examiners are required to answer 5 questions. In how many ways can this be done if (i) There are no restrictions of choosing a number of questions in either parts. (ii) At least two questions from Part A must be answered.

36. Find the nearest point on the line $2x + y = 5$ from the origin.

37. Differentiate $f(x) = \frac{1}{\sqrt[3]{x^2+x+1}}$

38. Integrate: $x^2 \cos x$

39. Solve $\tan^2 x = 3$

40. Prove that $\sqrt{5}$ is an irrational number.

SECTION-D

Note: Answer **all** the questions. $7X\, 5 = 35$

41. (A) Prove that $\begin{vmatrix} (q+r)^2 & p^2 & p^2 \\ q^2 & (r+p)^2 & q^2 \\ r^2 & r^2 & (p+q)^2 \end{vmatrix}$ $2pqr(p + q + r)^3$.

(OR)

(B) Let $\vec{a}$ and $\vec{b}$ be the two vectors to find the unit vectors perpendicular to both $\vec{a}$ and $\vec{b}$.

42. (A) Prove that $\sqrt{\frac{1-x}{1+x}}$ is approximately equal to $1-x+\frac{x^2}{2}$ when x is very small.

(OR)

(B) Discuss $f(x) = |x|$ is the continuous at all points of the real line $\mathbb{R}$.

43. (A) Show that the equation $4x^2 + 4xy + y^2 - 6x - 3y - 4 = 0$ represents a pair of parallel lines. Find the distance between them.

(OR)

(B) State and Prove the Quotient Rule.

44. (A) Find the pints of discontinuity of the function, where $f(x) = \begin{cases} \sin x, 0 \leq x \leq \frac{\pi}{4} \\ \cos x, \frac{\pi}{4} < x < \frac{\pi}{2} \end{cases}$

(OR)

(B) Prove that the medians of a triangle are concurrent.

45. (A) To prove that $\int e^{ax} \cos bx\, dx = \frac{e^{ax}}{a^2+b^2}(a \sin ax - b \cos bx) + c$

(OR)

(B) Find the derivative: $Y = x^{\log x} + (\log x)^x$

46. (A) Using Heron's formula, show that the equilateral triangle has the maximum area for any fixed perimeter.

(OR)

(B) Evaluate: $\int \frac{x+1}{x^2-3x+1} dx$

47. (A) If $+B+C = \frac{\pi}{2}$, then Show that $\tan A \tan B + \tan B \tan C + \tan C \tan A = 1$.

(OR)

(B) A construction company employs 2 executive engineers. Engineer-1 does the work for 60% of jobs of the company. Engineer-2 does the work for 40% of jobs of the company. It is known from the past experience that the probability of an error when engineer-1 does the work is 0.03, whereas the probability of an error in the work of engineer-2 is 0.04. Suppose a serious error occurs in the work, which engineer would you guess did the work?

HALF YEARLY / PUBLIC MODEL QUESTION PAPER -2022

MODEL -5

Time Allowed: 3 Hours **HIGHER SECONDARY FIRST YEAR** **Maximum Marks: 90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$

(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. Let $f_k(x) = \frac{1}{k}[\sin^k x + \cos^k x]$ where $x \in R$ and $k \geq 1$. Then $f_4(x) - f_6(x) =$
   (1) $\frac{1}{4}$ (2) $\frac{1}{12}$ (3) $\frac{1}{6}$ (4) $\frac{1}{3}$
2. The number of ways in which a host lady invite 8 people for a party of 8 out of 12 people of whom two do not want to attend the party together is
   (1) $2\times 11\, C_7 + 10\, C_8$ (2) $11C_7 + 10\, C_8$ (3) $12C_8 - 10\, C_6$ (4) $10C_6 + 2!$
3. If the square of the matrix $\begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is the unit matrix of order 2, then α, β *and* γ should satisfy the relation.
   (1) $1 + \alpha^2 + \beta\gamma = 0$ (2) $1 - \alpha^2 - \beta\gamma = 0$ (3) $1 - \alpha^2 + \beta\gamma = 0$ (4) $1 + \alpha^2 - \beta\gamma = 0$
4. If $f: \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = \lfloor x - 3 \rfloor + |x - 4|$ for $x \in \mathbb{R}$, then $\lim_{x \to 3^-} f(x)$ is equal to
   (1) -2 (2) -1 (3) 0 (4) 0
5. $\frac{d}{dx}\left(\frac{2}{\pi} sin x^\circ\right)$ is
   (1) $\frac{\pi}{180} cos x^\circ$ (2) $\frac{1}{90} cos x^\circ$ (3) $\frac{\pi}{90} cos x^\circ$ (4) $\frac{2}{\pi} cos x^\circ$
6. $\int \sqrt{\frac{1-x}{1+x}}\, dx$ is
   (1) $\sqrt{1-x^2} + \sin^{-1} x + c$ (2) $\sin^{-1} x - \sqrt{1-x^2} + c$
   (3) $-x^2 sinx + 2xcosx + 2sinx + c$ (4) $-x^2 sinx - 2xcosx + 2sinx + c$
7. A, B, and C try to hit a target simultaneously but independently. Their respective probabilities of hitting the targets are $\frac{3}{4}, \frac{1}{2}, \frac{5}{8}$. The probability that the target is hit by A or B but not by C is
   (1) $\frac{21}{64}$ (2) $\frac{7}{32}$ (3) $\frac{9}{64}$ (4) $\frac{7}{8}$
8. Dot product between any two vectors is zero to ensure the angel is
   (1) 0 (2) $\frac{\pi}{2}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{6}$
9. The pair of straight lines through the origin is a homogenous equation of degree is
   (1) 0 (2) 1 (3) 2 (4) 3
10. Locus of a point P moves equidistance from a fixed point O is
    (1) Ellipse (2) circle (3) square (4) angle bisector of the Δxoy.
11. Harmonic mean of two positive numbers a and b is
    (1) $\frac{1}{a+b}$ (2) $\frac{a+b}{2}$ (3) $\frac{2ab}{a+b}$ (4) $\frac{ab}{a+b}$
12. Sum of $1 + 3 + 5 + \cdots + (2n - 1)$ is
    (1) $2n$ (2) $\frac{n(n+1)}{2}$ (3) $\frac{n^2}{2}$ (4) n^2
13. Another notation $sin^{-1} x$ is
    (1) *cosecant x* (2) *tan x* (3) *arc* sin *x* (4) *cotant x*
14. If $\alpha + \beta = \frac{\pi}{2}$, $\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$ is reduced to
    (1) 1 (2) 2 (3) 3 (4) 4
15. $a^x = 1$ iff x is
    (1) 1 (2) ∞ (3) 0 (4) 4
16. Solve of odd function $\sqrt{6 - 4x - x^2} = x + 4$ is
    (1) 2 (2) -1 (3) 1 (4) -5
17. Solve of odd function is
    (1) Odd (2) even (3) both odd and even (4) none of these
18. $f(x) = x|x|$ is
    (1) Increasing (2) decreasing (3) strictly increasing (4) strictly decreasing

19. The n different objects arranged in arrow is nP_n is

(1) n (2) r (3) n^r (4) $n!$

20. If f(x) = $\begin{cases} x+2 & -1 < x < 3 \\ 5 & x = 3 \\ 8-x & x > 3 \end{cases}$, then at x = 3, $f'(x)$ is

(1)1 (2)-1 (3)0 (4) does not exists

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7\ X\ 2 = 14$

(ii) Question number **30** is compulsory.

21. For a sports meet, a winners' stand comprising of three wooden blocks is in the form as shown in figure. There are six different colours available to choose from and three of the wooden blocks is to be painted such that no two of them has the same colour. Find the probability that the smallest block is to be painted in red, where red is one of the six colours.
22. If $f(x) = |x+100| + x^2$, test whether $f'(-100)$ exists.
23. Compute: $\lim_{h\to 0} \frac{\sqrt{x+h}-\sqrt{x}}{x}$, $x > 0$.
24. Find the projection of $\overrightarrow{AB}$ on $\overrightarrow{CD}$ where A,B,C,D are the points (4,-3,0), (7,-5,-1), (-2,1,3), (0,2,5).
25. Give your own examples of matrices satisfying the conditions in each case: A and B such that AB ≠ BA.
26. Evaluate: $\int e^x \left(\frac{1}{x} - \frac{1}{x^2}\right) dx$.
27. Solve $tan\ 2x = -cot\left(x + \frac{\pi}{3}\right)$.
28. Prove that $nC_r = \frac{n}{r} \times (n-1)C_{(r-1)}$.
29. In $\Delta\ ABC$ to show that $\cos\frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}}$.
30. Define Condition of perpendicular lines.

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7\ X\ 3 = 21$

(ii) Question number **40** is compulsory.

31. If $\log_2 x + \log_4 x + \log_{16} x = \frac{7}{2}$, find the value of x.
32. A simple cipher takes a number and codes it, using the function f(x) =3x−4. Find the inverse of this function, determine whether the inverse is also a function and verify the symmetrical property about the line y = x (by drawing the lines).
33. Prove: $nC_r + nC_{r-1} = (n+1)C_r$.
34. Write the first 4 terms of the logarithmic series $\log\left(\frac{1+3x}{1-3x}\right)$.
35. Find the locus of a point P moves such that its distances from two fixed points A(1,0) and B (5,0), are always equal.
36. Evaluate: $\int \sqrt{25x^2 - 9}\, dx$
37. In a circle of diameter 40 cm, a chord is of length 20 cm. Find the length of the minor arc of the chord.
38. Define Laplace Expansion.
39. Define Polygon Addition.
40. Calculate $\lim_{x\to 4} \frac{16-x^2}{4+x}$.

SECTION-D

Note: Answer **all** the questions. $7X\ 5 = 35$

41. (A) Let A = {0, 1, 2, 3}. Construct relations on A of the following types:

(i) not reflexive, not symmetric, not transitive.

(ii) not reflexive, not symmetric, transitive.

(iii) not reflexive, symmetric, not transitive.

(iv) not reflexive, symmetric, transitive.

(v) reflexive, not symmetric, not transitive.

(OR)

(B) Resolve into Partial fractions: $\frac{2x}{(x^2+1)(x-1)}$.

42. (A) Prove that Geometrical meaning of a Scalar product of projection of one vector on another vector.

(OR)

(B) Express the matrix $A = \begin{bmatrix} 1 & 3 & 5 \\ -6 & 8 & 3 \\ -4 & 6 & 5 \end{bmatrix}$ as the sum of a symmetric and a skew-symmetric matrix.

43. (A) A consulting firm rents car from three agencies such that 50% from agency L, 30% from agency M and 20% from agency N. If 90% of the cars from L, 70% of cars from M and 60% of the cars from N are in good conditions (i) what is the probability that the firm will get a car in good condition? (ii) if a car is in good condition, what is probability that it has come from agency M?

(OR)

(B) Prove that $\sin\left(\frac{A}{2}\right) + \sin\left(\frac{B}{2}\right) + \sin\left(\frac{C}{2}\right) = 1 + 4\sin\left(\frac{\pi-A}{4}\right)\sin\left(\frac{\pi-B}{4}\right)\sin\left(\frac{\pi-C}{4}\right)$, if A + B + C = π.

44. (A) Prove that $\int \frac{dx}{\sqrt{x^2+a^2}} = \log\left|x + \sqrt{x^2 + a^2}\right| + c$.

(OR)

(B) Using the Mathematical induction, show that for any natural number n ≥ 2 , $\left(1 - \frac{1}{2^2}\right)\left(1 - \frac{1}{3^2}\right)\left(1 - \frac{1}{4^2}\right) \dots \left(1 - \frac{1}{n^2}\right) = \frac{n+1}{2n}$.

45. (A) (i) Define jump continuous.

(ii) Compute $\lim_{x \to a} \frac{x^n - a}{x - a} = na^{n-1}$.

(B) The 2nd, 3rd and 4th terms in the binomial expansion of $(x + a)^n$ are 240, 720 and 1080 for a suitable value of x. Find x, a and n.

46. (A) State and prove Heron's formula.

(OR)

(B) Find the distance (i) between two points $(5, 4)$ and $(2, 0)$ (ii) from a point $(1, 2)$ to the line $5x + 12y - 3 = 0$ (iii) between two parallel lines $3x + 4y = 12$ and $6x + 8y + 1 = 0$.

47. (A) State and prove Binomial Theorem for Positive integral index.

(OR)

(B) Evaluate: $(3x + 4)\sqrt{3x + 4}$.

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HALF YEARLY / PUBLIC MODEL QUESTION PAPER -2022

MODEL-6

Time Allowed: 3 Hours **HIGHER SECONDARY FIRST YEAR** **Maximum Marks: 90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$

(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. If y= cos(sinx^2), then $\frac{dy}{dx}$ at x = $\sqrt{\frac{\pi}{2}}$ is

(1)-2 (2)2 (3)-2$\sqrt{\frac{\pi}{2}}$ (4)0

2. The value 0f $\lim_{x\to 0}\frac{\sin x}{\sqrt{x^2}}$ is

(1) 1 (2) -1 (3) 0 (4) *limit does not exist*

3. If the point (8,−5) lies on the locus $\frac{x^2}{16}$ -$\frac{y^2}{25} = k$, then the value of k is

(1) 0 (2) 1 (3) 2 (4) 3

4. The sequence$\frac{1}{\sqrt{3}},\frac{1}{\sqrt{3}+\sqrt{2}},\frac{1}{\sqrt{3}+2\sqrt{2}},\cdots$form an

(1) AP (2) GP (3) HP (4) AGP.

5. If $a^2-aC_2 = a^2-aC_4$ then the value of 'a' is

(1) 2 (2) 3 (3) 4 (4) 5

6. The number of parallelograms that can be formed from a set of four parallel lines intersecting another set of three parallel lines.

(1) 6 (2) 9 (3) 12 (4) 18

7. The solution of $5x - 1 < 24$ and $5x + 1 > -24$ is

(1) (4, 5) (2) (−5, −4) (3) (−5, 5) (4) (−5, 4)

8. There is no bijection from A and B iff,

(1) $m \neq n$ (2) $m = n$ (3) $m \geq n$ (4) $m \leq n$

9. A function $f: R \to R$ is said to be an odd function

(1) $f(-x) = -f(x)$ (2) $f(-x) = f(x)$ (3) both (4) none of these

10. If α and β are roots of $ax^2 + bx + c = 0$, then

(1) $\alpha + \beta = -\frac{b}{a}$ (2) $\alpha\beta = \frac{c}{a}$ (3) both (4) none of these

11. sin 0 = 0 is

(1) $\theta = n\pi, n \in Z$ (2) $\theta = (2n+1)\frac{\pi}{2}, n \in Z$

(3) $\theta = (-1)^n n\pi, n\epsilon Z$ (4) none of these

12. To solve an equation of the form $a\cos\theta + b\sin\theta = c$

(1) $\theta = 2n\pi$ (2) $\theta = 2n\pi \pm \emptyset$ (3) $\theta = 2n\pi + \alpha \pm \emptyset$ (4) $\theta = 2n\pi + \alpha$

13. Relation between Permutation and Combinations

(1) $nP_r = nC_r \times r!$ (2) $nC_r = \frac{nP_r}{r!}$ (3) $r! = \frac{nP_r}{nC_r}$ (4) All

14. In the expansion of $(a+b)^n, n \in N$ .The co-efficient at equidistant from the beginning and from the end are equal due to the fact that

(1) $n!$ (2) $r!$ (3) $nC_r = nC_{n-r}$ (4) $nC_r = nC_{n+r}$

15. The co-ordinate of the image of the point (x_1, y_1) with respect to the line $ax + by + c = 0$ are given by

(1) $\frac{x-x_1}{a} = \frac{y-y_1}{b} = -\frac{(ax_1+by_1+c)}{a^2+b^2}$ (2) $\frac{x-x_1}{a} = \frac{y-y_1}{b} = -\frac{2(ax_1+by_1+c)}{a^2+b^2}$

(3) $\frac{y-y_1}{b} = -\frac{(ax_1+by_1+c)}{a^2+b^2}$ (4) $\frac{x-x_1}{a} = -\frac{(ax_1+by_1+c)}{a^2+b^2}$

16. If the all entries of a row or a column are zero, then the determinant is

(1) 1 (2) 0 (3) 2 (4) 3

17. If each element of a matrix A is a polynomial in x and if $|A|$ vanishes for $x = a$, Then the factor of $|A|$ is

(1) $(x+a)$ (2) $(x+a)^2$ (3) $(x-a)$ (4) $(x-a)^2$

18. l, m, n are the direction cosine of a vector ,iff $l^2 + m^2 + n^2 =$

(1) 1 (2) 0 (3) 2 (4) 3

19. $\int \frac{f'(x)}{f(x)}\,dx =$

(1) $\log|f(x)| + c$ (2) $f(x) + c$ (3) $\log|f'(x)| + c$ (4) $f'(x) + c$

20. $P(A/B) = \frac{P(A\cap B)}{P(B)}$, provided $P(B) \neq 0$ then

(1) Condition (2) Multiplication theorem
(3) Independent event (4) Total probability event

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7\,X\,2 = 14$
(ii) Question number **30** is compulsory.

21. The number of relations from a set containing m elements to a set containing n elements is 2^{mn}. In particular the number of relations on a set containing n elements is 2^{n^2} .
22. Factorize: $x^4 + 1$
23. Find the value of sin 34° + cos 64° − cos 4°.
24. Find the coefficient of x^{15} in $\left(x^2 + \frac{1}{x^3}\right)^{10}$.
25. If $P(r, c)$ is mid point of a line segment between the axes, then show that $\frac{x}{r} + \frac{y}{c} = 2$.
26. 4 boys and 4 girls form a line with the boys and girls alternating. Find the number of ways of making this line.
27. Solve: $\lim_{x\to 1} \frac{x^m - 1}{x^n - 1}$, m and n are integer.
28. State Baye's Theorem.
29. Write Bernoulli's formula and Integration by parts method.
30. Prove that $\frac{d}{dx}(cot^{-1}x) = -\frac{1}{1+x^2}$.

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7\,X\,3 = 21$
(ii) Question number **40** is compulsory.

31. If f: [−2, 2] ⟶ B is given by f(x)=$2x^3$, then find B so that f is onto.
32. The equations $x^2 - 6x + a = 0$ and $x^2 - bx + 6 = 0$ have one root in common. The other root of the first and the second equations are integers in the ratio 4 : 3. Find the common root.
33. The Government plans to have a circular zoological park of diameter 8 *km*. A separate area in the form of a segment formed by a chord of length 4 *km* is to be allotted exclusively for a veterinary hospital in the park. Find the area of the segment to be allotted for the veterinary hospital.
34. How many three-digit numbers are there with 3 in the unit place? (i) with repetition (ii) without repetition.
36. Expand $\frac{1}{(1+3x)^2}$ in the powers of x. Find a condition on x for which the expansion is valid.
37. If A is a square matrix such that $A^2 = A$, find the value of $7A - (I + A)^3$.
38. State and prove function of a Function Rule.
39. If A and B are independent, Then $\bar{A}$ and B are also independent.
40. Test the differentiability of the function $f(x) = |x - 2|$ at $x = 2$.

SECTION-D

Note: Answer **all** the questions. $7X\,5 = 35$

41. (A) (i) Prove that ((A ∪ B'∪ C) ∩ (A ∩ B' ∩ C')) ∪ ((A ∪ B ∪ C') ∩ (B' ∩ C')) = B' ∩ C' .
(ii) If 𝒫(A) denotes the power set of A, then find n(𝒫(𝒫(𝒫(∅)))).
(iii) Check the relation R = {(1, 1),(2, 2),(3, 3),...,(n, n)} defined on the set S = {1, 2, 3,...,n} for the three basic relations.

(OR)

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

42. (A) Evaluate: $\int (x-3)\sqrt{x+2}\;dx$.

(OR)

(B) Integration $x\,logx + x$.

43. (A) Prove that the points whose position vectors $2\hat{\imath} + 4\hat{\jmath} + 3\hat{k}$, $4\hat{\imath} + \hat{\jmath} + 9\hat{k}$ and $10\hat{\imath} - \hat{\jmath} + 6\hat{k}$ form a right angled triangle.

(OR)

(B) Draw the graph (i) $f(x) = x^2$ (ii) $f(x) = \frac{1}{2}x^2$ (iii) $f(x) = 2x^2$

44. (A) Two cards are drawn from a pack of 52 cards in succession. Find the probability that both are Jack when the first drawn card is (i) replaced (ii) not replaced.

(OR)

(B) If the letter of the word "LUCKY" are permuted in all possible ways and the strings thus formed are arranged in the dictionary order. Find the rank of the word.

45. (A) Evaluate: $\lim_{x\to\infty}\left(\frac{x^2-2x+1}{x^2-4x+2}\right)^x$

(OR)

(B) Find the angle between Pair of straight lines.

46. (A) If A + B + C = π, prove that $cos^2 A + cos^2 B + cos^2 C = 1 - 2\cos A \cos B \cos C$.

(OR)

(B) If $y = tan^{-1}\left(\frac{1+x}{1-x}\right)$, find y'

47. (A) Using the Mathematical induction, show that for any integer $n \geq 2$, $3n^2 > (n + 1)^2$

(OR)

(B) State and prove Napier's formula.

half yearly / public model question paper -2022

model -7

Time Allowed: 3 Hours **HIGHER SECONDARY FIRST YEAR** **Maximum Marks: 90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION-A

Note: (i) All questions are **compulsory**. $20 X 1 = 20$

(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. Find a so that the sum and product of the roots of the equation $2x^2 + (a-3)x + 3a - 5=0$ are equal is
   (1) 1 (2) 2 (3) 0 (4) 4
2. In a ΔABC, if (i)$sin\frac{A}{2}sin\frac{B}{2}sin\frac{C}{2} > 0$ (ii) $\sin AsinBsinC > 0$,then
   (1) Both (i) and (ii) are true (2) Only (i) is true
   (3) Only (ii) is true (4) Neither (i) nor (ii) is true.
3. The equation of the locus of the point whose distance from y-axis is half the distance from origin is
   (1) $x^2 +3y^2 =0$ (2) $x^2 -3y^2 =0$ (3) $3x^2 + y^2 =0$ (4) $3x^2 -y^2 =0$
4. The number of ways in which the following prize be given to a class of 30 boys first and second in mathematics, first and second in physics, first in chemistry and first in English is
   (1) $30^4 \times 29^2$ (2) $30^3 \times 29^3$ (3) $30^2 \times 29^4$ (4) 30×29^5.
5. $\int \frac{e^x(1+x)}{cos^2(xe^x)}\, dx$ is
   (1) $\cot(xe^x) + c$ (2) $\sec(xe^x) + c$ (3) $\tan(xe^x) + c$ (4) $\cos(xe^x) + c$
6. If f(x) = $x^2 - 3x$, then the points at which f(x) = f ' (x) are
   (1) both positive integers (2 both negative integers
   (3) both irrational (4)one rational and another irrational
7. Let f be a continuous function on [2,5] . If f takes only rational values for all $x$and $(3) = 12$, then $f(4.5)$ is equal to
   (1) $\frac{f(3)+f(4.5)}{7.5}$ (2) 12 (3) 17.5 (4) $\frac{f(4.5)+f(3)}{1.5}$
8. The number of reflexive relations on a set containing n elements is
   (1)2^{n^2} (2)2^{n^2-n} (3)$2^{\frac{n^2+n}{2}}$ (4)2^n
9. Cos(60°-A)CosACos(60°+A) =
   (1)$\frac{1}{4}$Cos3A (2) Tan 3A (3)$\frac{1}{4}$Sin 3A (4)Cot3A
10. The value of Sin($22\frac{1}{2}$°) is
    (1)$\frac{\sqrt{2-\sqrt{2}}}{2}$ (2) $\frac{\sqrt{\sqrt{2}+\sqrt{2}}}{2}$ (3) $\frac{\sqrt{2+\sqrt{2}}}{2}$ (4) $\frac{\sqrt{\sqrt{2}-2}}{2}$
11. If $(n-1)P_3:nP_4=1:10$,then n is
    (1)10 (2)1 (3)3 (4)8
12. The number of ways of arranging the letters of the word BANANA is
    (1)48 (2)50 (3)60 (4)62
13. The $(r+1)^{th}$ term in the expansion of $(a+b)^n$, n∈N is
    (1)$T_{r+1} = nC_r\, a^{n-r} b^r$, r=0,1,2,…,n (2)$nC_r =nC_{n-r}$
    (3) $T_{r+1} = nC_r\, a^n b^{n-r}$, r=0,1,2,…,n (4) $nC_r + nC_{n-r} = (n+1)C_r$
14. $1+\frac{x}{1!}+\frac{x^2}{2!}+\cdots$ is
    (1) e^{-x} (2) e^x (3)e (4)e^{-1}
15. $(1+x)^{-1} = 1-x+x^2-x^3+\ldots$ is valid only when
    (1)$|x| < 1$ (2) $|x| > 1$ (3) $|x| \leq 1$ (4) $|x| \geq 1$
16. The equations $a_1x + b_1y + c_1 =0$. and $a_2x + b_2y + c_2 =0$, such that both $c_1 > 0$ and $c_2 > 0$, and if $a_1a_2 + b_1b_2 < 0$, then the angle between them is
    (1)acute (2)obtuse (3)right (4)none of these

17. If any two matrices A and B of suitable orders then
    (1) $(A^T)^T = A$ (2) $(kA^T) = kA^T$ (3) $(AB)^T = B^T A^T$ (4) All the three
18. If two rows of a square matrix are identical then its determinant is
    (1) 2 (2) 3 (3) 0 (4) 1
19. If A and B are two square matrices of same order n then
    (1) $|AB| = |A||B|$ (2) If $|AB|$ =0 then either $|A|$ =0 or $|B|$ =0
    (3) $|A^n|=|A|^n$ (4) All the three
20. If A and B are any two events then P(A∩ $\bar{B}$) is
    (1) P(A)-P(A∩B) (2) P(A) (3) P(B) (4) P(B)-P(A∩B)

SECTION-B

Note: (i) Answer any **SEVEN** questions. $7 X 2 = 14$
(ii) Question number **30** is compulsory.

21. Simplify: $\sec\theta \begin{bmatrix} \sec\theta & \tan\theta \\ \tan\theta & \sec\theta \end{bmatrix} - \tan\theta \begin{bmatrix} \tan\theta & \sec\theta \\ \sec\theta & \tan\theta \end{bmatrix}$
22. Show that $\vec{a}X(\vec{b}+\vec{c}) + \vec{b}X(\vec{c}+\vec{a}) + \vec{c}X(\vec{a}+\vec{b}) = \vec{0}$
23. Check if $\lim_{x\to -5} f(x)$ exists or not, where f(x) = $\begin{cases} \frac{|x+5|}{x+5} & for\ x \neq -5 \\ 0 & for\ x = -5 \end{cases}$
24. Differentiate y= $(x^3-1)^{100}$
25. Integrate $4\cos(5-2x) + 9e^{3x-6} + \frac{24}{6-4x}$
26. A man has 2 ten rupee notes, 4 hundred rupee notes and 6 five hundred rupee notes in his pocket. If 2 notes are taken at random, what are the odds in favour of both notes being of hundred rupee denomination and also its probability?
27. Check the relation R = {(1, 1),(2, 2),(3, 3),...,(n, n)} defined on the set S = {1, 2, 3,...,n} for the three basic relations.
28. Solve $ax^2 + bx + c = 0$ by using completing the square.
29. Define radian measure.
30. Define the Inclusion-Exclusion principle.

SECTION-C

Note: (i) Answer any **SEVEN** questions. $7 X 3 = 21$
(ii) Question number **40** is compulsory.

31. Prove that $\lim_{x\to 0} \frac{sinx}{x} = 1$
32. Find the derivatives from the left and from the right at x = 1 (if they exist) for the function f(x)=$|x-1|$. Is it differentiable at x= 1 or not?
33. Integrate $\frac{8^{1+x}+4^{1-x}}{2^x}$
34. If A and B are independent then prove that $\bar{A}$ and $\bar{B}$ are independent.
35. Check whether the function f(x) = x|x| defined on [−2, 2] is one-to-one or not. If it is one-to-one, find a suitable co-domain so that the function becomes a bijection.
36. Prove that $\frac{\cot(180°+\theta)\sin(90°-\theta)\cos(-\theta)}{\sin(270°+\theta)\tan(-\theta)\mathrm{cosec}(360°+\theta)} = \cos^2\theta\ \cot\theta$.
37. Show that the points $(4,-3,1), (2,-4,5)$ *and* $(1,-1,0)$ form a right angled triangle.
38. Draw the graph of the Logarithmic and exponential functions.
39. Prove that $tan3A = \frac{3tanA - tan^3A}{1-3tan^2A}$
40. Show that $nC_r + nC_{r-1} = (n+1)\ C_r$

SECTION-D

Note: Answer **all** the questions. $7X\ 5 = 35$

41. A) Determine if f defined by $f(x) = \begin{cases} x^2 \sin\frac{1}{x} & ,if\ x \neq 0 \\ 0 & ,if\ x = 0 \end{cases}$ is continuous is $\mathbb{R}$

(OR)

B) Draw the graph of y = 2 sin(x – 1) + 3

42. A) Find the derivative with $tan^{-1}\left(\frac{sin\,x}{1+\cos x}\right)$ with respect to $tan^{-1}\left(\frac{cos\,x}{1+\sin x}\right)$

(OR)

B) Prove that $cos(\alpha + \beta) = cos\alpha\ cos\beta - sin\alpha\ sin\beta$

43. A) For the graph $y = x^2$, draw $(i) y = x^2 + 1,\ \ (ii) y = (x + 1)^2$

B) Solve $cos\theta = cos\alpha$

44. A) State and prove 'Law of Cosines'.

(OR)

B) Find the number of strings of 5 letters that can be formed with the letters of the word "$MATHEMATICS$".

45. A) A main road in a City has 4 crossroads with traffic lights. Each traffic light opens or closes the traffic with the probability of 0.4 and 0.6 respectively. Determine the probability of
    (i) a car crossing the first crossroad without stopping
    (ii) a car crossing first two crossroads without stopping
    (iii) a car crossing all the crossroads, stopping at third cross.
    (iv) a car crossing all the crossroads, stopping at exactly one cross.

(OR)

B) Write any five forms equation of straight line.

46. A) At a particular moment, a student needs to stop his speedy bike to avoid a collision with the barrier ahead at a distance 40 metres away from him. Immediately he slows (retardation) the bike under braking at a rate of 2 8 metre/second . If the bike is moving at a speed of 24m/s, when the brakes are applied, would it stop before collision?

(OR)

B) Discuss the relation between a Determinant and its cofactor determinant.

47. A) Show that the points whose position vectors $4\hat{\imath} + 5\hat{\jmath} + \hat{k}, -\hat{\jmath} - \hat{k}$, $3\hat{\imath} + 9\hat{\jmath} + 4\hat{k}$ and $-4\hat{\imath} + 4\hat{\jmath} + 4\hat{k}$ are coplanar.

(OR)

B) If A_i, B_i, C_i are the cofactors of a_i, b_i, c_i respectively, i = 1 to 3 in $|A| = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$,show that

$$\begin{vmatrix} A_1 & B_1 & C_1 \\ A_2 & B_2 & C_2 \\ A_3 & B_3 & C_3 \end{vmatrix} = |A|^2$$

HIGHER SECONDARY FIRST YEAR

MATHEMATICS

QUARTERLY MODEL QUESTION PAPER – 1

Time Allowed: 2.30 Hours] **[Maximum Marks:90**

Instructions: (a) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(b) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

SECTION – I

Note: (i) **All** questions are **compulsory.** $20\times1=20$

(ii) Choose the correct or most suitable answer from the given **four** alternatives. Write the option code and the corresponding answer.

1. If $A=\{(x,y): y=sinx, x\in\mathbb{R}\}$ and $B=\{(x,y): y=cosx, x\in\mathbb{R}\}$ then $A\cap B$ contains

(1) no element (2) infinitely many elements

(3) only one element (4) cannot be determined.

2. The number of relations on a set containing 3 elements is

(1) 9 (2) 81 (3) 512 (4) 1024

3. The function $f:[0,2\pi]\to[-1,1]$ defined by $f(x)=\sin x$ is

(1) one-to--one (2) onto

(3) bijection (4) cannot be defined

4. Let $f:\mathbb{R}\to\mathbb{R}$ be defined by $f(x)=1-|x|$. Then the range of f is

(1) $\mathbb{R}$ (2) $(1,\infty)$ (3) $(-1,\infty)$ (4) $(-\infty,1]$

5. If a quadratic equation with real co-efficient has no real roots,then its discriminant is

(1) 0 (2) <0 (3) >0 (4) 1

6. If $|x+2|\le 9$, then x belongs to

(1) $(-\infty,-7)$ (2) $[-11,-7]$ (3) $(-\infty,-7)\cup[11,\infty)$ (4) $(-11,7)$

7. If a and b are the roots of the equation $x^2 - kx + 16 = 0$ and satisfy $a^2 + b^2 = 32$, then the value of k is/are

(1)10 (2) –8 (3) –8,8 (4) 6

8. If $\sqrt{x+14} < 2$ then x belongs to

(1) $[-14,-10)$ (2) $(-14,-10)$

(3) $(-\infty,-10)$ (4) $[-14,-10)$

9. $\cos 1^\circ + \cos 2^\circ + \cos 3^\circ + \ldots + \cos 179^\circ$ is

(1) 0 (2) 1 (3) –1 (4) 89

10. Which one of the following is not true for any θ?

(1) $\sin\theta = -\frac{3}{4}$ (2) $\cos\theta = -1$ (3) $\tan\theta = 25$ (4) $\sec\theta = \frac{1}{4}$

11. A wheel is spinning at 2 radians/second. How many seconds will it take to make 10 complete revolutions?

(1) 10π seconds (2) 20π seconds

(3) 5π seconds (4) 15π seconds

12. $\dfrac{\sin 10^\circ - \cos 10^\circ}{\cos 10^\circ + \sin 10^\circ}$ is

(1) $\tan 35^\circ$ (2) $\sqrt{3}$ (3) $\tan 75^\circ$ (4) 1

13. The product of r consecutive positive integers is divisible by

(1) $r!$ (2) $(r-1)!$ (3) $(r+1)!$ (4) r^r

14. The number of sides of a polygon having 44 diagonals is

(1) 4 (2) 4! (3) 11 (4) 22

15. If ${}^nC_4, {}^nC_5, {}^nC_6$ are in AP then the value of n is

(1) 14 (2) 11 (3) 9 (4) 5

16. The sum of the digits in the unit's place of all the 4-digit numbers formed by 3, 4, 5 and 6 , without repetition, is

(1) 432 (2) 108 (3) 36 (4) 72

17. If a is the arithmetic mean and g is the geometric mean of two numbers, then

(1) $a \le g$ (2) $a \ge g$ (3) $a = g$ (4) $a > g$

18. The coefficient of $x^8 y^{12}$ in the expansion of $(2x+3y)^{20}$ is

(1) 0 (2) $2^8 3^{12}$ (3) $2^8 3^{12} + 2^{12} 3^8$ (4) ${}^{20}C_8 2^8 3^{12}$

19. The value of $\frac{1}{2!}+\frac{1}{4!}+\frac{1}{6!}+\cdots$ is

(1) $\frac{e^2+1}{2e}$ (2) $\frac{(e+1)^2}{2e}$ (3) $\frac{(e-1)^2}{2e}$ (4) $\frac{e^2+1}{2e}$

20. The remainder when 52^{40} is divided by 17 is

(1) 1 (2) 3 (3) 5 (4) 6

SECTION – II

Note: (i) Answer any **SEVEN** questions. $7 \times 2 = 14$

(ii) Question number **30 is compulsory.**

21. If $A = \{1,2,3,4\}$ and $B = \{3,4,5,6\}$, find $n\left(\left(A \cup B\right) \times \left(A \cap B\right) \times \left(A \Delta B\right)\right)$.

22. In the set $\mathbb{Z}$ of integers, define mRn if $m-n$ is a multiple of 12. Prove that R is an equivalence relation.

23. If $A \times A$ has 9 elements $S = \left\{\left(a,b\right) \in A \times A : a > b\right\}$, where $(2,-1)$ and $(2,1)$ are two elements, then find the remaining elements of S.

24. Prove that $\log a + \log a^2 + \log a^3 + \cdots + \log a^n = \frac{n(n+1)}{2} \log a$.

25. Solve: $\left(x-2\right)\left(x+3\right)^2 < 0$.

26. If $A + B = 45^\circ$, show that $\left(1+\tan A\right)\left(1+\tan B\right) = 2$

27. Prove that $\frac{\sin 4x + \sin 2x}{\cos 4x + \cos 2x} = \tan 3x$

28. Out of the 6 consonants and 4 vowels, how many strings of 3 consonants and 2 vowels can be formed?

29. Show that $\sum_{k=1}^{n} \frac{1}{k\left(k+1\right)} = 1 - \frac{1}{n+1}$

30. Prove that $\log_4 2 - \log_8 2 + \log_{16} 2 - \cdots = 1 - \log_e 2$.

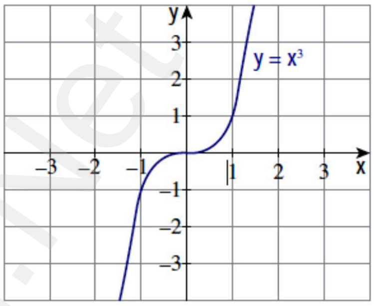
SECTION – III

Note: (i) Answer any **SEVEN** questions. $7 \times 3 = 21$

(ii) Question number **40 is compulsory.**

31. If $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = 3x - 5$, prove that f is a bijection and find its inverse.

32. Using the given curve $y = x^3$, draw $y = (x+1)^3$ with the same scale.



33. If one root of $k(x-1)^2 = 5x - 7$ is double the other root, show that $k = 2$ or -25.

34. Resolve into partial fractions : $\dfrac{10x+30}{(x^2-9)(x+7)}$.

35. Suppose that a boat travels 10 km from the port towards east and then turns 60° to its left. If the boat travels further 8 km, how far from the port is the boat?

36. If $A + B + C = \dfrac{\pi}{2}$, prove that $\sin 2A + \sin 2B + \sin 2C = 4 \cos A \cos B \cos C$.

37. How many different selections of 5 books can be made from 12 different books if

    (i) Two particular books are always selected?

    (ii) Two particular books are never selected?

38. How many numbers are there between 100 and 500 with the digits 0, 1, 2, 3, 4, 5 if the repetition of digits is not allowed?

39. Find the coefficient of x^{15} in the expansion $\left(x^2 + \dfrac{1}{x^3}\right)^{10}$.

40. In a ΔABC, if $\tan \dfrac{A}{2} = \dfrac{5}{6}$ and $\tan \dfrac{C}{2} = \dfrac{2}{5}$, then show that a, b, c are in A.P.

SECTION – IV

Note: Answer **all** the questions. $7\times5=35$

41. (a) Show that the range of the function $\dfrac{1}{2cosx-1}$ is $\left(-\infty,-\dfrac{1}{3}\right]\cup[1,\infty)$.

(OR)

(b) Let $f,g:\mathbb{R}\to\mathbb{R}$ be defined as $f(x)=2x-|x|$ and $g(x)=2x+|x|$. Find $f\circ g$.

42. (a) Prove that the solution of $\dfrac{x+1}{x+3}<3$ is $(-\infty,-4)\cup(-3,\infty)$.

(OR)

(b) Determine the region in the plane determined by the inequalities $2x+3y\le35,\ y\ge2,\ x\ge5$.

43. (a) If $x\cos\theta=y\cos\left(\theta+\dfrac{2\pi}{3}\right)=z\cos\left(\theta+\dfrac{4\pi}{3}\right)$, then prove that $xy+yz+zx=0$.

(OR)

(b) Solve $\sqrt{3}\tan^2\theta+\left(\sqrt{3}-1\right)\tan\theta-1=0$.

44. (a) If the letters of the word APPLE are permuted in all possible ways and the strings then formed are arranged in the dictionary order, show that the rank of the word APPLE is 12.

(OR)

(b) A van has 8 seats. It has two seats in the front with two rows of three seats behind. The van belongs to a family, consisting of seven members, F,M, S_1, S_2, S_3, D_1,D_2. How many ways can the family sit in the van if

(i) There are no restriction?

(ii) Either F or M drives the van?

(iii) D_1,D_2 sits next to a window and F is driving?

45. (a) Using Mathematical Induction, show that for any natural number n,

$$\frac{1}{1\cdot 2}+\frac{1}{2\cdot 3}+\frac{1}{3\cdot 4}+\ldots+\frac{1}{n(n+1)}=\frac{n}{n+1}$$

(OR)

(b) Prove that $\sqrt[3]{x^3+7}-\sqrt[3]{x^3+4}$ is approximately equal to $\frac{1}{x^2}$ when x is large.

46. (a) Find the sum up to the 17^{th} term of the series $\frac{1^3}{1}+\frac{1^3+2^3}{1+3}+\frac{1^3+2^3+3^3}{1+3+5}+\ldots$

(OR)

(b) Show that $\frac{5}{1\times 3}+\frac{5}{2\times 4}+\frac{5}{3\times 5}+\ldots = \frac{15}{4}$

47. (a) Let $A=\{2,3,5\}$ and the relation $R=\{(2,5)\}$, write down the minimum number of ordered pairs to be included to R to make it an equivalence relation.

(OR)

(b) If $x=\sum_{n=0}^{\infty}\cos^{2n}\theta$, $y=\sum_{n=0}^{\infty}\sin^{2n}\theta$ and $z=\sum_{n=0}^{\infty}\cos^{2n}\theta\sin^{2n}\theta$, $0<\theta<\frac{\pi}{2}$ then show that $xyz=x+y+z$.

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