

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)  $[ML^2T^{-2}]$       (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  $\alpha$  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  $8\text{ cm}$  and  $2\text{ cm}$  are cooling. Their temperatures are  $127^\circ\text{C}$  and  $527^\circ\text{C}$  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  $927^\circ\text{C}$  and that of sink is  $27^\circ\text{C}$ . If the work done by the engine when it transfers heat from reservoir to sink is  $12.6 \times 10^6\text{ J}$ , the quantity of the heat absorbed by the engine from the reservoir is

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

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)  $\frac{qq_0}{4\pi\epsilon_0 r}$       (b)  $\frac{2qq_0}{4\pi\epsilon_0 r}$       (c)  $\frac{qq_0}{4\pi\epsilon_0 r^2} \pi r$       (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  $\lambda$ . The path difference (in terms of integer  $n$ ) corresponding to any point having half the peak intensity will be

- (a)  $(2n+1) \lambda/2$       (b)  $(2n+1) \lambda/4$       (c)  $(2n+1) \lambda/8$       (d)  $(2n+1) \lambda/16$

13. A certain radioactive material  ${}_Z X^A$  starts emitting  $\alpha$  and  $\beta$  particles successively such that the end product is  ${}_{Z-3} Y^{A-8}$ . The number of  $\alpha$  and  $\beta$  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.

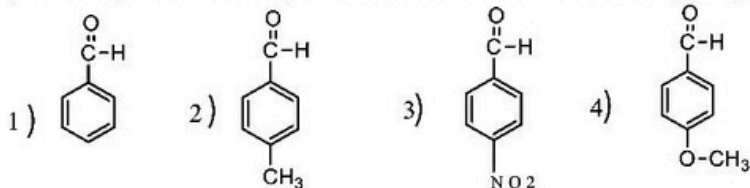
- (a)  $\frac{\sqrt{3}}{2} c$       (b)  $\sqrt{\frac{2}{3}} c$       (c)  $\frac{\sqrt{3}}{4} c$       (d)  $\frac{1}{2} c$

15. The contribution in the total current flowing through a semiconductor due to electrons and holes are  $\frac{3}{4}$  and  $\frac{1}{4}$  respectively. If the drift velocity of electron is  $\frac{5}{2}$  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)  $\frac{1}{2}$  g 2)  $\frac{1}{4}$  g 3)  $\frac{1}{8}$  g 4)  $\frac{1}{16}$  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  $0^\circ C$ ? ( )  
 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) 0 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 Raoult's 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) 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)  $\phi$                       (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  $f(x)=x+2, x \leq 0$ ;  $g(x)=3, x \geq 0$ , then the domain of  $f+g$  is -----  
 (A)  $\{0\}$                       (B)  $[0, \infty)$                       (C)  $(-\infty, 0)$                       (D)  $(-\infty, \infty)$
36. If  $f: R \rightarrow R$ , 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)  $30^\circ$                       (B)  $45^\circ$                       (C)  $60^\circ$                       (D)  $90^\circ$
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.  $\int \frac{(\sin^{-1} x)^3}{\sqrt{1-x^2}} dx$  is equal to -----  
 (A)  $\frac{(\sin^{-1} x)^3}{2} + c$  (B)  $\frac{(\sin^{-1} x)^3}{3} + c$  (C)  $\frac{\sin^{-1} x}{x} + c$  (D)  $\frac{(\sin^{-1} x)^4}{4} + c$
45.  $\int_0^{\frac{\pi}{2}} (x \cdot \sin^2 x \cdot \cos x) dx$  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  $\hat{i} - 2\hat{j} + \hat{k}$  on the vector  $4\hat{i} - 4\hat{j} + 7\hat{k}$  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)  $f(x, y) = \left[ \ln \sqrt{x^2 + y^2} - \ln y \right] + ye^{\frac{z}{y}}$  (D)  $f(x, y) = \frac{x-y}{x^2 + y^2}$

50. Let  $\vec{OA} = \hat{i} + 3\hat{j} - 2\hat{k}$  and  $\vec{OB} = 3\hat{i} + \hat{j} - 2\hat{k}$ . The vector  $\vec{OC}$  bisecting the angle  $AOB$  and  $C$  being a point on the line  $AB$ , is -----  
 (A)  $\vec{OA} = \hat{i} + 3\hat{j} - 2\hat{k}$  (B)  $2\hat{i} + \hat{j} - 2\hat{k}$  (C)  $2(\hat{i} + \hat{j} - \hat{k})$  (D)  $\hat{i} + \hat{j} - \hat{k}$
51. Let  $\vec{a} = \hat{i} - \hat{k}$ ,  $\vec{a} = x\hat{i} + \hat{j} + (1-x)\hat{k}$  and  $\vec{c} = y\hat{i} + x\hat{j} + (1+x-y)\hat{k}$ . The,  $[\vec{a} \vec{b} \vec{c}]$  depends on -----  
 (A) Only  $x$  (B) Only  $y$  (C) both  $x$  and  $y$  (D) neither  $x$  nor  $y$
52. If  $\vec{AO} + \vec{OB} = \vec{BO} + \vec{OC}$ , 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  $\Delta ABC$  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  $p \vee \neg p$  is a -----  
 (A) Contingency (B) Contradiction (C) Tautology (D) False statement
59.  $\lim_{x \rightarrow 0} \frac{1 - \cos x}{\sqrt{1+x}-1}$  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