MATHS

BOOKS - ARIHANT PUBLICATION

QUESTION PAPER 2020

Group A Answer All Questions

1. A is a square matrix of order 3. write the value n, $|2A| = n|A|$.

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2. A discrete random variable X has the probability distribution as given below:

X	0.5	1	1.5	2
$P(X)$	k	k^2	$2k^2$	k

Then, find the value of k.

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3. Find the derivative of $\tan^{-1}\left(\frac{\cos x + \sin x}{\cos x - \sin x}\right)$ w.r.t. x.

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4. If f(x) = sinx+2 in the interval [(-pi)/2,(pi)/2], what can you say about the greatest value of f(x)?

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5. If $\int_{-\frac{1}{2}}^{\frac{1}{2}} \cos x In \frac{1+x}{1-x} dx = kIn^2$ then write the value of k.

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6. Write the differential equation of all non-horizontal lines in a plane.

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7. If $\vec{a}$ and $\vec{b}$ are unit vectors and $\vec{a} - \vec{b}$ is also a unit vector, then write the measure of the angle between $\vec{a}$ and $\vec{b}$.

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8. Write the axis to which the plane by+cz+d=0 is parallal.

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9. Write down all the partitions of the set {a,b,c}.

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10. Write the domain of the function defined by f(x)=$\sin^{-1}x+\cos x$

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Group B Answer Any Three Questions

1. A man plans to start a poultry farm by investing at most ₹ 3000. He can buy old hens for ₹80 each and young ones for ₹ 140 each, but he cannot house more than 30 hens. Old hens lay 4 eggs per week ,each ell bing sold at ₹5. It costs ₹ 5 to feed an old hen and ₹8 to feed a young hen per week. Formulate his problem determining the number of hens of each type he should buy so as to earn a proft of more than ₹ 300 per week.

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2. Test whether the relation : $R=\{(m,n):2\mid(m+n)\}$ on $\mathbb{Z}$ is reflexive, symmetric or transitive.

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3. Prove that for any $f: X \to Y$, $foid_x = f = id_Y$ of.

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4. Solve equation $3\tan^{-1}\frac{1}{(2+\sqrt{3})} - \tan^{-1}\frac{1}{x} = \tan^{-1}\frac{1}{3}$

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5. Prove that $\tan\left\{\frac{\pi}{4} + \frac{1}{2}\cos^{-1}\frac{a}{b}\right\} + \tan\left\{\frac{\pi}{4} - \frac{1}{2}\cos^{-1}\left(\frac{a}{b}\right)\right\} = \frac{2b}{a}$.

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6. Four cards are drawn successively with replacement from a well shuffled pack of 52 cards. Find the probability distribution of the number of aces. Calculate the mean and variance of the number of aces.

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7. Find the inverse of the matrix $\begin{bmatrix} 4 & -2 \\ 3 & 1 \end{bmatrix}$

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8. There are two families A and B. There are 4 men, 6 women and 2 children in family A and 2 men, 2 women and 4 children in family B. The recommended daily amount of calories is 2400 for men, 1900 for women and 1800 for children, and 45 g of proteins for men, 55 g for women and 33 g for children. Represent the above information by matrices. Using matrices multiplication, calculate the total requirement of calories and proteins for each of the 2 families.

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9. Eliminate x,y,z from

a=x/y-z, b=y/z-x, c=z/x-y

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10. There are 25 girls and 15 boys in class XI and 30 boys and 20 girls in class XII. If a student chosen from a class, selected at random, happens to be a boy, find the probability that he has been chosen from class XII.

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11. Show that the tangent to the curve $x = a(t - \sin t), y = at(1 + \cos t)$ at $t = \frac{\pi}{2}$ has slope.(1- pi/2)`

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12. Examine the contiunity of the following functions at the indicated points .$f(x)$=$\begin{cases} 2x+1 & \text{if } x \leq 0 \\ x & \text{if } 0 < x < 1 \\ 2x-1 & \text{if } x \geq 1 \end{cases}$ at $x = 0, 1.$

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13. If sin (x + y) = y cos (x + y) then prove that

$$\frac{dy}{dx} = -\frac{1+y^2}{y^2}$$

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14. What is the derivative of $\sec^{-1}\left(\frac{1}{2x^2-1}\right)$,with respect to $\left(\sqrt{1-x^2}\right)$?

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15. Find the approximate value of $\sqrt{48.96}$

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16. Solve : $In\left(\frac{dy}{dx}\right)=3x+4y$ given that y=0, when x=0.

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17. Evaluate $\int \frac{4\sin x + 5\cos x}{5\sin x + 4\cos x} dx$

It is an integration of the form $\int \frac{a\sin x + b\cos x}{c\sin x + d\cos x}$dx. So, write $4\sin x + 5\cos x = a\frac{d}{dx}(5\sin x + 4\cos x) + b(5\sin x + 4\cos x)$

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18. Evaluate the following integrals :

$\int_0^{\pi/2} \log\left|\frac{4 + 3\sin x}{4 + 3\cos x}\right| dx.$

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19. The area between $x = y^2$ and $x = 4$ is divided into two equal parts by the line $x = a$. Find the value of a.

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20. Solve the following differential equations

$$x\frac{dy}{dx} + y = y^2 \log x$$

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21. Prove that the measure of the angle between two main diagonals of a cube is $\cos^{-1}\frac{1}{3}$.

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22. Prove that the four points with position vectors $2\vec{a} + 3\vec{b} - \vec{c}, \vec{a} - 2\vec{b} + 3\vec{c}, 3\vec{a} + 4\vec{b} - 2\vec{c}$ and $\vec{a} - 6\vec{b} + 6\vec{c}$ are coplanar.

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23. If $\overrightarrow{a} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\overrightarrow{b} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ then verify that $\overrightarrow{a} \times \overrightarrow{b}$ is perpendicular to both $\overrightarrow{a}$ and $\overrightarrow{b}$.

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24. Passing throughthe point $(2, -3, 1)$ and $(-1, 1-7)$ and perpendicular to the plane $x - 2y + 5z + 1 = 0.$

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25. Find the perpendicular distance of the point $(-1, 3, 9)$ from the line

$$\frac{x-13}{5} = \frac{y+8}{-8} = \frac{z-31}{1}$$

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Group C Answer Any One Questions

1. Find the solution of the following differential equations:

(4x+6y+5)dx-(2x+3y+4)dy=0

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2. Find the area of the smaller region bounded by the ellipse $\frac{x^2}{9}+\frac{y^2}{4}=1$ and the line $\frac{x}{3}+\frac{y}{2}=1.$

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3. Evaluate : $\int \frac{x^5+x^4+x^3+x^2+4x+1}{x^2+1}dx$

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4. Show that $\vec{a}, \vec{b}$ and $\vec{c}$ are coplanar if $\vec{a}+\vec{b}, \vec{b}+\vec{c}$ and $\vec{c}+\vec{a}$ are coplanar.

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5. Find the shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $\frac{x+3}{-3} = \frac{y-7}{2} = \frac{z-6}{4}$ Find also the equation of the line of shortest distance.

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6. Solve the following LPP graphically Optimize $Z = 5x_1 + 25x_2$ subject to $-0.5x_1 + x_2 \leq 2, x_1 + x_2 \geq 2, -x_1 + 5x_2 \geq 5, x_1, x_2 \geq 0$

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7. If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \pi \text{prove that} x^4 + y^4 + z^4 + 4x^2y^2z^2 = 2(x^2y$

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8. (Z,*) where a* b = a+b-ab for all $a, b \in Z$ prove that the given binary operation * is associative and commutative.

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9. The probability of a shooter hitting a target is $\frac{3}{4}$ Find the minimum number of times he must fire, so that the probability of hitting the target atleast once is greater than 0.999.

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10. Prove the following:

$$\begin{bmatrix} (b+c)^2 & a^2 & bc \\ (c+a)^2 & b^2 & ca \\ (a+b)^2 & c^2 & ab \end{bmatrix}$$

$=(a^2+b^2+c^2)(a+b+c)(b-c)(c-a)(a-b)$

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11. If A,B,C are matrices of order 2×2 each and $2A + B + C = \begin{bmatrix} 1 & 2 \\ 3 & 0 \end{bmatrix}$

$A + B + C = \begin{bmatrix} 0 & 1 \\ 2 & 1 \end{bmatrix}$

$A + B - C = \begin{bmatrix} 1 & 2 \\ 1 & 0 \end{bmatrix}$ find A,B and C.

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12. If $y = x^{\sin x} + x^3 \dfrac{\sqrt{x^2 + 4}}{\sqrt{x^3 + 3}}$ find $\dfrac{dy}{dx}$.

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13. Show that the semivertical angle of a cone of given slant height is $\tan^1 \sqrt{2}$ when its volume is maximum.

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