# JNU MCA
## Solved Paper 2009

**1.** If $u = F(x-y, y-z, z-x)$, then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$ is equal to

(a) 3 (b) 0
(c) 1 (d) None of these

**2.** Disk allocation used in UNIX is similar to

(a) continuous allocation
(b) indexed allocation
(c) linked allocation
(d) a variant of linked allocation

**3.** The positive integer just greater than $(1+0.0001)^{10000}$ is

(a) 4 (b) 5
(c) 2 (d) 3

**4.** The height of an open cylinder of given surface and the greatest volume is equal to

(a) two times the radius of the base
(b) half of the radius of the base
(c) radius of the base
(d) 1/9th of the radius of the base

**5.** If $(G, *)$ is an abelian group, then

(a) $x = x^{-1}$, for any $x \in G$
(b) $x = x^2$, for any $x \in G$
(c) $(x * y)^2 = x^2 * y^2$, for any $x, y \in G$
(d) $G$ is of finite order

**6.** Consider the following

**Statements**

A. Dhoni is a good sportsman.
B. Sportsmen are healthy.

**Conclusions**

I. All healthy persons are sportsmen.
II. Dhoni is healthy.

Which one of the following is derived as conclusion?

(a) Only conclusion I follows
(b) Only conclusion II follows
(c) Either I or II follows
(d) Neither I nor II follows

**7.** The value of $\int_0^{\infty}\int_x^{\infty} \frac{e^{-y}}{y}\,dxdy$ is

(a) −1 (b) 1
(c) 0 (d) ∞

**8.** For which three values of $c$, the given matrix $A$ is not invertible?

$$A = \begin{pmatrix} 2 & c & c \\ c & c & c \\ 8 & 7 & c \end{pmatrix}$$

(a) {2, 8, 7} (b) {1, 2, 8}
(c) {0, 2, 7} (d) None of these

**9.** The surface area of the section of the cylinder $x^2 + y^2 = a^2$ made by the plane $x + y + z = a$ is

(a) $3\pi a^2$ (b) $\sqrt{3}\pi a^2$
(c) $\sqrt{3\pi a^2}$ (d) None of these

**10.** If $A$ and $B$ are symmetric matrices, which of these are certainly symmetric?

I. $A^2 - B^2$ II. $(A+B)(A-B)$
III. $ABA$ IV. $ABAB$

(a) I and III only
(b) I and IV only
(c) II and III only
(d) II, III and IV only

**11.** If a system is in an unsafe state, then

(a) it is deadlocked
(b) it is starving
(c) it may enter into deadlock
(d) it will never enter into deadlock

**12.** The solution of differential equation $\frac{dy}{dx} + y\cos x = \frac{1}{2}\sin 2x$ is given by

(a) $y = \cos x - 1 + Ce^{-\cos x}$ (b) $y = \sin x - 1 + Ce^{-\cos x}$
(c) $y = \sin x - 1 + Ce^{-\sin x}$ (d) $y = \cos x - 1 + Ce^{-\sin x}$

**13.** In an LPP model in its standard form, three of the constraints are

I. $x_1 + x_2 \le 2$ II. $2x_1 + 2x_2 \le 3$
III. $3x_1 + 3x_2 \le 8$

Removal of which of the constraints will not affect the optimality?

(a) II and III (b) I and II
(c) I and III (d) I only

**14.** Given a $2 \times 2$ matrix $A$ with eigen values 2 and −3, the eigen values of the matrix $A^2$ are

(a) 4 and −9
(b) 2 and −9
(c) 4 and 9
(d) Cannot be determined from the given data

**15.** For what value of $k$, will the equations $2x + 3y = 5$ and $6x + ky = 15$ have an infinite number of solutions?
(a) 7 (b) 8
(c) 9 (d) 10

**16.** In the bisection method for finding the roots of the equation, the approximate relative error is always
(a) greater than the relative error
(b) equal to the relative error
(c) less than the relative error
(d) None of the above

**17.** The fastest logic family out of the following is
(a) ECL (b) RTL
(c) DTL (d) TTL

**18.** The strongest of the following algebraic structures is
(a) group (b) field
(c) ring (d) monoid

**19.** If A + B means A is the daughter of B, A× B means A is the son of B, A− B means A is the wife of B, then in the expression Z × T− S× U+ P, what is U to Z?
(a) Mother
(b) Grandmother
(c) Father
(d) Cannot be determined

**20.** There are sixteen 2 by 2 matrices whose entries are 1's and 0's. Of these, how many are invertible?
(a) 6 (b) 8
(c) 10 (d) None of these

**21.** Cyclomatic number of a graph is also known as its
(a) rank (b) complexity
(c) nullity (d) None of these

**22.** The function $f(x) = \begin{cases} 0 & , x = 0 \\ \sin\dfrac{1}{x} & , x \neq 0 \end{cases}$ is
(a) continuous
(b) discontinuous
(c) differentiable such that $f'(0) = 1$
(d) differentiable such that $f'(0) = -1$

**23.** Using $(r-1)^s$ complement scheme, the result of adding $(+F12A)_{16}$ with $(-1BCD)_{16}$ will be
(a) 10D55C (b) 11D55C
(c) 00D55D (d) 10D55D

**24.** Find the odd one.
(a) Ballot (b) Manifesto
(c) Election (d) Vote

**25.** The value of $\int_0^2 dx \int_0^{x^2} e^{y/x} dy$ is
(a) $1 - e^2$ (b) $e^2 - 1$
(c) $1 - e$ (d) $e - 1$

**26.** The volume of the solid bounded by the surface $x = 0, y = 0, z = 0$ and $x + y + z = 1$ is given by
(a) 1/2 (b) 1/3
(c) 1/6 (d) None of these

**27.** In MCA, JNU Entrance Examination, a student scores 4 marks for every correct answer and loses 1 marks for every wrong answer. If he attempts 75 questions and secures 125 marks, the number of questions he attempts correctly is
(a) 35 (b) 40
(c) 42 (d) 46

**28.** Which of the following parameter passing techniques is supported by C++ but not by C?
(a) Pass by value
(b) Pass by reference
(c) Pass by value-result
(d) All of the above

**29.** The solution of differential equation $\dfrac{dy}{dx} = \sin\left(\dfrac{y}{x}\right) + \dfrac{y}{x}$ is given by
(a) $\cot(y/2x) = Cx$
(b) $\cot(2x/y) = Cx$
(c) $\tan(2x/y) = Cx$
(d) $\tan(y/2x) = Cx$

**30.** If PAINT is coded as 74128 and EXCEL is coded as 93596, how will ACCEPT be encoded?
(a) 455978 (b) 547978
(c) 554978 (d) 735961

**31.** What is the output of the following C++ program?
```
void hello
(int x = 0, int y = 0)
 {cout << "Hi There";}
void hello (int x)
{cout << "How are U doing today?";}
void main (void)
{int a = 10;
Hello (a);
}
```
(a) Hi there
(b) How are U doing today
(c) Results in runtime error
(d) Results in compilation error

**32.** The solution of $\dfrac{d^2y}{dx^2} - 2\dfrac{dy}{dx} + y = xe^x \sin x$ is given by
(a) $y = (C_1 + C_2x)e^x - (x\sin x + 2\cos x)e^x$
(b) $y = xe^x - (x\sin x + 2\cos x)e^x$
(c) $y = (C_1 + C_2x)e^x + (x\sin x + 2\cos x)e^x$
(d) $y = (C_1 + C_2x)e^x + (x\cos x + 2\sin x)e^x$

**33.** The area bounded by $y^2 = 4 - x$ and $y^2 = x$ is
(a) $\dfrac{16}{3\sqrt{2}}$ sq units (b) $\dfrac{8}{3\sqrt{2}}$ sq units
(c) $\dfrac{16\sqrt{2}}{3}$ sq units (d) $\dfrac{16\sqrt{3}}{3}$ sq units

**34.** Point out the odd one.
(a) Advise (b) Counsel
(c) Suggest (d) Direct

**35.** The coordinates of the centre of the smallest circle touching the circle $x^2 + y^2 = 4$ and the line $x + y = 5\sqrt{2}$ is
(a) $\left(\dfrac{7}{2\sqrt{2}}, \dfrac{7}{2\sqrt{2}}\right)$ (b) $\left(\dfrac{3}{2}, \dfrac{3}{2}\right)$
(c) $\left(\dfrac{7}{2\sqrt{2}}, \dfrac{7}{3\sqrt{2}}\right)$ (d) None of these

**36.** The mean marks of 25 students of section X-A in an examination is 67 and that of 30 students of Section X-B is 75. The mean of the marks of all the 55 students is
(a) 71 (b) 71.4
(c) 72 (d) 72.4

**37.** As oxygen is related to burn, carbon dioxide is related to
(a) isolate (b) foam
(c) extinguish (d) explode

**38.** What is the negation of $\sim (p \leftrightarrow q)$?
(a) $\sim p \leftrightarrow \sim q$ (b) $\sim p \leftrightarrow q$
(c) $p \rightarrow \sim q$ (d) None of these

**39.** The equation of the plane containing the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and the point $(0, 7, -7)$ is
(a) $x + y + z = 1$ (b) $x + y + z = 2$
(c) $x + y + z = 0$ (d) None of these

**40.** How many characters per second (7 bits + 1 parity) can be transmitted over a 2400 bits per second line if the transfer is synchronous?
(a) 300 (b) 240
(c) 250 (d) 275

**41.** An equilateral triangle is inscribed in the parabola $y^2 = 4ax$, such that one vertex of this triangle coincides with the vertex of the parabola. The length of this side of triangle is
(a) $4a\sqrt{3}$ (b) $6a\sqrt{3}$
(c) $2a\sqrt{3}$ (d) $8a\sqrt{3}$

**42.** In a hypothetical language, all operators have equal precedence and associate to the left. The value of the expression $5 \times 3 - 2 - 1 \times 2$ in this language would be
(a) 15 (b) 11
(c) 8 (d) 20

**43.** Euler formula for testing the planarity of a graph with $v$ vertices, $e$ edges and $r$ faces is
(a) $v = e - r + 1$ (b) $v = e - r + 2$
(c) $v = e + r + 2$ (d) $v = e + r$

**44.** The output of the SQL statement SELECT 'Hi' FROM DUAL WHERE NULL = NULL; will be
(a) Hi (b) FALSE
(c) TRUE (d) No output

**45.** The value of $\lambda$, so that the vector $U = (x + 3y)\,\mathbf{i} + (y - 2z)\,\mathbf{j} + (x + \lambda z)\,\mathbf{k}$ is a solenoidal vector, is
(a) −2 (b) 1
(c) 3 (d) None of these

**46.** If MADRAS can be written as ARSARS, how can ARKONAM be written in that code?
(a) ROAAKNM (b) ROAKANM
(c) ROAKNNM (d) ROAKNAM

**47.** The value of $\oint_C \frac{e^{2z}}{(z+1)^4}\,dz$, where $C$ is the circle $|z| = 2$ is
(a) $\frac{\pi}{3} ie^{-2}$ (b) $\frac{2\pi}{3} ie^{-2}$
(c) $\frac{8\pi}{3} ie^{-2}$ (d) None of these

**48.** To implement the expression $\bar{A}BCD + AB\bar{C}\bar{D} + \overline{ABCD}$, it takes one OR gate and
(a) one AND gate
(b) three AND gates
(c) three AND gates and four inverters
(d) three AND gates and three inverters

**49.** The probability that the ace of spades will be drawn from a pack of well-shuffled cards atleast once in 104 consecutive trials using Poisson distribution is
(a) $e^2$ (b) $e^{-2}$
(c) $1 - e^2$ (d) $1 - e^{-2}$

**50.** The vectors $\mathbf{a} = \mathbf{i} + \mathbf{j} + m\mathbf{k}$, $\mathbf{b} = \mathbf{i} + \mathbf{j} + (m+1)\,\mathbf{k}$ and $\mathbf{c} = \mathbf{i} - \mathbf{j} + m\mathbf{k}$ are coplanar, if $m$ is equal to
(a) 1 (b) 4
(c) 3 (d) None of these

**51.** Dual of $(p \rightarrow q) \rightarrow r$ is
(a) $(q \rightarrow p) \rightarrow r$ (b) $p \rightarrow (q \rightarrow r)$
(c) $(p \vee \sim q) \vee r$ (d) None of these

**52.** Consider the following subsets of the real space $R^3$
I. $\{(x_1, x_2, x_3) : x_2, x_3 = 0\}$
II. $\{(x_1, x_2, x_3) : x_2 - x_3 + 2x_1 = 0\}$
III. $\{(x_1, x_2, x_3) : x_3 \le x_2 \le x_1$ must be true$\}$
How many of them are subspaces of $R^3$?
(a) 0 (b) 1
(c) 2 (d) 3

**53.** Choose a word that belongs to the group of ohm : watt : volt
(a) Light (b) Electricity
(c) Hour (d) Ampere

**54.** The harmonic mean of the roots of the equation $(5 + \sqrt{2})x^2 - (4 + \sqrt{5})x + 8 + 2\sqrt{5} = 0$ is
(a) 2 (b) 6
(c) 8 (d) 4

**55.** Relations produced from an E-R model will always be in
(a) first normal form (b) second normal form
(c) third normal form (d) fourth normal form

**56.** The region of the Argand plane defined by $|z - i| + |z + i| \le 4$ is
(a) interior of an ellipse
(b) exterior of a circle
(c) interior and boundary of an ellipse
(d) None of the above

**57.** If $x + iy = \frac{1}{1 - \cos\theta + 2i\sin\theta}$, $\theta \neq 2n\pi, n \in I$, then maximum value of $x$ is
(a) 1 (b) 2
(c) 1/2 (d) 1/3

**58.** Find out the meaning of the given declaration in C language int (* $p$) [5];
(a) $p$ is a one dimensional array of length 5 of pointers to integers
(b) $p$ is a pointer to a 5-element integer array
(c) Same as int (* $p$) [5];
(d) None of the above

**59.** Which set of numbers is similar to the set (63, 49, 35)?
(a) (72, 40, 24) (b) (72, 48, 24)
(c) (64, 40, 28) (d) (81, 63, 45)

**60.** The only value of $x$ satisfying the equation $6\sqrt{\frac{x}{x+4}} - 2\sqrt{\frac{x+4}{x}} = 11$, where $x \in R$ is

(a) 4/35 (b) −4/35
(c) 16/3 (d) −16/3

**61.** If CHARCOAL is coded as 45164913 and MORALE is coded as 296137, how is the word COLLER coded?

(a) 397758
(b) 497758
(c) 483359
(d) 493376

**62.** In a class, there are 18 boys who are over 160 cm tall. If these constitute three-fourth of the boys and the total number of boys are two-thirds of the total number of students in the class, then the number of girls in the class is

(a) 6 (b) 12
(c) 18 (d) 24

**63.** Centre of the arc represented by $\arg\left(\frac{z-3i}{z-2i+4}\right) = \frac{\pi}{4}$ is

(a) $\frac{1}{2}(5i+5)$ (b) $\frac{1}{2}(5i-5)$
(c) $\frac{1}{2}(9i+5)$ (d) $\frac{1}{2}(9i-5)$

**64.** The dual simplex method starts with a/an

(a) feasible but superoptimal solution
(b) feasible but suboptimal solution
(c) infeasible but superoptimal solution
(d) infeasible but suboptimal solution

**65.** The flip-flop most suitable for parallel loading of data is

(a) $R-S$ flip-flop (b) $D$ flip-flop
(c) $J-K$ flip-flop (d) $T$ flip-flop

**66.** If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = 3\pi/2$, then the value of $x^{100} + y^{100} + z^{100} - \frac{9}{x^{101} + y^{101} + z^{101}}$ is

(a) 0 (b) 1
(c) 2 (d) 3

**67.** Using binary arithmetic 1001011 divided by 1011 results in a remainder

(a) 1010 (b) 1001
(c) 1101 (d) 1111

**68.** The maximum value of $1 + \sin\left(\frac{\pi}{4} + \theta\right) + 2\cos\left(\frac{\pi}{4} - \theta\right)$ for real value of θ is

(a) 3 (b) 4
(c) 5 (d) None of these

**69.** The number of possible binary trees with 4 nodes is

(a) 12 (b) 13
(c) 14 (d) 15

**70.** A differential equation associated to the primitive $y = a + be^{5x} + ce^{-7x}$ is

(a) $y_3 + 2y_2 - y_1 = 0$
(b) $4y_3 + 5y_2 - 20y_1 = 0$
(c) $y_3 + 2y_2 - 35y_1 = 0$
(d) None of the above

**71.** A shelf holds $n$ books in a row. How many ways are there to choose $r$ books so that no two adjacent books are chosen?

(a) ${}^{n}C_{r}$ (b) ${}^{n+1}C_{r}$
(c) ${}^{n-r+1}C_{r}$ (d) ${}^{n-r}C_{r}$

**72.** Choose the pair in which the words are differently related.

(a) Beautician : Parlour
(b) Chemist : Medicine
(c) Lawyer : Court
(d) Engineer : Site

**73.** Using signed magnitude representation overflow can be detected with the operands as carry into the sign and the carry out of the sign bit by using the gate

(a) OR (b) AND
(c) XOR (d) NOT

**74.** As RATIONAL is to RATNIOLA, TRIBAL is to

(a) TIRLAB (b) TRIALB
(c) TIRLBA (d) TRILBA

**75.** Rahul and Sarvesh take turns in throwing two dice; the first to throw 10 (sum of two dice) is being awarded the prize. If Rahul gets the first turn to throw the dice, their chances of winning are in the ratio

(a) 10 : 11 (b) 11 : 10
(c) 11 : 12 (d) 12 : 11

**76.** The probability density function $f(x)$ of a continuous random variable $x$ is defined by

$$f(x) = \begin{cases} Ax^{-3} & , 5 \le x \le 10 \\ 0 & , \text{otherwise} \end{cases}$$

The value of $A$ is

(a) 50 (b) 1
(c) −200 (d) 200/3

**77.** In the cigarette smoking population 70% are men and 30% are women, 10% of these men and 20% of these women smoke 'WILLS'. The probability that a person smoking 'WILLS' will be a man is

(a) 6/13 (b) 7/13
(c) 3/13 (d) 10/13

**78.** In 1's complements arithmetic a carry generated should be

(a) added (b) subtracted
(c) appended (d) discarded

**79.** If $P$ is a variable on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ with $AA'$ as the major axis, then the maximum area of the $\Delta APA'$ is

(a) $ab$ (b) $2ab$
(c) $ab/2$ (d) $\sqrt{ab}$

**80.** Select the odd numeral pair.

(a) 24-21 (b) 46-32
(c) 62-23 (d) 84-24

**81.** The incidence of occupational disease in an industry is such that the workers have 20% chance of suffering from it. The probability that out of 6 workers 4 or more will catch the disease is

(a) 2/3 (b) 40/3125
(c) 53/3125 (d) 50/3125

**82.** There are four algorithms A1, A2, A3, A4 with complexity of the order of $\log(n), \log(\log(n)), n\log(n), n/\log(n)$ respectively. Which of these algorithms is the best?
(a) A1 (b) A2
(c) A3 (d) A4

**83.** The arithmetic mean of the series ${}^nC_0, {}^nC_1, {}^nC_2, \ldots, {}^nC_n$ is
(a) $2^n/(n+1)$ (b) $2^n/n$
(c) $2^{n-1}/(n+1)$ (d) None of these

**84.** If a variate $X$ is expressed as a linear function of two variables $U$ and $V$ in the form $X = aU + bV$, then mean $\bar{X}$ of $X$ is
(a) $a\bar{U} - b\bar{V}$ (b) $\bar{U} + \bar{V}$
(c) $b\bar{U} + a\bar{V}$ (d) None of these

**85.** The standard deviation (SD) of a variate $x$ is $\sigma$. The SD of the variate $(ax+b)/c$, where $a, b, c$ are constants, is
(a) $\left(\frac{a}{c^2}\right)\sigma$ (b) $\left|\frac{a}{c}\right|\sigma$
(c) $\left(\frac{a^2}{c^2}\right)\sigma$ (d) None of these

**86.** A student obtains 75%, 80% and 85% marks in three subjects. If the marks of another subject is added, the average cannot be less than
(a) 60% (b) 65%
(c) 80% (d) 90%

**87.** Which one of the following transformations reduces the differential equation $\frac{dz}{dx} + \frac{z}{x}\log z = \frac{z}{x^2}(\log z)^2$ into the form $\frac{du}{dx} + uP(x) = Q(x)$?
(a) $u = \log z$ (b) $u = e^z$
(c) $u = (\log z)^{-1}$ (d) $u = (\log z)^2$

**88.** The value of ${}^nC_0\,{}^{2n}C_n - {}^nC_1\,{}^{2n-1}C_n + {}^nC_2\,{}^{2n-2}C_n - {}^nC_3\,{}^{2n-3}C_n + \ldots + (-1)^n\,{}^nC_n\,{}^nC_n$, is
(a) 0 (b) 1
(c) $(-1)^n$ (d) $2^n$

**89.** Q is the brother of R, P is the sister of Q, T is the brother of S, S is the daughter of R, then Q is the uncle of whom?
(a) R and P (b) P and T
(c) Q and T (d) S and T

**90.** The necessary and sufficient condition for a complete graph of $n$ vertices $K_n$ to be Eulerian is
(a) $n$ should be even
(b) $n$ should be odd
(c) $n$ is a composite number
(d) $n$ is a prime number

**91.** Solution of the differential equation $2y\sin x\frac{dy}{dx} = 2\sin x\cos x - y^2\cos x$ satisfying $y(\pi/2) = 1$ is given by
(a) $y^2 = \sin x$ (b) $y = \sin^2 x$
(c) $y^2 = \cos x + 1$ (d) $y^2\sin x = 4\cos^2 x$

**92.** What is the possible number of binary relations on a set $S$ having $n$ elements. Which are symmetric and antisymmetric?
(a) 0 (b) 1
(c) $n^2$ (d) $2^n$

**93.** The equation $\left|\sqrt{x^2+(y-1)^2} - \sqrt{x^2+(y+1)^2}\right| = k$ will represent a hyperbola for
(a) $k \in (0, 2)$ (b) $k \in (-2, 1)$
(c) $k \in (1, \infty)$ (d) $k \in (0, \infty)$

**94.** A hash table can store a maximum of 10 records. Currently there are records in locations 1, 3, 4, 7, 8, 9, 10. The probability of a new record going into location 2, with a hash function resolving collisions by linear probing is
(a) 0.6 (b) 0.1
(c) 0.2 (d) 0.5

**95.** If $a+b+c \neq 0$ and $\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$, then the total number of different values of $x$ is equal to
(a) 1 (b) 2
(c) 3 (d) None of these

**96.** The UPSC has a list of 150 persons. Out of these, 50 are women and 100 are men. 125 of them know Hindi and remaining do not know Hindi. 90 of them are teachers and remaining are not teachers. What is the probability of selecting a Hindi-knowing woman teacher as examiner?
(a) 1/6 (b) 3/5
(c) 2/9 (d) 5/6

**97.** An attribute of one table matching the primary key of another table is known as
(a) candidate key (b) composite key
(c) foreign key (d) secondary key

**98.** Let $p(x) = 0$ be a polynomial equation of least possible degree with rational coefficients having $\sqrt[3]{7} + \sqrt[3]{49}$ as one of its roots. The product of all the roots of $p(x) = 0$, is
(a) 56 (b) 63
(c) 7 (d) 49

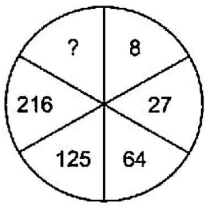
**99.** The value of $\tan 100° + \tan 125° + \tan 100°\tan 125°$ is
(a) 0 (b) 1/2 (c) −1 (d) 1

**100.** Contrapositive of the statement "If a number is divisible by 9, then it is divisible by 3" is
(a) if a number is not divisible by 3, it is not divisible by 9
(b) if a number is not divisible by 3, it is divisible by 9
(c) if a number is not divisible by 9, it is not divisible by 3
(d) None of the above

**101.** In the set of integers, a relation $R$ is defined as $aRb$, if and only if $b = |a|$. Relation $R$ is
(a) reflexive (b) irreflexive
(c) symmetric (d) antisymmetric

**102.** $A$ and $B$ are two sets with cardinality $m$ and $n$ respectively. The number of possible one-to-one mappings from $A$ to $B$, when $m < n$ is
(a) $m^n$ (b) ${}^mC_n$
(c) ${}^nP_m$ (d) ${}^mP_2$

**103.** The missing number in the given figure is




(a) 4 (b) 305
(c) 343 (d) 729

**104.** The most general values for which $\tan\theta = -1, \cos\theta = 1/\sqrt{2}$ are

(a) $n\pi + 7\pi/4$ (b) $n\pi + (-1)^n 7\pi/4$
(c) $2n\pi + 7\pi/4$ (d) $2n\pi + (-1)^n 7\pi/4$

**105.** The meaning of 'baud' in network is

(a) the number of bits transmitted per unit time
(b) the number of bytes transmitted per unit time
(c) the rate at which the signal changes
(d) None of the above

**106.** The radius of the circle in which the sphere $x^2 + y^2 + z^2 + 2x - 2y - 4z - 19 = 0$ is cut by the plane $x + 2y + 2z + 7 = 0$, is

(a) 2 (b) 3
(c) 4 (d) 1

**107.** If every region of a simple planar graph (with $n$ vertices and $e$ edges) embedded in a plane is bounded by $k$ edges, then

(a) $e = \dfrac{k(n-2)}{k-2}$ (b) $e = \dfrac{k(k-2)}{n-2}$
(c) $e = \dfrac{n(k-2)}{n-2}$ (d) $e = \dfrac{n(n-2)}{k-2}$

**108.** Given a 32-bit machine and the memory management scheme with page size $4k$, how many pages are possible?

(a) $2^{12}$ (b) $2^{20}$
(c) $2^{32}$ (d) $2^4$

**109.** The equation of the tangent to the conic $x^2 - y^2 - 8x + 2y + 11 = 0$ at (2, 1), is

(a) $x + 2 = 0$ (b) $2x + 1 = 0$
(c) $x - 2 = 0$ (d) $x + y + 1 = 0$

**110.** Heap allocation is required for languages that

(a) support recursion
(b) support dynamic data structures
(c) use dynamic scope rules
(d) None of the above

**111.** Sanjay travelled from a point $x$ straight to $y$ at a distance of 80 m. He turned right and walked 50 m, then again turned right and walked 70 m. Finally, he turned right and walked 50 m. How far is he from the starting point?

(a) 10 m (b) 20 m
(c) 50 m (d) 70 m

**112.** Thrashing occurs quite often when the page allocation policy is

(a) local (b) global
(c) Both (a) and (b) (d) None of these

**113.** If $\omega$ is a complex cube root of unity, then the value of the expression

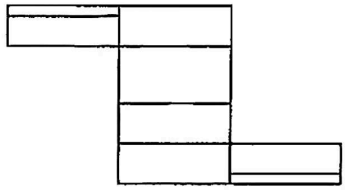
$$\cos\left[\{(1-\omega)(1-\omega^2) + \ldots + (10-\omega)(10-\omega^2)\}\frac{\pi}{900}\right] \text{ is}$$

(a) $-1$ (b) 0
(c) 1 (d) $\sqrt{3}/2$

**114.** The refresh rate below which a picture flickers is

(a) 25 (b) 30
(c) 35 (d) 60

**115.** How many rectangles are there in the given figure?



(a) 8 (b) 17
(c) 18 (d) 20

**116.** The distance of the point (1, 0, $-3$) from the plane $x - y - z = 9$ measured parallel to the line $\dfrac{x-2}{2} = \dfrac{y+2}{3} = \dfrac{z-6}{-6}$ is

(a) 6 units
(b) 5 units
(c) 8 units
(d) 7 units

**117.** Identify the group of letters, which is different from others.

(a) BDGK (b) JLOS
(c) NPSW (d) MORU

**118.** An LPP having 2 optimal solutions must have

(a) more than 3 constraints
(b) more than 2 optimal solutions
(c) even numbers of constraints
(d) None of the above

**119.** A unit vector in $XZ$-plane making angles $\pi/4$ and $\pi/3$ respectively with $\mathbf{u} = 2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$ and $\mathbf{v} = \mathbf{j} - \mathbf{k}$ is

(a) $\dfrac{1}{\sqrt{2}}(-\mathrm{i} + \mathrm{k})$ (b) $\dfrac{1}{\sqrt{2}}(\mathrm{i} - \mathrm{k})$
(c) $-\dfrac{1}{\sqrt{2}}(\mathrm{i} + \mathrm{k})$ (d) None of these

**120.** Which of the following methods gives the least error when $e^x$ is integrated from 0 to 0.4?

(a) Trapezoidal rule with the interval width as 0.2
(b) Trapezoidal rule with the interval width as 0.1
(c) Simpson's rule with the interval width as 0.1
(d) Simpson's rule with the interval width as 0.2

# Answers *with* Solutions

**1.** (b) $u = F(x-y, y-z, z-x)$

Let $r = x-y, s = y-z, t = z-x$

$\Rightarrow u = F(r,s,t)$

$$\Rightarrow \frac{\partial u}{\partial x} = \frac{\partial u}{\partial r}\cdot\frac{\partial r}{\partial x} + \frac{\partial u}{\partial s}\cdot\frac{\partial s}{\partial x} + \frac{\partial u}{\partial t}\cdot\frac{\partial t}{\partial x}$$

$$= \frac{\partial u}{\partial r}(1-0) + \frac{\partial u}{\partial s}(0) + \frac{\partial u}{\partial t}(0-1)$$

$$= \frac{\partial u}{\partial r} - \frac{\partial u}{\partial t} \quad \ldots(i)$$

$$\frac{\partial u}{\partial y} = \frac{\partial u}{\partial r}\cdot\frac{\partial r}{\partial y} + \frac{\partial u}{\partial s}\cdot\frac{\partial s}{\partial y} + \frac{\partial u}{\partial t}\cdot\frac{\partial t}{\partial y}$$

$$= \frac{\partial u}{\partial r}(0-1) + \frac{\partial u}{\partial s}(1-0) + \frac{\partial u}{\partial t}(0)$$

$$= -\frac{\partial u}{\partial r} + \frac{\partial u}{\partial s} \quad \ldots(ii)$$

$$\frac{\partial u}{\partial z} = \frac{\partial u}{\partial r}\cdot\frac{\partial r}{\partial z} + \frac{\partial u}{\partial s}\cdot\frac{\partial s}{\partial z} + \frac{\partial u}{\partial t}\cdot\frac{\partial t}{\partial z}$$

$$= \frac{\partial u}{\partial r}(0) + \frac{\partial u}{\partial s}(0-1) + \frac{\partial u}{\partial t}(1-0)$$

$$= -\frac{\partial u}{\partial s} + \frac{\partial u}{\partial t} \quad \ldots(iii)$$

Adding Eqs. (i), (ii) and (iii), we get

$$\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$$

**2.** (b) Disk allocation used in UNIX is similar to indexed allocation.

**3.** (d) Let $x = (1 + 0.0001)^{10000}$

$$\Rightarrow x = \left(1 + \frac{1}{n}\right)^n \quad (\text{put } n = 10000)$$

$$\Rightarrow x = 1 + n\times\frac{1}{n} + \frac{n(n-1)}{2!}\times\left(\frac{1}{n}\right)^2 + \ldots$$

$$= 1 + 1 + \frac{1}{2!}\left(1-\frac{1}{n}\right) + \frac{1}{3!}\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right) + \ldots$$

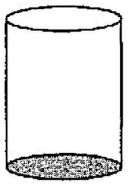
Clearly, $2 < x < e$

(Since, $1 + 1 + \frac{1}{2!}(1 - n) + \frac{1}{3!}\left(1-\frac{1}{n}\right)\left(1-\frac{2}{n}\right) + \ldots$

$$< 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \ldots = e)$$

**4.** (c) Surface area of cylinder,

$S = 2\pi rh + \pi r^2 = c$ (say) $\quad \ldots(i)$



Volume, $V = \pi r^2 h$

$$\Rightarrow V = \pi r^2\left[\frac{c - \pi r^2}{2\pi r}\right] \quad \text{[from Eq. (i)]} \ldots(ii)$$

$$\Rightarrow V = \frac{cr}{2} - \frac{\pi r^3}{2}$$

For greatest volume

$$\frac{dV}{dr} = 0$$

$$\Rightarrow \frac{c}{2} - \frac{\pi}{2}\times 3r^2 = 0$$

$$\Rightarrow 3r^2 = \frac{c}{\pi}$$

$$\Rightarrow r = \sqrt{\frac{c}{3\pi}}$$

From Eq. (ii),

$$h = \frac{c - \pi r^2}{2\pi r}$$

$$= \frac{3\pi r^2 - \pi r^2}{2\pi r}$$

$$= \frac{2\pi r^2}{2\pi r} = r$$

**5.** (c) If $G$ is abelian group, then

$$x * y = y * x$$

$$\Rightarrow (x * y)^2 = (x * y) * (x * y)$$

$$= x * x * y * y$$

$$= x^2 * y^2$$

**6.** (b) We have statements

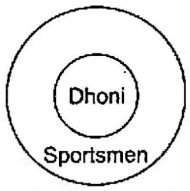
A. Dhoni is a good sportsman.


(Good sportsman)

B. Sportsmen are healthy.


(Healthy person)

Conclusious from complete structrure of the previous two statements.

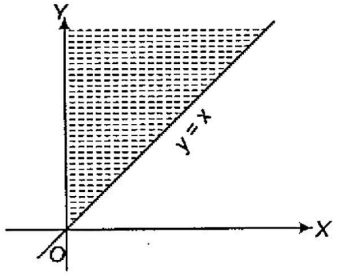



(Healthy person)

I. First conclusion is wrong because this is not necessary that all healthy persons are sportsmen. But this statement is correct that all sportsmen are healthy.

II. Dhoni is healthy, is the correct conclusion.

**7.** (b) Region of $I = \int_0^\infty\int_x^\infty \frac{e^{-y}}{y}dxdy$




By changing the order of integration, we get

$$I = \int_0^\infty \int_0^y \frac{e^{-y}}{y} dxdy = \int_0^\infty \frac{e^{-y}}{y} [x]_0^y \, dy$$

$$= \int_0^\infty e^{-y} \, dy = [-e^{-y}]_0^\infty = 1$$

**8.** (c) $|A| = \begin{vmatrix} 2 & c & c \\ c & c & c \\ 8 & 7 & c \end{vmatrix} = 0$

$$\Rightarrow \quad 2(c^2 - 7c) - c(c^2 - 8c) + c(7c - 8c) = 0$$

$$\Rightarrow \quad -c^3 + 9c^2 - 14c = 0$$

$$\Rightarrow \quad c^3 - 9c^2 + 14c = 0$$

$$\Rightarrow \quad c(c^2 - 9c + 14) = 0$$

$$\Rightarrow \quad c(c-2)(c-7) = 0$$

$$\Rightarrow \quad c = 0, 2, 7$$

**9.** (b) Required surface area

$$= 4 \int_0^a \int_0^{\sqrt{a^2 - x^2}} \sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 + 1} \, dxdy$$

$$= 4 \int_0^a \int_0^{\sqrt{a^2 - x^2}} \sqrt{3} \, dxdy$$

(since, $x + y + z = a \Rightarrow \frac{\partial z}{\partial x} = -1, \frac{\partial z}{\partial y} = -1$)

$$= 4\sqrt{3} \int_0^a \int_0^{\sqrt{a^2 - x^2}} dxdy$$

$$= 4\sqrt{3}$$ (area of circle of first quadrant)

$$= 4\sqrt{3}\left(\frac{\pi a^2}{4}\right) = \sqrt{3}\,\pi a^2$$

**10.** (a) I. $(A^2 - B^2)^T = (AA - BB)^T = (AA)^T - (BB)^T$

$= A^T A^T - B^T B^T = AA - BB = A^2 - B^2$

(As, $A$ and $B$ are symmetric. So, $A^T = A$ and $B^T = B$)

$\Rightarrow$ $A^2 - B^2$ is symmetric.

II. $[(A + B)(A - B)]^T = (A - B)^T (A + B)^T$

$= (A^T - B^T)(A^T + B^T) = (A - B)(A + B)$

As, $[(A + B)(A - B)]^T \neq (A + B)(A - B)$

So, $(A + B)(A - B)$ is not symmetric.

III. $(ABA)^T = A^T B^T A^T = ABA$

So, $ABA$ is symmetric.

IV. $(ABAB)^T = B^T A^T B^T A^T = BABA$

So, $ABAB$ is not symmetric.

Thus, I and III are symmetric only.

**11.** (c) In an unsafe state, deadlock is a possibility.

**12.** (c) Differential equation is

$$\frac{dy}{dx} + y \cos x = \frac{1}{2} \sin 2x$$

$$\text{IF} = e^{\int \cos x \, dx} = e^{\sin x}$$

$\Rightarrow$ Solution is

$$y \times e^{\sin x} = \frac{1}{2} \int \sin 2x \, e^{\sin x} \, dx$$

$$= \int e^{\sin x} \cdot \sin x \cos x \, dx$$

Put $\sin x = t$

$\Rightarrow$ $\cos x \, dx = dt$

$$= \int t e^t \, dt$$

$$= (t - 1) e^t + C$$

$$= (\sin x - 1) e^{\sin x} + C$$

$$\Rightarrow \quad y = \sin x - 1 + Ce^{-\sin x}$$

**13.** (c) $x_1 + x_2 \leq \frac{3}{2}$ satisfies both constraints $x_1 + x_2 \leq 2$ and $x_1 + x_2 \leq \frac{8}{3}$ simultaneously

$\Rightarrow$ Removal of I and III will not affect optimality.

**14.** (c) Eigen values of $A$ are 2 and $-3$, so eigen values of $A^2$ will be $(2)^2$ and $(-3)^2$ *i.e.*, 4 and 9.

**15.** (c) For infinite solution, second equation should be multiple of first equation.

So, for $2x + 3y = 5$

and $6x + ky = 15$

We have, $\frac{2}{6} = \frac{3}{k} = \frac{5}{15}$

$\Rightarrow$ $k = 9$

**16.** (d) Approximate relative error $\gtreqless$ relative error.

**17.** (a) ECL is faster than others.

In fact, ECL > TTL > DTL > RTL.

**18.** (b) Due to some additional properties than others, field is the strongest algebraic structure.

**19.** (b) The given expression is Z × T − S × U + P.

This means Z is son of T, who is wife of S, who is son of U, who is daughter of P.

Thus, U is grandmother of Z.

**20.** (a) Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

Matrix $A$ is invertible.

$\Rightarrow$ $|A| \neq 0$

$\Rightarrow$ $ad - bc \neq 0$

Given, $a, b, c, d \in \{0, 1\}$

$\Rightarrow$ $|A| \neq 0 \Rightarrow |A| = \pm 1$

For $|A| = 1$

$a = d = 1, \quad b = 0, c = 0$

$b = 1, c = 0$

$b = 0, c = 1$

For $|A| = -1$

$b = c = 1, \quad a = d = 0$

$a = 0, d = 1$

$a = 1, d = 0$

So, over all six matrices are invertible.

**21.** (c) Nullity is known as cyclomatic number.

**22.** (b) $\lim_{x \to 0} \sin \frac{1}{x}$ does not exist.

$\Rightarrow$ $f(x)$ is discontinuous at $x = 0$

**23.** (c) $+ (F\,1\,2\,A)_{16} = + (61738)_{10}$

$- (1\,B\,C\,D)_{16} = \frac{-(7117)_{10}}{(54621)_{10}}$

$(54621)_{10} = (1101010101011101)_2$

$= (D55D)_{16}$

**24.** (c) Election is odd one from the others and rest three terms are associated with it.

**25.** (b) $\int_0^2 dx \int_0^{x^2} e^{y/x} \, dy = \int_0^2 dx \, [xe^{y/x}]_0^{x^2}$

$$= \int_0^2 [xe^x - e^0] \, dx = \int_0^2 (xe^x - 1) \, dx$$

$$= [xe^x - e^x - x]_0^2$$

$$= 2e^2 - e^2 - 2 + 1$$

$$= e^2 + 1 - 2 = (e^2 - 1)$$

**26.** (c) $x=0, y=0, z=0$ and $x+y+z=1$
form a tetrahedron whose vertices are $(0,0,0),(1,0,0),(0,1,0)$ and $(0,0,1)$ whose volume is

$$V=\frac{1}{6}\begin{vmatrix}1&0&0\\0&1&0\\0&0&1\end{vmatrix}=\frac{1}{6}$$

**27.** (b) Let $x$ = number of questions attempted correctly, then

$$125=4x-(75-x)$$
$$\Rightarrow \quad x=40$$

**28.** (c) Pass by value result is supported by C++ but not by C.

**29.** (d) $$\frac{dy}{dx}=\sin\left(\frac{y}{x}\right)+\frac{y}{x} \qquad ...(i)$$

$$y=vx \Rightarrow \frac{dy}{dx}=v+x\frac{dv}{dx}$$

Thus, Eq. (i) becomes

$$v+x\frac{dv}{dx}=\sin v+v$$
$$\Rightarrow \quad \frac{dv}{\sin v}=\frac{dx}{x}$$
$$\Rightarrow \quad -\log(\text{cosec}\, v+\cot v)=\log x+\log C$$
$$\Rightarrow \quad Cx=\frac{1}{\text{cosec}\, v+\cot v}=\frac{\sin v}{1+\cos v}=\tan\frac{v}{2}$$
$$\Rightarrow \quad \tan\frac{y}{2x}=Cx$$

**30.** (a) Word : P A I N T E X C E L
7 4 1 2 8 9 3 5 9 6
$\Rightarrow$ A = 4, C = 5, E = 9, P = 7, T = 8
So, ACCEPT has code 455978.

**31.** (b) Main function reads $a=10$ and passing only one parameter in hello function. So, how are $U$ doing today is printed.

**32.** (a) Given differential equation is

$$\frac{d^2y}{dx^2}-2\frac{dy}{dx}+y=x\,e^x\sin x$$

Auxiliary equation is $m^2-2m+1=0 \Rightarrow m=1,1$

$\therefore$ Complementary function is

$$y=(C_1+C_2\,x)\,e^x$$

Particular integral is

$$\frac{1}{(D-1)^2}e^x\cdot(x\sin x)$$
$$=e^x\cdot\frac{1}{D^2}(x\sin x)=e^x\iint(x\sin x\,dx)\,dx$$
$$=e^x(-x\sin x-2\cos x)$$

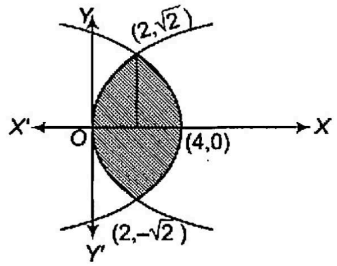
$\therefore$ Solution is

$$y=(C_1+C_2x)\,e^x-(x\sin x+2\cos x)\,e^x$$

**33.** (c) Solving $y^2=4-x$ and $y^2=x$, we get

$$4-x=x \Rightarrow x=2$$
$$\Rightarrow \quad y=\pm\sqrt{2}$$

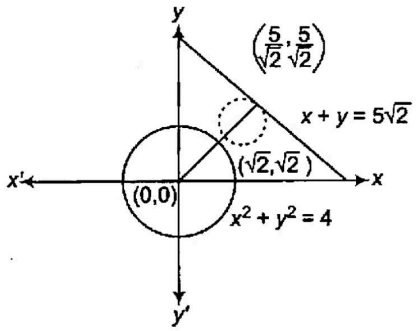
$\Rightarrow$ Both curves intersect at $(2,\sqrt{2})$ and $(2,-\sqrt{2})$.
Therefore, required area is bounded.




$$=2\left[\int_0^2\sqrt{x}\,dx+\int_2^4\sqrt{4-x}\,dx\right]$$
$$=2\left[\frac{2}{3}\left[x^{\frac{3}{2}}\right]_0^2-\frac{2}{3}\left[(4-x)^{\frac{3}{2}}\right]_2^4\right]$$
$$=\frac{4}{3}[(2^{3/2}-0)-(0-2^{3/2})]$$
$$=\frac{4}{3}\times2\times2^{\frac{3}{2}}=\frac{4\times2\times2\sqrt{2}}{3}$$
$$=\frac{16\sqrt{2}}{3}$$

**34.** (d) Advise, counsel and suggest are forms of suggestion, whereas direct is to implement something for which direction has been given.

**35.** (a) For the smallest circle centre of both circles will lie on $y=x$




$\Rightarrow$ Point of contact of circles is $(\sqrt{2},\sqrt{2})$ and point of contact of tangent to the smallest circle is $\left(\frac{5}{\sqrt{2}},\frac{5}{\sqrt{2}}\right)$

Centre of smallest circle is

$$\left(\frac{\frac{5}{\sqrt{2}}+\sqrt{2}}{2},\frac{\frac{5}{\sqrt{2}}+\sqrt{2}}{2}\right)$$
$$\equiv\left(\frac{7}{2\sqrt{2}},\frac{7}{2\sqrt{2}}\right)$$

**36.** (b) Mean marks of all 55 students is

$$\overline{X}=\frac{n_1\overline{X}_1+n_2\overline{X}_2}{n_1+n_2}$$
$$=\frac{25\times67+30\times75}{55}=\frac{785}{11}=71.4 \text{ (approx)}$$

**37.** (c) Oxygen burns and carbon dioxide extinguishes.

**38.** (b) $\sim(p\leftrightarrow q)=\sim[(\sim p\vee q)\wedge(\sim q\vee p)]$
$=(p\wedge\sim q)\vee(q\wedge\sim p)$
$=\sim p\leftrightarrow q$

**39.** (c) Equation of the plane containing the line $\frac{x+1}{-3}=\frac{y-3}{2}=\frac{z+2}{1}$ and the point $(0,7,-7)$ will be

$$a(x+1)+b(y-3)+c(z+2)=0$$
where $$-3a+2b+c=0$$
and $$a+4b-5c=0 \text{ (due to } (0,7,-7))$$
$$\Rightarrow \quad a=b=c$$

So, equation of plane is

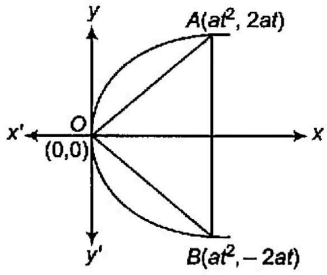
$$x+1+y-3+z+2=0$$
$$\Rightarrow \quad x+y+z=0$$

**40.** (a) Number of characters per second transmitted

$$= \frac{\text{(transmission per second in bits)}}{\text{(number of bits to be transmitted per character)}}$$

$$= \frac{2400}{7+1} = \frac{2400}{8} = 300$$

**41.** (d) $\Delta OAB$ will be equilateral, if




$$OA = AB \Rightarrow OA^2 = AB^2$$

$$a^2t^4 + 4a^2t^2 = (4at)^2 = 16a^2t^2$$

$$\Rightarrow \quad 12a^2t^2 = a^2t^4$$

$$\Rightarrow \quad t^2 = 12$$

$$\Rightarrow \quad OA = \sqrt{a^2t^4 + 4a^2t^2} = \sqrt{144a^2 + 48a^2}$$

$$\Rightarrow \quad = \sqrt{192a^2} = 8a\sqrt{3}$$

**42.** (a) According to the rule given,

$$= 5 \times 3 - 2 - 1 \times 2$$

$$= 5 \times 3 - 2 - 2 = 5 \times 3 - 0$$

$$= 5 \times 3 = 15$$

(As association is to the left and operators have same precedence).

**43.** (b) According to Euler's formula for planar graph,

$$r = e - v + 2 \quad \Rightarrow \quad v = e - r + 2$$

**44.** (d) Nothing can be selected as table has no entry. So, there will be no output.

**45.** (a) $\mathbf{U} = (x + 3y)\,\mathbf{i} + (y - 2z)\,\mathbf{j} + (x + \lambda z)\,\mathbf{k}$

is a solenoidal vector.

$$\Rightarrow \quad \nabla \cdot \mathbf{U} = 0$$

$$\Rightarrow \quad \frac{\partial}{\partial x}(x + 3y) + \frac{\partial}{\partial y}(y - 2z) + \frac{\partial}{\partial z}(x + \lambda z) = 0$$

$$\Rightarrow \quad 1 + 1 + \lambda = 0, \Rightarrow \quad \lambda = -2$$

**46.** (a) In coding, each alphabet (letter) of word is replaced by letter at it's two times position taken with rotation, so code of ARKONAM will be ROAAKNM.

**47.** (c) Given, $I = \oint_C \frac{e^{2z}}{(z+1)^4}\,dz$

where $C : |z| = 2$

poles of the integrand are $z = -1$ of order 4 which lies inside the circle $|z| = 2$

$\Rightarrow$ From Cauchy's integral theorem for the derivative

$$I = \frac{2\pi i}{3!}\left[\frac{d^3}{dz^3}(e^{2z})\right]_{z=-1}$$

$$= \frac{2\pi i}{6} \times 8 \times e^{-2}$$

$$= \frac{8\pi}{3} ie^{-2}$$

**Note** Cauchy's integral formula for the derivative is given by

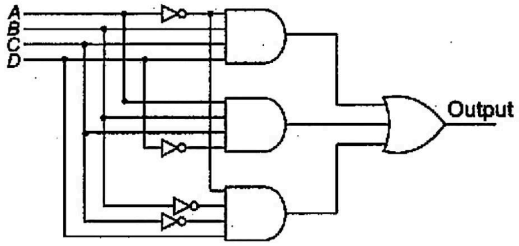
$$\int \frac{f(z)}{(z-a)^n} = \frac{2\pi i}{(n-1)!} f^{n-1}(a)$$

$$= \frac{2\pi i}{(n-1)!}\left[\frac{d^{n-1}}{dz^{n-1}} f(z)\right]_{z=a}$$

In the above problem, $n = 4$, $a = -1$

$$f(z) = e^{2z}$$

**48.** (c) Four inverters are needed for $A, B, C$ and $D$ and for three expressions, three AND gates are required,




$(\bar{A}BCD + ABC\bar{D} + \overline{ABCD})$

**49.** (d) For Poisson distribution

$$P(X = r) = \frac{e^{-\lambda} \cdot \lambda^r}{r!}$$

where $r = 0, 1, 2, \ldots$

where $\lambda$ is the mean.

$\Rightarrow$ Probability of atleast one

$$P(X \geq 1) = 1 - P(X = 0) = 1 - e^{-\lambda}$$

Now, probability of drawing an ace of spade in a single trial $= \frac{1}{52}$

$$\Rightarrow \quad \lambda = 104 \times \frac{1}{52} = 2$$

$$\Rightarrow \quad P(X \geq 1) = 1 - e^{-2}$$

**50.** (d) Vectors $\mathbf{a} = \mathbf{i} + \mathbf{j} + m\mathbf{k}$, $\mathbf{b} = \mathbf{i} + \mathbf{j} + (m+1)\mathbf{k}$ and $\mathbf{c} = \mathbf{i} - \mathbf{j} + m\mathbf{k}$ will be coplanar, if

$$\begin{vmatrix} 1 & 1 & m \\ 1 & 1 & m+1 \\ 1 & -1 & m \end{vmatrix} = 0$$

Using $R_1 \to R_1 - R_2, R_2 \to R_2 - R_3$

$$\Rightarrow \quad \begin{vmatrix} 0 & 0 & -1 \\ 0 & 2 & 1 \\ 1 & -1 & m \end{vmatrix} = 0$$

$$\Rightarrow \quad -1(0 - 2) = 0$$

$$\Rightarrow \quad 2 = 0$$

which is not possible.

Given vectors are not coplanar for any $m$.

**51.** (d) $(p \to q) \to r \equiv (\sim p \vee q) \to r \equiv \sim(\sim p \vee q) \vee r$

$$\equiv (p \wedge \sim q) \vee r$$

It's dual will be $(\sim p \vee q) \wedge \sim r$.

Which is not equivalent to any given expression.

**52.** (c) I. $\{(x_1, x_2, x_3) : x_2, x_3 = 0\}$ is a subspace of $R^3$.

II. $\{(x_1, x_2, x_3) : x_2 - x_3 + 2x_1 = 0\}$ is a subspace of $R^3$.

III. $\{(x_1, x_2, x_3) : x_3 \leq x_2 \leq x_1\}$ is not a subspace as $(3, 2, 1)$ is it's member.

But $-1(3, 2, 1) = (-3, -2, -1)$ do not belong to it.

**53.** (d) ohm : watt : volt : ampere

**54.** (d) If $x_1$ and $x_2$ are roots of the equation

$$(5 + \sqrt{2})x^2 - (4 + \sqrt{5})x + (8 + 2\sqrt{5}) = 0$$

then

$$x_1 + x_2 = \frac{4 + \sqrt{5}}{5 + \sqrt{2}}$$

and $$x_1 x_2 = \frac{8 + 2\sqrt{5}}{5 + \sqrt{2}}$$

Harmonic mean of $x_1$ and $x_2$ is

$$\frac{2x_1x_2}{x_1 + x_2} = \frac{2(8 + 2\sqrt{5})}{4 + \sqrt{5}} = 4$$

**55.** (a) Relations produced from an E-R model will always be in first normal form (1NF). In 1NF, all the tuples should have atomic values. There should not be duplicacy.

**56.** (c) $|z-i|+|z+i|\le 4$

$\Rightarrow |x+iy-i|+|x+iy+i|\le 4$

$\Rightarrow |x+i(y-1)|+|x+i(y+1)|\le 4$

$\Rightarrow \sqrt{x^2+(y-1)^2}+\sqrt{x^2+(y+1)^2}\le 4$

$\Rightarrow \sqrt{x^2+(y-1)^2}\le 4-\sqrt{x^2+(y+1)^2}$

Squaring both sides,

$x^2+y^2-2y+1\le 16+x^2+y^2+2y+1-8\sqrt{x^2+(y+1)^2}$

$\Rightarrow 8\sqrt{x^2+(y+1)^2}\le 4y+16$

$\Rightarrow 2\sqrt{x^2+(y+1)^2}\le y+4$

Squaring both sides,

$4(x^2+y^2+2y+1)\le y^2+8y+16$

$\Rightarrow 4x^2+3y^2\le 12$

$\Rightarrow \frac{x^2}{3}+\frac{y^2}{4}\le 1$

which is the interior and boundary of ellipse

$\frac{x^2}{3}+\frac{y^2}{4}=1$

**57.** (c) $x+iy=\frac{1}{1-\cos\theta+2i\sin\theta}$

$=\frac{(1-\cos\theta)-2i\sin\theta}{(1-\cos\theta)^2+4\sin^2\theta}$

$\Rightarrow x=\frac{1-\cos\theta}{(1-\cos\theta)^2+4\sin^2\theta}$

$=\frac{(1-\cos\theta)}{(1-\cos\theta)^2+4(1-\cos^2\theta)}$

$=\frac{1}{(1-\cos\theta)+4(1+\cos\theta)}=\frac{1}{5+3\cos\theta}$

Maximum value of $x=\frac{1}{5-3}=\frac{1}{2}$ [min $(\cos\theta)=-1$]

**58.** (b) The given declaration

int (*p) [5];

This means that $p$ is a pointer to a 5-element integer array.

**59.** (d) $63:49:35=9:7:5$

and $81:63:45=9:7:5$

**60.** (d) Put $\sqrt{\frac{x}{x+4}}=y$ in the given equation, then we get

$6y-\frac{2}{y}=11$

$\Rightarrow 6y^2-11y-2=0$

$\Rightarrow 6y^2+y-12y-2=0$

$\Rightarrow y(6y+1)-2(6y+1)=0$

$\Rightarrow (6y+1)(y-2)=0$

$\Rightarrow y=2 \quad \left(\because y\ne -\frac{1}{6}\right)$

$\Rightarrow y^2=4$

$\Rightarrow \frac{x}{x+4}=4$

$\Rightarrow 4x+16=x$

$\Rightarrow 3x=-16$

$\Rightarrow x=-\frac{16}{3}$

**61.** (d) Word : CHARCOAL : MORALE

Code : 45164913 : 296137

$\Rightarrow$ C = 4, O = 9, L = 3, E = 7, R = 6

So, COLLER will be coded as 493376.

**62.** (b) $\frac{3}{4}$th of boys = 18 boys

$\Rightarrow$ Number of boys $=18\times\frac{4}{3}=24$

Number of boys is $\frac{2}{3}$rd, so number of girls will be $\frac{1}{3}$rd of students, hence number of girls will be half of the number of boys.

$\therefore$ Number of girls $=\frac{24}{2}=12$

**63.** (d) Let $z=x+iy$, then from given, we get

$\arg[x+i(y-3)]-\arg((x+4)+i(y-2))=\frac{\pi}{4}$

$\Rightarrow \tan^{-1}\frac{y-3}{x}-\tan^{-1}\frac{y-2}{x+4}=\frac{\pi}{4}$

$\Rightarrow \tan^{-1}\frac{\frac{y-3}{x}-\frac{y-2}{x+4}}{1+\frac{y-3}{x}\cdot\frac{y-2}{x+4}}=\frac{\pi}{4}$

$\Rightarrow \frac{(x+4)(y-3)-x(y-2)}{x(x+4)+(y-3)(y-2)}=\tan\frac{\pi}{4}=1$

$\Rightarrow xy-3x+4y-12-xy+2x = x^2+4x+y^2-2y-3y+6$

$\Rightarrow x^2+y^2+5x-9y+18=0$

which is a circle with centre $\left(-\frac{5}{2},\frac{9}{2}\right)$.

*i.e.*, $-\frac{5}{2}+\frac{9}{2}i=\frac{1}{2}(9i-5)$

**64.** (b) In dual simplex method, suboptimal solution is optimised.

**65.** (b) The $D$ flip-flop is the most suitable for parallel loading of data.

**66.** (a) $\sin^{-1}x+\sin^{-1}y+\sin^{-1}z=\frac{3\pi}{2}$

which is possible only when

$\sin^{-1}x=\sin^{-1}y=\sin^{-1}z=\frac{\pi}{2}$

$\left(\text{since}, -\frac{\pi}{2}\le\sin^{-1}x\le\frac{\pi}{2}\right)$

$\Rightarrow x=y=z=1$

Therefore,

$x^{100}+y^{100}+z^{100}-\frac{9}{x^{101}+y^{101}+z^{101}}$

$=1+1+1-\frac{9}{1+1+1}=3-3=0$

**67.** (b) 1011)1001011(110

1011

01111

1011

1001

$\Rightarrow$ Remainder = 1001

**68.** (b) $1+\sin\left(\frac{\pi}{4}+\theta\right)+2\cos\left(\frac{\pi}{4}-\theta\right)$

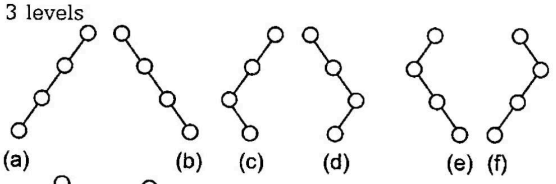
$=1+\frac{1}{\sqrt{2}}(\cos\theta+\sin\theta)+2\frac{1}{\sqrt{2}}(\cos\theta+\sin\theta)$

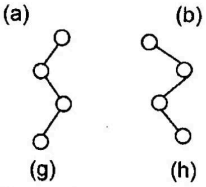
$=1+\frac{3}{\sqrt{2}}(\cos\theta+\sin\theta)=1+3\sin\left(\frac{\pi}{4}+\theta\right)$

So, maximum value = 1 + 3 = 4

**69.** (c) With 4 nodes, we can go to level from 0 to 3 in following ways

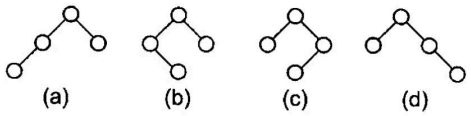
3 levels

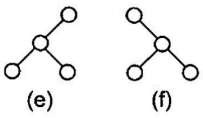



Total = 8 trees

2 levels




Total = 6 trees

1 level : For 1 level, a binary tree is not possible with four nodes.

0 level : Binary tree is not possible with 4 nodes.

So, total = 8 + 6 = 14 trees.

**70.** (c) $y = a + be^{5x} + ce^{-7x}$

$$\Rightarrow \quad y_1 = 5be^{5x} - 7ce^{-7x}$$

$$y_2 = 25be^{5x} + 49ce^{-7x}$$

and $\quad y_3 = 125\, be^{5x} - 343\, ce^{-7x} \quad \therefore\ y_3 + 2y_2 - 35\, y_1 = 0$

**71.** (c) Let $b_1, b_2, b_3, \ldots, b_r$ denote the $r$ objects which are selected

$\boxed{a_1}\ b_1\ \boxed{a_2} b_2\ \boxed{a_3} b_3 \ldots b_r\ \boxed{a_{r+1}}$

Then, $\quad a_1 + a_2 + a_3 + \ldots + a_{r+1} = n - r$

where $\quad a_1 \geq 0, a_2 \geq 1, a_3 \geq 1, \ldots, a_r \geq 1, a_{r+1} \geq 0$

$$\Rightarrow \quad a_1 + (a_2 - 1) + (a_3 - 1) + \ldots + (a_r - 1) + a_{r+1} = (n - r) - (r - 1)$$

Therefore, required number of ways

= Total number of non-negative integral solutions of

$x_1 + x_2 + x_3 + \ldots + x_{r+1} = n - 2r + 1$

which is equal to

$${}^{(n-2r+1)+(r+1)-1}C_{r+1-1} = {}^{n-r+1}C_r$$

**Note** Number of non-negative integral solutions of

$x_1 + x_2 + \ldots + x_r = n$

is equal to $\quad {}^{n+r-1}C_{r-1}$

where $\quad x_1, x_2, x_3, \ldots, x_r \geq 0$

**72.** (b) Chemist Medicine is differently related than others because rest three are related as first one indicates job and second one is related to the place where that job is performed.

**73.** (c) XOR gate is needed to identify over flow.

**74.** (d) Word : R A T I O N A L

Code : R A T N I O L A

Similarly,

Word : T R I B A L

Code : T R I L B A

Thus, the code is TRILBA.

**75.** (d) Sum 10 is obtained in 3 cases, (4,6), (5,5) and (6,4)

$\therefore$ Probability of getting 10 in single throw $= \frac{3}{36} = \frac{1}{12}$

$P$(Rahul wins)

$$= \frac{1}{12} + \frac{11}{12} \times \frac{11}{12} \times \frac{1}{12} + \left(\frac{11}{12}\right)^4 \times \frac{1}{12} + \ldots$$

$$= \frac{1}{12}\left[1 + \left(\frac{11}{12}\right)^2 + \left(\frac{11}{12}\right)^4 + \ldots\right] = \frac{1}{12} \times \frac{1}{1 - \left(\frac{11}{12}\right)^2} = \frac{12}{23}$$

and, $P$(Sarvesh wins) $= 1 - \frac{12}{23} = \frac{11}{23}$

Their winning ratio is 12 : 11.

**76.** (d) Given $f(x)$ is probability density function

$$\Rightarrow \quad \int_{-\infty}^{\infty} f(x)\, dx = 1$$

$$\therefore \quad \int_5^{10} Ax^{-3}\, dx = 1$$

$$\Rightarrow \quad A\left[\frac{x^{-3+1}}{-3+1}\right]_5^{10} = 1$$

$$\Rightarrow \quad \frac{A}{-2}\left(\frac{1}{100} - \frac{1}{25}\right) = 1$$

$$\Rightarrow \quad \frac{A}{50}\left(1 - \frac{1}{4}\right) = 1$$

$$\Rightarrow \quad \frac{A}{50} \times \frac{3}{4} = 1$$

$$\Rightarrow \quad A = \frac{200}{3}$$

**77.** (b) Let

$m \rightarrow$ men

$w \rightarrow$ women

$W \rightarrow$ Wills

$$P(m) = \frac{70}{100}, P(w) = \frac{30}{100},$$

$$\therefore \quad P\left(\frac{W}{m}\right) = \frac{10}{100}, P\left(\frac{W}{w}\right) = \frac{20}{100}$$

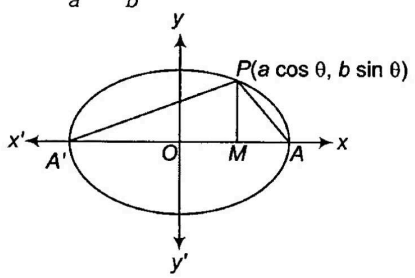
Now, by using Baye's theorem,

$$P\left(\frac{m}{W}\right) = \frac{P\left(\frac{W}{m}\right) \cdot P(m)}{P\left(\frac{W}{m}\right) \cdot P(m) + P\left(\frac{W}{w}\right) \cdot P(w)}$$

$$= \frac{\frac{10}{100} \times \frac{70}{100}}{\frac{10}{100} \times \frac{70}{100} + \frac{20}{100} \times \frac{30}{100}} = \frac{700}{700 + 600} = \frac{7}{13}$$

**78.** (a) In 1's complement arithmetic, carry generated should be added.

**79.** (a) Ellipse is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$




where $AA' = 2a$

Let variable point $P$ is $(a \cos\theta, b \sin\theta)$.

Then, area of $\Delta APA' = \frac{1}{2}(AA')(PM)$

$$= \frac{1}{2} \times 2a \times b\sin\theta$$

$$= ab\sin\theta$$

Maximum area of $\Delta APA' = ab$ (since, $|\sin\theta| \leq 1$)

**80.** (c) In each pair except 62-23, sum of digits in first number is twice that of sum of digits in the second number.

**81.** (c) Probability of disease $= 20\% = \frac{1}{5} = p$ (say)

Probability that out of 6 workers, 4 or more will catch the disease

$$= {}^6C_4\, p^4 (1-p)^2 + {}^6C_5\, p^5 (1-p) + {}^6C_6\, p^6$$

$$= 15\left(\frac{1}{5}\right)^4\left(\frac{4}{5}\right)^2 + 6\left(\frac{1}{5}\right)^5\left(\frac{4}{5}\right) + \left(\frac{1}{5}\right)^6$$

$$= \frac{240+24+1}{625\times 25} = \frac{265}{25\times 625} = \frac{53}{3125}$$

**82.** (b) As, $\log(\log(n)) < \log(n) < \frac{n}{\log(n)} < n\log(n)$

So, A2 is best algorithms among all 4 algorithms given. Because $A_2$ algo have least complexity among them.

**83.** (a) Arithmetic mean of series ${}^nC_0, {}^nC_1, \ldots, {}^nC_n$ is

$$A = \frac{{}^nC_0 + {}^nC_1 + \ldots + {}^nC_n}{n+1} = \frac{2^n}{n+1}$$

**84.** (d) $X = aU + bV$

$\Rightarrow$ Mean of $X = \overline{X} = a\overline{U} + b\overline{V}$

**85.** (b) Variance of $\frac{ax+b}{c}$

*i.e.*,

$$V\left(\frac{ax+b}{c}\right) = \frac{a^2}{c^2}V(x)$$

$$\Rightarrow \text{SD of } \frac{ax+b}{c} = \sqrt{\frac{a^2}{c^2}V(x)} = \left|\frac{a}{c}\right|\sigma$$

**86.** (a) Average marks in percentage

$$= \frac{75+80+85+0}{4} = 60$$

**87.** (c) $\frac{dz}{dx} + \frac{z}{x}\log z = \frac{z}{x^2}(\log z)^2$

$$\Rightarrow \frac{1}{z(\log z)^2}\times\frac{dz}{dx} + \frac{1}{\log z}\times\frac{1}{x} = \frac{1}{x^2}$$

Put, $u = (\log z)^{-1}$

$$\Rightarrow \frac{du}{dx} = -(\log z)^{-2}\times\frac{1}{z}\times\frac{dz}{dx}$$

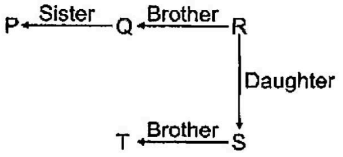
Now, given equation becomes

$$-\frac{du}{dx} + \frac{u}{x} = \frac{1}{x^2}$$

$$\Rightarrow \frac{du}{dx} - \frac{u}{x} = -\frac{1}{x^2}$$

**88.** (c) ${}^nC_0\,{}^{2n}C_n - {}^nC_1\,{}^{2n-1}C_n + {}^nC_2\,{}^{2n-2}C_n - \ldots + (-1)^n\,{}^nC_n\,.{}^nC_n = (-1)^n$

**89.** (d)




Hierarchy of relation diagram. It gives S and T has Q as their uncle.

**90.** (b) $K_n$ will be Eularian if degree of each vertex is even and in $K_n$, degree of each vertex is $n-1$. So, $n-1$ should be even, hence, $n$ should be odd.

**91.** (a) $2y\sin x\frac{dy}{dx} = 2\sin x\cos x - y^2\cos x$ ...(i)

Let $y^2 = z$

$$\Rightarrow 2y\frac{dy}{dx} = \frac{dz}{dx}$$

Now, Eq. (i) becomes,

$$\sin x\frac{dz}{dx} = 2\sin x\cos x - z\cos x$$

$$\Rightarrow \frac{dz}{dx} = 2\cos x - z\cot x$$

$$\Rightarrow \frac{dz}{dx} + (\cot x)z = 2\cos x$$

$$\text{IF} = e^{\int \cot x\,dx} = e^{\log\sin x} = \sin x$$

$\therefore$ Hence, solution is

$$z\cdot\sin x = \int 2\cos x\sin x\,dx$$

$$= \int \sin 2x\,dx$$

$$= -\frac{1}{2}\cos 2x + C$$

$$\Rightarrow y^2\sin x = -\frac{1}{2}\cos 2x + C$$

Since, $y(\pi/2) = 1$

$$\Rightarrow 1 = -\frac{1}{2}\times -1 + C$$

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

$$\Rightarrow y^2\sin x = \frac{1}{2}(1-\cos 2x)$$

$$\Rightarrow y^2\sin x = \sin^2 x$$

$$\Rightarrow y^2 = \sin x$$

**92.** (d) The number of binary relations which are both symmetric and antisymmetric can have any number of $n$ available diagonal elements of $S\times S$, which are equal to

$${}^nC_0 + {}^nC_1 + {}^nC_2 + \ldots + {}^nC_n = 2^n$$

**93.** (a) $\left|\sqrt{x^2+(y-1)^2} - \sqrt{x^2+(y+1)^2}\right| = k$ will be hyperbola if $(0,1)$ and $(0,-1)$ are foci and $k$ is less than distance between $(0,1)$ and $(0,-1)$ *i.e.*, 2.

$\Rightarrow k \in (0,2)$

**94.** (a) If a new record is for location 7, 8, 9, 10, or 2, then it will go in location 2, so out of 10 possibilities 6 are in favour.

So, probability $= \frac{6}{10} = 0.6$

**95.** (c) $\begin{vmatrix} a-x & c & b \\ c & b-x & a \\ b & a & c-x \end{vmatrix} = 0$

$$\Rightarrow \begin{vmatrix} a+b+c-x & c & b \\ a+b+c-x & b-x & a \\ a+b+c-x & a & c-x \end{vmatrix} = 0$$

(by using $C_1 \to C_1 + C_2 + C_3$)

$$\Rightarrow (a+b+c-x)\begin{vmatrix} 1 & c & b \\ 1 & b-x & a \\ 1 & a & c-x \end{vmatrix} = 0$$

$$\Rightarrow (a+b+c-x)\begin{vmatrix}1 & c & b\\ 0 & b-c-x & a-b\\ 0 & a-c & c-b-x\end{vmatrix}=0$$

(by using $R_2 \to R_2 - R_1$, $R_3 \to R_3 - R_1$)

$$\Rightarrow (a+b+c-x)\{(-x+(b-c)\}\{-x-(b-c)\}-(a-b)(a-c)]=0$$

$$\Rightarrow (a+b+c-x)[x^2-(b^2+c^2-2bc)-(a^2-ab-ac+bc)]=0$$

$$\Rightarrow (a+b+c-x)(x^2-a^2-b^2-c^2+ab+bc+ca)=0$$

which has 3 different values for $x$.

**96.** (a) $P$(Hindi knowing woman teacher)
$= P$(Hindi knowing) $P$(woman) $P$(teacher)
$$=\frac{125}{150}\times\frac{50}{150}\times\frac{90}{150}=\frac{5}{6}\times\frac{1}{3}\times\frac{3}{5}=\frac{1}{6}$$

**97.** (c) By definition of foreign key.

**98.** (a) $x=\sqrt[3]{7}+\sqrt[3]{49}$

$$\Rightarrow x^3=7+49+3\times\sqrt[3]{7\times49}\,(\sqrt[3]{7}+\sqrt[3]{49})$$

$$\Rightarrow x^3-56=3x\sqrt[3]{343}=21x$$

$$\Rightarrow x^3-21x-56=0$$

So, product of roots $= 56$

**99.** (d) $\tan(100°+125°)=\dfrac{\tan 100°+\tan 125°}{1-\tan 100°\tan 125°}$

$= \tan(225°) = \tan(180°+45°)$
$= \tan 45° = 1$

$$\Rightarrow \tan 100°+\tan 125°=1-\tan 100°\tan 125°$$

$$\Rightarrow \tan 100°+\tan 125°+\tan 100°\tan 125°=1$$

**100.** (c) Contrapositive of $p \Rightarrow q$ is $\sim q \Rightarrow \sim p$.

**101.** (d) $(a, b)$ and $(b, a) \in R$

$\Rightarrow |b| = a$ and $|a| = b \Rightarrow a = b$
Hence, $R$ is anti-symmetric.

**102.** (c) Number of possible one-to-one mappings equal to number of ways in which $m$ elements of $A$ can be given one value each from $n$ elements of $B$. *i.e.*, ${}^nP_m$.

**103.** (c) The numbers are $2^3, 3^3, 4^3, 5^3, 6^3$ so missing one is $7^3 = 343$.

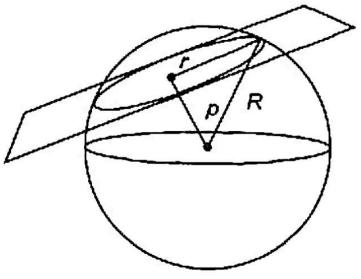
**104.** (c) $\tan\theta = -1$ and $\cos\theta = \dfrac{1}{\sqrt{2}}$ are both satisfied by $\theta = \dfrac{7\pi}{4}$ and hence, most general solution is $2n\pi + \dfrac{7\pi}{4}$.

**105.** (c) Baud rate is the rate at which signal changes. A baud is a unit of measure for analog signaling.

**106.** (b) $x^2+y^2+z^2+2x-2y-4z-19=0$

$$\Rightarrow (x+1)^2+(y-1)^2+(z-2)^2=(5)^2$$

Centre is $(-1, 1, 2)$ and radius is $5 = (R)$.




Perpendicular distance from $(-1, 1, 2)$ on the plane $x + 2y + 2z + 7 = 0$ is

$$p=\frac{-1+2+4+7}{\sqrt{1^2+2^2+2^2}}=4$$

Radius of circle, $r=\sqrt{R^2-p^2}=\sqrt{5^2-4^2}=3$

**107.** (a) As each edge can be present in two regions and number of regions equal $e - n + 2$, so we get

$$(e-n+2)\,k=2e$$

$$\Rightarrow e(k-2)=k(n-2)$$

$$\Rightarrow e=\frac{k(n-2)}{(k-2)}$$

**108.** (b) $\text{Number of pages}=\dfrac{\text{Number of addresses}}{\text{Page size}}$

$$=\frac{2^{32}}{4k}=\frac{2^{32}}{2^2\times2^{10}}$$

$$=\frac{2^{32}}{2^{12}}=2^{20}$$

**109.** (c) Equation of the tangent at $(2, 1)$ to the conic $x^2 - y^2 - 8x + 2y + 11 = 0$ is

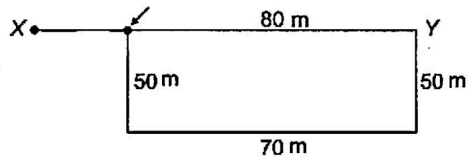
$$x\cdot2-y\cdot1-4(x+2)+(y+1)+11=0$$

$$\Rightarrow -2x+4=0$$

$$\Rightarrow x-2=0$$

**110.** (a)

**111.** (a) The following is the description of Sanjay's walk.




Final point is $80 - 70 = 10$ m from starting point.

**112.** (a) Thrashing occurs quite often when the page allocation policy is local.

**113.** (b) $(a-\omega)(a-\omega^2)=a^2-a(\omega+\omega^2)+\omega^3$

$$=a^2+a+1$$

$$\Rightarrow \sum_{a=1}^{10}(a-\omega)(a-\omega^2)=\sum_{a=1}^{10}(a^2+a+1)$$

$$=\frac{10\times11\times21}{6}+\frac{10\times11}{2}+10=450$$

$$\Rightarrow \cos\left[\{(1-\omega)(1-\omega^2)+\ldots+(10-\omega^2)\}\frac{\pi}{900}\right]$$

$$=\cos\left[\frac{450\pi}{900}\right]=\cos\frac{\pi}{2}=0$$

**114.** (b) The refresh rate below which a picture flickers is 30. A refresh rate (most commonly the "vertical refresh rate") is the number of times in a second that a display hardware draws the data or the "refresh rate" is the number of times a display's image is remained or refreshed per second.

**115.** (c) There are total 18 rectangles in the given figure.

**116.** (d) If the point on plane $x - y - z = 9$ parallel to

$$\frac{x-2}{2}=\frac{y+2}{3}=\frac{z-6}{-6}$$

passing from $(1, 0, -3)$ is $(a, b, c)$.

Then, $\dfrac{a-1}{2}=\dfrac{b-0}{3}=\dfrac{c+3}{-6}=k$ (say)

$$\Rightarrow a=2k+1,\ b=3k,\ c=-3-6k$$

Now, $(a, b, c)$ is on the plane $x - y - z = 9$

So, $2k + 1 - 3k + 3 + 6k = 9$

$\Rightarrow \quad 5k = 5 \Rightarrow k = 1$

So, $(a, b, c) = (3, 3, -9)$

Distance between $(1, 0, -3)$ and $(3, 3, -9)$ is

$$\sqrt{2^2 + 3^2 + (-6)^2} = 7$$

**117.** (d)

| | | | |
|---|---|---|---|
| B → 2 ] 2 | J → 10 ] 2 | N → 14 ] 2 | M → 13 ] 2 |
| D → 4 = ] 3 | L → 12 = ] 3 | P → 16 = ] 3 | O → 15 = ] 3 |
| G → 7 ] | O → 15 = ] | S → 19 = ] | R → 18 = ] |
| K → 11 ] 4 | S → 19 ] 4 | W → 23 ] 4 | U → 21 ] 3 |

So, MORE is different from others.

**118.** (b) If there are two optimal solutions, then there will be infinite optimal solutions (line segment joining these two optimal solutions will have each point on it as optimal solution).

**119.** (b) Let $a\mathbf{i} + b\mathbf{k}$ be the required unit vector, then we have

$$a^2 + b^2 = 1 \qquad \ldots(i)$$

$$\therefore \quad (a\mathbf{i} + b\mathbf{k}) \cdot \mathbf{u} = 1 \cdot |\mathbf{u}| \cos \frac{\pi}{4}$$

$$\Rightarrow \quad 2a - b = \frac{3}{\sqrt{2}} \qquad \ldots(ii)$$

and $\quad (a\mathbf{i} + b\mathbf{k}) \cdot \mathbf{v} = 1 \cdot |\mathbf{v}| \cos \frac{\pi}{3}$

$$\Rightarrow \quad -b = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \quad b = -\frac{1}{\sqrt{2}} \qquad \ldots(iii)$$

Putting in Eq. (ii), we get $a = \frac{1}{\sqrt{2}}$

$$\therefore \quad a\mathbf{i} + b\mathbf{k} = \frac{1}{\sqrt{2}}(\mathbf{i} - \mathbf{k})$$

**120.** (c) Simpson's rule with smaller width will give more accurate result because higher (second degree) degree curve is fitted with more accuracy.