MATHS

BOOKS - CHHAYA PUBLICATION MATHS (BENGALI ENGLISH)

QUESTION PAPER 2017

Unit 1

1. The value of $\sin\left(\cos^{-1} x\right) - \cos\left(\sin^{-1} x\right)$ is

A. 1

B. x

C. $\frac{1}{x}$

D. 0

Answer: D

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2. Let R be the set of real numbers and the mappings $f: R \to R$ and $g: R \to R$ be defined by $f(x) = 5 - x^2$ and $g(x) = 3x - 5$, then the value of $(f \circ g)(-1)$ is

A. 8

B. -59

C. 54

D. 16

Answer: B

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3. If R is a relation defined as $R = \{(x, y): x, y \in N \text{ and } x + 3y = 12\}$, then find the domain and range of R.

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4. Evaluate: $\sec^2\left(\tan^{-1}2\right)+\cos ec^2\left(\cot^{-1}3\right)$.

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5. An operation '*' is defined on a set A={1,2,3,4} as follows: a*b=ab(mod5), all $a, b \in A$,Prepare the composition table for '*' on A and from the table show that, '*' is a binary opration and '*' is commutative on A.

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6. Solve: $\tan^{-1}(x+1)+\tan^{-1}(x-1)=\tan^{-1}\frac{8}{31}$.

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7. Let $f(x)=x^{13}+x^{11}+x^9+x^7+x^5+x^3+x+19$. Then $f(x)=0$ has

A. 13 real roots

B. only one positive and only two negative real roots

C. not more than one real root

D. has two positive and one negative real root

Answer: C

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8. Let $d: R \to R$ be such that f is injective and $f(x)f(y) = f(x+y)$ for $\forall x, y \in R$. If $f(x), f(y), f(z)$ are in GP, then x,y,z are in

A. AP always

B. GP always

C. AP depending on the value of x,y,z

D. GP depending on the value of x,y,z

Answer: A

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9. On the set R of real numbers we define xPy if and only if $xy \geq 0$. Then the relation P is

A. reflexive but not symmetric

B. symmetric but not reflexive

C. transitive but not reflexive

D. reflexive and symmetric but not transitive

Answer: D

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10. On R, the relation p be defined by 'xpy holds if and only if x-y is zero or irrational'. Then

A. p is reflexive and transitive but not symmetric

B. p is reflexive and symmetric but not transitive

C. p is symmetric and transitive but not reflexive

D. p is equivalence relation

Answer: B

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11. The possible value of x, which satisfy the trigonometric equation $\tan^{-1}\left(\frac{x-1}{x-2}\right)+\tan^{-1}\left(\frac{x+1}{x+2}\right)=\frac{\pi}{4}$ are

A. $\pm\frac{1}{\sqrt{2}}$

B. $\pm\sqrt{2}$

C. $\pm\frac{1}{2}$

D. ± 2

Answer: A

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12. On set A={1,2,3}, relations R and S are given by R={(1,1),(2,2),(3,3),(1,2),(2,1)}, S={(1,1),(2,2),(3,3),(1,3),(3,1)}. Then

A. $R \cup S$ is an equivalence relation

B. $R \cup S$ is reflexive and transitive but not symmetric

C. $R \cup S$ is reflexive and symmetric but not transitive

D. $R \cup S$ is symmetric and transitive but not reflexive

Answer: C

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13. On R, the set of real numbers, a relation p is defined as 'apb if and only if $1 + ab > 0$'. Then

A. p is an equivalence relation

B. p is reflexive and transitive but not symmetric

C. p is reflexive and symmetric but not transitive

D. p is only symmetric

Answer: C

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Unit 2

1. If the inverse of the matrix A exists, then the value of det (A^-1)

A. 0

B. 1

C. $\frac{1}{\det A}$

D. $\det A$

Answer: D

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2. Show that $A = \frac{1}{3}\begin{bmatrix} -1 & 2 & -2 \\ -2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ is proper orthogonal matrix.

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3. Prove that, $\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_x z & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix} = 0$

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4. If $A = \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix}$, then show that $A^2 - 5A + 7I_2 = 0$: hence find A^{-1}.

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5. Solve by Cramer's rule: $x + 3y = 4, y + 3z = 7, 4y + z = 6.$

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6. Prove that, $\begin{vmatrix} 2ab & a^2 & b^2 \\ a^2 & b^2 & 2ab \\ b^2 & 2ab & a^2 \end{vmatrix} = -\left(a^3+b^3\right)^2.$

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7. Without expanding the determinant, show that the determinant $\begin{vmatrix} a^2+10 & ab & ac \\ ab & b^2+10 & bc \\ ac & bc & c^2+10 \end{vmatrix}$ is divisible by 100.

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Unit 3

1. If $f(x) = |x| + |x-1|$, then $f(x)$ is

A. continuous at x=0 and x=1

B. continous at x=0 but discotunous at x=1

C. continous at x=1 but discotunous at x=0

D. None of these

Answer: A

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2. The value of $\int_{-a}^{a} \frac{xe^{x^4}}{1+x^2} dx$ is

A. 0

B. 1

C. a

D. 2a

Answer: A

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3. The degree of the differential equation $\frac{d^3y}{dx^3} + y = \sqrt[3]{1 + \frac{dy}{dx}}$ is

A. 1

B. 2

C. 4

D. 3

Answer: D

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4. If $x = \sqrt{a^{\sin^{-1}t}}$ and $y = \sqrt{a^{\cos^{-1}t}}$ show that $\frac{dy}{dx} = -\frac{y}{x}$.

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5. Varify Rolle's theorem for the function $f(x) = x^2 - 4x + 3$ in $1 \leq x \leq 3$.

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6. Evalute: $\int \frac{\cos x - \cos 2x}{1 - \cos x} dx.$

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7. A particle starts with the velocity u and moves in a straight line, its acceleration being always equl to its displacement. If v be the velocity when its desplacement is x, then show that $v^2 = u^2 + x^2$.

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8. Find the interval where $f(x) = \frac{1}{1 + x^2}$ decreases.

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9. If $f(x) = f(a + x)$, then prove that the value of $\int_a^{a+t} f(x)dx$ is independent of a.

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10. If $f(x) = \left(\frac{a+x}{b+x}\right)^{a+b+2x}$, then prove that $f'(0) = \left[2\log\frac{a}{b} + \frac{b^2 - a^2}{ab}\right]\left(\frac{a}{b}\right)^{a+b}$.

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11. $\begin{bmatrix} 3 & -2 \\ 6 & -k \end{bmatrix} = A$,also $\det A = 0$ then find k.

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12. $\int \cos^{-1}\sqrt{\frac{x}{a+x}}dx$

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13. Evalute $\int \frac{xdx}{x^4 - x^2 + 1}$

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14. Solve: $ydx - \left(x + 2y^2\right)dy = 0.$

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15. In a certain culture the rate of increment of bactreria at any instant is proportional to the cube root of the number of bacteria present at that instant. If the number of becteria becomes 8 times hours, in how much time that number becomes 64 times?

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16. Evalute: $\int_0^{\frac{\pi}{4}} \log(1 + \tan\theta)d\theta.$

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17. From the definition of the definite integral, find the value of $\int_1^2 5x^2 dx$.

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18. Using calculus, find the maximum value of the function $\left(\frac{x}{a}\right)^x$.

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19. Using integration, prove that the area of the closed region bounded by the curves $y^2 = 4x$ and $x^2 = 4y$ is $\frac{16}{3}$ sq. unit.

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20. If the staight line $\frac{x}{h} + \frac{y}{k} = 1$touches the curve $\left(\frac{x}{a}\right)^n + \left(\frac{y}{b}\right)^n = 1$, then show that $\left(\frac{a}{h}\right)^{\frac{n}{n-1}} + \left(\frac{b}{k}\right)^{\frac{n}{n-1}} = 1$.

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21. Solve: $xdy - ydx = \sqrt{x^2 + y^2}dx.$

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Unit 4

1. If the direction ratios of a straight line are proportional to 0,1,-1, then its inclination with z-axis is

A. $\frac{\pi}{2}$

B. π

C. $\frac{3\pi}{2}$

D. $\frac{3\pi}{4}$

Answer: D

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2. If $\vec{\alpha} = 2\hat{i} + 3\hat{j} - 6\hat{k}$ and $\vec{\beta} = p\hat{i} - \hat{j} + 2\hat{k}$ are two parallel vectors, then the value of p is

A. $-\frac{1}{3}$

B. $\frac{2}{3}$

C. $-\frac{2}{3}$

D. $-\frac{3}{2}$

Answer: C

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3. If $\vec{a} = 3\hat{i} + \hat{j} + 9\hat{k}$ and $\vec{b} = \hat{i} + \lambda\hat{j} + 3\hat{k}$ then the value of λ for which the vector $\left(\vec{a} + \vec{b}\right)$ and $\left(\vec{a} - \vec{b}\right)$ are perpendicular to each other.

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4. Find the vector equation of a plane through the point $\hat{i}+\hat{j}+\hat{k}$ and parallel to the plane $\vec{r}.\left(2\hat{i}-\hat{j}+2\hat{k}\right)=5$.

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5. The position vectors of four points A,B,C and D are $4\hat{i}+8\hat{j}+12\hat{k}, 2\hat{i}+3\hat{i}+4\hat{j}+6\hat{k}, 3\hat{i}+5\hat{j}+4\hat{k}, \text{ and } 5\hat{i}+8\hat{j}+5\hat{k}$ respectively. Using vector method prove that the four points A,B,c and D are coplaner.

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6. Prove that $\left(\vec{\beta}-\frac{\vec{\alpha}\cdot\vec{\beta}}{\left|\vec{\alpha}\right|^2}.\vec{\alpha}\right)$ is perpendicular to the vector $\vec{\alpha}$.

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7. Find the shortest distance between the straight lines $\vec{r} = -4\hat{i} + 4\hat{j} + \hat{k} + \lambda_1\left(\hat{i} + \hat{j} - \hat{k}\right)$ and $\vec{r} = -3\hat{i} - 8\hat{j} - 3\hat{k} + \lambda_2($

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8. A variable plane is at a constant distance p from the origin and meets the coordinate axes in A,B and C. Show that the locus of the centroid of the tetrahedron OABC is $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{16}{p^2}$.

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Unit 5

1. Find solution of $\begin{vmatrix} x+a & b \\ a & x+b \end{vmatrix} = 0$

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2. Solve the following Linear programming problem in graphical method Subject to the constraints, $5x + 10y \leq 50$.

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Unit 6

1. If $f(X)$ is the probability distribution function of a random variable X and X can assume only two values x_1 and x_2, then the value of $f(x_1) + f(x_2)$ is

A. > 1

B. < 1

C. $= \frac{1}{2}$

D. $= 1$

Answer: D

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Unit 7

1. An unbaised die is throwns 3 times. If the first thrown is a 5, the conditional probability of getting 16 as a sum is

A. $\frac{1}{9}$

B. $\frac{1}{18}$

C. $\frac{1}{108}$

D. $\frac{5}{16}$

Answer: C

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Unit 8

1. If $P(A) = \frac{2}{3}, P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{2}$,then find the value of $P(A \cap B^c)$.

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Unit 9

1. If X is a discete random variable, then show that $E(X - \overline{X}) = 0$.

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Unit 10

1. A man is known to speak the truth 3 out of 4 times. He throws an unbaised die and reports that it is a six. Find the probability that it is a actually six.

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Unit 11

1. If the sum of the mean and variance of a binomial distribution for 5 random trials is 1.8, then find the binomal distribution.

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Unit 2

1. The linear system of equations $\left.\begin{array}{l} 8x-3y-5z=0 \\ 5x-8y+3z=0 \\ 3x+5y-8z=0 \end{array}\right\}$ has

A. only 'zero solution'

B. no non-zero solution

C. only finite number of non-zero solutions

D. infinitely many non-zero solutins

Answer: D

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2. Let P be the set of all non-singular matrices of order 3 over R and Q be the set of all orthogonal matrices of order 3 over R. Then

A. P is proper subject of Q

B. Q is proper subset of P

C. Neither P is proper subset of Q nor Q is proper subset of P

D. $P \cap Q = \phi$, the void set

Answer: B

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3. Let $A = \begin{pmatrix} x+2 & 3x \\ 3 & x+2 \end{pmatrix}, B = \begin{pmatrix} x & 0 \\ 5 & x+2 \end{pmatrix}$. Then all solutions of x of the equation det(AB)=0 is

A. $1, \ -1, 0, 2$

B. $1, 4, 0, \ -2$

C. $1, \ -1, 4, 3$

D. $-1, 4, 0, 3$

Answer: B

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4. The value of detA, where $A = \begin{pmatrix} 1 & \cos\theta & 0 \\ -\cos\theta & 1 & \cos\theta \\ -1 & -\cos\theta & 1 \end{pmatrix}$ lies in

A. 1,2

B. 1,0

C. 0,1

D. 2,1

Answer: C

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5. Let $A = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$. Then for positive integer n, A^n is

A. $\begin{pmatrix} 1 & n & n^2 \\ 0 & n^2 & n \\ 0 & 0 & n \end{pmatrix}$

B. $\begin{pmatrix} 1 & n & n\left(\frac{n+1}{2}\right) \\ 0 & 1 & n \\ 0 & 0 & 1 \end{pmatrix}$

C. $\begin{pmatrix} 1 & n^2 & n \\ 0 & n & n^2 \\ 0 & 0 & n^2 \end{pmatrix}$

D. $\begin{pmatrix} 1 & n & 2n-1 \\ 0 & \frac{n+1}{2} & n^2 \\ 0 & 0 & \frac{n+1}{2} \end{pmatrix}$

Answer: B

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6. Let a,b,c be such that $b(a+c) \neq = 0$. If

$$\begin{vmatrix} a & a+1 & a-1 \\ -b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix} + \begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ (-1)^{n+2}a & (-1)^{n+1}b & (-1)^{n}c \end{vmatrix} = 0,$$ then the value of n is

A. any integer

B. zero

C. any even integer

D. any odd integer

Answer: D

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Unit 3

1. Cosider the non-constant differentiable function f of one variable which obeys the relation $\frac{f(x)}{f(y)} = f(x-y)$. If $f'(0) = p$ and $f'(5) = q$, then

$f'(-5)$ is

A. $\frac{p^2}{q}$

B. $\frac{q}{p}$

C. $\frac{p}{q}$

D. q

Answer: A

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2. If $f(x) = \log_5 \log_3 x$, then $f'(e)$ is equal to

A. $e \log_e 5$

B. $e \log_e 3$

C. $\frac{1}{e \log_e 5}$

D. $\frac{1}{e \log_e 3}$

Answer: C

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3. Let $F(x) = e^x, G(x) = e^{-x}$ and $H(x) = G(F(x))$, where x is a real variable. Then $\frac{dH}{dx}$ at x=0 is

A. 1

B. -1

C. $-\frac{1}{e}$

D. $-e$

Answer: C

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4. If $f''(0) = k, k \neq 0,$ then the value of $\lim_{x \to 0} \frac{2f(x) - 3f(2x) + f(4x)}{x^2}$ is

A. k

B. 2k

C. 3k

D. 4k

Answer: C

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5. If $y = e^{m \sin^{-1} x}(-1 \leq x \leq 1)$, Prove that,

$$(1 - x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = m^2 y.$$

A. m^2

B. 2

C. -1

D. $-m^2$

Answer: A

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6. The chord of the curve $y = x^2 + 2ax + b$, joining the points where $x = \alpha$ and $x = \beta$, is parallel to the tangent to the curve at abscissa x=

A. $\frac{a+b}{2}$

B. $\frac{2a+b}{3}$

C. $\frac{2\alpha+\beta}{3}$

D. $\frac{\alpha+\beta}{2}$

Answer: D

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7. Let $f(x) = \begin{cases} \frac{x^p}{(\sin x)^q}, & \text{if } 0 < x \leq \frac{\pi}{2}, (p, q \in R) \\ 0 & \text{if } x=0. \end{cases}$ Then Lagrange's mean value theorem is applicable to f(x) in closed interval [0,x].

A. for all p,q

B. only when $p > q$

C. only when $p < q$

D. for no value of p,q

Answer: B

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8. $\lim_{x \to 0} (\sin x)^{2 \tan x} =$

A. 2

B. 1

C. 0

D. does not exist

Answer: B::D

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9. $\int \cos(\log x)dx = F(x) + c$, where c is an arbitaray constant. Here F(x)=

A. $x[\cos(\log x) + \sin(\log x)]$

B. $x[\cos(\log x) - \sin(\log x)]$

C. $\frac{x}{2}[\cos(\log x) + \sin(\log x)]$

D. $\frac{x}{2}[\cos(\log x) - \sin(\log x)]$

Answer: C

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10. Let $I = \int_{10}^{19} \frac{\sin x}{1 + x^8} dx$. Then,

A. $|I| < 10^{-9}$

B. $|I| < 10^{-7}$

C. $|I| < 10^{-5}$

D. $|I| > 10^{-7}$

Answer: B

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11. Let $I_1 = \int_0^n [x]dx$ and $I_2 = \int_0^n \{x\}dx$, where [x] and {x} are integral and fractional parts of x and $\cap eN - \{1\}$. Then $\frac{I_1}{I_2}$ is equal to

A. $\frac{1}{n-1}$

B. $\frac{1}{n}$

C. n

D. $n-1$

Answer: D

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12. Evalute : $\lim_{n \to \infty} \left[\frac{n}{n^2+1^2} + \frac{n}{n^2+2^2} + \ldots\ldots . + \frac{1}{2n} \right].$

A. $\frac{n\pi}{4}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{4n}$

D. $\frac{\pi}{2n}$

Answer: B

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13. The value of the integral $\int_0^1 e^{x^2} dx$

A. < 1

B. > 1

C. ≤ 1

D. lies in the closed interval [1,e]`

Answer: B

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14. $\int_0^{100} e^{x-[x]}dx =$

A. $\frac{e^{100}-1}{100}$

B. $\frac{e^{100}-1}{e-1}$

C. $100(e-1)$

D. $\frac{e-1}{10}$

Answer: C

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15. Solution of $(x+y)^2\frac{dy}{dx} = a^2$ ('a' being a constant) is

A. $\frac{x+y}{a} = \tan\frac{y+c}{a}$,c is an arbitrary constant

B. $xy = a\tan cx$, c is an arbitary constant

C. $\frac{x}{a} = \tan\frac{y}{c}$, c is an arbitrary constant

D. $xy = \tan(x + c)$, c is an arbitrary constant

Answer: A

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16. The integrating factor of the first order differential equation $x^2(x^2 - 1)\frac{dy}{dx} + x(x^2 + 1)y = x^2 - 1$ is

A. e^x

B. $x - \frac{1}{x}$

C. $x + \frac{1}{x}$

D. $\frac{1}{x^2}$

Answer: B

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17. If $f(x) = \int_{-1}^{x} |t| dt$, then for any $x \geq 0$, $f(x)$ is equal to

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

B. $1 - x^2$

C. $\frac{1}{2}(1 + x^2)$

D. $1 + x^2$

Answer: C

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18. Let for all $x > 0$, $f(x) = \lim_{n \to \infty} n\left(x^{\frac{1}{n}} - 1\right)$, then

A. $f(xy) + f\left(\frac{1}{x}\right) = 1$

B. $f(xy) = f(x) + f(y)$

C. $f(xy) = xf(y) + yf(x)$

D. $f(xy) = xf(x) + yf(y)$

Answer: B

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19. Let $I = \int_0^{100\pi} \sqrt{1 - \cos 2x} dx$, then

A. $I = 0$

B. $I = 200\sqrt{2}$

C. $I = \pi\sqrt{2}$

D. $I = 100$

Answer: B

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20. The area (sq. units) of the figure bounded by the parabolas $x = -2y^2$ and $x = 1 - 3y^2$ is

A. $\frac{4}{3}$

B. $\frac{2}{3}$

C. $\frac{3}{7}$

D. $\frac{6}{7}$

Answer: A

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21. Tangents are drawn to the ellipse $\frac{x^2}{9}+\frac{y^2}{5}=1$ at the ends of both latusrectum. The area of the quadrilateral so formed is

A. 27

B. $\frac{13}{2}$

C. $\frac{15}{4}$

D. 45

Answer:

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22. The value of K in order that $f(x) = \sin x - \cos x - Kx + 5$ decreases for all positive real values of x given by

A. $K < 1$

B. $K \geq 1$

C. $K > \sqrt{2}$

D. $K < \sqrt{2}$

Answer: C

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23. For real x, the greatest value of $\frac{x^2 + 2x + 4}{2x^2 + 4x + 9}$ is

A. 1

B. -1

C. $\frac{1}{2}$

D. $\frac{1}{4}$

Answer: C

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24. Find solution of

$ydx + xdy = xy(dy - dx)$

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25. If $f(x) = x^n$, n being a non-negative integer, then the values of n for which $f'(\alpha + \beta) = f'(\alpha) + f'(\beta)$ for all $\alpha, \beta > 0$ is

A. 1

B. 2

C. 0

D. 5

Answer: B::C

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26. Let f be a non-constant continuous function for all $x \geq 0$. Let f satisfy the relation $f(x)f(a-x)=1$ for some $a \in R^+$. Then $I=\int_0^a \frac{dx}{1+f(x)}$ isd equal to

A. a

B. $\frac{a}{4}$

C. $\frac{a}{2}$

D. $f(a)$

Answer: C

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27. If the line $ax + by + c = 0, ab \neq 0,$ is a tangent to the curve $xy = 1 - 2x,$ then

A. $a > 0, b < 0$

B. $a > 0, b > 0$

C. $a < 0, b > 0$

D. $a < 0, b < 0$

Answer: B::D

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28. Two particles move in the same straight line starting at the same moment from the same point in the same deirectin. The first moves with constant velocity u and the second starts from rest with constant acceletation f. Then

A. they will be at the gratest distance at the end of time $\frac{u}{2f}$ from the start

B. they will be at the gratest distance at the end of time $\frac{u}{f}$ from the start

C. their greatest distance is $\frac{u^2}{2f}$

D. their greatest distance is $\frac{u^2}{f}$

Answer: B::C

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29. If the tangents to $y^2 = 4ax$ at the point $\left(at^2, 2at\right)$ where $|t| > 1$ is a normal $x^2 - y^2 = a^2$ at the point $(a\sec\theta, a\tan\theta)$, then t=

A. $-\cos ec\theta$

B. $-\sec\theta$

C. $2\tan\theta$

D. $2\cos\theta$

Answer: A::C

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30. $\int \frac{x^2-1}{x^4+3x^2+1} dx (x > 0)$ is

A. $\tan^{-1}\left(x+\frac{1}{x}\right)+c$

B. $\tan^{-1}\left(x-\frac{1}{x}\right)+c$

C. $\log_e \left| \frac{x+\frac{1}{x}-1}{x+\frac{1}{x}+1} \right| + c$

D. $\log_e \left| \frac{x-\frac{1}{x}-1}{x-\frac{1}{x}+1} \right| + c$

Answer: A

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Unit 4

1. The equation of the plane through (1,2,-3) and (2,-2,1) and parallel to x axis is

A. $y - z + 1 = 0$

B. $y - z - 1 = 0$

C. $y + z - 1 = 0$

D. $y + z + 1 = 0$

Answer: D

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2. Three lines are drawn from the origin O with direction ratio proportional to 1,-1,1,2,-3,0 and 1,0,3. The three lines are

A. coincident

B. coplanar

C. not coplanar

D. perpendicular to each other

Answer: B

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3. For many vector $\vec{x}$, the value of $\left(\vec{x} \times \hat{i}\right)^2 + \left(\vec{x} \times \hat{j}\right)^2 + \left(\vec{x} \times \hat{k}\right)^2$ is equal to

A. $\left|\vec{x}\right|^2$

B. $2\left|\vec{x}\right|^2$

C. $3\left|\vec{x}\right|^2$

D. $4\left|\vec{x}\right|^2$

Answer: B

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4. If the sum of two unit vectors is a unit vector then show that the magnitude of their difference is $\sqrt{3}$

A. $\sqrt{2}$ units

B. 2 units

C. $\sqrt{3}$ units

D. $\sqrt{5}$ units

Answer: C

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