1. The potential energy of a particle varies with distance x from a fixed origin as

$$U = \left(\frac{A\sqrt{x}}{x+B}\right)$$

where, A and B are constants. The dimension of AB are

(a) $[ML^{5/2}T^{-2}]$ (b) $[ML^{2}T^{-2}]$ (c) $[M^{3/2}L^{3/2}T^{-2}]$ (d) $[ML^{7/2}T^{-2}]$

2. A satellite in force free space sweeps stationary interplanetary dust at a rate $\frac{dM}{dt} = \alpha v$, where M is the mass, v is the velocity of the satellite and α is a constant. What is the deceleration of the satellite?

(a) $-\frac{2\alpha v^2}{M}$ (b) $-\frac{\alpha v^2}{M}$ (c) $-\alpha v^2$ (d) $\frac{\alpha v^2}{M}$

3. Four particles, each of mass M and equidistant from each other, move along a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is

(a) $\sqrt{GM/R}$ (b) $\sqrt{2\sqrt{2}\,GM/R}$ (c) $\sqrt{(1+2\sqrt{2})GM/R}$ (d) $\frac{1}{2}\sqrt{(1+2\sqrt{2})GM/R}$

4. Two spheres of radii $8\ cm$ and $2\ cm$ are cooling. Their temperatures are $127°C$ and $527°C$ respectively. Find the ratio of energy radiated by them in the same time

(a) 0.06 (b) 0.5 (c) 1 (d) 2

5. In a Carnot engine, the temperature of reservoir is $927°C$ and that of sink is $27°C$. If the work done by the engine when it transfers heat from reservoir to sink is $12.6 \times 10^6 J$, the quantity of the heat absorbed by the engine from the reservoir is

(a) $16.8 \times 10^6\ J$ (b) $4 \times 10^6\ J$ (c) $7.6 \times 10^6\ J$ (d) $4.25 \times 10^6\ J$

6. When a big drop of water is formed from n small drops of water, the energy loss is $3E$, where E is the energy of the bigger drop. If R is the radius of the bigger drop and r is the radius of the smaller drop, then number of smaller drops (n) is

(a) $4R/r^2$ (b) $4R/r$ (c) $2R^2/r$ (d) $4R^2/r^2$

7. Two point electric charges of magnitude q and $2q$ are at distance d apart from each other. A third charge Q is introduced in such a way that net force acting on q and $2q$ is zero. The position of the charge Q is:

(a) $(\sqrt{2}-1)d$ from the charge q (b) $(\sqrt{2}-1)d$ from the charge $2q$
(c) $(\sqrt{3}-1)d$ from the charge q (d) none of these.

8. A charges particle of charge q is moved around a charge $+q$ along a circular path of radius r from A to B. The work done is

(a) $\frac{qq_0}{4\pi\varepsilon_0 r}$ (b) $\frac{2qq_0}{4\pi\varepsilon_0 r}$ (c) $\frac{qq_0}{4\pi\varepsilon_0 r^2}\ \pi r$ (d) zero.

9. The magnetic field at the point of intersection of diagonals of a square wire loop of side L carrying current I is

(a) $\frac{\mu_0 I}{\pi L}$ (b) $\frac{2\mu_0 I}{\pi L}$ (c) $\frac{\sqrt{2}\mu_0 I}{\pi L}$ (d) $\frac{2\sqrt{2}\mu_0 I}{\pi L}$

10. A conducting circular loop is placed in a uniform magnetic field of induction B tesla with its plane normal to the field. Now, the radius of the loop starts shrinking at the rate (dr/dt). Then the induced *emf* at the instant when radius is r, will be

(a) $\pi r\ B\ (dr/dt)$ (b) $2\pi r\ B\ (dr/dt)$ (c) $\pi r^2\ (dB/dt)$ (d) $\left(\frac{\pi r^2}{2}\right)^2 B\ (dr/dt)$

11. A simple harmonic motion is given by $y = 7\left[\frac{\sqrt{3}}{2}\sin 2\pi t + \frac{1}{2}\cos 2\pi t\right]$ in meter. What is the amplitude of motion if y is in metre?

(a) $21m$ (b) $14m$ (c) $7m$ (d) $3.5m$

12. Young's double slit experiment has been carried out using monochromatic light of wave length λ. The path difference (in terms of integer n) corresponding to any point having half the peak intensity will be

(a) (2n+1) λ/2 (b) (2n+1) λ/4 (c) (2n+1) λ/8 (d) (2n+1) λ/16

13. A certain radioactive material ${}_ZX^A$ starts emitting α and β particles successively such that the end product is ${}_{Z-3}Y^{A-8}$. The number of α and β particles emitted are

(a) 4 and 3 respectively (b) 2 and 1 respectively (c) 3 and 4 respectively
(d) 3 and 8 respectively

14. At what speed does the kinetic energy of a particle equal to its rest energy? Consider c is the velocity of light in free space.

(a) $\frac{\sqrt{3}}{2}\ c$ (b) $\sqrt{\frac{2}{3}}C$ (c) $\frac{\sqrt{3}}{4}\ c$ (d) $\frac{1}{2}\ c$

15. The contribution in the total current flowing through a semiconductor due to electrons and holes are ¾ and ¼ respectively. If the drift velocity of electron is 5/2 times that of holes at this temperature, then the ratio of concentration of electrons and holes is

(a) 6:5 (b) 5:6 (c) 3:2 (d) 2:3

16) During the electrolysis of aqueous solution of sodium chloride, P^H of the electrolyte ( )
1) remains constant 2) gradually increases 3) gradually decreases 4)decreases first and then increases

17) Find the volume of Cl_2 at NTP produced during electrolysis of $MgCl_2$ which produces 6.6 g of Mg ( )
(at weight of Mg=24.3)
1) 6 Lt 2) 5 Lt 3) 10 Lt 4) 9 Lt

18) Which of the following nucleus is unstable ? ( )
1) $_5B^{10}$ 2) $_4Be^{10}$ 3) $_5N^{14}$ 4) $_8o^{16}$

19) The half-life period of radioactive element is 140 days. After 560 days, one gram of the element will ( )
reduce to
1) ½ g 2) ¼ g 3) 1/8 g 4) 1/16 g

20) The molarity of a solution containing 5.3 g of anhydrous Na_2CO_3 per litre is ( )
1) 0.01M 2) 0.05M 3) 0.02 M 4) 1 M

21) Which of the following modes of expressing concentration is independent of temperature ( )
1) molarity 2) molality 3) formality 4) normality

22) The volume of 0.025M H_2SO_4 required for the complete neutralization of 25ml of 0.03M$Ca(OH)_2$ ( )
solution is
1) 20 ml 2) 30 ml 3) 25 ml 4) 35 ml

23)The crystal lattice of BaF_2, the co-ordination number of Ba^{2+} is 8, the co-ordination number of ( )
F^- must be ___.
1) 2 2) 3 3) 4 4) 6

24) At what temperature kinetic energy is 0.3 mole of Helium be the same as the total kinetic ( )
energy of 0.4 mole of Argon at 400K.
1) 533.33 K 2) 600 K 3) 672 K 4) 573 K

25)At what temperature the most probable velocity of 'CO' molecule is twice that at 0^0C ? ( )
1) 1092 K 2) 890 K 3) 993 K 4) 1080 K

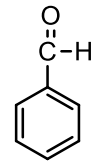
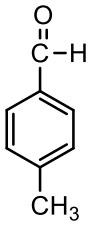
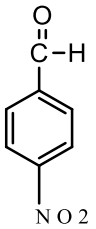
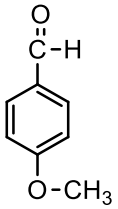
26) If the R.M.S. velocity of oxygen at 27K 400 m/sec what is the R.M.S velocity of H_2 ( )
at same temperature ?
1) 1000m/sec 2) 1200 m/sec 3) 1400m/sec 4) 1600 m/sec

27) Radio active decay follows which order Kinetics ? ( )
1) O 2) 1 3) 2 4) 3

28) For a n^{th} order reaction, Half life period is inversely proportional to _____ ( )
1) a^{1-n} 2) a^{n-1} 3) a 4) a^{n-2}

29) In which of the following case Raoults law is not applied? ( )
1)1M Nacl 2)1M Urea 3)1M Glucose 4)1M Sucrose

30) Increasing order of Nucleophilic addition reactions of the following compounds ? ( )

1) 
2) 
3) 
4) 

1) 3>1>2>4 2) 1 >3>4>2 3)1 >2>3< 4 4) 4>3>2>1

31. The least integral value of k for which $(k-2)x^2+8x+k+4>0$ for all $x\in R$, is -------
(A) 2 (B) 3 (C) 4 (D) 5

32. If X and Y are two sets, then $X\cap(Y\cup X)'$ equals to ---------
(A) X (B) Y (C) ϕ (D) $X\cup Y$

33. Let A and B have 3 and 6 elements respectively. What can be the minimum number of elements in $A\cup B$?------
(A) 3 (B) 6 (C) 9 (D) 18

34. The relation R defined on the set N of natural numbers by $xRy\Leftrightarrow 2x^2-3xy+y^2=0$ is -----
(A) Not symmetric but reflexive
(B) Only symmetric
(C) Symmetric but not reflexive
(D) Only reflexive

35. If f and g are two functions defined as $f(x)=x+2,\ x\le 0;\ g(x)=3, x\ge 0$, then the domain of $f+g$ is ------
(A) $\{0\}$ (B) $[0,\infty)$ (C) $(-\infty,0)$ (D) $(-\infty,\infty)$

36. If $f:R\to R$, defined by $f(x)=x^2+1$,then the value of $f^{-1}(17)$ and $f^{-1}(-3)$ respectively are ------
(A) $\phi,\{-4,4\}$ (B) $\{-3,3\},\phi$ (C) $\{-3,4\},\phi$ (D) $\{-4,4\},\phi$

37. The angle between the lines $2x-y+5=0$ and $3x+y+4=0$ is -------
(A) 30^0 (B) 45^0 (C) 60^0 (D) 90^0

38. The equation of the median of a triangle formed by the lines $x+y-6=0, x-3y-2=0$ and $5x-3y+2=0$, is ---------
(A) $x=2, x+9y+14=0$ and $7x-9y-2=0$ (B) $x=2, x+9y-14=0$ and $7x-9y+2=0$
(C) $x=2, x+9y-14=0$ and $7x-9y-2=0$ (D) $x=2, x+9y+14=0$ and $7x+9y-2=0$

39. The family of the lines $x(a+2b)+y(a+3b)=a+b$ passes through the point for all values of a and b, then the coordinates of the point are ---------
(A) (2, -1) (B) (-2, 1) (C) (2, 1) (D) (1, 2)

40. The lines $(a+2b)x+(a-3b)y=a-b$ for different values of a and b, pass through the fixed point whose coordinate are -----
(A) $\left(\frac{2}{5},\frac{2}{5}\right)$ (B) $\left(\frac{1}{5},\frac{1}{5}\right)$ (C) $\left(\frac{3}{5},\frac{2}{5}\right)$ (D) $\left(\frac{3}{5},\frac{3}{5}\right)$

41. The range of m for which the line $y = mx + 2$ cuts the circle $x^2 + y^2 = 1$ at distinct or coincident point, is ------

(A) $[-\sqrt{3}, \sqrt{3}]$ (B) $(0, \sqrt{3})$ (C) $[\sqrt{3}, \infty)$ (D) $(-\infty, -\sqrt{3}] \cup [\sqrt{3}, \infty]$

42. The focus of the parabola $y^2 - x - 2y + 2 = 0$ is ----------

(A) $\left(\frac{1}{4}, 0\right)$ (B) $\left(\frac{1}{4}, \frac{2}{3}\right)$ (C) $\left(\frac{5}{4}, 1\right)$ (D) $\left(\frac{5}{4}, \frac{4}{5}\right)$

43. $\int sin^{-1}x \; dx$ is equal to -------

(A) $x \sin^{-1} x + \sqrt{sin^2 x - 1}$+c (B) $x \sin^{-1} x + \sqrt{1 - x^2} + c$

(C) $x \sin^{-1} x + \sqrt{1 - sin^2 x} + c$ (D) $x \sin^{-1} x + \sqrt{sin^2 x + 1} + c$

44. $\int \frac{\left(\sin^{-1} x\right)^3}{\sqrt{1-x^2}} dx$ is equal to -------

(A) $\frac{\left(\sin^{-1} x\right)^3}{2} + c$ (B) $\frac{\left(\sin^{-1} x\right)^3}{3} + c$ (C) $\frac{\sin^{-1} x}{x} + c$ (D) $\frac{\left(\sin^{-1} x\right)^4}{4} + c$

45. $\int_0^{\pi} (x \cdot \sin^2 x \cdot \cos x) dx$ is equal to ---------

(A) $\frac{-4}{9}$ (B) $\frac{-2}{9}$ (C) $\frac{-5}{9}$ (D) 0

46. The differential equation of family of parabolas with foci at the origin and axis along the $x-$axis , is -------

(A) $x\left(\frac{dy}{dx}\right)^2 + 2x\frac{dy}{dx} - y = 0$ (B) $y\left(\frac{dy}{dx}\right)^2 + 2x\frac{dy}{dx} + y = 0$

(C) $y\left(\frac{dy}{dx}\right)^2 + 2x\frac{dy}{dx} - y = 0$ (D) $x\left(\frac{dy}{dx}\right)^2 + 2x\frac{dy}{dx} + y = 0$

47. A curve passing through the point $\left(1, \frac{\pi}{4}\right)$ and its slope at any point is given by $\frac{y}{x} - \cos^2\left(\frac{y}{x}\right)$. Then the curve has the equation ------

(A) $y = x \tan^{-1}(\ln 2)$ (B) $y = x \tan^{-1}\left(\ln \frac{e}{x}\right)$

(C) $y = \frac{1}{x} \tan^{-1}\left(\ln \frac{e}{x}\right)$ (D) $y = \frac{1}{x} \tan^{-1}(\ln 2)$

48. The projection of the vector $\hat{i} - 2j + k$ on the vector $4\hat{i} - 4j + 7k$ is -----

(A) $\frac{\sqrt{6}}{10}$ (B) $\frac{3}{10}$ (C) $\frac{\sqrt{6}}{19}$ (D) $\frac{19}{9}$

49. Which of the following function is not homogeneous?

(A) $f(x,y) = x\left[\ln \frac{2x^2 + y^2}{x} - \ln(x+y)\right] + y^2 \tan \frac{x+2y}{3x-y}$ (B) $f(x,y) = x^{\frac{1}{3}} \cdot y^{\frac{-2}{3}} \tan^{-1} \frac{x}{y}$

(C) $f(x,y) = \left[\ln \sqrt{x^2 + y^2} - \ln y\right] + ye^{x/y}$ (D) $f(x,y) = \frac{x-y}{x^2+y^2}$

50. Let $\overrightarrow{OA}=\hat{i}+3j-2k$ and $\overrightarrow{OB}=3\hat{i}+j-2k$. The vector $\overrightarrow{OC}$ bisecting the angle AOB and C being a point on the line AB, is --------

(A) $\overrightarrow{OA}=\hat{i}+3j-2k$ (B) $2\hat{i}+j-2k$ (C) $2(\hat{i}+j-k)$ (D) $\hat{i}+j-k$

51. Let $\vec{a}=\hat{i}-k$, $\vec{a}=x\hat{i}+j+(1-x)k$ and $\vec{c}=y\hat{i}+xj+(1+x-y)k$. The, $\left[\vec{a}\ \vec{b}\ \vec{c}\right]$ depends on ------

(A) Only x (B) Only y (C) both x and y (D) neither x nor y

52. If $\overrightarrow{AO}+\overrightarrow{OB}=\overrightarrow{BO}+\overrightarrow{OC}$, then A,B,C are -------

(A) Collinear (B) coplanar (C) non-collinear (D) equal

53. The direction cosines of any normal to the $xy-$ plane are --------

(A) 1, 0, 0 (B) 0, 0, 1 (C) 1, 1, 0 (D) 0, 1, 0

54. The equation of the plane through $(1,1,1)$ and passing through the line of intersection of the plane $x+2y-z+1=0$ and $3x-y-4z+3=0$ is --------

(A) $8x+5y-11z+8=0$ (B) $8x+5y+11z+8=0$

(C) $8x-5y-11z+8=0$ (D) $8x-5y-11z-8=0$

55. A sphere of constant radius k passes through origin and meets axes in A,B,C. The centroid of the ΔABC lies on the sphere ------

(A) $5(x^2+y^2+z^2)=4k^2$ (B) $x^2+y^2+z^2=4k^2$

(C) $3(x^2+y^2+z^2)=4k^2$ (D) $9(x^2+y^2+z^2)=4k^2$

56. Equation of the plane containing the straight line $\frac{x}{2}=\frac{y}{3}=\frac{z}{4}$ and perpendicular to the plane containing the straight lines $\frac{x}{3}=\frac{y}{4}=\frac{z}{2}$ and $\frac{x}{4}=\frac{y}{2}=\frac{z}{3}$ is----------

(A) $x+2y-2z=0$ (B) $x+2y+z=0$ (C) $3x+2y-2z=0$ (D) $5x+2y-4z=0$

57. If p and q are simple propositions, then $p\rightarrow q$ is false, when------

(A) p is true and q is false (B) p is false and q is true

(C) p and q are true (D) p and q are false

58. The proposition $p\vee\ p$ is a -----

(A) Contingency (B) Contradiction (C) Tautology (D) False statement

59. $\lim\limits_{x\to 0}\frac{1-\cos x}{\sqrt{1+x}-1}$ is -------

(A) 0 (B) 1 (C) 2 (D) 3

60. If $y=\sin^{-1}\left(\frac{5\sin x+4\cos x}{\sqrt{41}}\right)$ then $\frac{dy}{dx}$ is -------

(A) 0 (B) 1 (C) 2 (D) 3