
# Padasalai's Telegram Groups!

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# ARTHI TUITION CENTER- KATTUPUTHUR (UNSOLVED)

**Time: 2.30 Hours** **Maximum Marks: 90**

## PART-I

**I. Choose the correct answer. Answer all the questions.** **[20 × 1 = 20]**

1. Let R be the universal relation on a set X with more than one element then R is..... .
   (a) not reflexive (b) not symmetric (c) transitive (d) none of the above
2. The value of $\log_a b \log_b c \log_c a$ is ..... .
   (a) 2 (b) 1 (c) 3 (d) 4
3. If $\log_{\sqrt{}} 0.25 = 4$ then the value of $x$ is ..... .
   (a) 0.5 (b) 2.5 (c) 1.5 (d) 1.25
4. The product of $r$ consecutive positive integers is divisible by ..... .
   (a) $r!$ (b) $(r-1)!$ (c) $(r+1)!$ (d) $r^r$
5. The value of $\tan 75° - \cot 75°$ is ..... .
   (a) 1 (b) $2+\sqrt{3}$ (c) $2-\sqrt{3}$ (d) $2\sqrt{3}$
6. If $(1+x^2)^2(1+x)^n = a_0 + a_1 x + a_2 x^2 .... + x^{n+4}$ and if $a_0, a_1, a_2$, are in AP, then $n$ is ..... .
   (a) 1 (b) 2 (c) 3 (d) 4
7. If $nC_{12} = nC_6$ then $nC_2$ = ..... .
   (a) 72 (b) 306 (c) 152 (d) 153
8. The line $(p+2q)x + (p-3q)y = p-q$ for different values of $p$ and $q$ passes through the point ..... .
   (a) $\left(\frac{3}{2}, \frac{5}{2}\right)$ (b) $\left(\frac{2}{5}, \frac{2}{5}\right)$ (c) $\left(\frac{3}{5}, \frac{3}{5}\right)$ (d) $\left(\frac{2}{5}, \frac{3}{5}\right)$
9. The number of terms in the expansion of $[(a+b)^2]^{18}$ = ..... .
   (a) 19 (b) 18 (c) 36 (d) 37
10. A line passes through the point (2, 2) and is perpendicular to the line $3x + y = 5$ then its $y$ intercept is ..... .
    (a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) 5 (d) $\frac{1}{3}$
11. If $a$ and $b$ are the roots of the equation $x^2 - kx + 16 = 0$ satisfy $a^2 + b^2 = 32$, then the value of $k$ is ..... .
    (a) 10 (b) −8 (c) −8, 8 (d) 6

12. If A is a square matrix of order 3 then $|kA|$ = ..... .

(a) $k|A|$ (b) $k^2|A|$ (c) $k^3|A|$ (d) $k|A^3|$

13. If ABCD is a parallelogram then $\overrightarrow{AB}+\overrightarrow{AD}+\overrightarrow{CB}+\overrightarrow{CD}$ = ..... .

(a) $2(\overrightarrow{AB}+\overrightarrow{AD})$ (b) $4\overrightarrow{AC}$ (c) $4\overrightarrow{BD}$ (d) $\vec{0}$

14. $\lim_{x\to 0} x\cot x$ = ..... .

(a) 0 (b) 1 (c) –1 (d) $\infty$

15. If $x=\frac{1-t^2}{1+t^2}$ and $y=\frac{2t}{1+t^2}$ then $\frac{dy}{dx}$ = ..... .

(a) $\frac{y}{x}$ (b) $\frac{-y}{x}$ (c) $-\frac{x}{y}$ (d) $\frac{x}{y}$

16. If $y=\frac{(1-x)^2}{x^2}$ then $\frac{dy}{dx}$ is ..... .

(a) $\frac{2}{x^2}+\frac{2}{x^3}$ (b) $-\frac{2}{x^2}+\frac{2}{x^3}$ (c) $-\frac{2}{x^2}-\frac{2}{x^3}$ (d) $-\frac{2}{x^3}+\frac{2}{x^2}$

17. If $y=\frac{\sin x+\cos x}{\sin x-\cos x}$ then $\frac{dy}{dx}$ at $x=\frac{\pi}{2}$ is ..... .

(a) 1 (b) 0 (c) –2 (d) 2

18. $\int \frac{\sin^8 x-\cos^8 x}{1-2\sin^2 x\cos^2 x}dx$ is .....

(a) $\frac{1}{2}\sin 2x+c$ (b) $-\frac{1}{2}\sin 2x+c$ (c) $\frac{1}{2}\cos 2x+c$ (d) $-\frac{1}{2}\cos 2x+c$

19. An urn contains 5 red and 5 black balls. A balls is drawn at random, its colour is noted and is returned to the urn. Moreover, 2 additional balls of the colour drawn are put in the urn and then a ball is drawn at random. The probability that the second ball drawn is red will be .... .

(a) $\frac{5}{12}$ (b) $\frac{1}{2}$ (c) $\frac{7}{12}$ (d) $\frac{1}{4}$

20. Let A and B be two events such that $P(\overline{A\cup B})=\frac{1}{6}$, Then the events A and B are $P(A\cap B)=1/4$ and $P(\overline{A})=1/4$ is ..... .

(a) Equally likely but not independent (b) Independent but not equally likely
(c) Independent and equally likely (d) Mutually inclusive and dependent

## PART-II

**II. Answer any seven questions. Question No. 30 is compulsory.** **[7 × 2 = 14]**

21. Let A and B are two sets such that $n(A) = 3$ and $n(B) = 2$. If $(x,-1)$, $(y, 2)$ and $(z, 1)$ are in $A \times B$, find A and B where $x, y, z$ are distinct elements.

22. Solve $|5x - 12| < -2$

23. If ${}^{10}P_{r-1} = 2 \times 6\, P_r$, find $r$.

24. The number of bacteria in a certain culture doubles every hour. If there were 30 bacteria present in the culture originally, how many bacteria will be present at the end of 2nd hour, 4th hour and $n^{th}$ hour?

25. Find |A| if $A = \begin{bmatrix} 0 & \sin\alpha & \cos\alpha \\ \sin\alpha & 0 & \sin\beta \\ \cos\alpha & -\sin\beta & 0 \end{bmatrix}$

26. Find the value of $\lambda$ for which the vectors $\vec{a} = 3\hat{i} + 2\hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + \lambda\hat{j} + 3\hat{k}$ are parallel.

27. Evaluate $\lim_{x\to\pi} \frac{\sin 3x}{\sin 2x}$

28. Find the derivative of $\sin x^2$ with respect to $x^2$.

29. Let the matrix $M = \begin{bmatrix} x & y \\ z & 1 \end{bmatrix}$. If $x$, $y$ and $z$ are chosen at random from the set {1, 2, 3}, and repetition is allowed (*i.e.*, $x = y = z$), what is the probability that the given matrix M is a singular matrix?

30. Evaluate $\frac{x^2}{1+x^6}$

## PART-III

**III. Answer any seven questions. Question No. 40 is compulsory.** **[7 × 3 = 21]**

31. If $f, g, h$ are real valued functions defined on R, then prove that $(f+g) \circ h = f \circ h + g \circ h$. What can you say about $fo(g+h)$? Justify your answer.

32. Solve $\frac{4}{x+1} \leq 3 \leq \frac{6}{x+1}, x > 0$

33. Prove that $\cos^{-1}\frac{4}{5} + \tan^{-1}\frac{3}{5} = \tan^{-1}\frac{27}{11}$

34. There are 15 candidates for an examination. 7 candidates are appearing for mathematics examination while the remaining 8 are appearing for different subjects. In how many ways can they be seated in a row so that no two mathematics candidates are together?

35. Prove that if $a, b, c$ are in H.P. if and only if $\frac{a}{c} = \frac{a-b}{b-c}$

36. If (– 4, 7) is one vertex of a rhombus and if the equation of one diagonal is $5x - y + 7 = 0$, then find the equation of another diagonal.

37. Verify the existence of $\lim_{x\to 1} f(x)$, where $f(x) = \begin{cases} \frac{|x-1|}{x-1}, & \text{for } x \neq 1 \\ 0, & \text{for } x = 1 \end{cases}$

38. If $y = \sin^{-1} x$ then find $y''$.

39. Evaluate $\cot^2 x + \tan^2 x$

40. Show that $\begin{vmatrix} 2bc-a^2 & c^2 & b^2 \\ c^2 & 2ca-b^2 & a^2 \\ b^2 & a^2 & 2ab-c^2 \end{vmatrix} = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}^2$

## PART-IV

**IV. Answer all the questions.** [7 × 5 = 35]

41. (*a*) The total cost of airfare on a given route is comprised of the base cost C and the fuel surcharge S in rupee. Both C and S are functions of the mileage $m$;
$C(m) = 0.4m + 50$ and $S(m) = 0.03m$. Determine a function for the total cost of a ticket in terms of the mileage and find the airfare for flying 1600 miles. [OR]

(*b*) Evaluate $\int \sqrt{x^2 + x + 1}\, dx$

42. (*a*) Determine the region in the plane determined by the inequalities $y \geq 2x$ and $-2x + 3y \leq 6$ [OR]

(*b*) 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 $x = 0$.

43. (*a*) Prove that ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$ [OR]

(*b*) If the binomial coefficients of three consecutive terms in the expansion of $(a + x)^n$ are in the ratio 1 : 7 : 42, then find $n$.

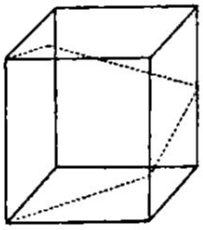
44. (*a*) Prove that (*i*) $\sin A + \sin(120° + A) + \sin(240° + A) = 0$
(*ii*) $\cos A + \cos(120° + A) + \cos(120° - A) = 0$ [OR]

(*b*) A box contains two white balls, three black balls and four red balls. In how many ways can three balls be drawn from the box, if at least one black ball is to be included in the draw?

45. (*a*) Show that $\begin{vmatrix} a^2 + x^2 & ab & ac \\ ab & b^2 + x^2 & bc \\ ac & bc & c^2 + x^2 \end{vmatrix}$ is divisible by $x^4$ [OR]

(*b*) If $\begin{bmatrix} 0 & p & 3 \\ 2 & q^2 & -1 \\ r & 1 & 0 \end{bmatrix}$ is skew-symmetric, find the values of $p$, $q$ and $r$

46. (*a*) In a shopping mall there is a hall of cuboid shape with dimension 800 × 800 × 720 units, which needs to be added the facility of an escalator in the path as shown by the dotted line in the figure. Find (*i*) The minimum total length of the escalator. (*ii*) The heights at which the escalator changes its direction. (*iii*) The slopes of the escalator at the turning points.



[OR]

(*b*) Evaluate $\lim_{x \to a} \frac{\sqrt{x-b} - \sqrt{a-b}}{x^2 - a^2} (a > b)$

47. (*a*) Evaluate $\int \frac{3x+5}{x^2+4x+7}\, dx$ [OR]

(*b*) A factory has two Machines - I and II. Machine-I produces 60% of items and Machine-II produces 40% of the items of the total output. Further 2% of the items produced by Machine-I are defective whereas 4% produced by Machine-II are defective. If an item is drawn at random what is the probability that it is defective?

# ARTHI TUITION CENTER

(UNSOLVED)

**Time: 2.30 Hours** **Maximum Marks: 90**

## PART-I

**I. Choose the correct answer. Answer all the questions.** **[20 × 1 = 20]**

1. If $n(A) = 2$ and $n(B \cup C) = 3$ then $n[(A \times B) \cup (A \times C)]$ is ..... .
   (a) $2^3$ (b) $3^2$ (c) 6 (d) 5
2. For any two sets A and B, $A \cap (A \cup B)$ = ..... .
   (a) B (b) $\phi$ (c) A (d) none of these
3. $\cos 1° + \cos 2° + \cos 3° + \cos 4° + .... \cos 179°$ = ..... .
   (a) 0 (b) 1 (c) –1 (d) 89
4. The value of $\log_9 27$ is ..... .
   (a) $\frac{2}{3}$ (b) $\frac{3}{2}$ (c) $\frac{3}{4}$ (d) $\frac{4}{3}$
5. The value of $\frac{\sin 3\theta + \sin 5\theta + \sin 7\theta + \sin 9\theta}{\cos 3\theta + \cos 5\theta + \cos 7\theta + \cos 9\theta}$ = ..... .
   (a) $\tan 3\theta$ (b) $\tan 6\theta$ (c) $\cot 3\theta$ (d) $\cot 6\theta$
6. In 3 fingers the number of ways 4 rings can be worn in ..... ways.
   (a) $4^3 - 1$ (b) $3^4$ (c) 68 (d) 64
7. Everybody in a room shakes hands with everybody else. The total number of shake hands is 66. The number of persons in the room is ..... .
   (a) 11 (b) 12 (c) 10 (d) 6
8. The H.M of two positive number whose AM and G.M. are 16, 8 respectively is ..... .
   (a) 10 (b) 6 (c) 5 (d) 4
9. The co-efficient of the term independent of $x$ in the expansion of $\left(2x + \frac{1}{3x}\right)^6$ is ..... .
   (a) $\frac{160}{27}$ (b) $\frac{160}{27}$ (c) $\frac{80}{3}$ (d) $\frac{80}{9}$
10. The value of $\begin{vmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{vmatrix}^2$ is ..... .
    (a) $abc$ (b) $-abc$ (c) 0 (d) $a^2b^2c^2$
11. The value of $x$ for which the matrix $A = \begin{bmatrix} e^{x-2} & e^{7+x} \\ e^{2+x} & e^{2x+3} \end{bmatrix}$ is singular is ..... .
    (a) 9 (b) 8 (c) 7 (d) 6

12. If $|\vec{a}+\vec{b}|=60$, $|\vec{a}-\vec{b}|=40$ and $|\vec{b}|=46$ then $|\vec{a}|$ is ..... .

(a) 42 (b) 12 (c) 22 (d) 32

13. Given $\vec{a}=2\vec{i}+\vec{j}-8\vec{k}$ and $\vec{b}=\vec{i}+3\vec{j}-4\vec{k}$ then $|\vec{a}+\vec{b}|=$ ..... .

(a) 13 (b) $\frac{13}{3}$ (c) $\frac{4}{13}$ (d) $\frac{3}{13}$

14. If $f(x)=\begin{cases} kx & \text{for } x\leq 2 \\ 3 & \text{for } 2 \end{cases}$ is continuous at $x=2$ then the value of $k$ is ..... .

(a) $\frac{3}{4}$ (b) 0 (c) 1 (d) $\frac{4}{3}$

15. If $f: R\to R$ is defined by $f(x)=\lfloor x-3\rfloor+|x-4|$ for $x\in R$ then $\lim\limits_{x\to 3^-} f(x)$ is equal to ..... .

(a) –2 (b) –1 (c) 0 (d) 1

16. $\lim\limits_{x\to\infty}\left(\frac{x^2+5x+3}{x^2+x+3}\right)^x$ is ..... .

(a) $e^4$ (b) $e^2$ (c) $e^3$ (d) 1

17. $\int\frac{e^x\left(x^2\tan^{-1}x+\tan^{-1}x+1\right)}{x^2+1}dx$ is ..... .

(a) $e^x\tan^{-1}(x+1)+c$ (b) $\tan^{-1}(e^x)+c$

(c) $e^x\frac{\left(\tan^{-1}x\right)^2}{2}+c$ (d) $e^x\tan^{-1}x+c$

18. $\int\frac{\sec x}{\sqrt{\cos 2x}}dx=$ ..... .

(a) $\tan^{-1}(\sin x)+c$ (b) $2\sin^{-1}(\tan x)+c$

(c) $\tan^{-1}(\cos x)+c$ (d) $\sin^{-1}(\tan x)+c$

19. $\int\frac{e^{6\log x}-e^{5\log x}}{e^{4\log x}-e^{3\log x}}dx=$ ..... .

(a) $x+c$ (b) $\frac{x^3}{3}+c$ (c) $\frac{3}{x^3}+c$ (d) $\frac{1}{x^2}+c$

20. It is given that the events A and B are such that $P(A)=\frac{1}{4}$, $P(A/B)=\frac{1}{2}$, and $P(B/A)=\frac{2}{3}$ then $P(B)=$ ..... .

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

## PART-II

**II. Answer any seven questions. Question No. 30 is compulsory.** **[7 × 2 = 14]**

21. In the set Z of integers, define $m$R$n$ if $m - n$ is a multiple of 12. Prove that R is an equivalence relation.

22. Simplify: $\frac{1}{2+\sqrt{3}} + \frac{3}{4-\sqrt{5}} + \frac{6}{7-\sqrt{8}}$

23. Find the value of $\sin 22\frac{1}{2}^{\circ}$

24. The number of bacteria in a certain culture doubles every hour. If there were 30 bacteria present in the culture originally, how many bacteria will be present at the end of 2nd hour, 4th hour and $n^{th}$ hour?

25. If the sum of the distance of a moving point in a plane from the axis is 1, then find the locus of the point.

26. If $(a, a + b, a + b + c)$ is one set of direction ratios of the line joining (1, 0, 0) and (0, 1, 0) then find a set of values of $a, b, c$.

27. Find $\frac{dy}{dx}$ for $y = (x^2 + 4x + 6)^5$

28. Evaluate $\int \sqrt{25x^2 - 9}\, dx$

29. A bag contains 5 white and 7 black balls. 3 balls are drawn at random. Find the probability that (*i*) all are white (*ii*) one white and 2 black.

30. If $(k, 2)$, (2, 4) and (3, 2) are vertices of the triangle of area 4 square units then determine the value of $k$.

## PART-III

**III. Answer any seven questions. Question No. 40 is compulsory.** **[7 × 3 = 21]**

31. In the set Z of integers define $m$R$n$ if $m - n$ is a multiple of 12. Prove that R is an equivalence relation.

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

33. A polygon has 90 diagonals. Find the number of its sides?

34. If $n$ is an odd positive integer, prove that the coefficients of the middle terms in the expansion of $(x + y)^n$ are equal.

35. Find the equation of the line passing through the point (1, 5) and also divides the co-ordinate axes in the ratio 3:10

36. Prove that $\begin{vmatrix} 1 & x & x \\ x & 1 & x \\ x & x & 1 \end{vmatrix}^2 = \begin{vmatrix} 1-2x^2 & -x^2 & -x^2 \\ -x^2 & -1 & x^2-2x \\ -x^2 & x^2-2x & -1 \end{vmatrix}$

37. If G is the centroid of a triangle ABC prove that $\overrightarrow{GA} + \overrightarrow{GB} + \overrightarrow{GC} = 0$

38. Find $\frac{dy}{dx}$ for $y = \sqrt{1 + 2\tan x}$

39. Evaluate $\dfrac{\sqrt{x}}{1+\sqrt{x}}\,dx$

40. Find the relation between $a$ and $b$ if $\lim\limits_{x\to 3} f(x)$ exists where $f(x) = \begin{cases} ax+b & \text{if } x>3 \\ 3ax-4b+1 & \text{if } x<3 \end{cases}$

## PART-IV

**IV. Answer all the questions.** **[7 × 5 = 35]**

41. (*a*) From the curve $y=|x|$, draw (*i*) $y=|x-1|+1$ (*ii*) $y=|x+1|-1$ (*iii*) $y=|x+2|-3$ [OR]

(*b*) Resolve into partial fraction $\dfrac{x+4}{(x^2-4)(x+1)}$

42. (*a*) Find the number of positive integers greater than 6000 and less than 7000 which are divisible by 5, provided that no digit is to be repeated. [OR]

(*b*) If ${}^nP_r = {}^nP_{r+1}$ and ${}^nC_r = {}^nC_{r-1}$, find the values of $n$ and $r$.

43. (*a*) In a $\Delta ABC$, prove that $b^2 \sin 2C + c^2 \sin 2B = 2bc \sin A$. [OR]

(*b*) Differentiate the following $s(t) = \sqrt[4]{\dfrac{t^3+1}{t^3-1}}$

44. (*a*) Find the equation of the lines make an angle 60° with the positive $x$ axis and at a distance $5\sqrt{2}$ units measured from the point (4, 7) along the line $x-y+3=0$ [OR]

(*b*) If $y = A\cos 4x + B\sin 4x$, A and B are constants then Show that $y_2 + 16y = 0$

45. (*a*) Find the sum up to the 17th term of the series $\dfrac{1^3}{1} + \dfrac{1^3+2^3}{1+3} + \dfrac{1^3+2^3+3^3}{1+3+5} + \ldots$ [OR]

(*b*) A shopkeeper in a Nuts and Spices shop makes gift packs of cashew nuts, raisins and almonds.
Pack I contains 100 gm of cashew nuts, 100 gm of raisins and 50 gm of almonds.
Pack-II contains 200 gm of cashew nuts, 100 gm of raisins and 100 gm of almonds.
Pack-III contains 250 gm of cashew nuts, 250 gm of raisins and 150 gm of almonds.
The cost of 50 gm of cashew nuts is ₹ 50, 50 gm of raisins is ₹10, and 50 gm of almonds is ₹ 60. What is the cost of each gift pack?

46. (*a*) Find matrix C if $A = \begin{bmatrix} 3 & 7 \\ 2 & 5 \end{bmatrix}$, $B = \begin{bmatrix} -3 & 2 \\ 4 & -1 \end{bmatrix}$ and $5C + 2B = A$. [OR]

(*b*) The probability that a new railway bridge will get an award for its design is 0.48, the probability that it will get an award for the efficient use of materials is 0.36, and that it will get both awards is 0.2. What is the probability, that (*i*) it will get at least one of the two awards (*ii*) it will get only one of the awards.

47. (*a*) $\lim\limits_{\alpha\to 0} \dfrac{\sin(\alpha^n)}{(\sin\alpha)^m}$ [OR]

(*b*) Evaluate $I = \int \sin^{-1}\left(\dfrac{2x}{1+x^2}\right)dx$