MATHEMATICS

1. The last digit in 3^{400} is
   a. 1
   b. 3
   c. 7
   d. 9

2. Every pair of real numbers a and b satisfies one and only one, of the conditions a>b, a = b, b <a

   This property of the real numbers is known as the
   a. Transitive law
   b. Associative law
   c. Trichotomy law
   d. Commutative law

3. Consider the following statements:

   Assertion(A): The set of rational numbers is dense

   Reason (R): The set of integers is a subset of the set of rational numbers.

   Of these statements
   a. Both A and R are true and R is correct explanation of A
   b. Both A and R are true but R is not a correct explanation of R
   c. A is true, but R is false
   d. A is false, but R is true

4. The number i^i is
   a. a purely imaginary number
   b. an irrational number
   c. a rational number
   d. an integer

5. If $x+iy = \sqrt{2}+3i$, then x^2+y is
   a. 5
   b. 7
   c. 13
   d. $\sqrt{2}+3$

6. Given two integers a and b, b>0 we can find integers q and r such that

   $a = bq + r, 0 \le r < b.$

   This statement is called
   a. Euclidean algorithm
   b. Archimedean property
   c. Division algorithm
   d. None of the above

7. The g.c.d of 1547 and 560 is 7, which can be expressed as λ. 1547 + μ. 560 (where λ, μ are integers). The values of λ and μ are respectively
   a. 21, 58
   b. −21, 58
   c. 21, -58
   d. −21, -58

8. If the positive greatest common divisor of a and b be denoted by (a, b), then which of the following statements are associated with the g.c.d. theory?
   1. If (a, b) = 1, then integers s and t can be found such that 1= sa + tb
   2. If (a,b) = 1, a|c and b|c, then ab| c.
   3. If (a, b) = d, a- a_1d, b = b_1d, then (a_1 b_1)≠ 1

   Select the correct answer using the codes given below:

   Codes
   a. 1 and 2
   b. 1 and 3
   c. 2 and3
   d. 1, 2 and 3

9. Consider the following statements.

   Assertion(A): The polynomial x^2+1 has no zeros in the real number system.

   Reason (R): A polynomial with coefficients which are complex numbers has all its zeros in the complex number system

   Of these statements
   a. Both A and R are true and R is the correct explanation of A
   b. Both A and R are true but R is not a correct explanation of A
   c. A is true, but R is false

d. A is false, but R is true

10. The range of values of x for which the function $x(x+1)(x+3)$ is positive ,is

a. $\{x|x>0\}$

b. $\{x|-3<x<-1\}$

c. $\{x|x>0 \text{ or } -3<x<-1\}$

d. None of the above

11. If the polynomial $2x^4+kx^3-75k$ is divided by x the remainder is 150, then the value of k will be

a. -2

b. -1

c. 1

d. 2

12. $x+2$ is a factor of

a. x^4+2

b. x^4-x^2+12

c. x^4-2x^2-x+2

d. x^4+2x^3-x-2

13. If $\alpha+\beta+\gamma=5$

$\alpha\beta+\beta\gamma+\gamma\alpha=7$

$\alpha\beta\gamma=3$, then

the equation whose roots are α, β and γ is

a. $x^3-7=0$

b. $x^3-7x^2+3=0$

c. $x^3-5x^2+7x-3=0$

d. $x^3+7x^2-3=0$

14. If α , β , γ are the roots of the equation $x^3+4x+2=0$, then the value of $\frac{1}{\alpha+\beta}+\frac{1}{\beta+\gamma}+\frac{1}{\gamma+\alpha}$ is

a. 0

b. [illegible]

c. 2

d. 4

15. If α, β , γ are the roots of the equation $x^3+ax^2+bx+c=0$, then b equals

a. $\alpha+\beta+\gamma$

b. $\alpha\beta+\beta\gamma+\gamma\alpha$

c. $\alpha\beta\gamma$

d. None of the above

16. The roots of the equation $x^2-7ix-12=0$ are

a. 3i and – 3i

b. 4i and – 4i

c. 3i and 4i

d. – 3i and –4i

17. If α is a repeated root of the polynomial equation $f(x)=0$, then

a. $f(\alpha)=0$ but $f'(\alpha)\neq 0$

b. $f(\alpha)\neq 0$ but $f'(\alpha)=0$

c. $f'(\alpha)\neq 0$ and $f''(\alpha)=0$

d. $f(\alpha)=0$ and $f'(\alpha)=0$

18. The collection of all subsets of the given set S consisting of n elements is denoted by P(S). The total number of elements in P(S) is

a. [illegible]

b. n

c. [illegible]

[illegible] 2^n-1

19. For subsets A and B of a non-empty set X, the operations '+' and '.' Is defined by

$A+B=(A-B)\cup(B-A)$

And $A.B=A\cap B$

Which of the following on the set of all subsets of X correct?

1. $A+B=A+C \Rightarrow B=C$

2. $A.(B+C)=A.B+A.C$

Select the correct answer from the codes given below:

Codes

a. 1 and 2

b. 1 alone

c. 2 alone

d. none is correct

20. Consider the following statements :

Assertion (A): Let I be the set of positive integers and J be the set of positive even integers. These two sets are cardinally equivalent.

Reason (R): There exists a one-one correspondence between I and J.

Of these statements

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not a correct explanation of A

c. A is true but R is false

d. A is false , but R is true

21. Two sets X and Y and four relations f_1, f_2, f_3 and f_4 are given as follows:

$X=\{1,2,3,4\}$, $Y=\{\alpha, \beta, \gamma\}$

$f_1 = \{(1,\alpha), (2, \alpha), (3, \beta), (4, \gamma)\}$

$f_2 = \{(1, \alpha), (1, \beta), (2, \alpha), (3, \beta), (4, \beta)\}$

$f_3 = \{(1, \beta), (2, \beta), (3, \beta), (4, \gamma)\}$

$f_4 = \{(1, \alpha), (2, \beta), (3, \gamma)\}$

Mappings from X to Y are defined by

a. f_1 and f_2

b. f_1 and f_3

c. f_2 and f_4

d. f_1 and f_4

22. Let A be a set and "~" an equivalence relation defined on A. Let a, b, c, d be arbitrary elements of the set A and if [a], [b] etc denote equivalence classes, then which of the following statements is correct?

1. $[a] = [b]$ if and only if $a \sim b$

2. $[a] \cap [b]$ is the empty set if and only if $a \nsim b$

3. if $c \in [a]$, $d \in [b]$, and $[a] \neq [b]$, then $c \nsim d$

Select the correct answer using the codes given below:

Codes

a. 1 alone

b. 2 alone

c. 3 alone

d. All are correct

23. An example of a ring with infinite number of elements is

a. $<Z^+, +, \cdot>$, Z^+, the set of positive integers

b. $<R^+, +, \cdot>$, R^+, the set of positive reals

c. $<Q^+, +, \cdot>$, Q^+ the set of positive rationals

d. $<Z, +, \cdot>$, Z, the set of all integers

24. R denotes the set of real numbers and "*" is an operation on R such that $\alpha * \beta = \alpha + \beta + \alpha\beta$ for all $\alpha, \beta \in R$.

If $S \subseteq R$,then which one of the following pairs is an Abelian group?

a. $(S, *)$, $S = R$

b. $(S, *)$, $S = R \setminus \{0\}$

c. $(S, *)$, $S = R \setminus \{1\}$

d. $(S, *)$, $S = R \setminus \{-1\}$

25. If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ then A^n is

a. $\begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$

b. $\begin{bmatrix} 3^n & (-4)^n \\ 1 & (-1)^n \end{bmatrix}$

c. $\begin{bmatrix} 1+2n & 4n \\ 1+n & 1-n \end{bmatrix}$

d. $\begin{bmatrix} 1+2n & -4n \\ 1+n & 1-2n \end{bmatrix}$

26. Consider the following statements :

Assertion (A): If a 2×2 matrix commutes with every 2×2 matrix, then it is scalar matrix.

Reason (R): A 2×2 matrix commutes with every 2×2 matrix

Of these statements

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true , but R is not a correct explanation of A

c. A is true, but R is false

d. A is false, but R is true

27. The value of the determinant

$\begin{vmatrix} 1986 & 1987 & 1988 \\ 1989 & 1990 & 1991 \\ 1992 & 1993 & 1994 \end{vmatrix}$ is

a. 0

b. 1

c. -1

d. None of the above

28. If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 3 \\ 0 & 0 & 2 \end{bmatrix}$ then the determinant of AB has the value

a. 4

b. 8

c. 16

d. 32

29. The inverse of the matrix $\begin{bmatrix} -0.5 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is

a. $\begin{bmatrix} 0.5 & 0 & 0 \\ 0 & -4 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

b. $\begin{bmatrix} 0.5 & 0 & 0 \\ 0 & -4 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

c. $\begin{bmatrix} -2 & 0 & 0 \\ 0 & 0.25 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

d. $\begin{bmatrix} 2 & 0 & 0 \\ 0 & -0.25 & 0 \\ 0 & 0 & -1 \end{bmatrix}$

30. The system of the equation

x+ 2y +z = 9

2x +y + 3z =7

can be expressed as

a. $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 3 \end{bmatrix} = \begin{bmatrix} 9 \\ 7 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}$

b. $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 3 \end{bmatrix} \begin{bmatrix} 9 \\ 7 \end{bmatrix} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$

c. $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 9 \\ 7 \end{bmatrix}$

d. Non e of the [illegible]bove.

31. Which one o[illegible]llowing functions f : R →R is [illegible]r all real x?

a. [illegible]$^{\cot x}$

b. lo[illegible] sin [illegible]

c. cos log $(1+x^2)$

d. $\frac{2x^2-8x+7}{x^3+1}$

32. $\lim_{x\to 0} \frac{\sin ax}{\sin bx}$ (a≠0, b≠ 0) is

a. a/b

b. b/a

c. a.b

d. does not exist

33. $\lim_{x\to\infty} \frac{ax+b}{cx}$ is

a. a/c

b. ∞

c. b

d. none of the above

34. If the function $f(x) = \begin{cases} 2x+1, & [illegible]1 \\ \alpha x^2 + [illegible], & x>1 \end{cases}$ is differentiable for every [illegible] then the values of α and β are given b[illegible]

a. α =0, β = 2

b. α =3 , β = 0

c. α = 4 , β = -1

d. α = - 1, [illegible] = 4

35. The tange[illegible] a[illegible] 4) to the curve y = $5x^3$- 2x +7 [illegible] pe[illegible]endi[illegible]ular to

a. [illegible] + 3y [illegible] 5 =0

b. x [illegible] y- 5 =0

c. 2[illegible] − 26y +5 = 0

d. None of the above

36. A particle moves along a straight line starting from the origin O. After t second it is s meters from O, where s = 27t- t^3. The direction of the speed changes at the end of

a. $3\sqrt{3}$ second

b. 6 seconds

c. 3 seconds

d. $\frac{3\sqrt{3}}{2}$ seconds

37. The derivative of $\tan^{-1}\left(\frac{2x}{1-x^2}\right)$ with respect to $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$ is

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

b. 1

c. 0

d. 2

38. The differential coefficient of sin x with respect to log x is

a. cos x

b. x cos x

c. $\frac{\cos x}{\log x}$

d. $\frac{\cos x}{x}$

39. If $y = \sin x^{\sin x^{\sin x^{\cdots}}}$ then $\frac{dy}{dx}$ is

a. $\frac{y^2 \cot x}{1 - y\log \sin x}$

b. $\frac{y^2 \cot x}{1 + y\log x}$

c. $\frac{y^2 \cot x}{1 - y\log \sin x}$

d. None of the above

40. Using Rolle's theorem the equation $a_0x^n + a_1x^{n-1} + \ldots + \ldots + a_n = 0$ has atleast one root between 0 and 1 if

a. $\frac{a_0}{n} + \frac{a_1}{n-1} + \ldots + a_{n-1} = 0$

b. $\frac{a_0}{n-1} + \frac{a_1}{n-2} + \ldots + a_{n-2} = 0$

c. $na_0 + (n-1)a_1 + \ldots + a_{n-1} = 0$

d. $\frac{a_0}{n+1} + \frac{a_1}{n} + \ldots + a_n = 0$

41. Taylor's expansion of the function $f(x) = \frac{1}{1+x^2}$ is

a. $\sum_{n=0}^{\infty} (-1)^n x^{2n}$ for $-1 < x < 1$

b. $\sum_{n=0}^{\infty} (-1)^n x^{2n}$ for all real x

c. $\sum_{n=0}^{\infty} x^{2n}$ for $-1 < x < 1$

d. $\sum_{n=0}^{\infty} (-1)^n x^{n}$ for $-1 < x < 1$

42. If $f(x) = x^3 - 6x^2 - 36x + 7$, then $f(x)$ increases with x for the range of the values

a. $x < -1$ and $x > 5$

b. $x < -2$ and $x > 6$

c. $x < -3$ and $x > 3$

d. $x < -4$ and $x > 1$

43. The sum of the perimeters of a circle and a square is l. If the sum of the areas is least, then

a. side of the square is double the radius of the circle

b. side of the square is $\frac{1}{2}$ of the radius of the circle

c. side of the square is equal to the radius of the circle

d. None of the above

44. If $u = \left(\frac{y}{x}\right)$, then :

a. $x\frac{\partial u}{\partial x} - y\frac{\partial u}{\partial y} = 0$

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

c. $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2u$

d. $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \ldots$

45. Consider the following statements:

Assertion (A): For $x = r\cos\theta$, $y = r\sin\theta$, $\frac{\partial x}{\partial r} = 1\Big/\frac{\partial r}{\partial x}$ and $\frac{\partial x}{\partial \theta} = 1\Big/\frac{\partial \theta}{\partial x}$

Reason (R): $\frac{dy}{dx} = 1\Big/\frac{dy}{dx}$ of these statements

a. Both A and R are true, and r is the correct explanation of A

b. Both A and R are true, but R is not a correct explanation of A

c. A is true, but R is false

d. A is false, but R is true

46. The length of the subnormal to the curve $y = x^3$ at (2, 8) is:

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

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

c. 96

d. None of the above

47. If the normal to the curve $y^2 = 5x - 1$, at the point (1, -2) is of the form $ax - 5y + b = 0$, then a and b are

a. 4, -14

b. 4, 14

c. -4, 14

d. -4, -14

48. If $y = \frac{2}{1-x^2}$, then which one of the following does not hold?

a. x = 1 is a vertical asymptote for the curve

b. x = -1 is a vertical asymptote for the curve

c. y = 0 is a horizontal asymptote for the curve

d. y = 2 is a horizontal asymptote for the curve

49. If the functions u, v, w of three independent variables, x, y, z are not independent, then the Jacobian of u, v, w with respect to x, y, z is always equal to

a. 1

b. 0

c. the Jacobian of x, y, z with respect to u, v, w

d. infinity

50. The radius of curvature of the curve $y = e^x$ at the point where it crosses the y-axis is

a. 2

b. $\sqrt{2}$

c. $2\sqrt{2}$

d. $\frac{1}{2}\sqrt{2}$

51. The curve $y = x^3 - 3x^2 - 9x + 9$ has a point of inflextion at

a. x = - 1

b. x = 1

c. x = - 3

d. x = 3

52. As $n \to \infty$, the expression $\frac{1}{n}\left(\sin 0 + \sin\frac{\pi}{2n} + \sin\frac{2\pi}{2n} + \sin\frac{3\pi}{2n} + \sin\frac{4\pi}{2n} + \ldots + \sin\frac{(n-1)\pi}{2n}\right)$ *tends to*

a. 1

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

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

d. $\frac{\pi^2}{6}$

53. If $f(x) = \int_0^{x^2} \sqrt{(\sin t + \cos t)}\,dt$, then the derivative of $f(x)$ w.r.t. x is

a. $\sqrt{(\sin x^2 + \cos x^2)}$

b. $2x\sqrt{(\sin x^2 + \cos x^2)}$

c. $\frac{2x(-\sin x^2 + \cos x^2)}{\sqrt{(\sin x^2 + \cos x^2)}}$

d. None of the above

54. The value of the integral $\int_0^{\infty} \frac{x^2}{2^x}\,dx$ is

a. 2 log 2

b. 2

c. $(\log 2)^{-2}$

d. $2(\log 2)^{-3}$

55. The segment of the circle $x^2+y^2=a^2$ cut of f by the chord x = b(0<b<a) revolves about the x-axis and generates the solid known as a segment of a sphere. The volume of this solid is

a. $\frac{\pi(a [illegible])^2(2a+b)}{3}$

b. $\frac{\pi(a-b)^2(2a+b)}{3}$

c. $\frac{\pi(2a+b)^2(a-b)}{3}$

d. $\frac{\pi(a+b)^2(2a-b)}{3}$

56. The length of the arc of the curve $6xy = x^4 + 3$ from x = 1 to x = 2 is

a. $\frac{13}{12}$ units

b. $\frac{17}{12}$ units

c. $\frac{19}{12}$ units

d. None of the above

57. The series $\sum \frac{n!\,2^n}{n^n}$ is

a. Convergent

b. Divergent

c. conditional convergent

d. none of the above

58. The series $\sum \frac{4.7.\ldots\ldots(3n+1)}{1.2.\ldots\ldots n} x^n$ is convergent, if

a. $|x| < 1$

b. $|x| < \frac{1}{3}$

c. $|x| < \frac{1}{4}$

d. $|x| < \frac{1}{2}$

59. The series $\frac{2}{1^2} - \frac{3}{2^2} + \frac{4}{3^2} - \frac{5}{4^2} + \dots$ is

a. conditional convergent
b. absolutely convergent
c. divergent
d. none of the above

60. Let Σu_n be a series of positive terms. Given that Σu_n is convergent and also $\lim_{n \to \infty} \frac{u_{n+1}}{u_n}$ exists, then the said limit is

a. necessarily equal to 1
b. necessarily greater than 1
c. may be equal to 1 or less than 1
d. necessarily less than 1

61. A solution curve of the equation $xy' = 2y$, passing through (1, 2), also passes through

a. (2, 1)
b. (0, 0)
c. (4, 24)
d. (24, 4)

62. An integral curve of the differential equation $x(4ydx+2xdy)+y^3(3ydx+5xdy)=0$ is

a. $x^4y^2 + x^3y^5=1$
b. $x^4y^2+x^3y^4=1$
c. $x^3y^3+x^4y^3=1$
d. $x^2y^4+x^3y^4=1$

63. The integrating factor of $y^2dx+(1+xy)dy=0$ is

a. e^{y}
b. e[illegible]
c. e[illegible]
d. e^{xy}

64. The singular solution of the equation $y=\frac{2}{3}x\frac{dy}{dx}-\frac{2}{3x}\left(\frac{dy}{dx}\right)^2$, x>0 is ??

a. $y = \pm x^2$
b. $y = x^3/6$
c. $y = x$
d. $y = y^2/6$

65. The orthogonal trajectories of the hyperbola xy = C is

a. $x^2 - y^2=C$
b. $x^2 = Cy^2$
c. $x^2 + y^2 = C$
d. $x = Cy^2$

66. The first order differential equation of the family of circles of fixed radius r with centers on the x-axis is

a. $y^2\left(\frac{dy}{dx}\right)^2 + y^2 = r^2$
b. $y^2 + \left(\frac{dy}{dx}\right)^2 = r^2$
c. $x^2\left(\frac{dy}{dx}\right)^2 + y^2 = r^2$
d. $y^2 - \left(\frac{dy}{dx}\right)^2 = r^2$

67. The particular integral of $(D^2+a^2)y = \sin ax$ $\left(D \equiv \frac{d}{dx}\right)$ is

a. $-\frac{x}{2a}\cos ax$
b. $\frac{x}{2a}\cos ax$
c. $-\frac{ax}{2}\cos ax$
d. $\frac{ax}{2}\cos ax$

68. A particular integral of the differential equation $\frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = \cos x + 3\sin x$ is

a. sin x
b. cos x
c. − sin x
d. − cos x

69. If y = x is a solution of $x^2y'' + xy' - y = 0$, then the second linearly independent solution of the above equation is

a. 1/x
b. x^2
c. x^{-2}

d. x^n

70. The primitive of the differential equation $(D^2 - 2D + 5)^2 y = 0$, $\left(where\ D = \frac{d}{dx}\right)$ is

a. $e^x\{(C_1+C_2x)\cos 2x+(C_3+C_4x)\sin 2x\}$

b. $e^{2x}\{(C_1+C_2x)\cos x + (C_3+C_4x)\sin s\}$

c. $(C_1e^x+C_2e^{2x})\cos x + (C_3e^x+C_4e^{2x})\sin x$

d. $e^x\{C_1\cos x + C_2\cos 2x+C_3\sin x + C_4\sin 2x\}$

71. The straight line ax + by + c = 0 and the co-ordinate axes form an isosceles triangle when

a. |a| =|b|

b. |a|=|c|

c. |b|=|c|

d. None of the above

72. If the distances of the lines

$x \sin\theta + y \cos\theta = \frac{1}{2} a \sin 2\theta$

and $x \cos\theta - y \sin\theta = a \cos 2\theta$

from the origin are p and q respectively, then the relation among p, q, a is

a. $4q^2 + p^2 = a^2$

b. $4p^2 + q^2 = a^2$

c. $p^2 + q^2 = a^2$

d. $p^2 - q^2 = a$

73. The angle between the pair of straight lines $(a^2- 3b^2)x^2-8abxy+(b^2-3a^2)y^2 = 0$ is

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

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

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

d. $\tan^{-1}\frac{b}{a}$

74. The equation of the line perpendicular to p = r cos (θ- α) is

a. p′= r cos (θ + α)

b. p′= r sin (θ - α)

c. p′ = - r sin (θ - α)

d. p′= - r cos (θ + α)

75. If the extremities of a diameter of a circle are A(-3, 7) and B(5, 1) , then the equation of the circle is

a. $x^2 + y^2 + 2x + 8y + 8 = 0$

b. $x^2 + y^2 - 2x - 8y - 8 = 0$

c. $x^2 + y^2 - 2x + 8y + 8 = 0$

d. $x^2 + y^2 + 2x - 8y + 8 = 0$

76. If a circle touches x-axis and cuts off a constant length $2l$ from the y-axis ,then the locus of its center is

a. $y^2 - x^2 = l^2$

b. $y^2 + x^2 = l^2$

c. $y = x + 2l$

d. $y = x + l$

77. The equation to the pair of tangents drawn from the origin to the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ is

a. $(gx - fy)^2 = c(x^2 + y^2)$

b. $(gx + fy)^2 = c(x^2 + y^2)$

c. (gx + fy) (gx- fy) = 0

d. None of the above

78. The radical axis of the circles $x^2 + y^2 = 2x$ and $2x^2 + 2y^2 - 3y = 5$ is

a. 4x + 3y + 5 =0

b. 4x – 3y + 5=0

c. $x^2 + y^2 + 2x - 3y - 5 = 0$

d. –4x + 3y + 5 = 0

79. The circles whose equations are

$x^2 + y^2 + 2\lambda x + c = 0$ and

$x^2 + y^2 + 2\mu y + d = 0$ are orthogonal is

a. λ + μ = 0

b. c+d = 0

c. λ + μ = c + d

d. $\lambda^2 - c = \mu^2 - d$

80. Match list I and List II and select the correct answer using the codes given below the lists:

List I

(Polar equation of curve)

A. $r^2 \sin 2\theta + a^2 = 0$

B. 2a/r = 1+ cos θ

C. r sin θ+ a = 0

D. r = a/2 cosθ

List II

(Identification of curve)

1. Rectangular hyperbola
2. Circle
3. Straight line
4. Parabola
5. Ellipse

Codes:

	A	B	C	D
a.	1	4	3	2
b.	1	4	3	5
c.	1	5	3	2
d.	5	4	3	2

81. The equation of the tangent to the hyperbola $xy = c^2$ at the point (x_1, y_1) is
   a. $xy_1 + yx_1 = 2c^2$
   b. $xy_1 + yx_1 = c^2$
   c. $xx_1 + yy_1 = c^2$
   d. $xx_1 + yy_1 = 2c^2$

82. The coordinates of the points of intersection of the line $\frac{x+1}{1} = \frac{y+3}{3} = \frac{z+2}{-2}$ with the plane $3x+4y+5z= 5$ is
   a. (5, 15, -14)
   b. (3,4,5)
   c. (1,3, -2)
   d. (3, 12, -10)

83. The plane $ax + by + cz = 0$ cuts the cone $xy+yz + zx = 0$ a perpendicular lines if
   a. $a+b+c=0$
   b. $\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=0$
   c. $a^2+b^2+c^2=0$
   d. $abc = 0$

84. The equation $x^2+y^2+z^2+xy+yz-zx=9$ represents
   a. a sphere with $x^2+y^2+z^2=9$, $x- y + z= 3$ as a great circle
   b. a cone with $x^2+y^2+z^2=9$, $x- y+z=3$ as a guiding circle
   c. a cylinder with $x^2+y^2+z^2=9$, $x- y +z =3$ as a guiding circle
   d. None of the above

85. The equation of a right circular cylinder , whose axis is the z-axis and radius 'a', is
   a. $x^2+z^2+y^2 =a^2$
   b. $z^2+y^2=a^2$
   c. $x^2+y^2=a^2$
   d. $z^2+x^2=a^2$

86. Match list I and List II and select the correct answer using the codes given below the lists:

List I

A. If $\vec{a}= a_1 i +a_2 j+a_3k$ and $\vec{b}=b_1 i+b_2 j+b_3k$ then $\vec{a}\times b$

B. If $\vec{a}=a_1 i +a_2 j+ a_3k$ $\vec{b}=b_1i+b_2j+b_3k$ and $\vec{c}= c_1i +c_2 j + c_3k$ then [a b c]

C. Moment of a force about a point

D. The scalar triple product [a b c]

List II

1. $\begin{vmatrix} i & j & k \\ b_1 & b_2 & b_3 \\ a_1 & a_2 & a_3 \end{vmatrix}$

2. $\begin{vmatrix} i & j & k \\ b_1 & b_2 & b_3 \\ a_1 & a_2 & a_3 \end{vmatrix}$

3. $\begin{vmatrix} i & j & i \\ b_3 & b_2 & b_1 \\ a_3 & a_2 & a_1 \end{vmatrix}$

4. $\begin{vmatrix} i & j & k \\ b_1 & b_2 & b_3 \\ a_1 & a_2 & a_3 \end{vmatrix}$

5. $\begin{vmatrix} i & j & k \\ b_1 & b_2 & b_3 \\ a_1 & a_2 & a_3 \end{vmatrix}$

6. $\begin{vmatrix} i & j & k \\ b_1 & b_2 & b_3 \\ a_1 & a_2 & a_3 \end{vmatrix}$

7. A scalar quantity
8. A vector quantity
9. Zero
10. None zero

Codes

	A	B	C	D
a.	3	4	7	10
b.	2	6	8	9
c.	1	4	7	10
d.	2	5	8	9

87. The resultant of two forces acting on a particle is at right angles to one of them and its magnitude is one –third of the

magnitude of the other. The ratio of the larger force to the smaller is

a. $3:2\sqrt{2}$

b. $3\sqrt{3}:2$

c. 3:2

d. 4:3

88. Two like parallel forces P and Q(P> Q) act on a rigid body. If the force P is displaced parallel to itself through a distance d, then the resultant of the forces P and Q would be shifted by a distance

a. $\frac{Pd}{P+Q}$

b. $\frac{Pd}{P-Q}$

c. $\frac{Qd}{P-Q}$

d. $\frac{Qd}{P+Q}$

89. If A, B, C are three forces in equilibrium acting at a point and if 60^0, 150^0 and 150^0 respectively denote the angles between A and B , B and C and C and A, then the forces are in proportion of

a. $\sqrt{3}:1:1$

b. $1:1:\sqrt{3}$

c. $1:\sqrt{3}:1$

d. 1:2.5 : 2.5

90. A string ABC has its extremities tied to two fixed points A and B in the same horizontal line. If a weight W is knotted at a given point C then the tension in the portion CA is (where a, b, c are the sides and Δ is the area of triangle ABC)

a. $\frac{Wb}{[illegible]}([illegible]^2+b^2 [illegible] c^2)$

b. $\frac{W[illegible]}{4[illegible]}(b^2+c^2-a^2)$

c. $\frac{Wb}{4c\Delta}(c^2+a^2-b^2)$

d. $\frac{Wb}{4c\Delta}(a^2+b^2-c^2)$

91. A train starts from rest from a station with constant acceleration for 2 minutes and attains a constant speed. If then runs for 11 minutes at this speed and retards uniformly during the next 3 minutes and stops at the next station which is 9km off. The maximum speed (in km.ph) attained by the train is

a. 30

b. 35

c. 40

d. 45

92. A bullet of mass 0.01 kg is fired from a rifle of mass 20kg with a speed of 100m/s. Velocity of recoil of the rifle (in m/s) is

a. 1

b. 0.05

c. 20

d. 0.01

93. The periodic time of a planet moving under inverse square law of acceleration is

a. $\pi a\sqrt{\frac{a}{\mu}}$

b. [illegible]

c. $2\pi a\sqrt{\frac{a}{\mu}}$

d. $\pi\sqrt{\frac{a}{\mu}}$

94. The pedal equation of the path of a central orbit is

a. $F=\frac{h^2}{p^3}\frac{dp}{dr}$

b. $F=\frac{p^2}{h^2}\frac{dr}{dp}$

c. $F=\frac{h^2}{p^3}\frac{dp}{dr}$

d. None of the above

95. A ball of mass m is suspended from a fixed point O by a light string of natural length l an d modulus of elasticity λ. If the ball is displaced vertically, its motion will be simple harmonic of period

a. $2\pi\sqrt{\frac{ml}{\lambda}}$

b. $2\pi\sqrt{\frac{ml}{\lambda}}$

c. $2\pi\sqrt{\frac{l}{m\lambda}}$

d. $2\pi\sqrt{\frac{\lambda m}{l}}$

96. If the differential equation of a particle executing simple harmonic motion about a point is

$$\frac{d^2x}{dt^2} + \mu x = 0$$

where is some constant of proportionality, then consider the following statements

1. Frequency of oscillation is $\sqrt{\frac{\mu}{\pi}}$
2. Maximum velocity of the particle is $\sqrt{\mu . a}$ where 'a' is the distance of the mean position from the point from where it starts moving
3. If the point from which the particle starts moving is altered there will be change in the time period of oscillation.

Of these statements

a. 1, 2 and 3 are correct
b. 1 and 2 are correct
c. 2 and 3 are correct
d. 1 and 3 are correct

97. Two balls are projected simultaneously with the same velocity from the top of a tower, one vertically upwards and the other vertically downwards. If they reach the ground in times t_1 and t_2, then the height of the tower is

a. $\frac{1}{2}g\, t_1\, t_2$
b. $\frac{1}{2}g(t_1^2+t_2^2)$
c. $\frac{1}{2}g(t_2^2 - t_1^2)$
d. $\frac{1}{2}g($ [illegible] $)$

98. A particle moves so that its position vector is given by $\vec{r}$ = cos ωt $\hat{i}$ +sin ωt $\hat{j}$ (where ω a constant). The velocity of the particle is

a. perpendicular to $\vec{r}$
b. parallel to $\vec{r}$
c. in a direction making an angle ω with the direction of $\vec{r}$
d. in a direction making an angle π/4 with the direction of $\vec{r}$

99. If a particle starts from rest at the highest point of a smooth vertical circular wire of radius 'a' ,then

1. the particle leaves the wire at a depth 2a/3 from the highest point
2. the tangent at the point on the circle, where the particle leaves the wire, makes with the horizontal an angle $\cos^{-1}(2/3)$
3. the subsequent parabolic path has latus rectum 16/27
4. the velocity of the particle at any height 'h' from the lowest point is $\sqrt{gh}$

Select the correct answer using the codes given below

Codes:

a. 1, 2, 3 and 4
b. 1, 2 and 3
c. 1 and 3
d. 2 and 4

100. If a satellite launched from the surface earth ,then which of the following statements are correct?

1. The velocity of escape is ten kilometers per second
2. The satellite will describe a parabolic path if it's velocity equals the escape velocity
3. The satellite can describe a circular orbit round earth when it's velocity is seven kilometers per second.
4. The satellite will describe a hyperbolic path if velocity exceeds escape velocity.

Select the correct answer from the codes given below:

Codes:

a. 1,2 and 3
b. 1,2,3 and 4
c. 2, 3 and 4
d. 2 and 4