IIT JAM
(MCA)

1. A student computes the sum of squares of the 40 natural numbers and gives an incorrect answer 22019. By mistake, the student forgot to add the square of one of the numbers. The missed number is
(A) 5 (B) 7 (C) 9 (D) 11

2. Which of the following is NOT software?
(A) Adobe (B) Browser (C) Compiler (D) Device Driver

3. For which of the following combinations, a JK Flip-Flop will enter into the complement of the present state?
(A) J = 0, K = 0 (B) J = 0, K = 1 (C) J = 1, K = 0 (D) J = 1, K = 1

4. For which of the following combinations an SR Flip-Flop is set to 1?
(A) S = 0, R = 0 (B) S = 0, R = 1 (C) S = 1, R = 0 (D) S = 1, R = 1

5. The number of distinct 3×3 matrices, constructed using nonnegative integers such that each row sum is 3, is
(A) 1000 (B) 729 (C) 300 (D) 99

6. Suppose T (n) = $\begin{cases} n, & \text{if } n = 1 \\ 5T\left(\frac{n}{5}\right) + n, & \text{if } n > 1 \end{cases}$ *The value of* $T(125)$ *is*
(A) 500 (B) 400 (C) 375 (D) 380

7. Consider the function f (m, n) = $\begin{cases} m, & \text{if } n = 1 \\ m + f(m, n-1), & \text{if } n > 1 \end{cases}$, for positive integers; m and n, f (m, n) is
(A) m + n (B) $\sum_{i=0}^{n=1}(m-i)$ (C) m^n (D) mn

8. Consider the following declaration in C

```
struct student {
        char name [12] ;
        float grade point ;
};
struct student MCA [5] ;
```

The number of bytes needed to store the array MCA is
(A) 16 (B) 25 (C) 70 (D) 80

9. Which of the following is a valid C directive?
(A) # include <stdio.h>; (B) # include <stdio.h> (C) include <stdio.h> ; (D) include <stdio.h>

10. Which of the following is NOT a Random Access Storage Device?
(A) Magnetic Tape (B) Hard Disk (C) Floppy Disk (D) CD

11. Let x = 0.125E + 01, y = $(1.01)_2$ and z = $(1.2)_8$. Which of the following is TRUE?
(A) x, y and z are equal
(B) Only x and y are equal
(C) Only x and z are equal
(D) All x, y and z are different

12. 10's complement of the decimal number 56789 is
(A) 01234 (B) 12345 (C) 43210 (D) 43211

13. The largest natural number whose base 7 representation has exactly four digits, is
(A) 2400 (B) 6666 (C) 2401 (D) 2401

14. Consider the following program segment

```
{ int x, i, j ;
    x = 0 ;
    for (i = 0; i <19; i++)
    for (j = i + 1; j < 20; j++)
    x ++; }
```

The value of x after executing the segment is
(A) 171 (B) 190 (C) 342 (D) 380

15. Consider the following C statements

```
P:  for (i = 0; i <8; i+ =3) {printf ("*") ;}
Q:  for (i = 4; i >0;I – =2) {printf ("*"); }
R:  for (i = 0; i <= 9; i+ =3) {printf ("*");}
S:  for (i = 0; i <7; I ++) {if (i%3= = 0) printf ("*");}
```

Which one of the following is a TRUE statement?
(A) P, Q, R and S give the same output
(B) P and S give the same output
(C) Q and R give the same output
(D) P, Q and S give the same output

16. Let x, y and z be Boolean variables. The number of possible values for the expression $xy + \bar{z}x$ is
(A) 1 (B) 2 (C) 4 (D) 8

17. The binary equivalent of the hexadecimal number A52C is
(A) 1010101101100
(B) 1010010100101100
(C) 1010111000101100
(D) 1010010100101101

18. The decimal value of $(21)_8 \times (101)_{16}$ lies in the interval
(A) 3000 – 3499 (B) 3500 – 3999 (C) 4000 – 4499 (D) 4500 – 4999

19. Consider the following program segment

```
{int n = 1;
float x, term;
float sum = 1;
term = 1;
while (n < 51)
{
        term * = – x * x/ (n * (n + 1));
        sum + = term;
        n + = 2;
        }
}
```

For a given x the valve of sum approximates the function

(A) sin x (B) cos x (C) e^{-x} (D) e^{-x^2}

20. Let f: N $\rightarrow$ N be defined as

$$f(n) = \begin{cases} 1, & \text{if } n = 1 \text{ or } n = 2 \\ f(n-1) + f(n-2), & \text{otherwise} \end{cases}.$$

What is the value of f (10)?

(A) 34 (B) 45 (C) 55 (D) 89

21. Let X and Y be 4 bit registers with initial contents as 1011 and 1001, respectively. The following sequences of operations are performed on the two registers:

$Y \leftarrow X \oplus Y$

$X \leftarrow X \oplus Y$

$Y \leftarrow X \oplus Y$

where $\oplus$ denotes XOR operation. The final contents of the two registers are

(A) X = 1001, Y = 1011 (B) X = 1011, Y = 1001

(C) X = 1011, Y = 1011 (D) X = 1001, Y = 1001

22. The Boolean expression $(x + y)(y + \bar{z})(z + \bar{x})$ is equal to

(A) xyz (B) $xy\bar{z}$ (C) $(\bar{x} + z)y$ (D) $(x + \bar{z})y$

23. Let x and y be independent Boolean variables, each taking values 0 or 1 with probabilities 0.5 and 0.5, respectively. The probability that $x + y(\bar{x} + \bar{y}) = 1$ is

(A) 0 (B) 0.25 (C) 0.5 (D) 0.75

24. The unit place of the number 27^{82} is

(A) 1 (B) 3 (C) 7 (D) 9

25. Consider the following C program

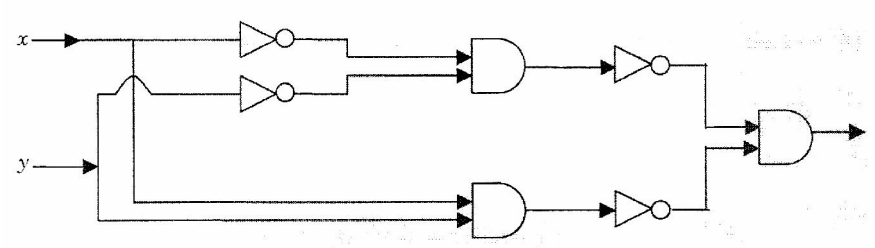
```
void main ( )
{
int i, s ;
for (i = 0; ; i + +)
{ s = s + i / (i – 2) ;
If (i > 5) break ;
}
}
```

Which one of the following is a TRUE statement?

(A) There is a syntax error (B) There is a type mismatch error

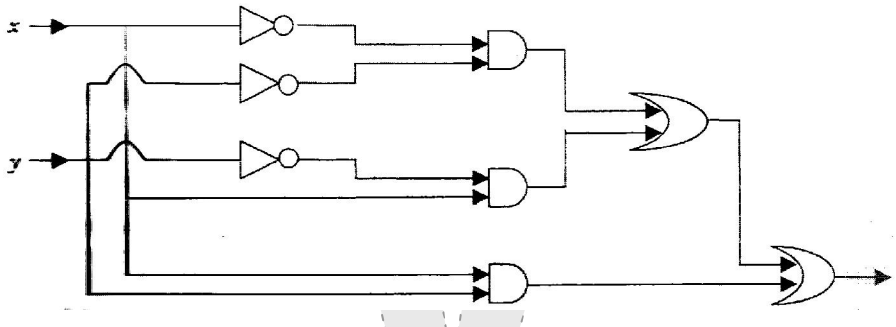
(C) There is a runtime error (D) There is no runtime error

26. The logic circuit diagram given in figure 1 is equivalent to



(A) AND gate (B) OR gate (C) NAND gate (D) XOR gate

27. The logic circuit diagram shown in figure 2 is equivalent to the Boolean expression



(A) $x + y$ (B) $x + \overline{y}$ (C) $\overline{x} + y$ (D) $\overline{x} + \overline{y}$

28. Consider the following C program segment

```
int gradepoint ;
char ch;
Switch (ch) {
Case ‘A‘ : {gradepoint = 10 ;}
Case ‘B‘ : {gradepoint = 8 ; break ; }
Case ‘C‘ : {gradepoint = 6 ; }
Default : {gradepoint = 0 ; } }
```

Executing the program segment for ch = ‘A’, ‘B’, ‘C’ gradepoints are respectively

(A) 10, 8, 6 (B) 10, 8. 0 (C) 8, 8, 6 (D) 8, 8, 0

29. What is the output of the following C program?

```
void fun (int * p)
{ int i, sum = 0:
for (i = 2; i < 4; + + i)
sum + = *(p+ i);
printf ("%d", sum);
}
void main ( )
{ int a[5] = {10, 20, 30, 40, 50};
fun (a + 1);
}
```

(A) 90 (B) 120 (C) 130 (D) 140

30. Which of the following is an 8-bit processor?

(A) Intel 80286 (B) Intel 8086 (C) Intel 8085 (D) Intel Pentium 11

31. The maximum number of characters that can be encoded in a fixed length encodings scheme with n bits is

(A) 2^n (B) n! (C) n^2 (D) n

32. BIOS is the acronym for

(A) Binary Input Output source (B) Basic Input Output support
(C) Binary Input Output system (D) Basic Input Output system

33. What is the sum of the interior angles of an n vertex simple polygon?

(A) $(n-2)\pi$ (B) $\frac{(n+3)\pi}{6}$ (C) $\frac{(n+1)\pi}{4}$ (D) $\frac{n\pi}{3}$

34. For a, b $\in$ **Z**, define a relation aRb if ab $\geq$ 0. Then the relation R is

(A) symmetric, reflexive and transitive
(B) symmetric and reflexive but NOT transitive
(C) symmetric and transitive but NOT reflexive
(D) reflexive and transitive but NOT symmetric

35. If $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix} = k$, then $\begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{vmatrix} =$

(A) 4k + 3 (B) 4k – 3 (C) 2k + 1 (D) k

36. If sinx + cosx = α then sin (2x) is

(A) $1-\alpha^2$ (B) $\alpha^2 - 1$ (C) $1+\alpha^2$ (D) α^2

37. The next term in the series 191, 211, 232, 254, _____ is

(A) 267 (B) 276 (C) 277 (D) 287

38. The number of ways in which 4 boys and 5 girls can sit in a row so that there is a girl between any two boys is

(A) 4! 5! (B) 3 (4! 5!) (C) 5 (4! 5!) (D) 15 (4! 5!)

39. The number of all functions f:{1,2,….,n} à {1, 2,…. ,m} is

(A) m (m – 1)…. (m – n + 1) (B) n (n – 1)…. (n – m + 1)

(C) m^n (D) n^m

40. Consider the following program

```
void swap (int a, int b)
{ int temp ;
temp = a ;
a = b ;
b = a ;
}
void main ( )
{ int x, y;
x = 2; y = 3;
swap (x, y);
printf ("x = %d y = %d \n", x, y);
}
```

The output of the program is

(A) x = 2 y = 2 (B) x = 2 y = 3 (C) x = 3 y = 2 (D) x = 3 y = 3

41. Match the file extensions in list 1 with the corresponding applications in List 2

	List – 1		**List – 2**
1.	mp3	P.	image
2.	xls	Q.	music
3.	jpeg	R.	database
4.	mdb	S.	spread sheet

(A) (1, Q), (2, S), (3, R), (4, P) (B) (1, Q), (2, S), (3, P), (4, R)

(C) (1, Q), (2, P), (3, S), (4, R) (D) (1, Q), (2, R), (3, P), (4, S)

42. Match the items of List 1 with the items of List 2

	List – 1		**List – 2**
1.	Operating Systems	P.	Pentium
2.	Application Software	Q.	Linux
3.	Processor	R.	Router
4.	Network	S.	Anti virus

(A) (1, Q), (2, S), (3, P), (4, R) (B) (1, Q), (2, R), (3, P), (4, S)

(C) (1, P), (2, S), (3, Q), (4, R) (D) (1, P), (2, R), (3, S), (4, Q)

43. Which of the following is a unit normal vector to the surface z = xy at P (2, -1, -1)?

(A) $\frac{i-2j+k}{\sqrt{6}}$ (B) i – 2j + k (C) –i + 2j + k (D) $\frac{-i+2j+k}{\sqrt{6}}$

44. Which of the following diseases is NOT caused by mosquito bite?

(A) Dengue (B) Encephalitis (C) Malaria (D) Typhoid

45. Match the following:

P.	Main memory	1.	Magnetic memory
Q.	Cache memory	2.	Dynamic random access memory
R.	Hard disk	3.	Optical memory
S.	CDROM	4.	Static random access memory

(A) P – 2, Q – 4, R – 3, S – 1 (B) P – 1, Q – 2, R – 3, S – 4
(C) P – 4, Q – 2, R – 1, S – 3 (D) P – 2, Q – 4, R – 1, S – 3

46. Who is the father of Bhishma in the Mahabharata?

(A) Bharat (B) Devavrata (C) Parashar (D) Shantanu

47. Who among the following is NOT a Nobel Laureate?

(A) Amartya Sen (B) J.C. Bose (C) Muhammad Yunus (D) S. Chandrasekhar

48. Consider the diherdral group $D_4 = \{e, r, r^2, r^3, f, rf, r^2f, r^3f\}$ with $r^4 = e = f^2$ and $rf = fr^{-1}$.
The product $r^3 fr^{-1} f^{-1} r^3 fr$ corresponds to

(A) f (B) rf (C) r^2f (D) r^3f

49. The point on the sphere $x^2 + y^2 + z^2 = 1$ farthest from the point (1, – 2, 1) is

(A) $\left(\frac{-1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{-1}{\sqrt{6}}\right)$ (B) $\left(\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{1}{\sqrt{6}}\right)$ (C) $\left(\frac{-1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{1}{\sqrt{6}}\right)$ (D) $\left(\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{-1}{\sqrt{6}}\right)$

50. The general solution of the differential equation y''' + y'' – y' – y = 0 is

(A) $(c_1 + xc_2 + x^2 c_3) e^x$ (B) $(c_1 + xc_2 + x^2 c_3) e^{-x}$ (C) $c_1e^x + (c_2 + xc_3) e^{-x}$ (D) $(c_1 + xc_2) e^x + c_3 e^{-x}$

51. What does XP stand for in the operating system Windows XP?

(A) Extra Power (B) Extended Product (C) Extra Performance (D) Experience

52. The solution of the differential equation $(x^2 y + xy^2)\, dx + \left(\frac{x^3}{3} + x^2y + \sin y\right) dy = 0$ is

(A) $\frac{x^3 y}{3} + \frac{x^2 y^2}{2} - \cos y = c$ (B) $\frac{x^3 y}{3} + \frac{x^2 y^2}{2} + \cos y = c$

(C) $\frac{x^3}{3} + \frac{x^2 y^3}{2} - \cos y = c$ (D) $\frac{x^3}{3} + \frac{x^2 y^3}{2} + \cos y = c$

53. Let D be the region in the first quadrant lying between $x^2 + y^2 = 1$ and $x^2 + y^2 = 4$. The value of the integral $\iint_D \sin(x^2 + y^2)\, dx\, dy$ is

(A) $\frac{\pi}{4}(\cos 1 - \cos 2)$ (B) $\frac{\pi}{4}(\cos 1 - \cos 4)$ (C) $\frac{\pi}{2}(\cos 1 - \cos 2)$ (D) $\frac{\pi}{2}(\cos 1 - \cos 4)$

54. If the line $y = mx$, $0 \le x \le 2$ is rotated about the line $y = -1$, then the area of the generated surface is

(A) $4\pi(1 + m)\sqrt{1+m}$ (B) $4\pi(1 + m^2)\sqrt{1+m}$ (C) $4\pi(1 + \sqrt{m})\sqrt{1+m^2}$ (D) $4\pi(1 + m)\sqrt{1+m^2}$

55. Let f be an increasing, differentiable function. If the curve $y = f(x)$ passes through (1, 1) and has length

$$L = \int_1^2 \sqrt{\left(1 + \frac{1}{4x^2}\right)}\, dx, 1 \le x \le 2,$$

then the curve is

(A) $y = \ln(\sqrt{x}) - 1$ (B) $y = 1 - \ln(\sqrt{x})$ (C) $y = \ln(1 + \sqrt{x})$ (D) $y = 1 + \ln(\sqrt{x})$

56. Let $U = \left\{ \begin{pmatrix} 1 & a & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} : a \in R \right\}$ and $V = \left\{ \begin{pmatrix} a & 0 & 0 \\ 0 & a & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} : a \in R \right\}$

The angle between U and V is

(A) 0 (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{3}$

57. Let $f(x) = x^3 + x^2 - x + 15$ and $g(x) = x^3 + 2x^2 - x + 15$. Then, over **Q**

(A) f is irreducible and g is reducible (B) f is reducible and g is irreducible

(C) Both f and g are reducible (D) Both f and g are irreducible

58. Let P be a 3×3 matrix such that for some **c**, the linear system **Px = c** has infinite number of solutions. Which one of the following is TRUE?

(A) The linear system **Px = b** has infinite number of solutions for all **b**

(B) Rank (P) = 3

(C) Rank (P) $\neq$ 1

(D) Rank (P) $\le$ 2

59. Let X be a binomial random variable with parameters n and p. If the mean and the standard deviation of X are 3 and $\frac{3}{2}$, respectively, then what is the value of (n, p)?

(A) $\left(4, \frac{3}{4}\right)$ (B) $\left(6, \frac{1}{2}\right)$ (C) $\left(9, \frac{1}{3}\right)$ (D) $\left(12, \frac{1}{4}\right)$

60. Two letters are chosen one after another without replacement from the English alphabet. What is the probability that the second letter chosen is a vowel?

(A) $\frac{4}{25}$ (B) $\frac{5}{26}$ (C) $\frac{5}{25}$ (D) $\frac{1}{5} \cdot \frac{1}{26}$

61. Let f (x, y) = $x^3 + y^3 + 3x^2 - 3y^2 - 5$. Then the local maximum and the local minimum of the function f are at the points

(A) (– 2, 0) and (– 2, 2), respectively (B) (– 2, 0) and (0, 2), respectively

(C) (0, 2) and (– 2, 0), respectively (D) (0, 2) and (0, 0), respectively

62. Consider the equations

$$\sin(\cos x) = x \quad \ldots..(1)$$

and

$$\cos(\sin x) = -x \quad \ldots..(2)$$

for $x \geq 0$. Then

(A) Only Equation (1) has a solution

(B) Only Equation (2) has a solution

(C) Both Equation (1) and (2) have solutions

(D) Neither Equation (1) nor Equation (2) has a solution

63. The area of the parallelogram with sides $\mathbf{x} = \vec{i} + \vec{j} + \vec{k}$ and $\mathbf{y} = -\vec{i} + \vec{j}$ is

(A) $\sqrt{6}$ (B) $2\sqrt{3}$ (C) $3\sqrt{2}$ (D) 6

64. Let $P = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$. The eigenvectors corresponding to the eigenvalues i and –i are respectively

(A) $\begin{pmatrix} 1 \\ i \end{pmatrix}$ and $\begin{pmatrix} -1 \\ i \end{pmatrix}$ (B) $\begin{pmatrix} 1 \\ i \end{pmatrix}$ and $\begin{pmatrix} i \\ -i \end{pmatrix}$ (C) $\begin{pmatrix} -1 \\ i \end{pmatrix}$ and $\begin{pmatrix} i \\ -i \end{pmatrix}$ (D) $\begin{pmatrix} i \\ 1 \end{pmatrix}$ and $\begin{pmatrix} -1 \\ i \end{pmatrix}$

65. Let P be a 2×2 matrix such that $P^{102} = 0$. Then

(A) $P^2 = 0$ (B) $(I - P)^2 = 0$ (C) $(I + P)^2 = 0$ (D) $P = 0$

66. For $n \geq 5$, the expression $1 + 2x + 3x^2 + 4x^3 + \ldots. + nx^{n-1}$, $x \neq 1$, is equal to

(A) $\frac{nx^n(1-x) - x^n + 1}{(1-x)^2}$ (B) $\frac{nx^n(x-1) - x^n + 1}{(1-x)^2}$ (C) $\frac{nx^n(x-1) + x^n - 1}{(1-x)^2}$ (D) $\frac{nx^n}{(1-x)^2}$

67. The integral $\int_0^{\frac{\pi}{2}} \min(\sin x, \cos x)\, dx$ equals

(A) $\sqrt{2} - 2$ (B) $2 - \sqrt{2}$ (C) $2\sqrt{2}$ (D) $2 + \sqrt{2}$

68. Let $f(x) = \int_0^x (t-1)(t-2)(t-3)(t-4)\, dt, 0 \leq x \leq 5$. Then F has local minimum at the points

(A) {0, 2, 4} (B) {1, 3, 5} (C) {0, 3, 4} (D) {3, 4, 5}

69. Let G = {n ∈ **Z** : 1 ≤n≤ 55, gcd (n, 56) = 1} be a multiplicative group modulo 56. Consider the Sets S_1 = {1, 9, 17, 25, 33, 41} and S_2 = {1, 15, 29, 43}. Which one of the following is TRUE?

(A) S_1 is a subgroup of G but S_2 is NOT a subgroup of G

(B) S_1 is NOT a subgroup of G but S_2 is a subgroup of G

(C) Both S_1 and S_2 are subgroup of G

(D) Neither S_1 nor S_2 is a subgroup of G

70. Which of the following pair of linear programming constraints is equivalent to the inequality; $|x_1 - x_2| \leq a$?

(A) $x_1 - x_2 \leq a, x_2 - x_1 \leq a$ (B) $x_1 - x_2 \leq a, x_2 - x_1 \leq -a$

(C) $x_1 - x_2 \leq -a, x_2 - x_1 \leq -a$ (D) $x_1 - x_2 \leq -a, x_2 - x_1 \leq a$

71. If the primal linear Programming problem is unbounded then which of the following is TRUE?

(A) Dual problem is unbounded

(B) Dual problem has a single bounded optimal solution

(C) Dual problem has multiple bounded optimal solutions

(D) Dual problem is infeasible

72. Consider the following Primal Linear Programming Problem:

Maximize $\mathbf{c}^T\mathbf{x}$

Subject to $\mathbf{PX = b}$

$\mathbf{x \geq 0}$

The Dual Linear Programming Problem is

(A) Minimize $\mathbf{y}^T\mathbf{b}$ Subject to: $\mathbf{P}^T\mathbf{y = c}$, **y** unrestricted

(B) Minimize $\mathbf{y}^T\mathbf{b}$ Subject to: $\mathbf{P}^T\mathbf{y \geq c}$, **y** unrestricted

(C) Minimize $\mathbf{y}^T\mathbf{b}$ Subject to: $\mathbf{P}^T\mathbf{y = c, y \geq 0}$

(D) Minimize $\mathbf{y}^T\mathbf{b}$ Subject to: $\mathbf{P}^T\mathbf{y \geq c, y \geq 0}$

73. Consider the function $f(x, y) = (x + y)^2 - (x + y) + 1$.

The absolute maximum value and the absolute minimum value of the function on the unit square { (x, y) : 0 ≤ x ≤ 1, 0 ≤ y ≤}, respectively are

(A) 3 and $\frac{3}{2}$ (B) $\frac{3}{2}$ and $\frac{3}{4}$ (C) 3 and $\frac{3}{4}$ (D) 2 and $\frac{3}{4}$

74. Let P be an n × n idempotent matrix, that is, $P^2 = P$. Which of the following is FALSE?

(A) P^T is idempotent

(B) The possible eigenvalues of P are 0 or 1

(C) The non diagonal entries of P can be Zero

(D) There are infinite numbers of n × n nonsingular matrices that are idempotent

75. Let $P = \begin{pmatrix} 1 & 0 & 5 \\ 1 & 2 & 5 \\ 1 & 3 & 1 \end{pmatrix}$. Then $8P^{-1}$ is equal to

(A) $\begin{pmatrix} 13 & -4 & -1 \\ -15 & 4 & 3 \\ 10 & 0 & -2 \end{pmatrix}$ (B) $\begin{pmatrix} 13 & -15 & 10 \\ -4 & 4 & 0 \\ -1 & 3 & -2 \end{pmatrix}$ (C) $\begin{pmatrix} 13 & 10 & -15 \\ -4 & 0 & 4 \\ -1 & -2 & 3 \end{pmatrix}$ (D) $\begin{pmatrix} 13 & -4 & -1 \\ 10 & 0 & -2 \\ -15 & 4 & 3 \end{pmatrix}$

76. A cow is tied with a pole by a 100 meter long rope. What is the probability that at some point of time the cow is at least 60 meters away from the pole?

(A) $\frac{9}{25}$ (B) $\frac{13}{25}$ (C) $\frac{16}{25}$ (D) $\frac{18}{25}$

77. Consider the following Linear Programming Problem:

Maximize $3x_1 + 8x_2$

Subject to $2x_1 + 5x_2 \leq 10$

$6x_1 + x_2 \leq 6$

$x_1, x_2 \geq 0$

The optimal value of the objective function is

(A) 0 (B) 3 (C) $\frac{111}{7}$ (D) 16

78. Let

$f(x, y) = xy^2 + yx^2$.

Suppose the directional derivative of f in the direction of the unit vector (u_1, u_2) at the point $(1, -1)$ is 1. Then among the following, (u_1, u_2) is

(A) $(-1, 0)$ (B) $(0, 1)$ (C) $(1, 0)$ (D) $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

79. Let θ, $0 \leq \theta \leq \pi$ be the angle between the planes

$x - y + z = 3$ and $2x - z = 4$

The value of θ is

(A) $\cos^{-1}\left(\frac{1}{5}\right)$ (B) $\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ (C) $\cos^{-1}\left(\frac{1}{\sqrt{15}}\right)$ (D) $\cos^{-1}\left(\frac{3}{\sqrt{15}}\right)$

80. Let $y(x) = x \sin x$ be one of the solution of an n^{th} order linear differential equation with constant coefficients. Then the minimum value of n is

(A) 1 (B) 2 (C) 3 (D) 4

81. The solution of the initial value problem

$xy' - y = 0$, with $y(1) = 1$ is

(A) $y(x) = x$ (B) $y(x) = \frac{1}{x}$ (C) $y(x) = 2x - 1$ (D) $y(x) = \frac{1}{2x-1}$

82. Let $\mathbf{x} = \vec{i} + \vec{j} + \vec{k}$, $\mathbf{y} = \alpha\,\vec{i} + \vec{k}$ and $\mathbf{z} = \vec{i} + \alpha\,\vec{j}$.

Then the volume of the parallelepiped with sides **x**, **y** and **z** is

(A) $1 + \alpha + \alpha^2$ (B) $1 + \alpha - \alpha^2$ (C) $1 - \alpha + \alpha^2$ (D) $\alpha^2 + \alpha - 1$

83. If Ω denotes the region bounded by the x-axis and the lines y = x and x = 1, then the value of the integral $\iint_{\Omega} \frac{\cos(2x)}{x}\,dx\,dy$ is

(A) $\frac{\sin 2}{2}$ (B) $\frac{\cos 2}{2}$ (C) cos 2 (D) sin 2

84. The spheres $x^2 + y^2 + z^2 = 1$ and $x^2 + (y - \sqrt{3})^2 + z^2 = 4$ intersect at an angle

(A) 0 (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{3}$

85. The function f defined on R by $f(x) = 3^x + 4^x - 5^x$ has

(A) exactly one zero (B) exactly two zeros (C) exactly three zeros (D) infinitely many zeros

86. Let G = {1, 2,…, p – 1} be the group with respect to multiplication modulo p. If the inverse of 110 in G is 4, then p is of the form

(A) 5n + 1 (B) 5n + 2 (C) 5n + 3 (D) 5n + 4

87. Let G be a group with respect to multiplication. If $x = \alpha\sqrt{2} + \beta\sqrt{3} \in G$ then x^{-1} is

(A) $\frac{\alpha\sqrt{2} + \beta\sqrt{3}}{2\alpha^2 + 3\beta^2}$ (B) $\frac{\alpha\sqrt{2} - \beta\sqrt{3}}{2\alpha^2 - 3\beta^2}$ (C) $\frac{\alpha\sqrt{2} + \beta\sqrt{3}}{2\alpha^2 - 3\beta^2}$ (D) $\frac{\alpha\sqrt{2} - \beta\sqrt{3}}{2\alpha^2 + 3\beta^2}$

88. Consider $f(x) = 1 + x\,e^{-x}$. The Newton – Raphson iterative scheme for finding a root of f (x) = 0 is

(A) $x_{n+1} = \frac{1 + x_n^2 e^{-x_n}}{(x_n - 1)e^{-x_n}}$ (B) $x_{n+1} = \frac{x_n^2 e^{-x_n} + x_n\left(1 + e^{-x_n}\right) - 1}{(x_n - 1)e^{-x_n}}$

(C) $x_{n+1} = \frac{x_n^2 e^{-x_n} + x_n\left(1 - e^{-x_n}\right) + 1}{(x_n - 1)e^{-x_n}}$ (D) $x_{n+1} = \frac{1 + x_n^2 e^{-x_n}}{1 + x_n e^{-x_n}}$

89. Consider

x	–1	0	1	2	3
f(x)	1	5	3	1	5

Applying Simpson's one third rule, the value of the integral $\int_{-1}^{3} f(x)\,dx$ is

(A) 10 (B) 12 (C) $\frac{41}{3}$ (D) 15

90. The slope of the tangent line to the curve $x = a(t - \sin t)$, $y = a(1 - \cos t)$, $t \in \mathbf{R}$, at $t = \frac{\pi}{2}$ is

(A) –1 (B) 0 (C) 1 (D) ∞

91. Let $f(x) = x^3 - x^2 + 1$, $0 \le x \le 1$. Then the absolute minimum value of f (x) is

(A) $\frac{14}{27}$ (B) $\frac{5}{9}$ (C) $\frac{23}{27}$ (D) 1

92. Suppose $z = x \sin\left(\frac{x}{y}\right) + y \sin\left(\frac{y}{x}\right)$, $xy \neq 0$. Then $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y}$ is equal to

(A) – z (B) 0 (C) z (D) 2z

93. Which of the following is FALSE?

(A) A unique interpolating polynomial of degree n is obtained from the given values at fixed n + 1 points

(B) The Lagrange interpolation formula can be applied to equispaced points

(C) The Newton's forward difference interpolation formula can be applied to non – equispaced points

(D) The trapezoidal rule gives exact value of the integral for linear functions

94. The maximum absolute error that occurs in rounding off a number after 6 places of decimal is

(A) 5×10^{-8} (B) 10^{-7} (C) 5×10^{-7} (D) 5×10^{-6}

95. Let $f(x) = 2x^3 - x^2 + 2x - 5$. Consider the following statements about the roots of $f(x) = 0$

P: At least one root is positive.

Q: At least one root is negative.

R: There is a root between x = 1 and x = 2.

Which one of the following is TRUE?

(A) P, Q and R are valid statements

(B) P and Q are valid statements but R is NOT is valid statement

(C) P and R are valid statements but Q is NOT a valid statement

(D) P is a valid statement but Q and R are NOT valid statements

96. Let $\mathbf{u}, \mathbf{v} \in \mathbf{R}^3$, $\mathbf{v} \neq \mathbf{0}$. Which of the following is FALSE?

(A) $\left|u\frac{v}{\|v\|}\right|$ is the length of the projection of u along v

(B) if $\mathbf{u.w} = \mathbf{v}.\mathbf{w}$ for all $\mathbf{w} \in \mathbf{R}^3$, then $\mathbf{u} = \mathbf{v}$

(C) $\mathbf{u} \cdot \mathbf{v} = \frac{1}{2}\left(\|u+v\|^2 - \|u-v\|^2\right)$

(D) $\|u+v\|^2 + \|u-v\|^2 = 2\left(\|u\|^2 + \|v\|^2\right)$

97. Let $P = \begin{pmatrix} 1 & i \\ i & -1 \end{pmatrix}$

Then

(A) P has two linearly independent eigenvectors

(B) P has an eigenvector

(C) P is nonsingular

(D) There exists a nonsingular matrix S such that $S^{-1}PS$ is a diagonal matrix

98. Let V be the vector space of all polynomials with real coefficients. If W is the vector subspace of V generated by $1 - x$, $x^2 - x$, $x^2 - 1$ and $x^2 - 3x + 2$, then the dimension of W is

(A) 1 (B) 2 (C) 3 (D) 4

99. If the bisection method is used to find a root of $x^3 + 7x^2 - x - 7 = 0$ in the interval [a, b] then a and b are

(A) – 6 and – 4 (B) – 4 and – 2 (C) 0 and 2 (D) 4 and 6

100. If $f(x, y, z) = x - y$ and $\nabla\left(\frac{f}{g}\right) = \frac{1}{z}\left(\hat{i} - \hat{j}\right) - \left(\frac{x-y}{z^2}\right)\hat{k}$ then g (x, y, z) is

(A) xyz (B) x (C) y (D) z

ANSWER KEY

1. (D)	2. (B)	3. (D)	4. (C)	5. (A)	6. (A)	7. (D)	8. (B)
9. (B)	10. (A)	11. (A)	12. (D)	13. (A)	14. (B)	15. (B)	16. (D)
17. (B)	18. (C)	19. (B)	20. (C)	21. (A)	22. (A)	23. (D)	24. (D)
25. (D)	26. (D)	27. (B)	28. (B)	29. (A)	30. (C)	31. (A)	32. (C)
33. (A)	34. (B)	35. (D)	36. (B)	37. (C)	38. (B)	39. (C)	40. (D)
41. (B)	42. (A)	43. (D)	44. (D)	45. (D)	46. (D)	47. (D)	48. (C)
49. (A)	50. (C)	51. (D)	52. (A)	53. (B)	54. (D)	55. (D)	56. (A)
57. (C)	58. (D)	59. (D)	60. (B)	61. (B)	62. (D)	63. (A)	64. (A)
65. (A)	66. (A)	67. (B)	68. (A)	69. (C)	70. (A)	71. (D)	72. (B)
73. (A)	74. (C)	75. (B)	76. (C)	77. (D)	78. (A)	79. (C)	80. (A)
81. (A)	82. (C)	83. (A)	84. (D)	85. (A)	86. (D)	87. (B)	88. (A)
89. (B)	90. (C)	91. (D)	92. (C)	93. (C)	94. (C)	95. (C)	96. (B)
97. (B)	98. (B)	99. (C)	100. (D)