MATHS

BOOKS - USHA MATHS (ODIA ENGLISH)

PRACTICE PAPER

Practice Paper

1. Let X, Y be non-empty sets such that $|X| = m$ and $|Y| = n$. If $m < n$, then how many one-to-one can be defined from X to Y?

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2. What is the value of $\sec^2\left(\tan^{-1}2\right) + \cos ec^2\left(\cot^{-1}3\right)$?

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3. With 4 different elements how many different determinant of order 2 can be constructed.

A. Complete dominance

B. Codominance

C. incomplete dominance

D. complete recessive

Answer: C

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4. If A is a square matrix of order 3 such that $|A| = 5$, then what is the value of $|adj(adjA)|$?

A. S. griseus

B. S. aureofacienns

C. S. noursil

D. saccharomyces cerevisiae

Answer: A

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5. If $f(x) = (1 + 2x)^{\frac{1}{x}}, x \neq 0$ is continuous at x=0, then what is the value of f(0) ?

A. Ex-situ conservation

B. In-situ conservation

C. in vitro conservation

D. in vivo conservation

Answer: B

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6. Write the least value of $f(x) = ax + \frac{b}{x}$, where $a > 0, b > 0$ and $x > 0$.

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7. Write the value of $\int \frac{\left(x^2+1\right)dx}{1+x^4}$.

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8. What will be the substitution for which the equation $\frac{dy}{dx} + p(x) \cdot y = q(x) \cdot y^n, n > 2$ can be reduced to linear form.

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9. If $\vec{a} = 2\vec{b}$ and $\vec{c} = -3\vec{b}$, then what is the angle between $\vec{a}$ and $\vec{c}$?

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10. What is the number of independent constants that occur in the general equation of a plane.

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11. Show that the relation R on Z – {0} defined by $R = \left\{(m, n) \mid \frac{m}{n} \text{ is power of 5}\right\}$ is an equivalence relation.

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12. Show that the function $f: \mathbb{R} \to \mathbb{R}$ defined by $f(x) = \begin{cases} x^2 - \frac{1}{x^2} & x \neq 0 \\ 0 & x = 0 \end{cases}$ is onto but not one-to-one.

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13. Solve for x, $\cos^{-1} x + \sin^{-1}\left(\frac{x}{2}\right) = \frac{\pi}{6}$.

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14. Prove that $\cos^{-1}\left(\frac{b + a\cos x}{a + b\cos x}\right) = 2\tan^{-1}\left(\sqrt{\frac{a-b}{a+b}}\tan\frac{x}{2}\right)$

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15. A diet for a sick person must contain at least 4000 units of vitamins, 50 units of minerals and 1400 units of calories. Two foods A and B, are available at a cost of Rs.4

and Rs. 3 per unit respectively. If one unit of A contains 200, units of vitamin, 1 unit of mineral and 40 calories and one units of B contains 100 units of vitamins, 2 units of minerals and 40 calories. Formulate the LPP to minimize the cost of foods.

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16. Prove that $\begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix} = 2\begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix}$

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17. Find inverse of the following matrices by elementary row/column operation (transformations):

$\begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$

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18. If $A = \begin{bmatrix} 1 & -2 & 2 \\ 3 & 1 & -1 \end{bmatrix}$ $B \begin{bmatrix} 2 & 4 \\ 1 & 2 \\ 3 & -1 \end{bmatrix}$ verify that $(AB)^T = B^T A^T$.

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19. Without expanding prove that $\begin{vmatrix} 1 & a & a^2 & -bc \\ 1 & b & b^2 & -ca \\ 1 & c & c^2 & -ab \end{vmatrix} = 0$

A. Mutualism

B. Commensalism

C. Amensalism

D. Competition

Answer: A

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20. Verify that $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ satisfies the equation $A^2 - (a+d)A + (ad-bc)I = 0$ where I is the 2x2 unit matrix.

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21. Test differentiability and continuity of the following functions.

$\left|1-\frac{1}{x}\right|$ at x = 1

A. 0.25

B. 0.5

C. 0.75

D. 1

Answer: B

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22. If x =sin t,y = sin 2t then prove that $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 4y = 0$

A. Methane

B. Carbon dioxide

C. Carbon monoxide

D. Hydrogen sulphide

Answer: A

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23. Find dy/dx if

$y = x\cot^{-1}\left(\frac{x}{y}\right)$

A. 1992

B. 1996

C. 2000

D. 2002

Answer: D

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24. Find the point (S) on the curve

$$x = \frac{3at}{1+t^2}, y = \frac{3at^2}{1+t^2}$$

where the tangent is perependicular to the line 4x+3y+5=0.

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25. Show that $2\sin x + 3\tan x > 3x$ for all $\xi n\left(0, \frac{\pi}{2}\right)$

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

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27. $\int_{\frac{\pi}{5}}^{3\frac{\pi}{10}} \frac{\sin x dx}{\sin x + \cos x}$

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28. Find the area of the region bounded by $y = 6x - x^2$x-axis and between ordinates x = 0 and x = 6.

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29. Solve : $\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$

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30. From a differential equation from the equation $y = ae^{2x} + be^{-x}$ by eliminating the arbitrary constants.

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31. Prove the following by vector method. An angle inscribed in a semi-circle is a right angle.

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32. Find the area of the triangle ABC with vertices A(1,2,4), B(3,1,-2) and C(4,3,1) by vector method.

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

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34. Prove that the two lines whose direction cosines are connected by the equations $l + 2m + 3n = 0, 3lm - 4\ln + mn = 0$ are perpendicular to each other.

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35. passing through the point $(-1, 3, 2)$ perpendicular to the planes $x + 2y + 2z = 5$ and $3x + 3y + 2z = 8$.

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36. Let $f: X \to Y$ and $g: Y \to Z$. Prove that gof is bijective if both f and g are bijective. Also prove that

$(gof)^{-1} = f^{-1}og^{-1}$.

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37. If $\sin^{-1}\left(\frac{x}{a}\right) + \sin^{-1}\left(\frac{y}{b}\right) = \sin^{-1}\left(\frac{c^2}{ab}\right)$,

then prove that $b^2x^2 + 2xy\sqrt{a^2b^2 - c^4} + a^2y^2 = c^4$

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38. Solve the following LPP graphically Maximize

$z = 20x_1 + 10x_2$

Subject to $x_1 + 2x_2 \leq 40$

$3x_1 + x_2 \geq 30$

$4x_1 + 3x_2 \geq 60$

$x_1, x_2 \geq 0$

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39. Solve the following system of equations by the matrix inversion method.

$x - y + z = 4$

$2x + y - 3z = 0$

$x + y + z = 2$

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40. Prove that the following. $\begin{bmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ bc & ca & ab \end{bmatrix}$ =(b-c)(c-a)(a-b)(bc+ca+ab)

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41. If $A = \begin{bmatrix} 0 & -\tan\left(\frac{\alpha}{2}\right) \\ \tan\left(\frac{\alpha}{2}\right) & 0 \end{bmatrix}$ show that

$(I + A) = (I - A)\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ where $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

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42. If $e^{y/x} = \frac{x}{a + bx}$ then show that $x^3 \frac{d}{dx}\left(\frac{dy}{dx}\right) = \left(x\frac{dy}{dx} - y\right)^2$

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43. Find the altitude of a right circular cylinder of maximum volume inscribed in a sphere of radius r.

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44. Evaluate $\int \frac{dx}{\cos x(1+2\sin x)}$

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45. Find the area of the regions into which the circle $x^2+y^2=4$ is divided by the line $x+\sqrt{3}y=2$.

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46. Prove the following by vector method. Altitudes of a triangle are concurrent.

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47. Find the distance of the point $(1, -1, -10)$ from the line $\frac{x-4}{1} = \frac{y+3}{-4} = \frac{z+1}{7}$ measured parallelto the line $\frac{x+2}{2} = \frac{y-3}{-3} = \frac{z-4}{8}$

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48. If a relation is symmetric and transitive on any non-empty set, then it is reflexive. Is it true or false? State with reason.

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49. What is the value of $\cos^{-1}\left(\cos\frac{7\pi}{6}\right)$?

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50. If A and B are symmetric matrices of the same order with $AB \neq BA$, final whether AB-BA is symmetric or skew symmetric.

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51. If a_{ij} is an element in ith row and jth column of a 3rd order determinant and c_{ij} be the cofactor of a_{ij}, then what is the value of $a_{12}c_{12} - a_{21}c_{21} + a_{13}c_{13} - a_{31}c_{31}$?

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52. What is the derivative of $\cos ec^{-1}x$ if $x < 0$?

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53. State Rolle.s theorem.

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54. What is the value of $\int_{-1}^{1} \ln\left(\frac{4-x}{4+x}\right)dx$?

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55. Write the order and degree of the differential equation

$$\frac{dy}{dx} = \left[1 + \left(\frac{d^2y}{dx^2}\right)^2\right]^{\frac{2}{3}}$$

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56. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, find the value of $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$.

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57. If a line is perpendicular to z-axis and makes an angle measuring 60^0 with x-axis, then the angle it makes with y-axis measures____.

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58. Show that the relation ~ on $\mathbb{Z} - \{0\} \times \mathbb{Z} - \{0\}$ defined by $(m, n) \sim (p, q) \Leftrightarrow mq = np$ is an equivalence relation.

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59. If $f(x) = \sqrt{x}$ and $g(x) = 1 - x^2$, then find gof and fog. If $h(x) = 1 - x$, then whether gof=h?

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60. Prove that $\sin^{-1}\left(\frac{\sqrt{1+x}+\sqrt{1-x}}{2}\right)=\frac{\pi}{4}+\frac{1}{2}\cos^{-1}x, 0<x<1$

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61. Solve:$\sin^{-1}2x+\sin^{-1}x=\frac{\pi}{3}$.

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62. Solve the following LPP graphically. Minimize $z=30x_1+45x_2$ subject to $2x_1+6x_2\geq 4$, $5x_1+2x_2\geq 5$ and $x_1, x_2\geq 0$

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63. A trust fund has Rs. 50,000 that is to be invested in two types of bonds .The first and second bonds respectively pay annual interest at the rate of 5% and 6% respectively .Using matrix multiplication , determine how to invest the money in these bonds so as to get a total annual interest of Rs. 2780 .

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64. Express $\begin{bmatrix} 2 & -1 & 3 \\ 5 & 7 & -2 \\ 1 & 4 & 6 \end{bmatrix}$ as a sum of a symmetric and a skew symmetric matrix.

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65. Show that x=2 is a root of

$$\begin{bmatrix} x & -6 & -1 \\ 2 & -3x & x-3 \\ -3 & 2x & x+2 \end{bmatrix} = 0$$

Solve this completely,

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66. Prove the following : $\begin{bmatrix} 1 & x & x^2 \\ x^2 & 1 & x \\ x & x^2 & 1 \end{bmatrix} = \left(1-x^3\right)^2$

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67. If $A = \begin{bmatrix} 2 & 1 \\ -1 & 3 \end{bmatrix}, B = \begin{bmatrix} 2 & 3 \\ 1 & 1 \end{bmatrix}$ and $C = \begin{bmatrix} 1 & 0 & 2 \\ -2 & 3 & 0 \end{bmatrix}$,verify (A+B)C=AC+BC

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68. Test differentiability of the following function at the indicated points.

$f(x) = [x^2 + 1] at x = -\frac{1}{2}$

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69. If $y = \tan^{-1}\left(\frac{1+\sin x}{1-\sin x}\right)^{\frac{1}{2}}$ and $z = \log\left(\frac{1+\cos x}{1-\cos x}\right)$, then prove that $\frac{dy}{dx} = \frac{-\sin x}{4}$

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70. If $y\sqrt{x^2+1} = \log\left\{\sqrt{x^2+1} - x\right\}$ then prove that $(x^2+1)\frac{dy}{dx} + xy + 1 = 0$

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71. Find the tangent to the curve $y = \cos(x + y), 0 \leq x \leq 2\pi$ which is parallel to the line x + 2y = 0

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72. Find the intervals where the function $f(x) = \tan x - 4(x - 2)$ is increasing and decreasing on $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

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73. Evaluate, $\int \frac{1}{(2-x)\sqrt{5-4x+x^2}}dx$

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74. Evaluate $\int \frac{2\cos x+7}{4-\sin x}dx$

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75. Evaluate, $\int_0^{\pi/4} \sin x dx$

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76. Solve the following differential equations

$$(1-x^2)\frac{dy}{dx}+2xy=x\sqrt{1-x^2}$$

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77. solve: $e^{-x}\frac{d^2y}{dx^2}=x$

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78. Find the scalar and vector projections of the vector $2\hat{i}-3\hat{j}-6\hat{k}$ on the line joining the points (3,4,-2) and (5,6,-3).

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79. In any triangle ABC, prove by vector method that $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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80. Show that $\left(\vec{a} \times \vec{b}\right)^2 = a^2b^2 - \left(\vec{a}.\ \vec{b}\right)^2$.

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81. Find the image of the point (3,5,7) with respect to the plane $2x + y + z = 6$.

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82. A variable plane is at a constant distance p from the origin and meets the axes at A,B,C. Through A,B,C plane are drawn parallel to the co-ordinate planes. Show that the locus of their points of intersection is $\frac{1}{x^2}+\frac{1}{y^2}+\frac{1}{z^2}=\frac{1}{p^2}$.

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83. Give an example of a relation f such that f = f^{-1}

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84. If $\sin^{-1}x+\sin^{-1}y+\sin^{-1}z=\pi$, show that $x\sqrt{1-x^2}+y\sqrt{1-y^2}+z\sqrt{1-z^2}=2xyz$

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85. 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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86. Prove that the following.

$$\begin{vmatrix} (v+w)^2 & u^2 & u^2 \\ v^2 & (w+u)^2 & v^2 \\ w^2 & w^2 & (u+v)^2 \end{vmatrix} = 2uvw(u+v+w)^3$$

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

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88. If $A = \begin{vmatrix} 1 & 2 & 0 \\ 1 & 1 & 0 \\ -1 & 4 & 0 \end{vmatrix}, B = \begin{vmatrix} 1 & 2 & 3 \\ 1 & 1 & -1 \\ 4 & -3 & 2 \end{vmatrix}$ and $C = \begin{vmatrix} 1 & 2 & 3 \\ 1 & 1 & -1 \\ 2 & 2 & 2 \end{vmatrix}$ then prove that $A(BC) = (AB)C$

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89. If $x = \frac{1 - \cos^2\theta}{\cos\theta}, y = \frac{1 - \cos^{2n}\theta}{\cos^n\theta}$ then show that $\left(\frac{dy}{dx}\right)^2 = n^2\left(\frac{y^2 + 4}{x^2 + 4}\right)$

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90. Find the coordinates of the point on the curve $x^2y - x + y = 0$ where the slope of the tangent is maximum.

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91. Evaluate $\int \ln(x^2 + x + 2)\,dx$

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92. Evaluate $\int_0^1 \frac{\ln(1+x)}{1+x^2}\,dx$

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93. Solve the differential equation.

$x(x+y)dy = \left(x^2+y^2\right)dx$

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94. If $\vec{a}$, $\vec{b}$, $\vec{c}$ are three mutually perpendicular vectors of equal magnitude, then prove that $\vec{a}+\vec{b}+\vec{c}$ is equally inclined to $\vec{a}$, $\vec{b}$ and $\vec{c}$ with an angle of measure $\cos^{-1}\frac{1}{\sqrt{3}}$

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95. Prove that the lines $\frac{x+3}{2} = \frac{y+5}{3} = \frac{z-7}{-3}$ and $\frac{x+1}{4} = \frac{y+1}{5} = \frac{z+1}{-1}$ are coplanar. Find the equation of plane containing them.

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