

WBJEE - 2016

PHYSICS & CHEMISTRY

Q.No.	+	○	□	⊗
01	C	B	B	*
02	C	B	B	D
03	B	B	D	C
04	B	C	C	D
05	B	**	A	C
06	B	B	C	B
07	B	*	D	A
08	C	D	D	B
09	**	C	D	B
10	B	D	A	D
11	*	C	D	C
12	D	B	C	A
13	C	A	*	C
14	D	B	C	D
15	C	B	C	D
16	B	D	B	D
17	A	C	B	A
18	B	A	B	D
19	B	C	B	C
20	D	D	B	*
21	C	D	C	C
22	A	D	**	C
23	C	A	B	B
24	D	D	*	B
25	D	C	D	B
26	D	*	C	B
27	A	C	D	B
28	D	C	C	C
29	C	B	B	**
30	*	B	A	B
31	C	A	A	B
32	A	B	C	**
33	B	**	A	A
34	**	A	B	C
35	A	C	**	A
36	A,D	*	*	A,C
37	*	A,C	A,D	A,B
38	A,C	A,B	*	*
39	A,B	*	A,C	A,D
40	*	A,D	A,B	*
41	C	A	D	D
42	B	C	A	A
43	B	C	C	B
44	B	B	C	C
45	B	C	C	B
46	A	A	B	C
47	C	A	B	D
48	C	B	B	C
49	B	D	B	B
50	C	A	A	C
51	A	B	C	B
52	A	C	C	B
53	B	B	B	C
54	D	C	C	D
55	A	D	A	A
56	B	C	A	C
57	C	B	B	C
58	B	C	D	C
59	C	B	A	B
60	D	B	B	B
61	C	C	C	B
62	B	D	B	B
63	C	A	C	A
64	B	C	D	C
65	B	C	C	C
66	C	C	B	B
67	D	B	C	C
68	A	B	B	A
69	C	B	B	A
70	C	B	C	B
71	B	B	D	A
72	B	A	B	C
73	A	C	B	D
74	C	D	A	B
75	D	B	C	B
76	A,C	B,D	A,B,D	A,B,D
77	B,D	A,B,D	A,C	A,C
78	A,B,D	A,C	B,D	A,B,D
79	A,C	A,B,D	A,B,D	A,C
80	A,B,D	A,C	A,C	B,D

* All options are incorrect

** Wrong question



ANSWERS & HINT
for
WBJEE - 2016
SUB : PHYSICS & CHEMISTRY

PHYSICS

CATEGORY - I (Q1 to Q30)

Only one answer is correct. Correct answer will fetch full marks 1. Incorrect answer or any combination of more than one answer will fetch – ¼ marks.

1. Two coils of self inductances 6mH and 8mH are connected in series and are adjusted for highest co-efficient of coupling. Equivalent self inductance L for the assembly is approximately
(A) 50 mH (B) 36 mH (C) 28 mH (D) 18 mH

Ans : (C)

Hint : $L_{eq} = L_1 + L_2 + 2\sqrt{L_1 L_2}$

$$= 6 + 8 + 2\sqrt{6 \times 8}$$

$$= 28 \text{ mH}$$

2. An 1 μF capacitor C is connected to a battery of 10 V through a resistance 1 M Ω . The voltage across C after 1 sec is approximately
(A) 5.6 V (B) 7.8 V (C) 6.3 V (D) 10 V

Ans : (C)

Hint : $\tau = CR = 1 \times 10^{-6} \times 10^6 = 1 \text{ s}$

In 1 time constant 63% charging is done.

$$\therefore \frac{63}{100} \times q_{\max} = \frac{63}{100} \times 1 \times 10 = 6.3 \mu\text{C} \Rightarrow V = \frac{q}{c} = \frac{6.3 \mu\text{C}}{1 \mu\text{F}} = 6.3 \text{ V}$$

3. Two equal resistances, 400 Ω each, are connected in series with a 8 V battery. If the resistance of first one increases by 0.5%, the change required in the resistance of the second one in order to keep the potential difference across it unaltered is to
(A) increase it by 1 Ω (B) increase it by 2 Ω
(C) increase it by 4 Ω (D) decrease it by 4 Ω

Ans : (B)

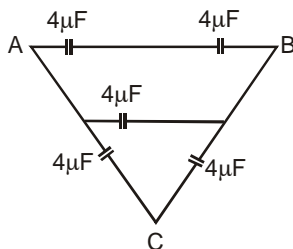
Hint : $\frac{0.5}{100} \times 400 = 2 \Omega$

4. Angle between an equipotential surface and electric lines of force is
(A) 0° (B) 90° (C) 180° (D) 270°

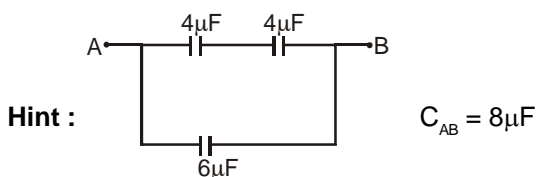
Ans : (B)

Hint : 90°

5. Equivalent capacitance between A & B in the figure is
 (A) $20 \mu\text{F}$ (B) $8 \mu\text{F}$ (C) $12 \mu\text{F}$ (D) $16 \mu\text{F}$



Ans : (B)



6. Two wires of same radius having lengths l_1 and l_2 and resistivities ρ_1 and ρ_2 are connected in series. The equivalent resistivity will be

- (A) $\frac{\rho_1 l_2 + \rho_2 l_1}{\rho_1 + \rho_2}$ (B) $\frac{\rho_1 l_1 + \rho_2 l_2}{l_1 + l_2}$
 (C) $\frac{\rho_1 l_1 - \rho_2 l_2}{l_1 - l_2}$ (D) $\frac{\rho_1 l_2 + \rho_2 l_1}{l_1 + l_2}$

Ans : (B)

Hint : $\frac{\rho_1 l_1}{A} + \frac{\rho_2 l_2}{A} = \rho_{eq} \frac{(l_1 + l_2)}{A}$

$$\rho_{eq} = \frac{\rho_1 l_1 + \rho_2 l_2}{l_1 + l_2}$$

7. A hollow metal sphere of radius R is charged with a charge Q. The electric potential and intensity inside the sphere are respectively

- (A) $\frac{Q}{4\pi \epsilon_0 R^2}$ and $\frac{Q}{4\pi \epsilon_0 R}$ (B) $\frac{Q}{4\pi \epsilon_0 R}$ and zero
 (C) Zero and Zero (D) $\frac{4\pi \epsilon_0 Q}{R}$ and $\frac{Q}{4\pi \epsilon_0 R^2}$

Ans : (B)

8. The potential difference V required for accelerating an electron to have the de Broglie wavelength of 1 \AA is
 (A) 100 V (B) 125 V (C) 150 V (D) 200 V

Ans : (C)

Hint : $\lambda = \frac{h}{\sqrt{2meV}}$

$$V = \frac{h^2}{2me\lambda^2} \approx 150 \text{ volt}$$

9. The work function of Cesium is 2.27 eV. The cut-off voltage which stops the emission of electrons from a cesium cathode irradiated with light of 600 nm wavelength is
 (A) 0.5 V (B) -0.2V (C) -0.5V (D) 0.2 V

Ans : (None of the given options correct)

Hint : $\frac{hc}{\lambda} < \phi$ (work function)

So no emission will take place.

10. The number of De-Broglie wavelengths contained in the second Bohr orbit of Hydrogen atom is
 (A) 1 (B) 2 (C) 3 (D) 4

Ans : (B)

11. The wavelength of second Balmer line in Hydrogen spectrum is 600 nm. The wavelength for its third line in Lyman series is
 (A) 800 nm (B) 600 nm (C) 400 nm (D) 200 nm

Ans : (None of the given options correct)

$$\text{Hint : } \frac{1}{\lambda_1} = R \left[\frac{1}{4} - \frac{1}{16} \right] \quad \left| \quad \frac{\lambda_2}{\lambda_1} = \frac{64}{15} \Rightarrow \frac{\lambda_2}{\lambda_1} = \frac{3}{15} \right.$$

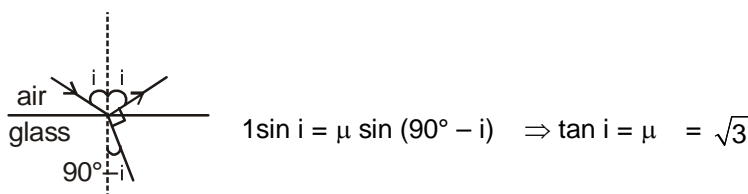
$$\frac{1}{\lambda_2} = R \left[1 - \frac{1}{16} \right] \quad \left| \quad \lambda_2 = \frac{600 \times 3}{15} \right.$$

$$\lambda_2 = 120 \text{ nm}$$

12. A ray of light strikes a glass plate at an angle of 60°. If the reflected and refracted rays are perpendicular to each other, the refractive index of glass is
 (A) $\frac{\sqrt{3}}{2}$ (B) $\frac{3}{2}$ (C) $\frac{1}{2}$ (D) $\sqrt{3}$

Ans : (D)

Hint : Assuming 60° as angle of incidence



13. Light travels through a glass plate of thickness t and having refractive index μ . If c be the velocity of light in vacuum, time taken by the light to travel through this thickness of glass is
 (A) $\frac{t}{\mu c}$ (B) $\frac{tc}{\mu}$ (C) $\frac{\mu t}{c}$ (D) μtc

Ans : (C)

Hint : $\Delta t = \frac{\text{distance}}{\text{speed of light}} = \frac{t}{\frac{c}{\mu}} = \frac{\mu t}{c}$

14. If $x=at+bt^2$ where x is in metre(m) and t is in hour (hr) then unit of b will be
 (A) m^2/hr (B) m (C) m/hr (D) m/hr^2

Ans : (D)

Hint : $[x] = [bt^2]$
 unit of $b = m/hr^2$

15. The vectors \vec{A} & \vec{B} are such that $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$. The angle between the two vectors will be

- (A) 0° (B) 60° (C) 90° (D) 45°

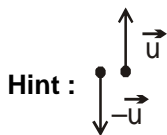
Ans : (C)

Hint : $A^2 + B^2 + 2AB\cos\theta = A^2 + B^2 - 2AB\cos\theta$
 $4AB \cos\theta = 0 \Rightarrow \cos\theta = 0 \Rightarrow \theta = 90^\circ$

16. At a particular height, the velocity of an ascending body is \vec{u} . The velocity at the same height while the body falls freely is

- (A) $2\vec{u}$ (B) $-\vec{u}$ (C) \vec{u} (D) $-2\vec{u}$

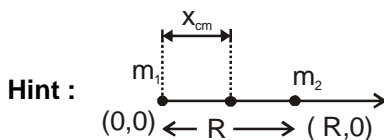
Ans : (B) Assuming no air resistance.



17. Two bodies of masses m_1 & m_2 are separated by a distance R . The distance of the centre of mass of the bodies from the mass m_1 is

- (A) $\frac{m_2 R}{m_1 + m_2}$ (B) $\frac{m_1 R}{m_1 + m_2}$ (C) $\frac{m_1 m_2}{m_1 + m_2} R$ (D) $\frac{m_1 + m_2}{m_1} R$

Ans : (A)



$$x_{cm} = \frac{m_1 \times 0 + m_2 R}{m_1 + m_2} = \frac{m_2 R}{m_1 + m_2}$$

18. The velocity of sound in air at 20°C and 1 atm pressure is 344.2 m/s. At 40°C and 2 atm pressure the velocity of sound in air is approximately

- (A) 350 m/s (B) 356 m/s (C) 363 m/s (D) 370 m/s

Ans : (B)

Hint :

$$\frac{V_1}{V_2} = \frac{\sqrt{\frac{\gamma R T_1}{M}}}{\sqrt{\frac{\gamma R T_2}{M}}}$$

$$\frac{V_1}{V_2} = \sqrt{\frac{293}{313}}$$

$$V_2 = 344.2 \sqrt{\frac{313}{293}} = 355.75 \approx 356 \text{ m/s}$$

19. The perfect gas equation for 4 g of hydrogen gas is

- (A) $PV = RT$ (B) $PV = 2RT$ (C) $PV = \frac{1}{2} RT$ (D) $PV = 4RT$

Ans : (B)

Hint : $PV = 2RT$ $\left(n = \frac{4}{2} = 2 \right)$

20. If the temperature of the Sun gets doubled, the rate of energy received on the Earth will increase by a factor of

- (A) 2 (B) 4 (C) 8 (D) 16

Ans : (D)

Hint : $E \propto T^4$ \therefore 16 times

21. A particle vibrating simple harmonically has an acceleration of 16 cms^{-2} when it is at a distance of 4 cm from the mean position. Its time period is

- (A) 1s (B) 2.572s (C) 3.142s (D) 6.028s

Ans : (C)

Hint : $\left| \vec{a} \right| = \omega^2 x$

$16 \times 10^{-2} = \omega^2 (4 \times 10^{-2})$

$\omega = 2 \frac{\text{rad}}{\text{s}}$ $T = \frac{2\pi}{\omega} = \frac{2\pi}{2} = \pi = 3.142 \text{ s}$

22. Work done for a certain spring when stretched through 1 mm is 10 Joule. The amount of work that must be done on the spring to stretch it further by 1 mm is

- (A) 30 J (B) 40 J (C) 10 J (D) 20 J

Ans : (A)

Hint : $w_1 = \frac{1}{2} Kx^2$
 $w_2 = \frac{1}{2} K(2x)^2$

$\therefore w_2 = 4w_1$

\therefore more work required = $40\text{J} - 10\text{J} = 30\text{J}$

23. If the r.m.s velocity of Hydrogen gas at a certain temperature is c, then the r.m.s velocity of Oxygen gas at the same temperature is

- (A) $\frac{c}{8}$ (B) $\frac{c}{10}$ (C) $\frac{c}{4}$ (D) $\frac{c}{2}$

Ans : (C)

Hint : $\frac{V_{\text{rmsH}_2}}{V_{\text{rmsO}_2}} = \frac{\sqrt{\frac{3RT}{M_{\text{H}_2}}}}{\sqrt{\frac{3RT}{M_{\text{O}_2}}}} \Rightarrow \frac{c}{V_{\text{rmsO}_2}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{H}_2}}} = \sqrt{\frac{32}{2}} = \sqrt{16} = 4 \therefore \frac{c}{V_{\text{rmsO}_2}} = 4 \Rightarrow V_{\text{rmsO}_2} = \frac{c}{4}$

24. For air at room temperature the atmospheric pressure is $1.0 \times 10^5 \text{ Nm}^{-2}$ and density of air is 1.2 Kg m^{-3} . For a tube of length 1.0m closed at one end the lowest frequency generated is 84 Hz . The value of γ (ratio of two specific heats) for air is

- (A) 2.1 (B) 1.5 (C) 1.8 (D) 1.4

Ans : (D)

Hint : $f = \frac{v}{4l}$

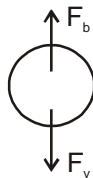
$$\therefore \sqrt{\frac{\gamma P}{\rho}} = 84 \times 4$$

$$\therefore \sqrt{\frac{\gamma P}{\rho}} = 84 \times 4 = \gamma = \frac{(84 \times 4)^2 \times 1.2}{1.0 \times 10^5} = 1.354 \approx 1.4$$

25. A gas bubble of 2 cm diameter rises through a liquid of density 1.75 g cm^{-3} with a fixed speed of 0.35 cms^{-1} . Neglect the density of the gas. The co-efficient of viscosity of the liquid is

- (A) 870 poise (B) 1120 poise (C) 982 poise (D) 1089 poise

Ans : (D)



Hint :

$$F_v = F_b$$

$$6\pi r \eta v_T = \frac{4}{3} \pi r^3 \rho_l g$$

solving above equation

$$\eta = 1089 \text{ poise}$$

26. The temperature of the water of a pond is 0°C while that of the surrounding atmosphere is -20°C . If the density of ice is ρ , coefficient of thermal conductivity is k and latent heat of melting is L then the thickness Z of ice layer formed increases as a function of time t as

- (A) $Z^2 = \frac{60k}{\rho L} t$ (B) $Z = \sqrt{\frac{40k}{\rho L} t}$ (C) $Z^2 = \frac{40k}{\rho L} \sqrt{t}$ (D) $Z^2 = \frac{40k}{\rho L} t$

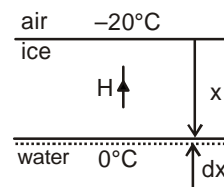
Ans : (D)

Hint : $H = \frac{dQ}{dt} = \frac{KA(0 - (-20))}{x}$

$$\frac{dm}{dt} L = \frac{KA(20)}{x}$$

$$\rho A \frac{dx}{dt} L = \frac{KA(20)}{x}$$

$$\int_0^z x dx = \frac{20K}{\rho L} \int_0^t dt, z^2 = \frac{40K}{\rho L} t$$



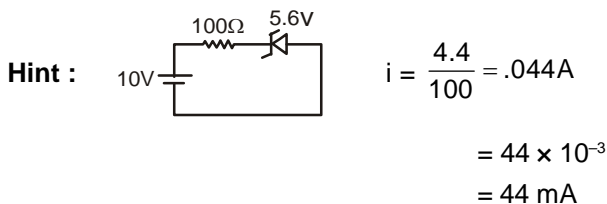
27. 1000 droplets of water having 2 mm diameter each coalesce to form a single drop. Given the surface tension of water is 0.072 Nm^{-1} . The energy loss in the process is
 (A) $8.146 \times 10^{-4} \text{ J}$ (B) $4.4 \times 10^{-4} \text{ J}$ (C) $2.108 \times 10^{-5} \text{ J}$ (D) $4.7 \times 10^{-1} \text{ J}$

Ans : (A)

Hint : $U_f - U_i = \Delta E$, $R = n^{1/3} r$
 $= S 4\pi 100r^2 - 1000 S 4\pi r^2$
 $= -3600 S \pi r^2$
 $E_{\text{loss}} = 3600 \times 0.072 \times 3.14 \times (1 \times 10^{-3})^2$
 $= 813.888 \times 10^{-6}$
 $= 8.146 \times 10^{-4} \text{ J}$

28. A Zener diode having break-down voltage 5.6 V is connected in reverse bias with a battery of emf 10 V and a resistance of 100Ω in series. The current flowing through the Zener is
 (A) 88 mA (B) 0.88 mA (C) 4.4 mA (D) 44 mA

Ans : (D)



29. In case of a bipolar transistor $\beta = 45$. The potential drop across the collector resistance of $1 \text{ k}\Omega$ is 5 V. The base current is approximately
 (A) $222 \mu\text{A}$ (B) $55 \mu\text{A}$ (C) $111 \mu\text{A}$ (D) $45 \mu\text{A}$

Ans : (C)

Hint : $\beta = 45$ $\frac{I_c}{I_b} = 45$
 $I_c \times 1 \times 10^3 = 5$
 $I_c = 5 \times 10^{-3}$
 $I_b = \frac{I_c}{45} = \frac{5 \times 10^{-3}}{45}$
 $= 0.111 \times 10^{-3}$
 $= 111 \mu\text{A}$

30. An electron enters an electric field having intensity $\vec{E} = 3\hat{i} + 6\hat{j} + 2\hat{k} \text{ Vm}^{-1}$ and magnetic field having induction $\vec{B} = 2\hat{i} + 3\hat{j} \text{ T}$ with a velocity $\vec{v} = 2\hat{i} + 3\hat{j} \text{ ms}^{-1}$. The magnitude of the force acting on the electron is (Given $e = -1.6 \times 10^{-19} \text{ C}$)
 (A) $2.02 \times 10^{-18} \text{ N}$ (B) $5.16 \times 10^{-16} \text{ N}$
 (C) $3.72 \times 10^{-17} \text{ N}$ (D) $4.41 \times 10^{-18} \text{ N}$

Ans : (None of the given options are correct)

Hint : $\vec{F} = q\vec{E}$
 $|\vec{F}| = |q||\vec{E}|$
 $= 1.6 \times 10^{-19} \times 7$

$$= 1.12 \times 10^{-18} \text{ N}$$

$$\vec{v} \text{ is parallel to } \vec{B} \therefore \vec{F}_m = q (\vec{v} \times \vec{B}) = \vec{0}$$

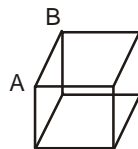
$$\therefore \text{net force} = 1.12 \times 10^{-18} \text{ N}$$

Category II (Q31 to Q35)

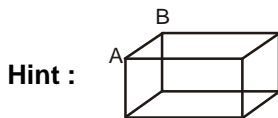
Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer or any combination of more than one answer will fetch – ½ marks

31. The effective resistance between A and B in the figure is $\frac{7}{12} \Omega$ if each side of the cube has 1Ω resistance. The effective resistance between the same two points, when the link AB is removed, is

- (A) $\frac{7}{12} \Omega$ (B) $\frac{5}{12} \Omega$ (C) $\frac{7}{5} \Omega$ (D) $\frac{5}{7} \Omega$



Ans : (C)



Assuming, x – as an equivalent of the remaining without link

$$\frac{7}{12} = \frac{1(x)}{1+x} = \frac{x}{1+x}$$

$$7(1+x) = 12x$$

$$7 + 7x = 12x$$

$$7 = 5x$$

$$x = \frac{7}{5} \Omega$$

32. A current $I = I_0 e^{-\lambda t}$ is flowing in a circuit consisting of a parallel combination of resistance R and capacitance C. The total charge over the entire pulse period is

- (A) $\frac{I_0}{\lambda}$ (B) $\frac{2I_0}{\lambda}$
 (C) $I_0 \lambda$ (D) $e^{I_0 \lambda}$

Ans : (A)

Hint :

$$I = I_0 e^{-\lambda t}$$

$$\frac{dQ}{dt} = I_0 e^{-\lambda t}, \int_0^Q dQ = I_0 \int_{t=0}^{t=\infty} e^{-\lambda t} dt$$

$$Q = \frac{I_0}{\lambda}$$

33. For Fraunhofer diffraction to occur
- (A) Light source should be at infinity
 (B) Both source and screen should be at infinity
 (C) Only the source should be at finite distance
 (D) Both source and screen should be at finite distance

Ans : (B)

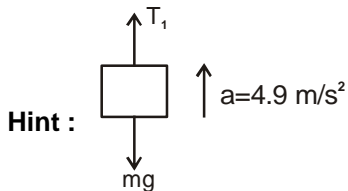
Hint : Both source and screen should be at infinity (condition of Fraunhofer diffraction's experimental set-up)

34. The temperature of a blackbody radiation enclosed in a container of volume V is increased from 100°C to 1000°C . The heat required in the process is
- (A) $4.79 \times 10^{-4} \text{ cal}$ (B) $9.21 \times 10^{-5} \text{ cal}$
 (C) $2.17 \times 10^{-4} \text{ cal}$ (D) $7.54 \times 10^{-4} \text{ cal}$

Ans : (Information is not sufficient)

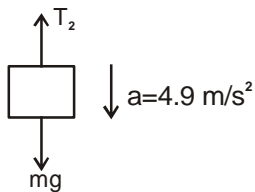
35. A mass of 1 kg is suspended by means of a thread. The system is (i) lifted up with an acceleration of 4.9 ms^{-2} . (ii) lowered with an acceleration of 4.9 ms^{-2} . The ratio of tension in the first and second case is
- (A) 3:1 (B) 1:2
 (C) 1:3 (D) 2:1

Ans : (A)



$$T_1 - mg = \frac{mg}{2}$$

$$T_1 = \frac{3mg}{2} \text{ ——— (I)}$$



$$(mg - T_2) = \frac{mg}{2}$$

$$T_2 = \frac{mg}{2} \text{ ——— (II)}$$

$$\frac{T_1}{T_2} = \frac{3mg}{\cancel{2}} \times \frac{\cancel{2}}{mg} = \frac{3}{1}$$

Category III (Q36 to Q40)

One or more answer(s) is (are) correct. Correct answer(s) will fetch marks 2. Any combination containing one or more incorrect answer will fetch 0 marks. If all correct answers are not marked and also no incorrect answer is marked then score = 2×number of correct answers marked/actual number of correct answers.

36. A rectangular coil carrying current is placed in a non-uniform magnetic field. On that coil the total
 (A) force is non-zero (B) force is zero
 (C) torque is zero (D) torque is non-zero

Ans : (A,D)

Hint : In most general cases correct answers are A and D, but force and torque may be zero in some specific cases.

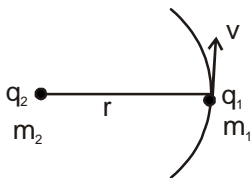
37. A charged particle of mass m_1 and charge q_1 is revolving in a circle of radius r . Another charged particle of charge q_2 and mass m_2 is situated at the centre of the circle. If the velocity and time period of the revolving particle be v and T respectively, then

$$(A) \quad v = \sqrt{\frac{q_1 q_2 r}{4\pi\epsilon_0 m_1}} \quad (B) \quad v = \frac{1}{m_1} \sqrt{\frac{q_1 q_2}{4\pi\epsilon_0 r}}$$

$$(C) \quad T = \sqrt{\frac{16\pi^3 \epsilon_0 m_1^2 r^3}{q_1 q_2}} \quad (D) \quad T = \sqrt{\frac{16\pi^3 \epsilon_0 m_2 r^3}{q_1 q_2}}$$

Ans : (None of the given options are correct)

Hint : Both charges are either both positive or both negative (since answers has the product $q_1 q_2$ inside square root). Hence circular motion is not possible. Thus question is wrong. Either q_1 or q_2 should be negative



$$\frac{m_1 v^2}{r} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

$$v = \sqrt{\frac{1}{4\pi\epsilon_0 m_1} \frac{q_1 q_2}{r}}$$

by $v = r\omega$ and $\omega = \frac{2\pi}{T}$, we can find out

$$T = \sqrt{\frac{16\pi^3 \epsilon_0 m_1 r^3}{q_1 q_2}}$$

Hence none answer is correct

38. The distance between a light source and photoelectric cell is d . If the distance is decreased to $d/2$ then
- (A) The emission of electron per second will be four times
 - (B) Maximum kinetic energy of photoelectrons will be four times
 - (C) Stopping potential will remain same
 - (D) The emission of electrons per second will be doubled

Ans : (A,C)

Hint : $I \propto \frac{1}{r^2}$ and $I \propto N$ (number of photons per second)

$\therefore N \propto \frac{1}{r^2}$, \therefore number of ejected electron become 4 times

$$KE_{\max} = h\nu - \phi$$

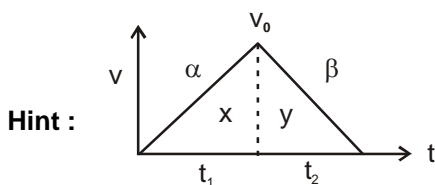
since ν remains unchanged hence, KE_{\max} as well as stopping potential remains unchanged

$$KE_{\max} = eV_s$$

39. A train moves from rest with acceleration α and in time t_1 covers a distance x . It then decelerates to rest at constant retardation β for distance y in time t_2 . Then

- (A) $\frac{x}{y} = \frac{\beta}{\alpha}$
- (B) $\frac{\beta}{\alpha} = \frac{t_1}{t_2}$
- (C) $x = y$
- (D) $\frac{x}{y} = \frac{\beta t_1}{\alpha t_2}$

Ans : (A,B)



$\tan\theta = \text{acceleration}$

$$\therefore \alpha = \frac{v_0}{t_1} \text{ and } \beta = \frac{v_0}{t_2}$$

$$\therefore \frac{\beta}{\alpha} = \frac{t_1}{t_2}$$

displacement = area of v-t graph

$$x = \frac{1}{2} t_1 \cdot v_0$$

$$y = \frac{1}{2} t_2 \cdot v_0$$

$$\text{hence } \frac{x}{y} = \frac{t_1}{t_2} = \frac{\beta}{\alpha}$$

40. A drop of water detaches itself from the exit of a tap when (σ = surface tension of water, ρ = density of water, R = radius of the tap exit, r = radius of the drop)

(A) $r > \left(\frac{2 R \sigma}{3 \rho g}\right)^{1/3}$

(B) $r > \frac{2 \sigma}{3 \rho g}$

(C) $\frac{2\sigma}{r} > \text{atmospheric pressure}$

(D) $r > \left(\frac{2 R \sigma}{3 \rho g}\right)^{2/3}$

Ans : (None of the options are correct)

Hint :

$$mg > T \cdot 2\pi R$$

$$\frac{4}{3} \pi r^3 \rho g > T \times 2\pi R$$

$$r > \left(\frac{3 TR}{2 \rho g}\right)^{1/3}$$

CHEMISTRY

CATEGORY - I (Q41 to Q70)

Only one answer is correct. Correct answer will fetch full marks 1. Incorrect answer or any combination of more than one answer will fetch – ¼ marks

41. The condition for a reaction to occur spontaneously is

(A) ΔH must be negative

(B) ΔS must be negative

(C) $(\Delta H - T\Delta S)$ must be negative

(D) $(\Delta H + T\Delta S)$ must be negative

Ans : (C)

Hint : For a reaction to occur spontaneously $\Delta G < 0$ i.e. $\Delta H - T\Delta S$ must be negative

42. The order of equivalent conductances at infinite dilution of LiCl, NaCl and KCl is

(A) LiCl > NaCl > KCl

(B) KCl > NaCl > LiCl

(C) NaCl > KCl > LiCl

(D) LiCl > KCl > NaCl

Ans : (B)

Size decreases
→

Hint : For $\text{Li}^+(\text{aq})$ $\text{Na}^+(\text{aq})$ $\text{K}^+(\text{aq})$

Ionic mobility increases
→

43. The molar solubility (in mol L⁻¹) of a sparingly soluble salt MX_4 is 'S'. The corresponding solubility product is 'Ksp'. 'S' in terms of 'Ksp' is given by the relation

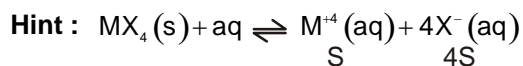
(A) $S = \left(\frac{K_{sp}}{128}\right)^{1/4}$

(B) $S = \left(\frac{K_{sp}}{256}\right)^{1/5}$

(C) $S = (256 K_{sp})^{1/5}$

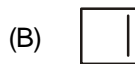
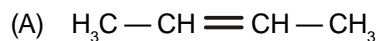
(D) $S = (128 K_{sp})^{1/4}$

Ans : (B)

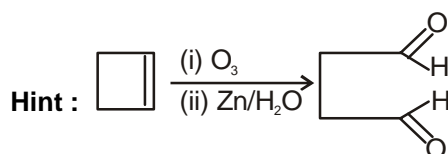


$$K_{\text{sp}} = [\text{M}^{+4}] \times [\text{X}^-]^4 = \text{S} \times (4\text{S})^4 = 256\text{S}^5 \therefore \text{S} = \left(\frac{K_{\text{sp}}}{256} \right)^{1/5}$$

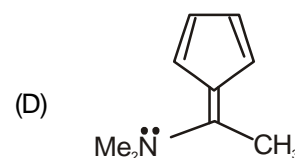
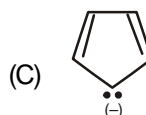
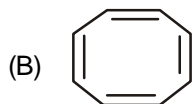
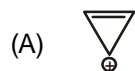
44. Ozonolysis of an alkene produces only one dicarbonyl compound. The structure of the alkene is :



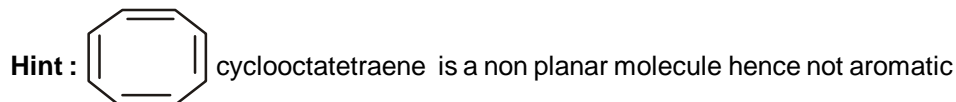
Ans : (B)



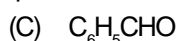
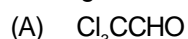
45. From the following compounds choose the one which is not aromatic :



Ans : (B)

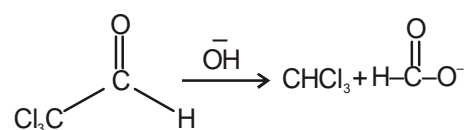


46. Amongst the following compounds, the one that will not respond to Cannizzaro reaction upon treatment with alkali is

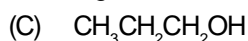
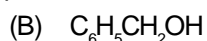
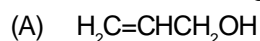


Ans : (A)

Hint : Cl_3CCHO formation is the 2nd last step in the haloform reaction mechanism. Hence on treatment with caustic alkali, Cl_3CCHO is hydrolysed and does not disproportionate.



47. Which of the following compounds would not react with Lucas reagent at room temperature?



Ans : (C)

Hint : $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ does not undergo $\text{S}_{\text{N}}1$ or $\text{S}_{\text{N}}2$ at room temperature

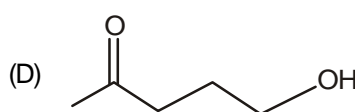
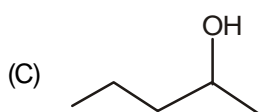
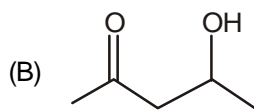
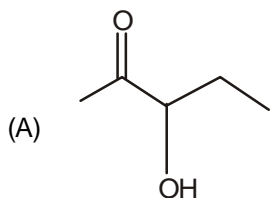
48. Amongst the following compounds the one which would not respond to iodoform test is

- (A) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ (B) $\text{ICH}_2\text{COCH}_2\text{CH}_3$ (C) CH_3COOH (D) CH_3CHO

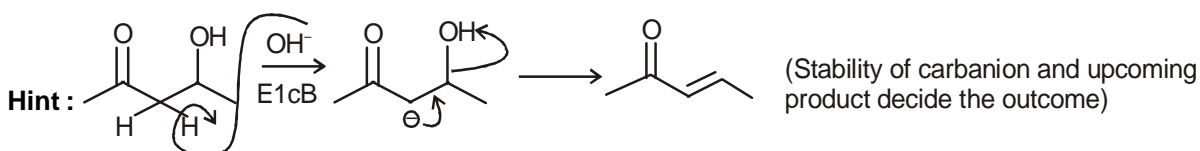
Ans : (C)

Hint : In acetic acid, the most acidic proton is attached to O atom. So deprotonation of α -hydrogen does not occur and hence no haloform reaction.

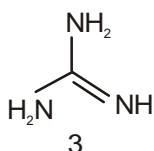
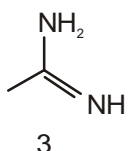
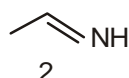
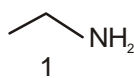
49. Which of the following will be dehydrated most readily in alkaline medium?



Ans : (B)



50. The correct order of basicity of the following compounds is



(A) $1 < 2 < 3 < 4$

(B) $1 < 2 < 4 < 3$

(C) $2 < 1 < 3 < 4$

(D) $4 < 3 < 2 < 1$

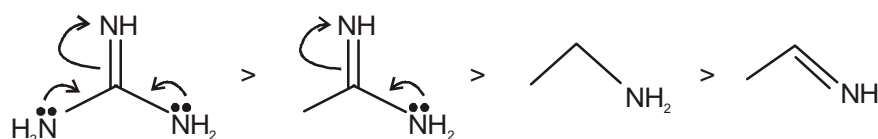
Ans : (C)

Hint : The basic strength order depends on

i) Accumulation of $-ve$ charge on N (double bonded) by another NH_2 group, thus intensifying the donor ability of N.

ii) The higher donor ability of sp^3 hybrid N as compared to sp^2 N.

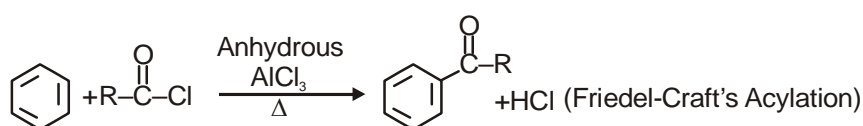
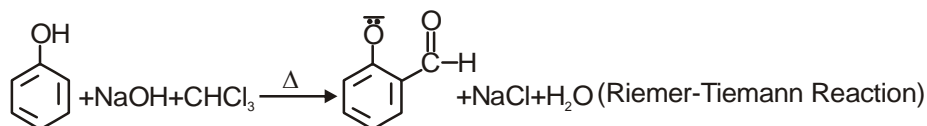
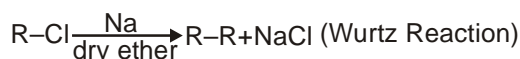
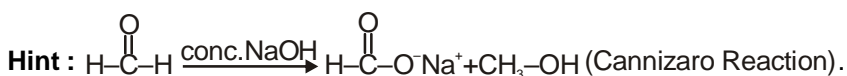
Hence the order of basic strength is



51. Which of the following reactions will not result in the formation of carbon-carbon bonds?

- (A) Cannizaro reaction (B) Wurtz reaction
(C) Reimer-Tiemann reaction (D) Friedel-Crafts acylation

Ans : (A)



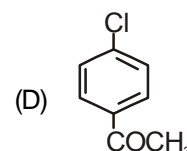
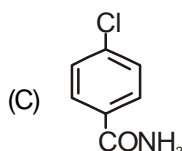
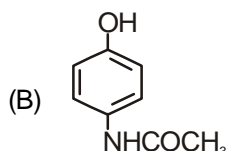
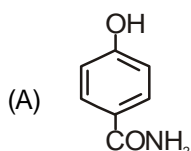
52. Point out the false statement.

- (A) Colloidal sols are homogenous
(B) Colloids carry +ve or -ve charges
(C) Colloids show Tyndall effect
(D) The size range of colloidal particles is 10-1000Å

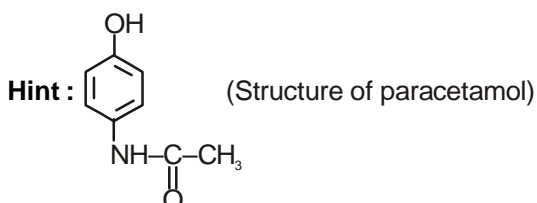
Ans : (A)

Hint : Colloidal sols are heterogeneous mixture of dispersed phase and dispersion medium.

53. The correct structure of the drug paracetamol is



Ans : (B)



54. Which of the following statements regarding Lanthanides is false?

- (A) All lanthanides are solid at room temperature.
(B) Their usual oxidation state is +3
(C) They can be separated from one another by ion-exchange method.
(D) Ionic radii of trivalent lanthanides steadily increases with increase in atomic number.

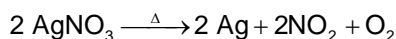
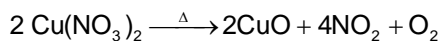
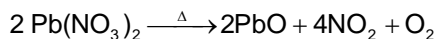
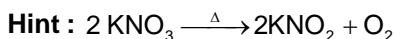
Ans : (D)

Hint : The ionic radii of trivalent lanthanides steadily **decreases** with increase in atomic number and the phenomenon is known as Lanthanoid contraction.

55. Nitrogen dioxide is not produced on heating

- (A) KNO_3 (B) $\text{Pb}(\text{NO}_3)_2$ (C) $\text{Cu}(\text{NO}_3)_2$ (D) AgNO_3

Ans : (A)



Heavy metal nitrates liberate NO_2 on heating.

56. The boiling points of HF, HCl, HBr and HI follow the order

- (A) $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$ (B) $\text{HF} > \text{HI} > \text{HBr} > \text{HCl}$ (C) $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$ (D) $\text{HCl} > \text{HF} > \text{HBr} > \text{HI}$

Ans : (B)

Hint : $\text{HF} > \text{HI} > \text{HBr} > \text{HCl}$

HF is hydrogen bonded, thus has highest boiling point, and it is liquid at or below 19°C . The remaining hydrogen halides are gaseous and their boiling points depend on the van der Waals' forces. Larger the size (or molecular mass), greater is the van der Waals' forces, hence higher is the boiling point. Thus the order is

$\text{HI} > \text{HBr} > \text{HCl}$. and overall $\text{HF} > \text{HI} > \text{HBr} > \text{HCl}$

57. In the solid state PCl_5 exists as

- (A) $[\text{PCl}_4]^-$ and $[\text{PCl}_6]^+$ ions (B) Covalent PCl_5 molecules only
(C) $[\text{PCl}_4]^+$ and $[\text{PCl}_6]^-$ ions (D) Covalent P_2Cl_{10} molecules only

Ans : (C)

Hint : In solid state PCl_5 exists as a combination of two complex ions. $[\text{PCl}_4]^+ [\text{PCl}_6]^-$

58. Which statement is not correct for ortho and para hydrogen?

- (A) They have different boiling points.
(B) Ortho-form is more stable than para-form.
(C) They differ in their nuclear spin
(D) The ratio of ortho to para hydrogen changes with change in temperature.

Ans : (B)

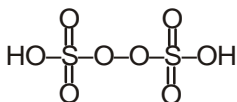
Hint : Ortho form is more stable than para form at and above room temperature, whereas at low temperature para form is more stable.

59. The acid in which O – O bonding is present is

- (A) $\text{H}_2\text{S}_2\text{O}_3$ (B) $\text{H}_2\text{S}_2\text{O}_6$ (C) $\text{H}_2\text{S}_2\text{O}_8$ (D) $\text{H}_2\text{S}_4\text{O}_6$

Ans : (C)

Hint : Marshall's acid or peroxodisulphuric acid.

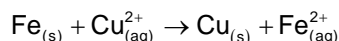


60. The metal which can be used to obtain metallic Cu from aqueous CuSO_4 solution is

- (A) Na (B) Ag (C) Hg (D) Fe

Ans : (D)

Hint : Iron displaces copper from the CuSO_4 solution



61. If radium and chlorine combine to form radium chloride, the compound would be
 (A) half as radioactive as radium (B) twice as radioactive
 (C) as radioactive as radium (D) not radioactive

Ans : (C)

Hint : Radioactivity is independent of chemical environment of an ion or atom.

62. Which of the following arrangements is correct in respect to solubility in water?

- (A) $\text{CaSO}_4 > \text{BaSO}_4 > \text{BeSO}_4 > \text{MgSO}_4 > \text{SrSO}_4$
 (B) $\text{BeSO}_4 > \text{MgSO}_4 > \text{CaSO}_4 > \text{SrSO}_4 > \text{BaSO}_4$
 (C) $\text{BaSO}_4 > \text{SrSO}_4 > \text{CaSO}_4 > \text{MgSO}_4 > \text{BeSO}_4$
 (D) $\text{BeSO}_4 > \text{CaSO}_4 > \text{MgSO}_4 > \text{SrSO}_4 > \text{BaSO}_4$

Ans : (B)

Hint : $\text{Be}^{2+} < \text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$ (Ionic size). As hydration energy decreases more rapidly than lattice energy, thus solubility decreases down the group. (Hydration energy $\propto \frac{\text{charge}}{\text{size}}$)

63. The energy required to break one mole of hydrogen-hydrogen bonds in H_2 is 436 kJ. What is the longest wavelength of light required to break a single hydrogen-hydrogen bond ?

- (A) 68.5 nm (B) 137 nm (C) 274 nm (D) 548 nm

Ans : (C)

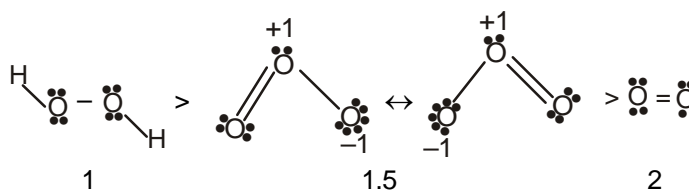
Hint : Amount of energy required (E) to break one H-H bond = $\frac{436 \times 10^3}{6.022 \times 10^{23}} \text{ J}$, Now apply $E = \frac{hc}{\lambda}$

64. The correct order of O-O bond length in O_2 , H_2O_2 and O_3 is

- (A) $\text{O}_2 > \text{O}_3 > \text{H}_2\text{O}_2$ (B) $\text{H}_2\text{O}_2 > \text{O}_3 > \text{O}_2$ (C) $\text{O}_3 > \text{O}_2 > \text{H}_2\text{O}_2$ (D) $\text{O}_3 > \text{H}_2\text{O}_2 > \text{O}_2$

Ans : (B)

Hint :



Bond order =

1

1.5

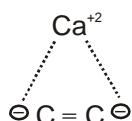
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65. The number of σ and π bonds between two carbon atoms in calcium carbide are

- (A) one σ , one π (B) one σ , two π (C) two σ , one π (D) one σ , $1\frac{1}{2}$ π

Ans : (B)

Hint :



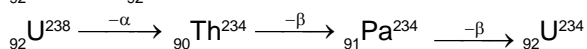
66. An element E loses one α and two β particles in three successive stages. The resulting element will be

- (A) An isobar of E (B) An isotone of E (C) An isotope of E (D) E itself

Ans : (C)

Hint : For example,

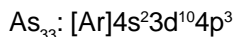
${}_{92}\text{U}^{238}$ and ${}_{92}\text{U}^{234}$ are isotopes



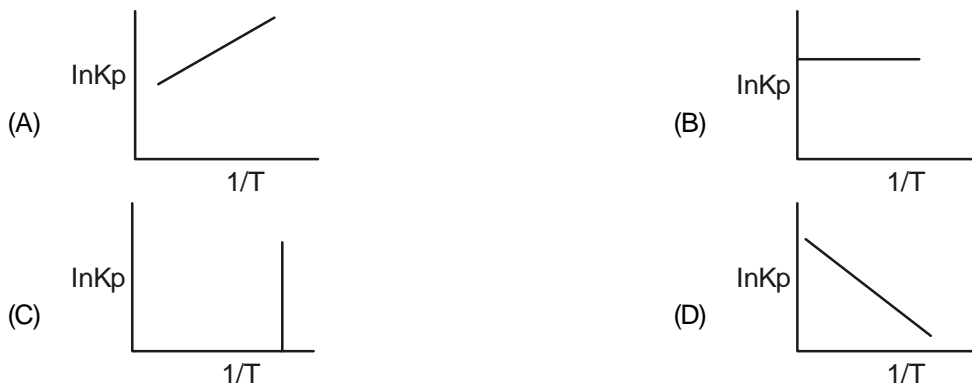
67. An element X belongs to fourth period and fifteenth group of the periodic table. Which of the following statements is true ?
- (A) It has a completely filled s-orbital and a partially filled d-orbital.
 - (B) It has completely filled s-and p-orbitals and a partially filled d-orbital.
 - (C) It has completely filled s-and p-orbitals and a half filled d-orbital.
 - (D) It has a half filled p-orbital, and completely filled s- and d-orbitals.

Ans : (D)

Hint : It's Arsenic



68. Which of the following plots represent an exothermic reaction ?



Ans : (A)

Hint : $\ln K_p = -\frac{\Delta H}{RT} + \text{constant}$

For exothermic reaction, ΔH is $-ve$. So when $\ln K_p$ is plotted against $1/T$, it's a straight line with positive slope and positive intercept.

69. If P^0 and P are the vapour pressure of the pure solvent and solution and n_1 and n_2 are the moles of solute and solvent respectively in the solution then the correct relation between P and P^0 is

(A) $P^0 = P \left[\frac{n_1}{n_1 + n_2} \right]$ (B) $P^0 = P \left[\frac{n_2}{n_1 + n_2} \right]$ (C) $P = P^0 \left[\frac{n_2}{n_1 + n_2} \right]$ (D) $P = P^0 \left[\frac{n_1}{n_1 + n_2} \right]$

Ans : (C)

Hint : $\frac{P^0 - P}{P^0} = \frac{n_1}{n_1 + n_2}$ or $1 - \frac{P}{P^0} = \frac{n_1}{n_1 + n_2}$ or $\frac{P}{P^0} = 1 - \frac{n_1}{n_1 + n_2}$ or $\frac{P}{P^0} = \frac{n_2}{n_1 + n_2}$ or $P = P^0 \left[\frac{n_2}{n_1 + n_2} \right]$

70. Ionic solids with Schottky defect may contain in their structure

- (A) cation vacancies only
- (B) cation vacancies and interstitial cations
- (C) equal number of cation and anion vacancies
- (D) anion vacancies and interstitial anions

Ans : (C)

Hint : In Schottky defect, there are missing of equal number of cation and anion.

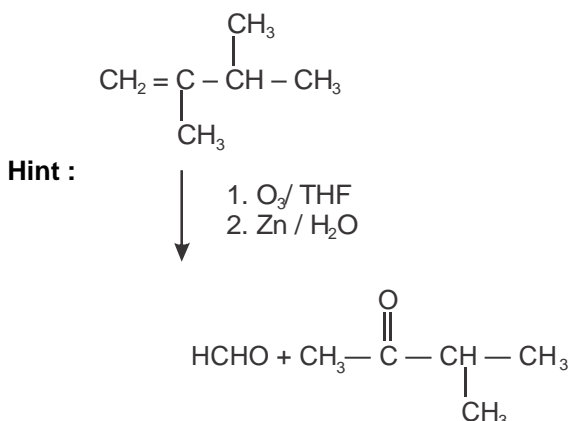
CATEGORY - II (Q71 to Q75)

Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer or any combination of more than one answer will fetch $-\frac{1}{2}$ marks.

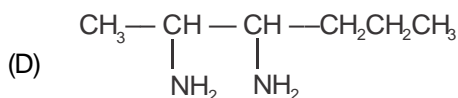
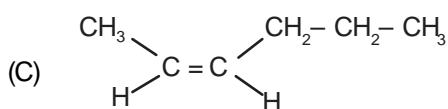
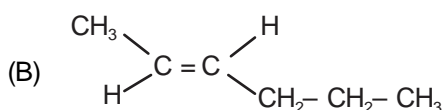
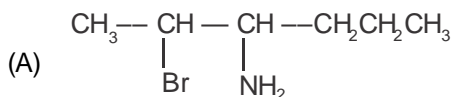
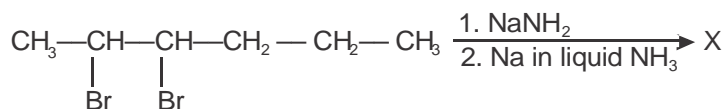
71. The major products obtained during ozonolysis of 2, 3 – dimethyl-1-butene and subsequent reductions with Zn and H_2O are

- (A) Methanoic acid and 2-methyl-2-butanone (B) Methanal and 3-methyl-2-butanone
 (C) Methanol and 2,2-dimethyl-3-butanone (D) Methanoic acid and 2-methyl-3-butanone

Ans : (B)

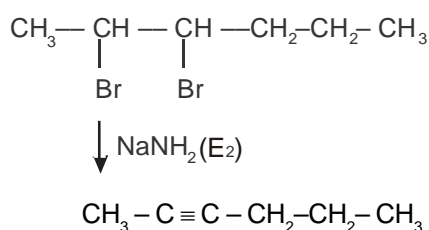


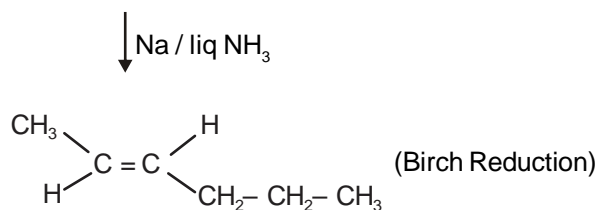
72. Identify X in the following sequence of reactions:



Ans : (B)

Hint :





73. Compound X is tested and the results are shown in the table :

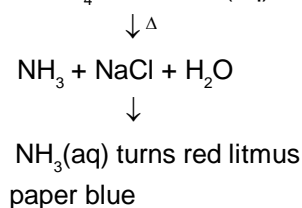
Text	Result
* aqueous sodium hydroxide is added, then heated gently	* Gas given off which turns damp red litmus paper blue
* dilute hydro chloric acid is added	* effervescence, gas given off which turns lime water milky and acidified $\text{K}_2\text{Cr}_2\text{O}_7$ paper green

Which ions are present in compound X?

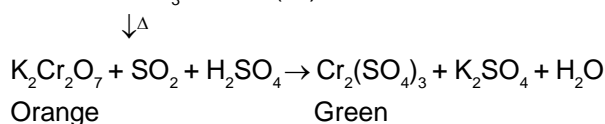
- (A) Ammonium ions and sulphite ions
 (B) Ammonium ions and carbonate ions
 (C) Sodium ions and carbonate ions
 (D) Ammonium ions and sulphate ions

Ans : (A)

Hint : For Test-I $\text{NH}_4\text{Cl} + \text{NaOH} (\text{aq})$



For Test-II $\text{SO}_3^{2-} + \text{HCl} (\text{dil})$



74. The time taken for an electron to complete one revolution in Bohr orbit of hydrogen atom is

- (A) $\frac{4m^2\pi r^2}{n^2h^2}$ (B) $\frac{n^2h^2}{4\pi r^2}$
 (C) $\frac{4\pi^2mr^2}{nh}$ (D) $\frac{nh}{4\pi^2mr^2}$

Ans : (C)

Hint : According to Bohr's model

$$mvr = \frac{nh}{2\pi r}$$

$$v = \frac{nh}{2\pi mr} \dots (i)$$

$$\text{and } T = \frac{2\pi r}{v} = \frac{2\pi r \times 2\pi r m}{nh} = \frac{4\pi^2mr^2}{nh}$$

75. Among the following, which should have the highest r.m.s. speed at the same temperature?

- (A) SO₂ (B) CO₂
 (C) O₂ (D) H₂

Ans : (B)

Hint : $V_{\text{rms}} = \sqrt{\frac{3RT}{M}}$ i.e. $V_{\text{rms}} \propto \frac{1}{\sqrt{M}}$ and Molecular mass of H₂ is least.

CATEGORY - III (Q76 to Q80)

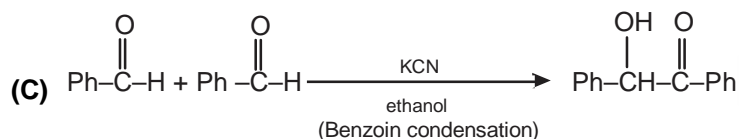
One or more answer(s) is (are) correct. Correct answer(s) will fetch marks 2. Any combination containing one or more incorrect answer will fetch 0 marks. If all correct answers are not marked and also no incorrect answer is marked then score = 2 × number of correct answers marked / actual number of correct answers.

76. Amongst the following compounds, the one(s) which readily react with ethanolic KCN?

- (A) Ethyl chloride (B) Chloro benzene
 (C) Benzaldehyde (D) Salicylic acid

Ans : (A, C)

Hint : (A) $\text{CH}_3\text{CH}_2 - \text{Cl} \xrightarrow[\text{ethanol}]{\text{KCN}} \text{CH}_3 - \text{CH}_2 - \text{CN} + \text{CH}_3 - \text{CH}_2 - \text{NC}$
 (major) (minor)



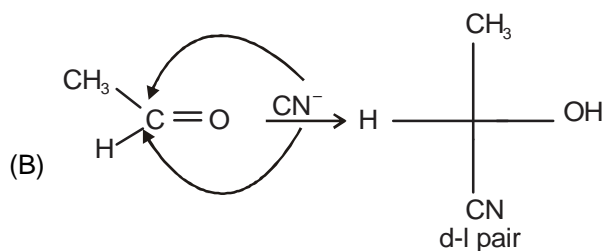
77. Choose the correct statement(s) among the following:

- (A) $\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{C}=\text{C} \\ \diagup \\ \text{H} \end{array}$ and $\begin{array}{c} \text{H} \\ \diagdown \\ \text{C}=\text{C} \\ \diagup \\ \text{CH}_3 \end{array}$ are enantiomers
 (B) CH₃CHO on reaction with HCN gives racemic mixture

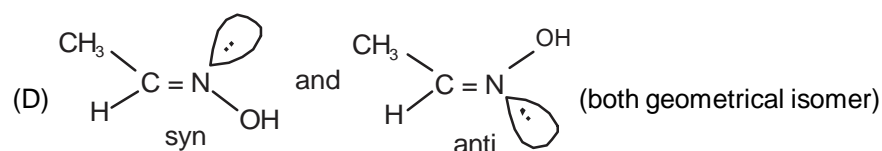
- (C) $\begin{array}{c} \text{C}_2\text{H}_5 \\ | \\ \text{CH}_3 - \text{C} - \text{H} \\ | \\ \text{OH} \end{array}$ and $\begin{array}{c} \text{C}_2\text{H}_5 \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{CH}_3 \end{array}$ are enantiomers
 (D) CH₃—CH=NOH shows geometrical isomerism

Ans : (B, D)

Hint : (A) $\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{C}=\text{C} \\ \diagup \\ \text{H} \end{array}$ and $\begin{array}{c} \text{H} \\ \diagdown \\ \text{C}=\text{C} \\ \diagup \\ \text{CH}_3 \end{array}$ are same molecule
 (trans) (trans)



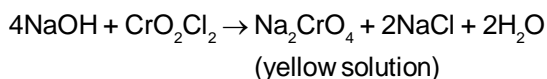
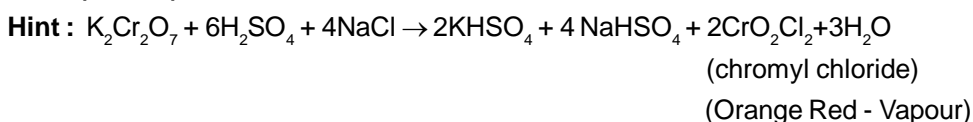
(C) Both have R-configuration, hence same molecule



78. Which of the following statement(s) is (are) correct when a mixture of NaCl and $K_2Cr_2O_7$ is gently warmed with conc. H_2SO_4 ?

- (A) A deep red vapour is evolved.
- (B) The vapour when passed through NaOH solution, gives a yellow solution.
- (C) Chlorine gas is also evolved.
- (D) Chromyl chloride is formed.

Ans : (A, B, D)

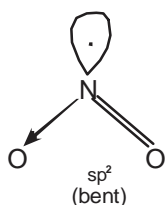
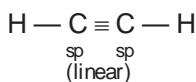
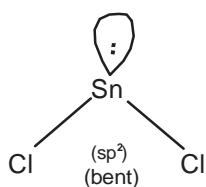
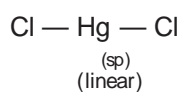


79. Of the following molecules, which have shape similar to CO_2 ?

- (A) $HgCl_2$
- (B) $SnCl_2$
- (C) C_2H_2
- (D) NO_2

Ans : (A, C)

Hint :

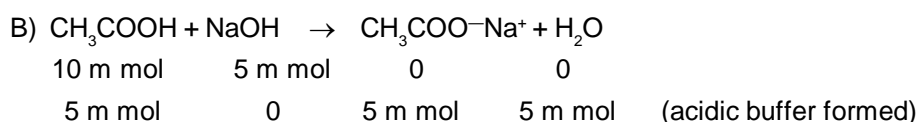


80. In which of the following mixed aqueous solutions $\text{pH} = \text{pK}_a$ at equilibrium?

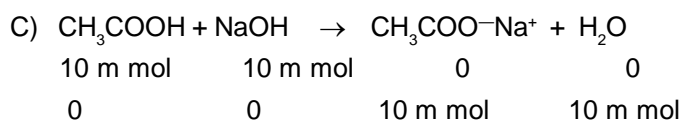
- (1) 100 ml of 0.1M CH_3COOH + 100 ml of 0.1M CH_3COONa
 (2) 100 ml of 0.1M CH_3COOH + 50 ml of 0.1M NaOH
 (3) 100 ml of 0.1M CH_3COOH + 100 ml of 0.1M NaOH
 (4) 100 ml of 0.1M CH_3COOH + 100 ml of 0.1M NH_3
 (A) (1) is correct (B) (2) is correct
 (C) (3) is correct (D) Both (1) and (2) are correct

Ans : (A, B, D)

Hint : A) $\text{pH} = \text{pK}_a + \log\left(\frac{0.1 \times 100}{0.1 \times 100}\right) = \text{pK}_a$ (correct) (acidic buffer)



$$\text{pH} = \text{pK}_a + \log\left(\frac{5}{5}\right) = \text{pK}_a \text{ (correct)}$$



$$\text{pH} = \frac{1}{2} (\text{pK}_w + \text{pK}_a + \log c) = \frac{1}{2} \left[14 + \text{pK}_a + \log\left(\frac{10}{200}\right) \right] \text{ (incorrect) (anionic hydrolysis)}$$

