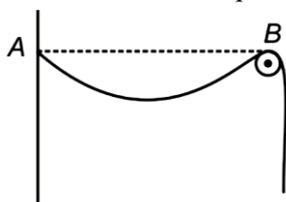
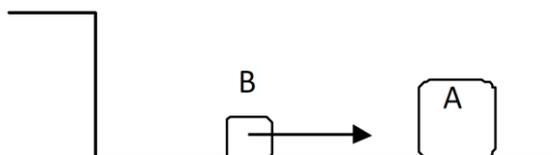


## PHYSICS

1. A uniform rope of length 13 m tied on a peg on a wall passes over a frictionless peg B fixed in level with peg A as shown in the figure. If in the equilibrium, length of the rope hanging between the pegs is 8 m, the angle which the rope makes with the wall at equilibrium is equal to

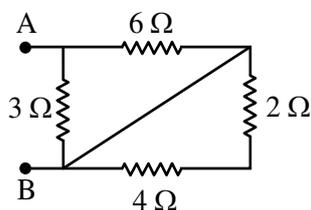


- (A)  $53^\circ$  (B)  $45^\circ$  (C)  $37^\circ$  (D)  $30^\circ$
2. Ionization potential of hydrogen atom is 13.6 eV, hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be :
- (A) one (B) four (C) three (D) two
3. Two pendulum A and B have time-periods T and  $5T/4$ . They start S.H.M. at the same time from the mean position. What will be the phase difference between them after the pendulum B has completed one oscillation ?
- (A)  $30^\circ$  (B)  $60^\circ$  (C)  $90^\circ$  (D)  $45^\circ$
4. A block A is kept at rest on a frictionless horizontal floor some distance away from a wall. Another block B of mass m is moving towards the block A as shown in the figure. The block B may undergo elastic collisions with the block A and the wall. If the two blocks collide only once, what should be range of values of mass M of the block A?

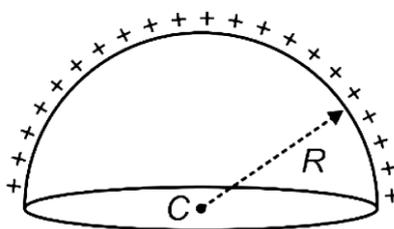


- (A)  $M > 5m$  (B)  $M \leq 3m$  (C)  $0.5m \leq M \leq 3m$  (D)  $m \leq M \leq 3m$
5. Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii  $R_1$  and  $R_2$  respectively. The ratio of the masses of X to that of Y is-
- (A)  $\frac{R_1}{R_2}$  (B)  $\left(\frac{R_1}{R_2}\right)^2$  (C)  $\frac{R_2}{R_1}$  (D)  $\left(\frac{R_1}{R_2}\right)^{1/2}$
6. A small circular conducting loop of radius a is placed coplanarly at the centre of a large square conducting loop of side length  $L$  ( $a \ll L$ ). Their mutual inductance is given by
- (A)  $\frac{4\sqrt{2}\mu_0 a^2}{L}$  (B)  $\frac{4\mu_0 a^2}{L}$  (C)  $\frac{2\sqrt{2}\mu_0 a^2}{L}$  (D)  $\frac{\sqrt{2}\mu_0 a^2}{\pi L}$
7. The wavefront of light wave travelling in vacuum are given by  $x + y + z = c$ , then the angle made by the direction of propagation of light with the x-axis is
- (A)  $\cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$  (B)  $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$  (C)  $45^\circ$  (D)  $0^\circ$
8. A body rolls down an inclined plane. If its rotational kinetic energy is 40% of its translational kinetic energy, then the body is
- (A) ring (B) hollow sphere (C) solid sphere (D) solid cylinder

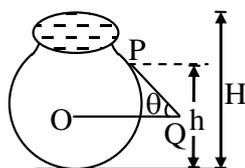
9. A nucleus at rest undergoes  $\alpha$ -decay emitting an  $\alpha$ -particle of mass  $m_\alpha$  and de Broglie wavelength  $\lambda$ . If mass of daughter nucleus is  $57 m_\alpha$ , then the total kinetic energy produced in the decay is given by  
 (A)  $\frac{58 h^2}{57 \lambda^2 m_\alpha}$  (B)  $\frac{87 h^2}{56 \lambda^2 m_\alpha}$  (C)  $\frac{29 h^2}{57 \lambda^2 m_\alpha}$  (D)  $\frac{57 h^2}{58 \lambda^2 m_\alpha}$
10. In a common-emitter amplifier, the voltage across a load resistance of  $2 \text{ k}\Omega$  is  $4 \text{ V}$ . If base resistance is  $1 \text{ k}\Omega$  and power gain is  $200$ , then the input voltage and base current respectively are  
 (A)  $0.2 \text{ V}, 0.2 \text{ mA}$  (B)  $0.2 \text{ V}, 0.4 \text{ mA}$  (C)  $0.4 \text{ V}, 0.2 \text{ mA}$  (D)  $0.2 \text{ V}, 0.1 \text{ mA}$
11. In a vernier calliper,  $1$  main scale division is equal to  $1 \text{ mm}$  and  $10$  vernier scale divisions are equal to  $9$  main scale divisions. To find the zero error of the instruments when the jaws are kept together, it is found that the  $6^{\text{th}}$  vernier scale division coincides with the  $6^{\text{th}}$  main scale division. The zero error of the vernier calliper is  
 (A)  $-0.6 \text{ mm}$  (B)  $+0.6 \text{ mm}$  (C)  $-0.4 \text{ mm}$  (D)  $+0.4 \text{ mm}$
12. In an astronomical telescope, objective is of focal length  $20 \text{ cm}$ . What should be tube length for magnifying power of  $10$ , under normal magnification?  
 (A)  $30 \text{ cm}$  (B)  $24 \text{ cm}$  (C)  $22 \text{ cm}$  (D)  $10 \text{ cm}$
13. What will be equivalent resistance between A and B



- (A)  $12\Omega$  (B)  $4\Omega$  (C)  $2\Omega$  (D)  $3\Omega$
14. A hemisphere of radius  $R$  as shown in figure is uniformly charged with a surface charge density  $\sigma$ . The electric field at the centre  $C$  is

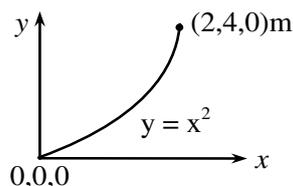


- (A)  $\frac{\sqrt{2}\sigma}{\epsilon_0}$  (B)  $\frac{\sigma}{4\epsilon_0}$  (C)  $\frac{\sigma}{2\epsilon_0}$  (D)  $\frac{\sigma}{\epsilon_0}$
15. Figure shows the vertical cross-section of a vessel filled with liquid of density  $\rho$ . The normal thrust per unit area on the walls of the vessel at point P, as shown will be –



- (A)  $H \rho g$  (B)  $(H - h) \rho g \cos \theta$  (C)  $(H - h) \rho g$  (D)  $h \rho g$

16. By applying a force  $\vec{F} = (3xy - 5z)\hat{j} + 4z\hat{k}$  a particle is moved along the path  $y = x^2$ , where all quantities are in SI units, from point  $(0, 0, 0)$  m to the point  $(2, 4, 0)$  m. The work done by force F on the particle (in joule), is



- (A)  $\frac{192}{5}$       (B)  $\frac{232}{5}$       (C)  $\frac{140}{5}$       (D)  $\frac{280}{5}$
17. An engine is supposed to operate between two reservoirs at temperature  $727^\circ\text{C}$  and  $227^\circ\text{C}$ . The maximum possible efficiency of such an engine is
- (A) 1      (B)  $3/4$       (C)  $1/4$       (D)  $1/2$

## CHEMISTRY

18. Match column I with column II and select the correct options

### Column I

- (a)  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$   
 (b)  $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$   
 (c)  $2\text{KClO}_3 \xrightarrow{\Delta} 2\text{KCl} + 3\text{O}_2$   
 (d)  $2\text{C} + \text{O}_2 \longrightarrow 2\text{CO}$

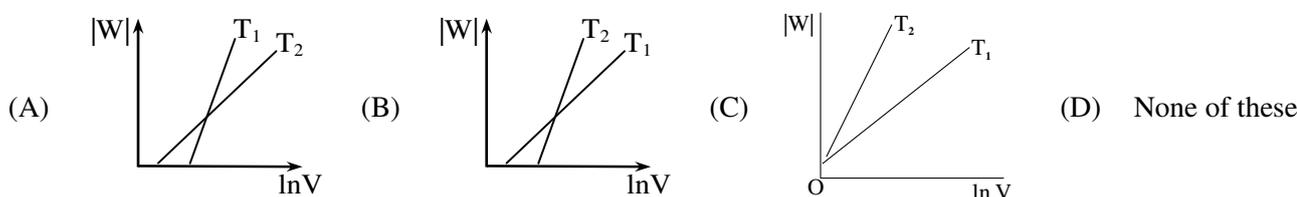
### Column II

1. Decomposition reactions  
 2. Combination reaction  
 3. Non-metal displacement reaction  
 4. Disproportionation reaction

- |     | [a] | [b] | [c] | [d] |     | [a] | [b] | [c] | [d] |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| (A) | 4   | 2   | 3   | 1   | (B) | 4   | 3   | 1   | 2   |
| (C) | 3   | 2   | 1   | 4   | (D) | 1   | 4   | 3   | 2   |

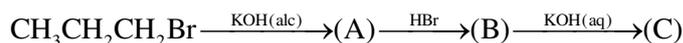
19. In the silver plating of copper,  $\text{K}[\text{Ag}(\text{CN})_2]$  is used instead of  $\text{AgNO}_3$ . The reason is
- (A) Less availability of  $\text{Ag}^+$  ions from  $\text{K}[\text{Ag}(\text{CN})_2]$ , as Cu cannot displace Ag from  $\text{K}[\text{Ag}(\text{CN})_2]$ , this ensure slow and uniform deposition of silver on copper.  
 (B)  $\text{Ag}^+$  ions are completely removed from solution if  $\text{K}[\text{Ag}(\text{CN})_2]$  is used and this ensure less consumption of raw material.  
 (C) more availability of  $\text{Ag}^+$  ions from  $\text{K}[\text{Ag}(\text{CN})_2]$ , as complex breaks easily in aqueous solution  $\text{K}[\text{Ag}(\text{CN})_2]$ , hence less voltage is required for electrolysis.  
 (D) more availability of  $\text{Ag}^+$  ions from  $\text{K}[\text{Ag}(\text{CN})_2]$ , as complex breaks easily in aqueous solution  $\text{K}[\text{Ag}(\text{CN})_2]$ , this results in faster electroplating.
20. Kjeldahl's method cannot be used for the estimation of nitrogen in
- (A) Azo compounds      (B) Pyridine      (C) Nitro compounds      (D) All the these
21. Which of the following compounds will not undergo azo coupling reaction with benzene diazonium chloride?
- (A) Nitrobenzene      (B) Anisole      (C) Phenol      (D) Aniline

22. The ejection of the photoelectron from the silver metal in the photoelectric effect experiment can be stopped by applying the voltage of 0.35V when the radiation 256.7 nm is used. Report the work function for silver metal in eV rounded upto one decimal place.
- (A) 4.5 (B) 3.5 (C) 2.5 (D) 1.5
23. When an ideal gas undergoes unrestricted expansion,
- (A) Cooling does not occur as these do work which is equal to loss in kinetic energy  
 (B) Cooling occurs as molecules collide with each other with loss of energy  
 (C) No cooling occurs as no attractive interactions exist among molecules  
 (D) Cooling occurs because the molecules lie above inversion temperature
24. Which one of the following molecules will have highest extent of inter molecular hydrogen bonding?
- (A) NH<sub>3</sub> (B) HF (C) H<sub>2</sub>O (D) HCl
25. Consider the reversible isothermal expansion of an ideal gas in a closed system at two different temperatures T<sub>1</sub> and T<sub>2</sub> (T<sub>1</sub> < T<sub>2</sub>). The correct graphical depiction of the dependence of work done (W) on the final volume (V) is



26. The decomposition of a substance follows first order kinetics. If its concentration is reduced to 1/8<sup>th</sup> of its initial value in 24 minutes, the rate constant of decomposition process is  $\frac{2.303}{y} \log(2) \text{ min}^{-1}$ , then 'y' is
- (A) 8 (B) 6 (C) 4 (D) 2
27. Which of the following crystals do not exhibit Frenkel defect?
- (A) ZnS (B) KBr (C) AgCl (D) AgBr
28. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below-
- $$\frac{1}{2} \text{Cl}_2(\text{g}) \xrightarrow{1/2 \Delta_{\text{diss}} \text{H}^\circ} \text{Cl}(\text{g}) \xrightarrow{\Delta_{\text{eg}} \text{H}^\circ} \text{Cl}^-(\text{g}) \xrightarrow{\Delta_{\text{hyd}} \text{H}^\circ} \text{Cl}^-(\text{aq})$$
- [data:  $\Delta_{\text{diss}} \text{H}^\circ_{\text{Cl}_2} = 240 \text{ kJ mol}^{-1}$ ,  $\Delta_{\text{eg}} \text{H}^\circ_{\text{Cl}} = -349 \text{ kJ mol}^{-1}$ ,  $\Delta_{\text{hyd}} \text{H}^\circ_{\text{Cl}^-} = -381 \text{ kJ mol}^{-1}$ ]
- The energy released (kJ) in the conversion of  $\frac{1}{2} \text{Cl}_2(\text{g}) \longrightarrow \text{Cl}^-(\text{aq})$  will be
- (A) 715 (B) 275 (C) 370 (D) 610
29. The decreasing order of the ionization potential of the following elements is
- (A) Ne > Cl > S > P > Al > Mg (B) Ne > Cl > S > P > Mg > Al  
 (C) Ne > Cl > P > S > Mg > Al (D) Ne > Cl > P > S > Al > Mg

30. In the following sequence of reactions



In product (C) is

- (A) Propan-2-ol      (B) Propan-1-ol      (C) Propyne      (D) Propene

31. Beryllium shows diagonal relationship with aluminium. Which of the following similarity is incorrect?

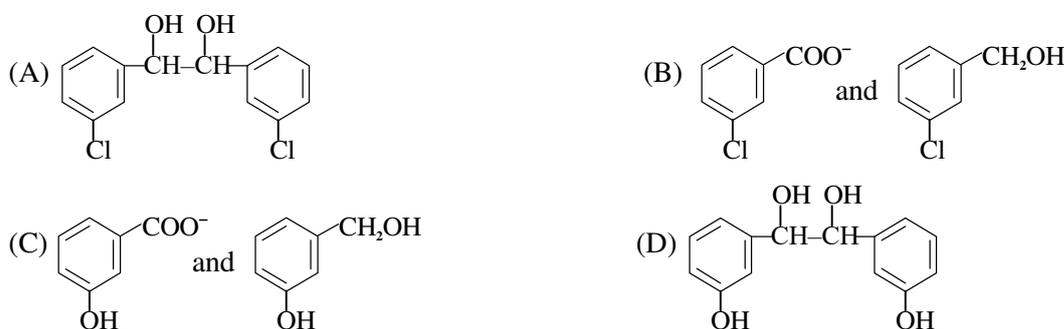
- (A) Be forms beryllates and Al forms aluminates.      (B)  $\text{Be}(\text{OH})_2$  like  $\text{Al}(\text{OH})_3$  is strongly basic  
(C) Be like Al is rendered passive by  $\text{HNO}_3$       (D)  $\text{Be}_2\text{C}$  like  $\text{Al}_4\text{C}_3$  yields methane on hydrolysis

32. Identify the compounds P, Q, and R in the following reactions.



- | P                                     | Q                      | R                                 | P                                     | Q                                 | R                       |
|---------------------------------------|------------------------|-----------------------------------|---------------------------------------|-----------------------------------|-------------------------|
| (A) $\text{B}(\text{OH})_3$           | $\text{B}_2\text{O}_3$ | $\text{Na}_2\text{B}_4\text{O}_7$ | (B) $\text{Na}_2\text{B}_4\text{O}_7$ | $\text{B}(\text{OH})_3$           | $\text{B}_2\text{O}_3$  |
| (C) $\text{Na}_2\text{B}_4\text{O}_7$ | $\text{B}_2\text{O}_3$ | $\text{B}(\text{OH})_3$           | (D) $\text{B}_2\text{O}_3$            | $\text{Na}_2\text{B}_4\text{O}_7$ | $\text{B}(\text{OH})_3$ |

33. When m-chlorobenzaldehyde is heated with 50% KOH solution, the product(s) obtained is(are)



34. Which of the following reactions occurs in the stratosphere?

- (A)  $\text{O}_2(\text{g}) + \text{O}(\text{g}) \xrightleftharpoons{\text{UV-rays}} \text{O}_3(\text{g})$       (B)  $\text{O}_2(\text{g}) \xrightarrow{\text{UV}} \text{O}(\text{g}) + \text{O}(\text{g})$   
(C)  $\text{Cl}\dot{\text{O}}(\text{g}) + \text{O}(\text{g}) \longrightarrow \dot{\text{Cl}}(\text{g}) + \text{O}_2(\text{g})$       (D) All of the above

## MATHEMATICS

35. The area (in sq. units) of the region  $A = \{(x, y) : (x-1)[x] \leq y \leq 2\sqrt{x}, 0 \leq x \leq 2\}$  where  $[t]$  denotes the greatest integer function is

- (A)  $\frac{4}{3}\sqrt{2} + 1$       (B)  $\frac{8\sqrt{2}}{3} - \frac{1}{2}$       (C)  $\frac{4}{3}\sqrt{2} - \frac{1}{2}$       (D)  $\frac{8}{3}\sqrt{2} - 1$

36. If  $\int \frac{\cos \theta}{5 + 7 \sin \theta - 2 \cos^2 \theta} d\theta = A \log_e |B(\theta)| + C$  then  $\frac{B(\theta)}{A}$  can be

- (A)  $\frac{2 \sin \theta + 1}{\sin \theta + 3}$       (B)  $\frac{2 \sin \theta + 1}{5(\sin \theta + 3)}$       (C)  $\frac{5(2 \sin \theta + 1)}{\sin \theta + 3}$       (D)  $\frac{5(\sin \theta + 3)}{2 \sin \theta + 1}$

37. The positive integer  $n$  for which  $2 \times 2^2 + 3 \times 2^3 + 4 \times 2^4 + \dots + n \times 2^n = 2^{n+10}$  is  
 (A) 510 (B) 511 (C) 512 (D) 513
38. Number of integral values of 'b' for which inequality  $(a^2 + 1)x^2 + 4(a + b)x + 2 < 0$  is true for at least one 'x' &  $\forall a \in \mathbb{R}$ , is  
 (A) 0 (B) 1 (C) 2 (D) 3
39. The number of  $3 \times 3$  non-singular matrices with four entries as 1 and all other entries as 0 is  
 (A) 6 (B) at least 7 (C) less than 4 (D) 5
40. Let  $g(x) = \frac{f(x)}{x+1}$  where  $f(x)$  is differentiable on  $[0, 5]$  such that  $f(0) = 4, f(5) = -1$ . There exists  $c \in (0, 5)$  such that  $g'(c)$  is  
 (A)  $-\frac{1}{6}$  (B)  $\frac{1}{6}$  (C)  $-\frac{5}{6}$  (D)  $-1$
41. If  $\{x\}$  denotes the fractional part of  $x$ , then  $\left\{\frac{5^{200}}{8}\right\}$  is  
 (A)  $\frac{5}{8}$  (B)  $\frac{3}{8}$  (C)  $\frac{1}{8}$  (D)  $\frac{1}{4}$
42. Find the variance for the given data, 8, 12, 13, 15, 22.  
 (A) 25.5 (B) 24.3 (C) 23 (D) 21.2
43. PQ is any focal chord of the parabola  $y^2 = 32x$ . The length of PQ can never less than  
 (A) 48 (B) 32 (C) 45 (D) 40
44. In an ellipse, if the lines joining a focus to the extremities of the minor axis make an equilateral triangle with the minor axis, then the eccentricity of the ellipse is  
 (A)  $\frac{1}{2}$  (B)  $\frac{1}{\sqrt{2}}$  (C)  $\frac{\sqrt{3}}{4}$  (D)  $\frac{\sqrt{3}}{2}$
45. If in a triangle ABC,  $\sin A, \sin B, \sin C$  are in AP, then  
 (A) the medians are in AP (B) the altitude are in GP  
 (C) the altitude are in HP (D) the altitudes are in AP

46. Equation  $3\cos^{-1}x - \pi x - \frac{\pi}{2} = 0$  has
- (A) more than two solutions (B) No solution  
(C) exactly one solution (D) two solutions
47. If  $f(x) = \sqrt{3|x| - x - 2}$  and  $g(x) = \sin x$ , then domain of function  $\text{fog}(x)$  is
- (A)  $\left\{ (4m+1)\frac{\pi}{2}; m \in \mathbb{I} \right\} \cup \left[ 2n\pi + \frac{7\pi}{6}, 2n\pi + \frac{11\pi}{6} \right]$  (B)  $\left\{ 2n\pi + \frac{7\pi}{6} \right\}_{n \in \mathbb{I}}$   
(C)  $\bigcup_{n \in \mathbb{I}} \left( 2n\pi + \frac{7\pi}{6}, 2n\pi + \frac{11\pi}{6} \right)$  (D)  $\left\{ 2n\pi + \frac{\pi}{2} \right\}_{n \in \mathbb{I}}$
48. If  $y = \frac{1}{x}$ , then  $\frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} =$
- (A)  $-\frac{1}{x^2}$  (B)  $\sqrt{\frac{1+y^4}{1+x^4}}$  (C) 0 (D) None of these
49. Which of the following point lies on the tangent to the curve  $x^4e^y + 2\sqrt{y+1} = 3$  at the point (1,0)?
- (A) (2,6) (B) (-2,4) (C) (-2,6) (D) (2,2)
50. The set of all values of  $\lambda$  for which the function  $f(x) = (1 - \cos^2 x)(\lambda + \sin x)$ ,  $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$  has exactly one maxima and exactly one minima is
- (A)  $\left(-\frac{3}{2}, \frac{3}{2}\right) - \{0\}$  (B)  $\left(-\frac{1}{2}, \frac{1}{2}\right)$  (C)  $\left(-\frac{3}{2}, \frac{3}{2}\right)$  (D)  $\left(-\frac{1}{2}, \frac{1}{2}\right)$

\* \* \* \* \*

**CLASS 12<sup>th</sup> MATH MOVING TO TARGET JEE****ANSWER KEY****SET - B****PHYSICS**

1. (C)
2. (C)
3. (C)
4. (B)
5. (B)
6. (C)
7. (B)
8. (C)
9. (C)
10. (A)
11. (B)
12. (C)
13. (C)
14. (B)
15. (C)

16. (A)

17. (D)

**CHEMISTRY**

18. (B)

19. (A)

20. (D)

21. (A)

22. (A)

23. (C)

24. (C)

25. (B)

26. (A)

27. (B)

28. (D)

29. (C)

30. (A)

31. (B)

32. (B)

33. (B)

34. (D)

**MATHEMATICS**

35. (B)

36. (C)

37. (D)

38. (A)

39. (B)

40. (C)

41. (C)

42. (D)

43. (B)

44. (D)

45. (C)

46. (C)

47. (A)

48. (C)

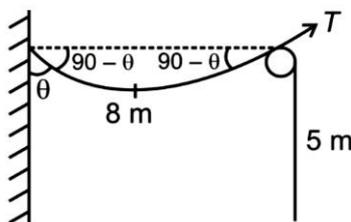
49. (C)

50. (A)

## SOLUTION

## PHYSICS

1. (C)


 $T = 5 mg$  For half part

$$T \cos\theta = 4 mg$$

$$\cos\theta = \frac{4}{5}$$

$$\theta = 37^\circ$$

2. (C)

Energy absorbed by  $e^- = 12.1 eV$ It will move from  $n = 1$  to  $n = 3$ 

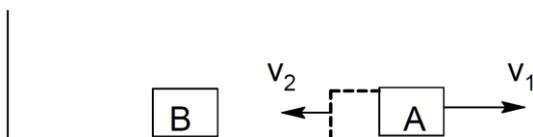
$$\text{Number of emitted wavelength} = \frac{n(n-1)}{2}$$

$$= \frac{3(2)}{2} = 3$$

3. (C)

When bigger pendulum completes one oscillation, smaller Pendulum completes  $\frac{5}{4}$  oscillation, i.e.difference of  $\frac{1}{4}$  oscillation. Hence  $\phi = 90^\circ$ .

4. (B)

Form only one collision  $v_2 \leq v_1$  $\vec{p} \text{ con.} \rightarrow$ 

$$mv = -mv_2 + Mv_1 \dots (1)$$

$$v = v_1 + v_2 \dots (2) \text{ [e eqn]}$$

From (1) &amp; (2)

$$v_1 = \frac{2mv}{M+m}, v_2 = \left( \frac{M-m}{M+m} \right) v$$

Using  $v_2 \leq v_1 \Rightarrow M \leq 3m$ 

5. (B)

$$R = \frac{\sqrt{2ME}}{qB}$$

$$R = \frac{\sqrt{2m \cdot qV}}{qB} \{E = qV\}$$

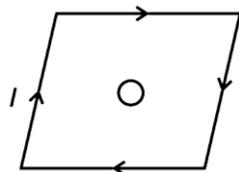
$$R \propto \sqrt{m}$$

$$m \propto R^2$$

$$\frac{m_1}{m_2} = \frac{R_1^2}{R_2^2}$$

So correct answer is (B)

6. (C)



$$B_c = 4 \times \frac{2\sqrt{2}\mu_0 I}{4\pi L} \text{ and } \phi = MI$$

$$\therefore M = \frac{2\sqrt{2}\mu_0 a^2}{L}$$

7. (B)

Wavefront is equally inclined to all the axis so light ray will be transverse to the wavefront.

$$\therefore \cos\theta \text{ with all axis} = \frac{1}{\sqrt{3}}$$

8. (C)

$$\text{Here, } \frac{KE_r}{KE_t} = \frac{\frac{1}{2}I\omega^2}{\frac{1}{2}mv^2} = \frac{mK^2(v/r)^2}{m.v^2} = \frac{K^2}{r^2} = \frac{40}{100}$$

$$\therefore K^2 = \frac{40}{100}r^2 = \frac{2}{5}r^2$$

Which is the case with a solid sphere.

9. (C)

$$KE_\alpha = \frac{p^2}{2m_\alpha} = \frac{1}{2m_\alpha} \times \left( \frac{h^2}{\lambda^2} \right) \text{ and}$$

$$Q = \frac{A}{A-4} \times (KE_\alpha)$$

$$= \frac{232}{228} \times \left( \frac{h^2}{2\lambda^2 m_\alpha} \right)$$

$$= \frac{29}{57} \frac{h^2}{\lambda^2 m_\alpha}$$

10. (A)

$$\text{Power gain} = \beta^2 \times \left( \frac{R_L}{R_B} \right)$$

$$200 = \beta^2 \times \left( \frac{2}{1} \right) \Rightarrow \beta = 10$$

$$I_C = \frac{4}{2} mA = 2mA$$

$$I_B = 0.2mA$$

$$V_m = 0.2 \times 1 = 0.2V$$

11. (B)

$$1 \text{ VSD} = \frac{9}{10} \text{ mm}$$

$$\therefore \text{Zero error} = 6 \times (1 \text{ mm}) - 6 \times \left(\frac{9}{10}\right) \text{ mm} \\ = +0.6 \text{ mm}$$

12. (C)

$$l = f_0 + f_e, \quad m = \frac{f_0}{f_e}$$

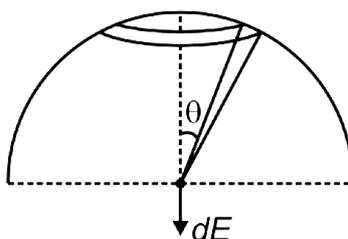
$$\Rightarrow 10 = \frac{20}{f_e} \Rightarrow f_e = 2 \text{ cm}$$

$$\therefore l = 20 + 2 = 22 \text{ cm}$$

13. (C)

$2\Omega$  and  $4\Omega$  resistance will be short circuited.  $3\Omega$  and  $6\Omega$  will be in parallel. So equivalent resistance will be  $2\Omega$ .

14. (B)



$$\int dE = \int_{\theta=0}^{\frac{\pi}{2}} \frac{1}{4\pi\epsilon_0} \times \frac{(\sigma \times 2\pi R \sin\theta R d\theta) \times (R \cos\theta)}{R^3}$$

$$= \frac{\sigma}{4\epsilon_0}$$

15. (C)

liquid pressure is always normal to the surface Hence thrust per unit area at point P = (H - h)  $\rho$ g.

16. (A)

$$\int dW = \int 3xy \cdot dy = \int 3 \cdot y^{3/2} \cdot dy$$

$$= 3 \cdot \frac{y^{5/2}}{5/2} = \frac{6}{5} [4]^{5/2} = \frac{32 \times 6}{5} = \frac{192}{5}$$

17. (D)

$$\text{Here } T_1 = 727^\circ\text{C} = 1000\text{K}$$

$$T = 227^\circ\text{C} = 500\text{K}$$

$$\eta_{\max} = 1 - \frac{T_2}{T_1} = 1 - \frac{500}{1000} = \frac{1}{2}$$

## CHEMISTRY

18. (B)

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

19. (A)

option (a) correctly explains the reason.

20. (D)

Kjeldahl's method for estimation of nitrogen fails for compounds containing nitrogen in the ring (pyridine) and compounds containing nitrogen directly linked to oxygen atom (pyridine) and compounds containing nitrogen directly linked to oxygen atom (nitro compounds) or another nitrogen atom (azo compounds).

21. (A)

Diazonium cation is a weak electrophile and hence reacts with electron rich compounds containing electron donating groups such as  $-\text{OH}$ ,  $-\text{NH}_2$  and  $-\text{OCH}_3$  groups and not with compounds containing electron withdrawing groups such as  $-\text{NO}_2$ , etc.

22. (A)

Energy of incident radiation (E)

$$= \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{256.7 \times 10^{-9}} = 0.0774 \times 10^{-17} \text{ J}$$

$$= 7.74 \times 10^{-19} \text{ J} = 4.83 \text{ eV}$$

$$[\because 1.602 \times 10^{-19} \text{ J} = 1 \text{ eV}]$$

The potential applied gives the kinetic energy to the electron.

K.E. of photoelectron =  $eV_0$

$$= 1.6 \times 10^{-19} \times 0.35 = 5.6 \times 10^{-20} \text{ J} = \frac{5.6 \times 10^{-20}}{1.602 \times 10^{-19}} = 0.349 = 0.35 \text{ eV}$$

$$\therefore \text{Work function} = (4.83 - 0.35) \text{ eV} = 4.48 \text{ eV} = 4.5 \text{ eV}$$

23. (C)

Ideal gases do not show Joule-Thomson effect.

24. (C)

Each  $\text{H}_2\text{O}$  molecule forms 4 hydrogen bonds.

25. (B)

$$w = -nRT \ln \frac{V_f}{V_i}$$

$$w = -nRT \ln \frac{V_b}{V_i}$$

$$|W| = nRT \ln \frac{V_b}{V_i}$$

$$|W| = nRT (\ln V_b - \ln V_i)$$

$$|W| = nRT \ln V_b - nRT \ln V_i$$

$$Y = mx - C$$

So, slope of curve 2 is more than curve 1 and intercept of curve 2 is more negative than curve 1.

26. (A)

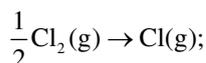
$$k = \frac{2.303}{24} \log \frac{1}{1/8} = \left( \frac{2.303}{24} \log 8 \right) \text{ minutes}^{-1} = \left( \frac{2.303}{24} \log 2^3 \right) \text{ minutes}^{-1}$$

$$= \left( \frac{2.303 \times 3}{24} \log 2 \right) \text{ minutes}^{-1} = \left( \frac{2.303}{8} \log 2 \right) \text{ minutes}^{-1}$$

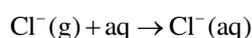
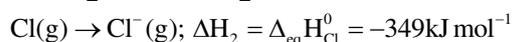
27. (B)

Frenkel defect is exhibited by compound having low coordination number and compound having large difference in size of cation and anion. This defect is not found in alkali metal halides because cations and anions have almost equal size and cations cannot be accommodated in interstitial sites.

28. (D)

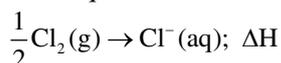


$$\Delta H_1 = \frac{1}{2} \Delta_{\text{diss}} H_{\text{Cl}_2}^0 = \frac{240}{2} = 120 \text{ kJ mol}^{-1}$$



$$\Delta H_3 = \Delta_{\text{hyd}} H^0 = -381 \text{ kJ mol}^{-1}$$

The required reaction is



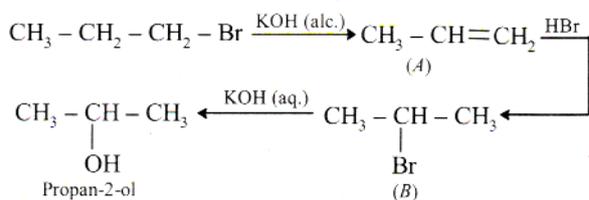
$$\text{Then } \Delta H = \frac{1}{2} \Delta_{\text{diss}} H^0 + \Delta_{\text{eg}} H^0 + \Delta_{\text{hyd}} H^0$$

$$= 120 + (-349) + (-381) = -610 \text{ kJ mol}^{-1}.$$

29. (C)

Ionisation energy increases from left to right in a period, but ionization energy of group-2 > ionization energy of group-13 and ionization energy of group-15 > ionization energy of group-16.

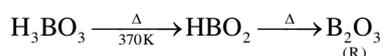
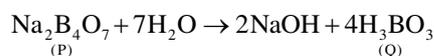
30. (A)



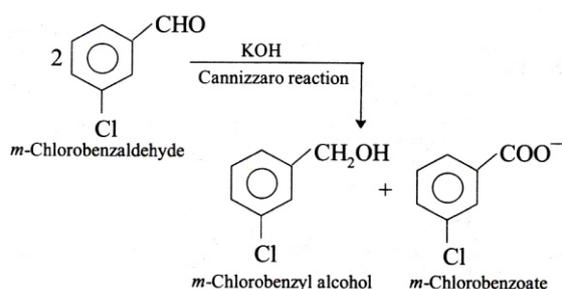
31. (B)

Both  $\text{Be}(\text{OH})_2$  and  $\text{Al}(\text{OH})_3$  are amphoteric in nature.

32. (B)



33. (B)

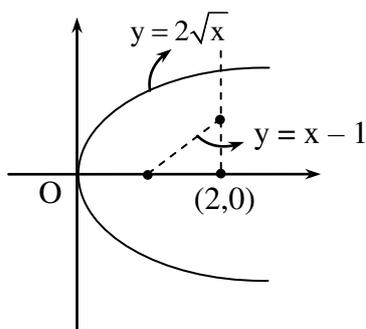


34. (D)

All of these reactions occurs in the stratosphere

# MATHEMATICS

35. (B)



$$y = [x](x-1)$$

$$y = \begin{cases} 0 & 0 \leq x < 1 \\ x-1 & 1 \leq x < 2 \end{cases}$$

$$\text{Area} = \int_0^2 2\sqrt{x} dx - \frac{1}{2} \times |x|$$

$$= \left[ \frac{4x^{3/2}}{3} \right]_0^2 - \frac{1}{2} = \frac{8\sqrt{2}}{3} - \frac{1}{2}$$

36. (C)

$$I = \int \frac{\cos \theta}{2\sin^2 \theta + 7\sin \theta + 3} d\theta \quad \sin \theta = t \Rightarrow \cos \theta d\theta = dt$$

$$\Rightarrow I = \frac{1}{2} \int \frac{dt}{t^2 + \frac{7}{2}t + \frac{3}{2}} = \frac{1}{2} \int \frac{dt}{\left(t + \frac{7}{4}\right)^2 - \left(\frac{5}{4}\right)^2}$$

$$= \frac{1}{5} \ln \left| \frac{2t+1}{t+3} \right| + C$$

$$= \frac{1}{5} \ln \left| \frac{2\sin \theta + 1}{\sin \theta + 3} \right| + C$$

$$\text{So } A = \frac{1}{5}, \quad \frac{B(\theta)}{A} = \frac{5(2\sin \theta + 1)}{\sin \theta + 3}$$

37. (D)

$$\text{Let } S = 2 \times 2^2 + 3 \times 2^3 + 4 \times 2^4 + \dots + n \times 2^n$$

$$2S = 2 \times 2^3 + 3 \times 2^4 + \dots + (n-1) \times 2^n + n \times 2^{n+1}$$

$$\Rightarrow -s = 2 \times 2^2 + 2^3 + 2^4 + \dots + 2^n - n \cdot 2^{n+1}$$

$$= 2 \times 2^2 + \frac{2^3(2^{n-2} - 1)}{1} - n \cdot 2^{n+1} = 2^{n+1} - n \cdot 2^{n+1}$$

$$\Rightarrow s = (n-1)2^{n+1} \Rightarrow (n-1)2^n \cdot 2 = 2^n \cdot 2^{10}$$

$$\Rightarrow n = 2^9 + 1 = 513$$

38. (A)

Since  $(a^2+1)x^2+4(a+b)x+2 < 0$ , for at least one  $x$ , hence discriminant must be positive.

$$\therefore (4(a+b))^2 - 4(a^2+1)(2) > 0 \quad \forall a \in \mathbb{R}$$

$$\Rightarrow 16(a^2+b^2+2ab) - 8(a^2+1) > 0 \quad \forall a \in \mathbb{R}$$

$$\Rightarrow 2(a^2+b^2+2ab) - (a^2+1) > 0 \quad \forall a \in \mathbb{R}$$

$$\Rightarrow a^2+4ab+2b^2-1 > 0 \quad \forall a \in \mathbb{R}$$

$$\Rightarrow a^2+a(4b)+(2b^2-1) > 0 \quad \forall a \in \mathbb{R}$$

Since above quadratic in 'a' must be positive  $\forall a \in \mathbb{R}$ , hence its discriminant must be negative.

$$\therefore (4b)^2 - 4(1)(2b^2-1) < 0$$

$$\Rightarrow 16b^2 - 8b^2 + 4 < 0 \Rightarrow 8b^2 + 4 < 0, \text{ which is not possible.}$$

Hence number of possible integral values of  $a$  is 0.

39. (B)

The matrix  $\begin{bmatrix} 1 & a & b \\ c & 1 & d \\ e & f & 1 \end{bmatrix}$  where exactly one of  $a, b, c, d, e, f$  is 1 and rest of them are zeros is invertible.

There are six such six matrices. Also  $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$  is invertible.

40. (C)

$$g'(c) = \frac{f(5) - f(0)}{6 - 1} \quad (\text{from L.M.V.T})$$

$$= \frac{-\frac{1}{6} - 4}{6} = \frac{-25}{6 \times 5} = -\frac{5}{6}$$

41. (C)

$$\frac{5^{200}}{8} = \frac{(5^2)^{100}}{8} = \frac{(1+24)^{100}}{8}$$

$$= \frac{1 + {}^{100}C_1 \cdot 24 + {}^{100}C_2 (24)^2 + \dots + {}^{100}C_{100} (24)^{100}}{8}$$

$$= \frac{1}{8} + \text{integer} \Rightarrow \left\{ \frac{5^{200}}{8} \right\} = \frac{1}{8}$$

42. (D)

$$\text{We have, } \bar{X} = \frac{8+12+13+15+22}{5} = 14$$

Calculation of Variance

$x_1$	$x_1 - \bar{X}$	$(x_1 - \bar{X})^2$
8	-6	36
12	-2	4
13	-1	1
15	1	1
22	8	64
		$\sum(x_1 - \bar{X})^2 = 106$

Here  $n = 5$  and  $\sum(x_1 - \bar{X})^2 = 106$

$$\therefore \text{Var}(X) = \frac{1}{n} \sum(x_1 - \bar{X})^2 = \frac{106}{5} = 21.2$$

43. (B)

Length of focal chord having one extremity  $(at^2, 2at)$  is  $a\left(t + \frac{1}{t}\right)^2$

$$\because \left|t + \frac{1}{t}\right| \geq 2 \Rightarrow a\left(t + \frac{1}{t}\right)^2 \geq 4a = 32$$

$\Rightarrow$  Length of focal chord  $\geq 32$

44. (D)

Let the equation of the ellipse be  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

Since length of the minor axis  $BB'$  is  $2b$ , the length of the line joining the focus  $S(ae, 0)$  to  $B(0, b)$  is also  $2b$ .

$$\Rightarrow a^2e^2 + b^2 \Rightarrow a^2 - b^2 + b^2 = 4b^2$$

$$\Rightarrow a^2 = 4b^2 \Rightarrow e^2 = \frac{a^2 - b^2}{a^2} = \frac{4b^2 - b^2}{4b^2} = \frac{3}{4}$$

$$\Rightarrow e = \frac{\sqrt{3}}{2}$$

45. (C)

Let the altitude from A, B, C be p, q, r respectively. Then

$$p = b \sin C, q = c \sin A, r = a \sin B$$

$$\therefore p : q : r = b \sin C : c \sin A : a \sin B$$

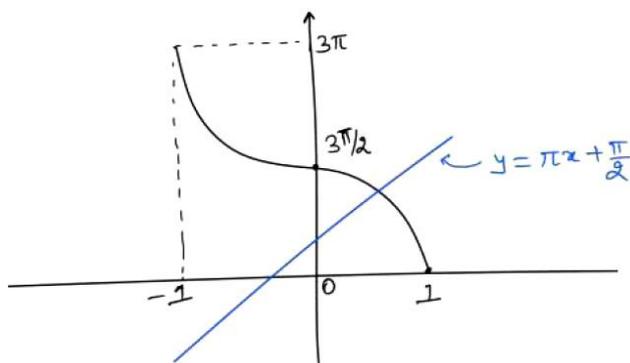
$$= \frac{1}{\sin A} : \frac{1}{\sin B} : \frac{1}{\sin C}$$

$\therefore \sin A, \sin B, \sin C$  are in AP

$\Rightarrow p, q, r$  are in HP

46. (C)

$$3\cos^{-1}x = \pi x + \frac{\pi}{2}$$



47. (A)

$$f(x) = \sqrt{3|x| - x - 2} \text{ and } g(x) = \sin x$$

For  $f \circ g(x) = \sqrt{3|\sin x| - \sin x - 2}$ , which is defined if  $3|\sin x| - \sin x - 2 \geq 0$

If  $\sin x > 0$ , then  $2\sin x - 2 \geq 0 \Rightarrow \sin x \geq 1$

$$\Rightarrow \sin x = 1 \Rightarrow x = 2n\pi + \frac{\pi}{2}$$

If  $\sin x < 0$  then  $-4\sin x - 2 \geq 0$  s

$$\Rightarrow -1 \leq \sin x \leq -\frac{1}{2}$$

$$\Rightarrow x \in \left[ 2n\pi + \frac{7\pi}{6}, 2n\pi + \frac{11\pi}{6} \right]$$

$$x \in \left[ 2n\pi + \frac{7\pi}{6}, 2n\pi + \frac{11\pi}{6} \right] \cup \left\{ 2m\pi + \frac{\pi}{2} \right\}, n, m \in \mathbb{I}$$

48. (C)

$$\text{Here } \sqrt{(1+y^4)} = \sqrt{\left(1 + \frac{1}{x^4}\right)} = \frac{\sqrt{1+x^4}}{x^2} \quad \left( \because y = \frac{1}{x} \right)$$

$$\Rightarrow \frac{\sqrt{1+y^4}}{\sqrt{1+x^4}} = \frac{1}{x^2} \quad \dots \text{(i)}$$

$$\text{But } y = \frac{1}{x}$$

$$\therefore \frac{dy}{dx} = -\frac{1}{x^2} \quad \dots \text{(ii)}$$

$$\text{From (i) to (ii) } \frac{\sqrt{1+y^4}}{\sqrt{1+x^4}} = -\frac{dy}{dx}$$

$$\Rightarrow \frac{dy}{\sqrt{(1+y^4)}} + \frac{dx}{\sqrt{(1+x^4)}} = 0$$

49. (C)

$$e^y y^1 x^4 + 4x^3 e^y + \frac{2y^1}{2\sqrt{y+1}} = 0 \text{ at } (1, 0)$$

$$\Rightarrow y^1 + 4 + y^1 = 0 \Rightarrow y^1 = 2$$

Equation of tangent at (1, 0) is  $2x + y - 2 = 0$

So option c is correct.

50. (A)

$$f(x) = \sin^2 x (\lambda + \sin x)$$

$$f'(x) = \sin x \cos x (2\lambda + 3 \sin x)$$

$\sin x = 0$  (one point)

$$\sin x = -\frac{2\lambda}{3} \in (-1, 1) - \{0\}$$

$$\Rightarrow \lambda \in \left(-\frac{3}{2}, \frac{3}{2}\right) - \{0\}$$

\* \* \* \* \*