MATHEMATICS

1. If I, N, R, Q denotes respectively the sets of integers natural numbers, real numbers and rational numbers, then consider the following statements
   1. $I \subset N \subset Q \subset R$
   2. $I \subset Q$ and $N \subset R$
   3. $I \subset R$, $N \subset Q$

   Of these statements
   a. 1, 2, 3 are correct
   b. 1 alone is correct
   c. 2 alone is correct
   d. 2 and 3 are correct

2. If p is real number such that $0 < p < 1$ and x and y are real numbers with $x < y$, then
   a. $p^x < p^y$
   b. $p^x > p^y$
   c. $p^y > p^x > 1$
   d. $p^y > 1 > p^x$

3. The real part of $(\sin x + i \cos x)^5$ is equal to
   a. $-\cos 5x$
   b. $-\sin 5x$
   c. $\sin 5x$
   d. $\cos 5x$

4. The modulus of $\frac{1+2i}{1-(1-i)^2}$ is equal to
   a. 1
   b. $\sqrt{5}$
   c. [illegible]
   d. 5

5. If a, b are any two integers and $b \neq 0$, then there exist a unique pair of integers q, r such that $a = bq + r$, where
   a. $0 \le r \le |b|$
   b. $0 \le |r| < |b|$
   c. $0 \le r < |b|$
   d. $-|b| \le r \le |b|$

6. For any positive integers n and m, the least positive number in the set $\{xn + ym | x$ and y are integers$\}$ is
   a. l. c. m{n, m}
   b. h. c. f.{n, m}
   c. $n + m$
   d. nm

7. If the gcd of a and b is denoted by (a, b) then consider the following statements
   1. if $(a, b) = d$, $a = a_1 d$, $b = b_1 d$ then $(a_1, b_1) = 1$
   2. if $(a, c) = d > 1$, $a | b$, $c | b$ then $ac | b$.
   3. if $(a, b) = 1$, $a | c$ and $b | c$, then $ab | c$.

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

8. If $f(x) = 2x + 4x^2$, $g(x) = 2 + 6x + 4x^2$ are polynomials in K[X], where K is the ring of integers modulo 8 then the degree of f(x) g(x) is
   a. 1
   b. 2
   c. 3
   d. 4

9. If $x^3 + 5x^2 - 3x + 2$ is divided by $x + 1$, then the remainder will be
   a. 5
   b. 9
   c. 10
   d. 11

10. If α, β, γ are the roots of $2x^3 - 3x^2 + 6x + 1 = 0$, then $\alpha^2 + \beta^2 + \gamma^2$ is
    a. $\frac{15}{4}$
    b. -3
    c. $-\frac{15}{4}$
    d. $\frac{33}{4}$

11. If the roots of the equation $x^n-1=0$ are 1, $\alpha_1, \alpha_2, \ldots, \alpha_{n-1}$ then $(1-\alpha_1)(1-\alpha_2)\ldots(1-\alpha_{n-1})$ is equal to

a. 0

b. 1

c. n

d. n+1

12. If for the equation $x^3-3x^2+kx+3=0$, one root is the negative of another , then the value of k is

a. 3

b. –3

c. 1

d. –1

13. If A={a, b,c} ,then the number of proper subsets of A is

a. 5

b. 6

c. 7

d. 8

14. Consider the following statements with regard to a relation R in real numbers defined by $xRy \Leftrightarrow 3x+4y=5$

1. 0R1

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

3. $\frac{2}{3}R\frac{3}{4}$

4. $\frac{3}{2}R\frac{1}{4}$

Of these statements

a. 2 and 3 are correct

b. 1 and 2 are correct

c. 3 and 4 are correct

d. 1 and 4 are correct

15. If α is a mapping of S into T and β is a mapping of T into S such that αβ= 1 and βα= 1, where 1 denotes the identity mapping then α and β are

1. 1- 1 mappings

2. Not onto

3. $\beta = \alpha^{-1}$

Select the correct answer the below:

Codes:

a. 1 and 2

b. 1 and 3

c. 2 and 3

d. 1, 2 and 3

16. Consider the following function, of which one of the more functions may be injectious ,from Z into Z.

1. $x \to x^2$

2. $x \to 2x$

3. $x \to 2+x$

Select the functions which are 1-1 using the codes given below.

Codes:

a. 1, 2 and 3

b. 1 and 2

c. 1 and 3

d. 2 and 3

17. If R={(x,y,)|x, y are integers such that x-y is divisible by 5} ,then R is

a. not a relation

b. an anti-symmetric relation

c. an equivalence relation

d. a relation which is not reflexive

18. Let <Z, + ,• > be the ring of integers . Define a R b iff a-b is even, then the relation R is

a. reflexive only

b. reflexive and symmetric only

c. symmetric and transitive only

d. an equivalence relation

19. Which one of the following is an example of non commutative ring?

a. Residue class ring mod 6

b. 2 × 2 matrices over a field

c. the ring of polynomials over Z_6

d. the ring of Gaussian integers

20. Consider the following statements :

1. every cyclic group is abelian

2. every abelian group is cyclic

3. there is atleast one abelian group of every finite order n>0

4. every group of order <4 is cyclic

Of these statements

a. 2 alone is correct

b. 1, 3 and 4 are correct

c. 1 and 4 are correct

d. 1 and 3 are correct

21. In the group S_3 of all permutations of 1, 2, 3 the inverse of $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix}$ is

a. $\begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix}$

b. $\begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{pmatrix}$

c. $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$

d. $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix}$

22. F is a field containing n elements. If $n \in \{122, 123, 124, 125\}$, then

a. n = 122

b. n = 123

c. n = 124

d. n = 125

23. Let I be the set of all integers and let * be a binary operation in I defined by a*b = a + b + 10 ∀a, b∈I, then (I,*) is an abelian group. The identity element of this group is

a. 0

b. 10

c. –10

d. 1

24. Consider the group (Z_7 , ⊗) of non-zero residue classes, under multiplication modulo 7. If [X] ∈Z_7 is such that [2] ⊗[X] = [illegible] , then which one of the following is correct?

a. [X]=[3]

b. [X] =[4]

c. [X]= [5]

d. [X] = [6]

25. Consider the following statements relating to matrix operations :

1. if A is a m × n matrix, then B has to be n × m matrix for AB and BA to be defined

2. If (A+ B) and AB are defined ,then A and B must be square matrices of the same order

3. If AB and BA are both defined, then AB= O implies BA= O where O is the null matrix

Of these statements

a. 1 and 2 are correct

b. 1 and 3 are correct

c. 2 and 3 are correct

d. 1, 2 and 3 are correct

26. If $2\begin{bmatrix} x & y \\ z & p \end{bmatrix} + 9\begin{bmatrix} -2 & 2 \\ 1 & [illegible] \end{bmatrix} = 18I$ where I is the identity matrix, then the values of x and y are

a. x = 0, y = [illegible]

b. x = 0, y = 0

c. x = 18, y = 2

d. x = [illegible], y = - 9

27. If $\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} = 0$,then one of the values of x is

a. (a + b+ c)

b. –(a+b+c)

c. $(a^2+b^2+c^2)$

d. $(a^3+b^3+c^3)$

28. Consider the following statements relating to any two matrices A and B such that AB is defined:

1. $(AB)^{-1}= B^{-1}A^{-1}$

2. $(AB)^T=B^TA^T$

3. Rank (AB)≤min (Rank A, Rank B)

Here A^T is the transpose and A^{-1} denotes the inverse of A

Of these statements

a. 1, 2 and 3 are correct

b. 1 and 2 are correct

c. 1 and 3 are correct

d. 2 and 3 are correct

29. If $A = \begin{pmatrix} -1 & 2 \\ 3 & -5 \end{pmatrix}$, then its inverse is

a. $\begin{pmatrix} -5 & -2 \\ -3 & -1 \end{pmatrix}$

b. $\begin{pmatrix} 5 & 2 \\ 3 & 1 \end{pmatrix}$

c. $\begin{pmatrix} -5 & 2 \\ 3 & -1 \end{pmatrix}$

d. $\begin{pmatrix} 3 & 3 \\ 2 & 1 \end{pmatrix}$

30. The system of equations

$x - y + 3z = 0$

$x + z = 0$

$x + y - z = 0$ has

a. a unique solution
b. finitely many solutions
c. infinitely many solutions
d. no solution

31. The set Q of not rational numbers is

a. Ordered and complete
b. Neither ordered nor complete
c. Ordered but not complete
d. Complete but not ordered

32. Which one of the following statements is not correct

a. every bounded and infinite sequence of real numbers has at least one limit point
b. every convergent real number sequence is bounded
c. every monotonic real number sequence is convergent
d. every increasing sequence of positive numbers diverges or has a single limit point

33. f is a function from R to R and 'a' is a real number. If f is given to be continuous at x =a , then $\lim_{x \to a} f(x)$

a. never exists
b. may or may not exist
c. always exists and is equal to f(a)
d. always exists but may or may not be equal to f(a)

34. A continuous function f from a bounded closed interval [a, b] to R

a. is always unbounded
b. may be bounded or unbounded
c. is always bounded and attains its bounds
d. is always bounded but may or may not attain its bounds

35. $\frac{d}{dx}\left(\arcsin\sqrt{\frac{x-\beta}{\alpha-\beta}}\right)$, $\alpha > x > \beta$ is equal to

a. $\frac{1}{\sqrt{(\alpha-x)(x-\beta)}}$

b. $\frac{1}{2(\alpha-x)(x-\beta)}$

c. $\frac{1}{(\alpha-x)(x-\beta)}$

d. $\frac{1}{2\sqrt{(\alpha-x)(x-\beta)}}$

36. The function f defined on A = (0 , 1) ∪ (2, 3) by f(x) = 1 if 0< x < 1 and f (x)= 2 if 2<x<3 is

a. not differentiable at some points of A
b. differentiable on A but f '' does not exist at some points of A
c. derivatives of all orders exist and are equal to zero though f is not a constant function
d. not a function that has the properties (a), (b) or (c)

37. A cube is expanding in such a way that its edge is changing at a rate of 5cm/sec. If its edge is 4 cm long, then the rate of change of its volume is

a. 100 cm^3/sec
b. 120 cm^3/sec
c. 180 cm^3/sec
d. 240 cm^3/sec

38. The derivative of the function f (x) = $\log^{x} x^{x}$ w.r.t. x is

a. $\frac{(\ln 3)}{2x(\ln x)^2}$

b. $\frac{2(\ln 3)}{x(\ln x)^2}$

c. $\frac{(\ln 3)}{2x(\ln x)^2}$

d. $\frac{(\ln 3)}{2x(\ln x)^2}$

39. If f(x) = e^{x} and g(x)=ln x then (gof)'(x) is equal to

a. 0
b. 1
c. E

d. 1+e

40. If $\frac{x}{y}+\frac{y}{x}=2$, then $\frac{dy}{dx}$ is

a. 1

b. 2

c. -1

d. -2

41. If $f(x) = ax + b$, $x \in [-1,1]$, then the point $c \in (-1,1)$ where $f'(c) = \frac{f(1)-f(-1)}{2}$

a. does not exist

b. can be any $c \in (-1,1)$

c. can be only $\frac{1}{2}$

d. can be only $-\frac{1}{2}$

42. If $f(x) = (1-x)^{5/2}$ and $f(x) = f(0) + xf'(0) + \frac{x^2}{2!} f''(\theta x)$, then the value of θ as $x \to 1$ is

a. $\frac{1}{5}$

b. $\frac{4}{5}$

c. $\frac{9}{25}$

d. $\frac{16}{25}$

43. The maximum and minimum values of $\left(x^4 - \frac{2}{3}x^3 - 2x^2 + 2x\right)$ in the interval [0, 3] are respectively

a. 51 and 0

b. $\frac{23}{48}$ and 0

c. $\frac{1}{}$ and 0

d. [illegible] and $\frac{1}{3}$

44. The equation of the asymptote to the curve $x^3+y^3=3axy$ is

a. $x+y=3a$

b. $x+y=-a$

c. $x+y=-2a$

d. $x+y=-3a$

45. The length of the subtangent of the rectangular hyperbola $x^2-y^2=a^2$ at the point $(a, \sqrt{2}\,a)$ is

a. $\sqrt{2}\,a$

b. $\frac{a^{3/2}}{\sqrt{2}}$

c. $2a$

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

46. The normal to the parabola $x^2 = 4ay$ at the point (2a, a) on it cuts the parabola again at the point whose coordinates are

a. (-2a , a)

b. (-4a, 4a)

c. (-6a , 9a)

d. (-8a , 16a)

47. If z be a function of x and y , then consider the following statements:

A. $\frac{\partial^2 z}{\partial x \partial y} = \frac{\partial^2 z}{\partial y \partial x}$ at the point x = a, y = b.

B. The partial derivatives $\frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$ are both continuous in x and y at the point x = a, y = b.

Of the above

a. statements A implies and is implied by statement B

b. it is possible that A is true but B is false, but if B is true then A is necessarily true

c. it is possible that A is false but B is true , but if A is true then B is necessarily true

d. it is possible that A is true that B is false and it is also possible that B is true but A is false

48. If $u = \sin^{-1}\left(\frac{x^{1/3}+y^{1/3}}{x^{1/2}+y^{1/2}}\right)^{1/2}$ then $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}$ is

a. $\frac{1}{12}\tan u$

b. $-\frac{1}{12}\tan u$

c. $\frac{12}{\tan u}$

d. $\frac{-12}{\tan u}$

49. The point of inflextion on the curve $a^2y^2=x^2(a^2-x^2)$ is

a. (0, 0)

b. $\left(\sqrt{\frac{3}{2}}, a, 0\right)$

c. $\left(-\sqrt{\frac{3}{2}}, a, 1\right)$

d. (1, 1)

50. If $y = x^4 + 2x^3 - 4x + 4$, then which one of the following statements is correct?

a. y is increasing for $x < -2$

b. y is decreasing for $-2 < x < -\frac{1}{2}$

c. y is decreasing for $-\frac{1}{2} < x < 1$

d. y is decreasing for $x > 1$

51. If f is a continuous function , then $\lim_{n\to\infty} \sum_{r=0}^{n-1} \left\{ f\left(\frac{r}{n}\right) \right\} \frac{1}{n}$ can be expressed as

a. $\int_0^1 f\left(\frac{1}{x}\right) dx$

b. $\int_0^1 f(x) dx$

c. $\int_0^1 x\, f(x) dx$

d. $\int_0^1 \frac{1}{x} f\left(\frac{1}{x}\right) dx$

52. If f (x) is continuous in [a, b] and F(x) is any function such that $F'(x) = f(x)$, then

a. $\int_a^b F(x)dx = f(b) - f(a)$

b. $\int_a^b F(x)dx = f(a) - f(b)$

c. $\int_a^b f(x)dx = F(b) - F(a)$

d. $\int_a^b f(x)dx = F(a) - F(b)$

53. If $f(x) = f(2a - x)$, then $\int_0^{2a} f(x)dx$ is

a. $2\int_0^a f(x)dx$

b. $-2\int_0^a f(x)dx$

c. $\int_a^b f(2a - x)dx$

d. 0

54. $\int_0^{\pi/2} \frac{\sin^{3/2} x}{\sin^{3/2} x + \cos^{3/2} x} dx$ is equal to

a. 0

b. 1

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

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

55. The value of the definite integral $\int_{-a}^{a} |x| dx$ is equal to

a. a

b. a^2

c. 0

d. 2a

56. The length of the cycloid with parametric equation x(t)=(t+sin t), y(t)=(1-cos t) between (0, 0) and (π, 2) is

a. 4 units

b. [illegible]π units

c. 2 units

d. $\frac{\pi}{2}$ units

57. Volume generated by the revolution of the curve $r = a(1 - \cos\theta)$ is

a. $\frac{32}{3}\pi a^2$

b. $\frac{32}{5}\pi a^2$

c. $\frac{32}{7}\pi a^2$

d. $\frac{32}{9}\pi a^2$

58. The series $\sum_{n=0}^{\infty} (2x)^n$ converges

a. for x with $-1 \le x \le 1$

b. for x with $-\frac{1}{2} < x < \frac{1}{2}$

c. for x with $-2 < x < 2$

d. for x with $-\frac{1}{2} \le x \le \frac{1}{2}$

59. If p and q are positive real numbers, then the series $\frac{2^p}{1^q} + \frac{3^p}{2^q} + \frac{4^p}{3^q} + \dots$ is convergent for

a. $p < q - 1$

b. $p < q + 1$

c. $p \ge q - 1$

d. $p \geq q+1$

60. Which of the following series is not convergent ?

a. $\frac{1}{2\sqrt{2}}+\frac{1}{3\sqrt{3}}+\frac{1}{4\sqrt{4}}+\ldots$

b. $1. \frac{1}{2}-1\ \frac{1}{3}+1\ \frac{1}{4}-1\ \frac{1}{5}+\ldots\ldots$

c. $\frac{1}{2}-\frac{1}{3}+\frac{1}{4}-\frac{1}{5}+\ldots$

d. $x+x^2+x^3+x^4+\ldots\ldots$ where $|x|<1$

61. The general solution of the differential equation $(x+a)\,p^2+(x-y)p-y=0$ is

a. $y=cx+\frac{ac^2}{c+1}$

b. $y=cx-\frac{ac^2}{c+1}$

c. $y=-cx+\frac{ac^2}{c+1}$

d. $y=-cx-\frac{ac^2}{c+1}$

62. The homogeneous differential equation $M(x, y)dx+N(x, y)\,dy=0$ can be reduced to a differential equation, in which the variables are separated ,by the substitution

a. $y=vx$

b. $xy=v$

c. $x+y=v$

d. $x-y=v$

63. The solution of the differential equation $\frac{dy}{dx}+\frac{y}{x}=x^2$ under the condition that $y=1$ when $x=1$ is

a. $4xy=$ [illegible]

b. $4xy=y^4+3$

c. $4x$[illegible]$^2+3$

d. 4[illegible]$=y^3+3$

64. The singular solution of $(xp-y)^2=p^2-1$, where p has the usual meaning is

a. $x^2+y^2=1$

b. $x^2-y^2=1$

c. $x^2+y^2=2$

d. $x^2-y^2=2$

65. The family of straight lines passing through the origin is represented by the differential equation

a. $ydx+xdy=0$

b. $xdx+ydy=0$

c. $xdy-ydx=0$

d. $ydy-xdx=0$

66. The equation $y-2x=c$ represents the orthogonal trajectories of the family

a. $y=Ce^{-2x}$

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

c. $xy=C$

d. $x+2y=C$

67. The differential equation of a family of circles having the radius r and center on the x-axis is

a. $y^2\left[1+\left(\frac{dy}{dx}\right)^2\right]=r^2$

b. [illegible]$^2\left[1+\left(\frac{dy}{dx}\right)\right]=r^2$

c. $(x^2+y^2)\left[1+\left(\frac{dy}{dx}\right)^2\right]=r^2$

d. $r^2\left[1+\left(\frac{dy}{dx}\right)^2\right]=x^2$

68. The general solution of the differential equation $\frac{d^4y}{dx^4}-6\frac{d^3y}{dx^3}+12\frac{d^2y}{dx^2}-8\frac{dy}{dx}=0$ is

a. $y=C_1+[C_2+C_3x+C_4x^2]e^{2x}$

b. $y=[C_1+C_2x+C_3x^2]e^{2x}$

c. $y=C_1+C_2x+C_3x^2+C_4x^3$

d. $y=C_1+C_2x+C_3x^2+C_4e^{2x}$

69. Two linearly independent solutions of the differential equation $4\frac{d^2y}{dx^2}+4\frac{dy}{dx}+5y=0$ are

a. $e^{-x/2}\cos x$ and $e^{-x/2}\sin x$

b. $e^{x/2}\cos x$ and $e^{x/2}\sin x$

c. $e^{x/2}\cos x$ and $e^{-x/2}\sin x$

d. $e^{-x/2}\cos x$ and $e^{x/2}\sin x$

70. The particular integral of $\frac{d^2y}{dx^2}+\frac{dy}{dx}=x^2+2x+4$ is

a. $\frac{x^3}{3}+4x$

b. $\frac{x^3}{3} + 4x$

c. $\frac{x^3}{3} + 4$

d. $\frac{x^3}{3} + 4x^2$

71. A straight line through (4, -3) cuts the axes such that the intercepts are equal in magnitude.

a. $x - y + 1 = 0$

b. $x + y + 1 = 0$

c. $x + y = 7$

d. $x - y = 7$

72. The lines $lx + my + n = 0$, $mx + ny + 1 = 0$ and $nx + ly + m = 0$ (l, m, n are all not all equal, are concurrent if

a. $l^2 + m^2 + n^2 = 1$

b. $lm + mn + nl = 1$

c. $lm + mn + nl = 0$

d. $1 + m + n = 0$

73. If the equation

$hxy + gx + fy + c = 0$ (h = 0)

represents two straight lines ,then

a. $2fgh = c^2$

b. $2fg = ch$

c. $fgh = c^2$

d. $fg = ch$

74. The distance of the point from the line

$4 \cos \theta + 3 \sin \theta = \frac{30}{r}$ is

a. 2

b. 4

c. [illegible]

d. 8

75. The equation of the circle on the chord $x \cos \alpha + y \sin \alpha - p = 0$ of the circle $x^2 + y^2 - a^2 = 0$, $(0 < p < a)$ as diameter is

a. $x^2 + y^2 - a^2 + 2p(x \cos \alpha + y \sin\alpha - p) = 0$

b. $x^2 + y^2 - a^2 - 2p(x \cos \alpha + y \sin \alpha - p) = 0$

c. $x^2 + y^2 + a^2 - 4p (x \cos \alpha + y \sin \alpha + p) = 0$

d. $x^2 + y^2 - a^2 + 4p(x \cos \alpha + y \sin \alpha - p) = 0$

76. From a point (x_1, y_1) if perpendicular tangents are drawn to the circle $x^2 + y^2 = 5$, then which one of the following equations represents the locus of (x_1, y_1) ?

a. $x^2 + 2y^2 = 5$

b. $2x^2 + y^2 = 10$

c. $x^2 + y^2 = 10$

d. $2x^2 + xy + 2y^2 = 5$

77. The equation of the common chord of the circles $x^2 + y^2 - 6x = 0$ and $x^2 + y^2 - 4y = 0$ is

a. $3x + 2y + 1 = 0$

b. $3x - 2y = 0$

c. $3x + 2y = 0$

d. $3x - 2y - 1 = 0$

78. Let $S_1 = x^2 + y^2 + 2g_1 x + 2f_1 y + c_1 = 0$

$S_2 = x^2 + y^2 + 2g_2 x + 2f_2 y + c_2 = 0$ be two circles .The slope of the radical axis of the two circles is

a. $\frac{(f_1 - f_2)}{(g_1 - g_2)}$

b. $\frac{(g_1 - g_2)}{(f_1 - f_2)}$

c. $-\frac{(f_1 - f_2)}{(g_1 - g_2)}$

d. $-\frac{(g_1 - g_2)}{(f_1 - f_2)}$

79. If λ, μ are parameters ,the orthogonal coaxal system of the system of circles $x^2 + y^2 + 2\lambda x + c = 0$ is

a. $x^2 + y^2 + 2\mu y - c = 0$

b. $x^2 + y^2 + 2\mu y + c = 0$

c. $x^2 + y^2 + 2\mu x - c = 0$

d. $x^2 + y^2 - 2\mu x + c = 0$

80. The condition that the straight line $\frac{1}{r} = \frac{1}{a} \cos \theta + \frac{1}{b} \sin \theta$ may touch the circle $r = 2c \cos \theta$ is

a. $\frac{2c}{a} - 1 = \frac{b^2}{c^2}$

b. $\frac{2c}{a} = 1 - \frac{c^2}{b^2}$

c. $\frac{2c}{a} = 1 + \frac{c^2}{b^2}$

d. $\frac{2a}{c} = 1 - \frac{c^2}{b^2}$

81. The equation of the parabola whose focus is (-3, 0) and the directrix is $x + 5 = 0$, is

a. $x^2 = 4(y - 4)$

b. $x^2 = 4(y+4)$

c. $y^2=4(x-4)$

d. $y^2=4(x+4)$

82. If the normal at (x_r, y_r), r = 1,2,3,4 on the rectangular hyperbola $xy = c^2$ meet in the point (α, β), then

a. $x_1+x_2+x_3+x_4=\alpha$

b. $x_1+x_2+x_3+x_4=\beta$

c. $x_1+x_2+x_3+x_4=\frac{1}{\alpha}$

d. $x_1+x_2+x_3+x_4=\frac{1}{\beta}$

83. The lines x= ay + b, z =cy + d and x = a'y + b', z = c' y+ d are perpendicular if

a. $aa' + cc' = 1$

b. $aa' + cc' = -1$

c. $bb' + dd' = 1$

d. $bb' + dd' = -1$

84. The equation $\sqrt{fx} + \sqrt{gy} + \sqrt{hz} = 0$ represents a

a. sphere

b. cylinder

c. cone

d. pair of planes

85. The equation of the cylinder which intersects the curve $x^2+y^2+z^2=1$, x + y + z =1 and whose generators are parallel to the axis of z, is

a. $x^2 + y^2 + xy - x - y = 0$

b. $x^2+y^2 + xy + x + y = 0$

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

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

86. Which one of the following is a; vector quantity?

a. Speed

b. Angular momentum

c. Power

d. Potential energy

87. The angle between the vectors

$\overline{A} = 2i - j + 2k$ and $\overline{B} = 6i - 3j + 6k$ is

a. 0^0

b. 30^0

c. 45^0

d. 60^0

88. If two forces of equal magnitude acting at a point give, as the resultant, a force of same magnitude, then the angle between the two force must be

a. 45^0

b. 60^0

c. 120^0

d. 135^0

89. A man carries a bundle at the end of a stick 3/2 metres long, which is placed on his shoulder. In order that the pressure on his shoulder may be three times the weight of the bundle, the distance between his hand and shoulder should be

a. 0.25 metre

b. 0.30 metre

c. 0.40 metre

d. 0.50 metre

90. If the sum of the moments of a number of coplanar forces about three non- collinear points are the same ,the system shall reduce to

a. a single force

b. a force and a couple

c. a couple

d. one in equilibrium

91. Suppose R is the resultant of a system of several coplanar forces $P_1, P_2, \ldots, P_n$ acting simultaneously at a point, then

$R\cos\theta = \sum_{i=1}^{n} P_i \cos\alpha_i = \sum_{i=1}^{n} X_i$ and

$R\sin\theta = \sum_{i=1}^{n} P_i \sin\alpha_i = \sum_{i=1}^{n} Y_i$

Where $\alpha^1, \alpha^2, \ldots \alpha_n, \theta$ are the angles which the system of forces $P_1, P_2, \ldots P_n$ and R makes with the horizontal lie. If the system is in equilibrium, then which one of the following relations is correct?

a. $\Sigma X_i + \Sigma Y_i = 0$

b. $\Sigma X_i - \Sigma Y_i = 0$

c. $\Sigma X_i = \Sigma Y_i = 0$

d. None of the above

92. If the forces 6w , 5w acting at a point (2, 3) in Cartesian regular co-ordinate are parallel to the positive x and y axis respectively, then the moments of the resultant force about the origin is

a. 8w

b. –3w

c. 3w

d. –8w

93. Two particles of m_1 and m_2 gms projected vertically upwards such that the velocity of projection of m_1 is double that of m_2. If the maximum heights to which m_1 and m_2 rise be h_1 and h_2 respectively , then

a. $h_1 = 2h_2$

b. $2h_1 = h_2$

c. $h_1 = 4h_2$

d. $4h_1 = h_2$

94. If a body of mass M kg and at rest is acted upon by a constant force of W kg weight, then in T seconds it moves through a distance of

a. $\frac{gTW}{2M}$ meters

b. $\frac{gTW^2}{2M}$ meters

c. $\frac{g^2TW}{2M}$ meters

d. $\frac{gT^2W}{2M}$ meters

95. A particle is describing an ellipse under a force μ/(distance)^2 towards a focus. If V is its velocity at a distance R, then its periodic time is

a. $\frac{2\pi}{\sqrt{\mu}}\left(\frac{V^2}{\mu}-\frac{2}{R}\right)^{\frac{3}{2}}$

b. $\frac{2\pi}{\sqrt{\mu}}\left(\frac{V^2}{\mu}-\frac{2}{R}\right)^{-\frac{3}{2}}$

c. $\frac{2\pi}{\sqrt{\mu}}\left(\frac{2}{R}-\frac{V^2}{\mu}\right)^{\frac{3}{2}}$

d. $\frac{2\pi}{\sqrt{\mu}}\left(\frac{2}{R}-\frac{V^2}{\mu}\right)^{-\frac{3}{2}}$

96. A particle executing a simple harmonic motion of amplitude 5 cm has a speed of 8 cm/sec when at a distance 3 cms from the center of the path. The period of the motion of the particle will be

a. $\frac{\pi}{2}$ sec

b. π sec

c. 2π sec

d. 4π sec

97. A particle of mass m moves in a straight line under an attractive force m μx towards a fixed point O on the line, x being the distance of the particle from O. If x = a at time t = 0, then the velocity of the particle at a distance x is given by

a.

b. μ(a-x)

c. μ (x- a)

d. $\sqrt{\mu(a^2-x^2)}$

e. $-\sqrt{\mu(a^2-x^2)}$

98. In order to keep a body in air above the earth for seconds, the body should be thrown vertically up with a velocity of

a. $\sqrt{6g}$ m/sec

b. $\sqrt{12g}$ m/sec

c. 6g m /sec

d. 12 g m /sec

99. If a particle of mass 4 gms moves in a horizontal circle under the action of a force of magnitude 400 dynes towards the center of the circle with a speed 20 cms/sec, then the radius of the circle will be

a. 2cm

b. 4cm

c. 8cm

d. 10cm

100. The escape velocity from the earth is about 11km/second. The escape velocity from the planet having twice the radius and the same means density as the earth is about

a. 5.5km/second

b. 11 km/second

c. 16.5km/second

d. 22km/second