WBJEE - 2017

Answer Keys by

Aakash Institute, Kolkata Centre

PHYSICS & CHEMISTRY

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

* None of the options are correct

 # Refer solutions

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ANSWERS & HINT
for
WBJEE - 2017
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 –1/4 marks. No answer will fetch 0 marks.

1. The velocity of a particle executing a simple harmonic motion is 13 ms^{-1}, when its distance from the equilibrium position (Q) is 3 m and its velocity is 12 ms^{-1}, when it is 5 m away from Q. The frequency of the simple harmonic motion is

    (A) $\dfrac{5\pi}{8}$ (B) $\dfrac{5}{8\pi}$ (C) $\dfrac{8\pi}{5}$ (D) $\dfrac{8}{5\pi}$

    Ans : (B)

    Hint : Using $v = \omega\sqrt{A^2 - x^2}$, $13^2 = \omega^2\left(A^2 - 3^2\right)$, $12^2 = \omega^2\left(A^2 - 5^2\right)$

    $\Rightarrow \omega = \dfrac{5}{8\pi}$

2. A uniform string of length L and mass M is fixed at both ends while it is subject to a tension T. It can vibrate at frequencies (ν) given by the formula (where n = 1, 2, 3, ...)

    (A) $\nu = \dfrac{n}{2}\sqrt{\dfrac{T}{ML}}$ (B) $\nu = \dfrac{n}{2L}\sqrt{\dfrac{T}{M}}$ (C) $\nu = \dfrac{1}{2n}\sqrt{\dfrac{T}{ML}}$ (D) $\nu = \dfrac{n}{2}\sqrt{\dfrac{TL}{M}}$

    Ans : (A)

    Hint : $\nu = \dfrac{n}{2L}\sqrt{\dfrac{T}{\mu}} = \dfrac{n}{2}\sqrt{\dfrac{T}{ML}}$

3. A uniform capillary tube of length l and inner radius r with its upper end sealed is submerged vertically into water. The outside pressure is p_0 and surface tension of water is γ. When a length x of the capillary is submerged into water, it is found that water levels inside and outside the capillary coincide. The value of x is

    (A) $\dfrac{l}{\left(l + \dfrac{p_o r}{4\gamma}\right)}$ (B) $l\left(l - \dfrac{p_o r}{4\gamma}\right)$ (C) $l\left(l - \dfrac{p_o r}{2\gamma}\right)$ (D) $\dfrac{l}{\left(l + \dfrac{p_o r}{2\gamma}\right)}$

    Ans : (D)

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(1)

Hint : For air inside capillary, $p_0(\ell A) = p'(\ell - x) A$ where p' is pressure in capillary after being submerged

$$\therefore p' = \frac{p_0 \ell}{\ell - x}$$

Now since level of water inside capillary coincides with outside, $\therefore p' - p_0 = \frac{2\gamma}{r}$

$$\therefore \frac{p_0 \ell}{\ell - x} - p_0 = \frac{2\gamma}{r} \Rightarrow x = \frac{\ell}{\left(1 + \frac{p_0 r}{2\gamma}\right)}$$

4. A liquid of bulk modulus k is compressed by applying an external pressure such that its density increases by 0.01%. The pressure applied on the liquid is

(A) $\frac{k}{10000}$ (B) $\frac{k}{1000}$ (C) 1000 k   (D) 0.01 k

Ans : (A)

Hint : $k = -\frac{P}{\Delta v / v} \Rightarrow \frac{P}{k} = -\frac{\Delta V}{V} = \frac{\Delta \rho}{\rho}$

$$\Rightarrow P = \frac{k \Delta \rho}{\rho} = \frac{k}{10000}$$

5. Temperature of an ideal gas, initially at 27ºC, is raised by 6ºC. The rms velocity of the gas molecules will,

(A) increase by nearly 2%   (B) decrease by nearly 2%

(C) increase by nearly 1%   (D) decrease by nearly 1%

Ans : (C)

Hint : $v_{rms} \propto \sqrt{T} \Rightarrow \frac{\Delta v}{v} = \frac{1}{2}\frac{\Delta T}{T} = \frac{1}{2} \times \frac{6}{300} = \frac{1}{100}$

$\therefore$ increases nearly by 1%

6. 2 moles of an ideal monatomic gas is carried from a state (P_0, V_0) to a state $(2P_0, 2V_0)$ along a straight line path in a P-V diagram. The amount of heat absorbed by the gas in the process is given by

(A) $3P_0V_0$ (B) $\frac{9}{2}P_0V_0$ (C) $6P_0V_0$ (D) $\frac{3}{2}P_0V_0$

Ans : (C)

Hint : $\Delta U = nC_v\Delta T = n\frac{3R}{2}\left(\frac{4P_0V_0}{nR} - \frac{P_0V_0}{nR}\right) = \frac{9}{2}P_0V_0$

$w = (2P_0 + P_0)\frac{V_0}{2} = \frac{3P_0V_0}{2}, \quad \Delta Q = W + \Delta U = 6P_0V_0$

7. A solid rectangular sheet has two different coefficients of linear expansion α_1 and α_2 along its length and breadth respectively. The coefficient of surface expansion is (for $\alpha_1 t << 1$, $\alpha_2 t << 1$)

(A) $\frac{\alpha_1 + \alpha_2}{2}$ (B) $2(\alpha_1 + \alpha_2)$ (C) $\frac{4\alpha_1\alpha_2}{\alpha_1 + \alpha_2}$ (D) $\alpha_1 + \alpha_2$

Ans : (D)

Hint : $\beta = \alpha_x + \alpha_y = \alpha_1 + \alpha_2$

8. A positive charge Q is situated at the centre of a cube. The electric flux through any face of the cube is (in SI units)

(A) $\dfrac{Q}{6\varepsilon_0}$ (B) $4\pi Q$ (C) $\dfrac{Q}{4\pi\varepsilon_0}$ (D) $\dfrac{Q}{6\pi\varepsilon_0}$

Ans : (A)

Hint : Total flux $= \dfrac{Q}{\varepsilon_0}$ using Gauss' law

$\therefore$ flux through one face $= \dfrac{Q}{6\varepsilon_0}$

9. Three capacitors of capacitance 1.0, 2.0 and 5.0 μF are connected in series to a 10V source. The potential difference across the 2.0 μF capacitor is

(A) $\dfrac{100}{17}$ V (B) $\dfrac{20}{17}$ V (C) $\dfrac{50}{17}$ V (D) 10 V

Ans : (C)

Hint : $C_{eq} = \dfrac{10}{17}\mu F$, $Q = \dfrac{100}{17}\mu C$

$\therefore$ Potential difference across 2 μF capacitor $= \dfrac{100/17\,\mu C}{2\,\mu F} = \dfrac{50}{17}$ V

10. A charge of 0.8 coulomb is divided into two charges Q_1 and Q_2. These are kept at a separation of 30 cm. The force on Q_1 is maximum when

(A) $Q_1 = Q_2 = 0.4$C (B) $Q_1 \approx 0.8$C, Q_2 negligible
(C) Q_1 negligible, $Q_2 \approx 0.8$C (D) $Q_1 = 0.2$ C, $Q_2 = 0.6$ C

Ans : (A)

Hint : Let the two parts be $(0.8 - q)$ and q

$F = \dfrac{k(0.8 - q)q}{r^2}$

Putting $\dfrac{dF}{dq} = 0$ we get q = 0.4 C

11. The magnetic field due to a current in a straight wire segment of length L at a point on its perpendicular bisector at a distance r (r >> L)

(A) decreases as $\dfrac{I}{r}$ (B) decreases as $\dfrac{I}{r^2}$

(C) decreases as $\dfrac{I}{r^3}$ (D) approaches a finite limit as $r \to \infty$

Ans : (B)

Hint : (By Biot-Savart's law $dB \propto \dfrac{1}{r^2}$)

12. The magnets of two suspended coil galvanometers are of the same strength so that they produce identical uniform

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(3)

magnetic fields in the region of the coils. The coil of the first one is in the shape of a square of side a and that of the second one is circular of radius $a/\sqrt{\pi}$. When the same current is passed through the coils, the ratio of the torque experienced by the first coil to that experienced by the second one is

(A) $1 : \dfrac{1}{\sqrt{\pi}}$ (B) 1 : 1 (C) $\pi : 1$ (D) $1 : \pi$

Ans : (B)

Hint : $\tau \propto A$

$$\frac{\tau_1}{\tau_2} = \frac{A_1}{A_2} = a^2/\pi r^2 = 1$$

13. A proton is moving with a uniform velocity of 10^6 ms^{-1} along the Y-axis, under the joint action of a magnetic field along Z-axis and an electric field of magnitude 2×10^4 Vm^{-1} along the negative X-axis. If the electric field is switched off, the proton starts moving in a circle. The radius of the circle is nearly (given : $\dfrac{e}{m}$ ratio for proton = 10^8 Ckg^{-1})

(A) 0.5 m (B) 0.2 m (C) 0.1 m (D) 0.05 m

Ans : (A)

Hint : Initially $F_E = F_m$
$\Rightarrow B = E/V = (2/100)T$
Now when E is switched off,

$$R = \frac{mv}{qB} = \frac{10^6 \times 100}{10^8 \times 2} = \frac{1}{2} = 0.5 \text{ m}$$

14. When the frequency of the AC voltage applied to a series LCR circuit is gradually increased from a low value, the impedance of the circuit
(A) monotonically increases (B) first increases and then decreases
(C) first decreases and then increases (D) monotonically decreases

Ans : (C)

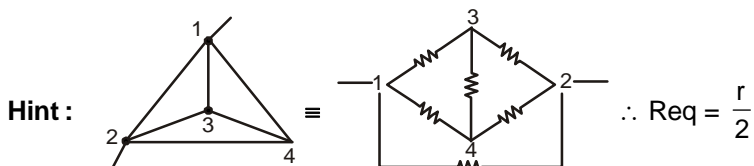**Hint :** $Z^2 = \left(\omega L - \dfrac{1}{\omega C} \right)^2 + R^2$
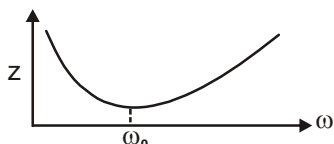
∴ As we gradually increase frequency, z first decreases and then increases

15. Six wires, each of resistance r, are connected so as to form a tetrahedron. The equivalent resistance of the combination when current enters through one corner and leaves through some other corner is

(A) r (B) 2r (C) $\dfrac{r}{3}$ (D) $\dfrac{r}{2}$

Ans : (D)

Hint :   ∴ Req = $\dfrac{r}{2}$

16. Consider the circuit shown in the figure. The value of the resistance X for which the thermal power generated in it is practically independent of small variation of its resistance is
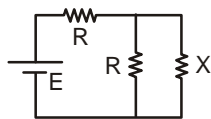
(A) $X = R$ (B) $X = \dfrac{R}{3}$ (C) $\dfrac{R}{2}$ (D) $X = 2R$

Ans : (C)

Hint : $i = \dfrac{E}{\left(R + \dfrac{Rx}{R+x} \right)}$

$$V_{Rx} = \dfrac{E\dfrac{Rx}{R+x}}{\left(R + \dfrac{Rx}{R+x} \right)} = \dfrac{Ex}{(R+2x)}$$

$$P_x = \dfrac{V^2_{Rx}}{x} = \dfrac{E^2 x}{(R+2x)^2}$$

$$\dfrac{dP_x}{dx} = E^2 \dfrac{(R-2x)}{(R+2x)^3}$$

$$\Rightarrow dP_x = \dfrac{E^2(R-2x)}{(R+2x)^3}.dx$$

(dP_x) will be zero for all (dx) if

$$\boxed{x = \dfrac{R}{2}}$$

17. Consider the circuit shown in the figure where all the resistances are of magnitude 1kΩ. If the current in the extreme right resistance X is 1 mA, the potential difference between A and B is


(A) 34 V   (B) 21 V   (C) 68 V   (D) 55 V

Ans : (A)

Hint :

$V_{AB} = 34$ volt

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(5)
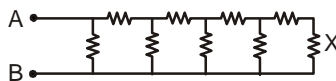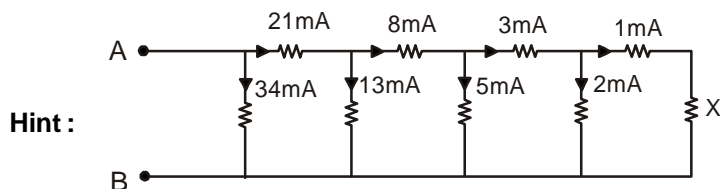
18. The ratio of the diameter of the sun to the distance between the earth and the sun is approximately 0.009. The approximate diameter of the image of the sun formed by a concave spherical mirror of radius of curvature 0.4 m is

(A) 4.5×10^{-6} m   (B) 4.0×10^{-6} m   (C) 3.6×10^{-3} m   (D) 1.8×10^{-3} m

Ans : (D)
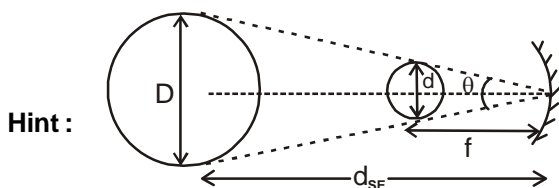
Hint :

$$\theta = \frac{D}{d_{SE}} = \frac{d}{f}$$

$$\Rightarrow d = \frac{D}{d_{SE}} \times f$$

$$d = 0.009 \times 0.2$$

$$= 1.8 \times 10^{-3} \text{ m}$$

19. Two monochromatic coherent light beams A and B have intensities L and $\frac{L}{4}$ respectively. If these beams are super-posed, the maximum and minimum intensities will be

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

Ans : (A)

Hint : $I_{maximum} = \left(\sqrt{L} + \sqrt{\frac{L}{4}} \right)^2 = \frac{9L}{4}$

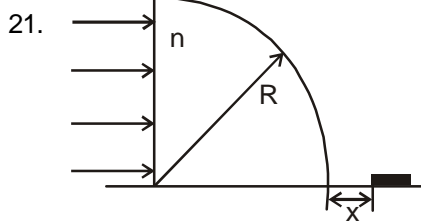$I_{minimum} = \left(\sqrt{L} - \sqrt{\frac{L}{4}} \right)^2 = \frac{L}{4}$

20. A point object is held above a thin equiconvex lens at its focus. The focal length is 0.1 m and the lens rests on a horizontal thin plane mirror. The final image will be formed at

(A)   infinite distance above the lens   (B)   0.1 m above the center of the lens

(C)   infinite distance below the lens   (D)   0.1 m below the center of the lens

Ans : (B)

Hint :
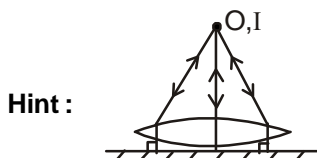
(image will be formed on object itself)

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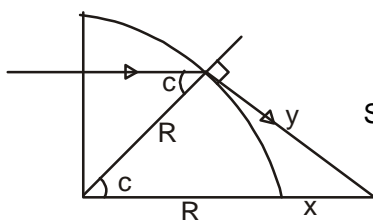
(6)

21.

A parallel beam of light is incident on a glass prism in the shape of a quarter cylinder of radius R = 0.05 m and refractive index n = 1.5 placed on a horizontal table as shown in the figure. Beyond the cylinder, a patch of light is found whose nearest distance x from the cylinder is

(A) $\left(3\sqrt{3}-4\right)\times10^{-2}m$ (B) $\left(2\sqrt{3}-2\right)\times10^{-2}m$ (C) $\left(3\sqrt{5}-5\right)\times10^{-2}m$ (D) $\left(3\sqrt{2}-3\right)\times10^{-2}m$

Ans : (C)

Hint:

$Sinc = \dfrac{1}{\mu} = \dfrac{2}{3}$

$Cosc = \dfrac{R}{R+x}$

$\sqrt{1-\dfrac{4}{9}} = \dfrac{R}{R+x}$,

$\dfrac{\sqrt{5}}{3} = \dfrac{R}{R+x}$

$x = \left(3\sqrt{5}-5\right)\times10^{-2}m$

22. The de Broglie wavelength of an electron is 0.4×10^{-10} m when its kinetic energy is 1.0 keV. Its wavelength will be 1.0×10^{-10} m, when its kinetic energy is

(A) 0.2 keV   (B) 0.8 keV   (C) 0.63 keV   (D) 0.16 keV

Ans : (D)

Hint : $\lambda = \dfrac{h}{p}, \lambda = \dfrac{h}{\sqrt{2mk}}$,

so $\lambda \propto \dfrac{1}{\sqrt{k}}$

$\Rightarrow \dfrac{0.4\times10^{-10}}{1.0\times10^{-10}} = \dfrac{\sqrt{k}}{\sqrt{1}}$

$\Rightarrow k = 0.16 \text{ keV}$

23. When light of frequency ν_1 is incident on a metal with work function W (where $h\nu_1 > W$), the photocurrent falls to zero at a stopping potential of V_1. If the frequency of light is increased to ν_2, the stopping potential changes to V_2. Therefore, the charge of an electron is given by

(A) $\dfrac{W\left(\nu_2+\nu_1\right)}{\nu_1 V_2 + \nu_2 V_1}$ (B) $\dfrac{W\left(\nu_2+\nu_1\right)}{\nu_1 V_1 + \nu_2 V_2}$ (C) $\dfrac{W\left(\nu_2-\nu_1\right)}{\nu_1 V_2 - \nu_2 V_1}$ (D) $\dfrac{W\left(\nu_2-\nu_1\right)}{\nu_2 V_2 - \nu_1 V_1}$

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(7)

Ans : (C)

Hint :
$$h\nu_1 = w + eV_1 \text{.....(i)}$$
$$h\nu_2 = w + eV_2 \text{....(ii)}$$

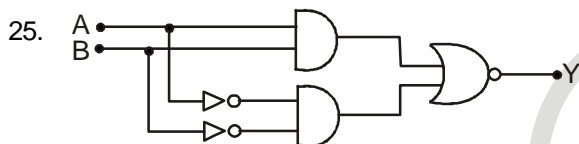$$\frac{\nu_1}{\nu_2} = \frac{W + eV_1}{W + eV_2}$$

$$\Rightarrow W\nu_1 + eV_2\nu_1 = W\nu_2 + eV_1\nu_2$$

$$\Rightarrow e = \frac{W(\nu_2 - \nu_1)}{V_2\nu_1 - V_1\nu_2}$$

24. Radon-222 has a half-life of 3.8 days. If one starts with 0.064 kg of Radon-222, the quantity of Radon-222 left after 19 days will be

(A) 0.002 kg   (B) 0.062 kg   (C) 0.032 kg   (D) 0.024 kg

Ans : (A)

Hint : $\frac{19}{3.8} = 5$, $\left(\frac{N}{N_0}\right) = \left(\frac{1}{2}\right)^5 \Rightarrow N = 0.064 \times \frac{1}{32} = 0.002$ kg

25.

In the given circuit, the binary inputs at A and B are both 1 in one case and both 0 in the next case. The respective outputs at Y in these two cases will be:

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

Ans : (B)

Hint : $Y = \overline{A.B + \overline{A}\,\overline{B}}$, for $A = 1, B = 1 \Rightarrow Y = 0$ and for $A = 0, B = 0 \Rightarrow Y = 0$

26. When a semiconducting device is connected in series with a battery and a resistance, a current is found to flow in the circuit. If, however, the polarity of the battery is reversed, practically no current flows in the circuit. The device may be

(A) a p-type semiconductor   (B) a n-type semiconductor

(C) an intrinsic semiconductor   (D) a p-n junction

Ans : (D)

Hint : By properties of p-n junction diode.

27. The dimension of the universal constant of gravitation G is

(A) $[ML^2T^{-1}]$ (B) $[M^{-1}L^3T^{-2}]$ (C) $[M^{-1}L^2T^{-2}]$ (D) $[ML^3T^{-2}]$

Ans : (B)

Hint : $[G] = \left[\frac{Fr^2}{m_1m_2}\right] = \left[\frac{MLT^{-2}L^2}{M^2}\right] = \left[M^{-1}L^3T^{-2}\right]$

28. Two particles A and B (both initially at rest) start moving towards each other under a mutual force of attraction. At the instant when the speed of A is v and the speed of B is 2v, the speed of the centre of mass is

(A) Zero   (B) v   (C) $\frac{3v}{2}$ (D) $-\frac{3v}{2}$

Ans : (A)

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(8)

Hint : $\vec{u}_{com} = 0$

$\therefore$ if $\vec{F} = 0$ then $\vec{v}_{com} = 0$ always

29. Three vectors $\vec{A} = a\,\vec{i} + \vec{j} + \vec{k}$; $\vec{B} = \vec{i} + b\,\vec{j} + \vec{k}$ and $\vec{C} = \vec{i} + \vec{j} + c\,\vec{k}$ are mutually perpendicular

$\left(\vec{i}, \vec{j}\text{ and }\vec{k}\text{ are unit vectors along X, Y and Z axis respectively}\right)$. The respective values of a, b and c are

(A) 0, 0, 0

(B) $-\dfrac{1}{2}, -\dfrac{1}{2}, -\dfrac{1}{2}$

(C) 1, –1, 1

(D) $\dfrac{1}{2}, \dfrac{1}{2}, \dfrac{1}{2}$

Ans : (B)

Hint :

$a + b + 1 = 0$

$1 + b + c = 0$

$\underline{a + 1 + c = 0}$

$2(a + b + c) + 3 = 0$

$a + b + c = -\dfrac{3}{2}$

$\Rightarrow -1 + c = \dfrac{-3}{2}$

$c = -0.5$

30. A block of mass 1 kg starts from rest at x = 0 and moves along the x-axis under the action of a force F=kt, where t is time and k =1 Ns^{-1}. The distance the block will travel in 6 seconds is

(A) 36 m   (B) 72 m   (C) 108 m   (D) 18 m

Ans : (A)

Hint : $F = kt = 1 \times a = \dfrac{dv}{dt}$

$v = \dfrac{kt^2}{2} = \dfrac{dx}{dt}$

$x = \dfrac{kt^3}{6} = 1 \times \dfrac{6 \times 6 \times 6}{6} = 36m$

Category II (Q31 to Q 35)

Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer or any combination of more than one answer will fetch –1/2 marks. No answer will fetch 0 marks.

31. A particle with charge Q coulomb, tied at the end of an inextensible string of length R meter, revolves in a vertical plane. At the centre of the circular trajectory there is a fixed charge of magnitude Q coulomb. The mass of the moving charge M is such that $Mg = \dfrac{Q^2}{4\pi\varepsilon_0 R^2}$. If at the highest position of the particle, the tension of the string just vanishes, the horizontal velocity at the lowest point has to be

(A) 0   (B) $2\sqrt{gR}$ (C) $\sqrt{2gR}$ (D) $\sqrt{5gR}$

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(9)

Ans : (B)
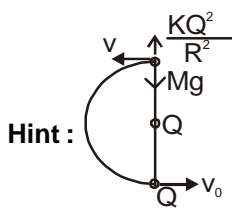
Hint :

As T = 0

$$Mg - \frac{KQ^2}{R^2} = \frac{mv^2}{R} \qquad \Rightarrow v = 0 \qquad \left[\because Mg = \frac{KQ^2}{R^2} \right]$$

$$\therefore W_g = \Delta KE \quad \Rightarrow mg(2R) = \frac{1}{2}mv_0^2 \quad \therefore v_0 = 2\sqrt{gR}$$

32. A bullet of mass 4.2×10^{-2} kg, moving at a speed of 300 ms^{-1}, gets stuck into a block with a mass 9 times that of the bullet. If the block is free to move without any kind of friction, the heat generated in the process will be

(A) 45 cal   (B) 405 cal   (C) 450 cal   (D) 1701 cal

Ans : (B)

Hint :

$$KE_{loss} = \frac{mM}{2(m+M)}(v-0)^2 \quad = 9 \times 4.2 \times 45 \text{ J} \quad = \frac{1701}{4 \cdot 2} = 405 \text{ cal}$$

33. A particle with charge e and mass m, moving along the X-axis with a uniform speed u, enters a region where a uniform electric field E is acting along the Y-axis. The particle starts to move in a parabola. Its focal length (neglecting any effect of gravity) is

(A) $\dfrac{2mu^2}{eE}$ (B) $\dfrac{eE}{2mu^2}$ (C) $\dfrac{mu}{2eE}$ (D) $\dfrac{mu^2}{2eE}$

Ans : (D)
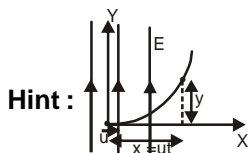
Hint :

$$y = \frac{1}{2} \times \left[\frac{Ee}{m} \right] \times \frac{x^2}{u^2}, \quad y = \frac{Ee}{2mu^2}x^2, \text{ As } x^2 = 4ay, \quad \therefore x^2 = \frac{2mu^2}{Ee}y, \quad a = \frac{2mu^2}{4Ee} = \frac{mu^2}{2Ee}$$

34. A unit negative charge with mass M resides at the midpoint of the straight line of length 2a adjoining two fixed charges of magnitude +Q each. If it is given a very small displacement x(x << a) in a direction perpendicular to the straight line, it will

(A) come back to its original position and stay there

(B) execute oscillations with frequency $\dfrac{1}{2\pi}\sqrt{\dfrac{Q}{4\pi\varepsilon_0 Ma^3}}$

(C) fly to infinity

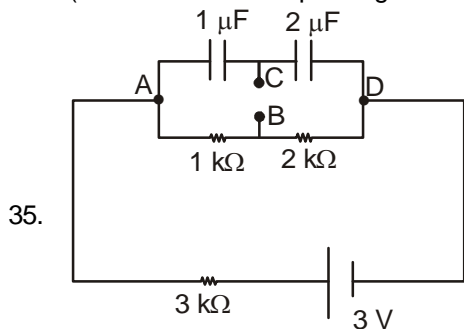(D) execute oscillations with frequency $\dfrac{1}{2\pi}\sqrt{\dfrac{Q}{4\pi\varepsilon_0 Ma^2}}$

Ans : (*)

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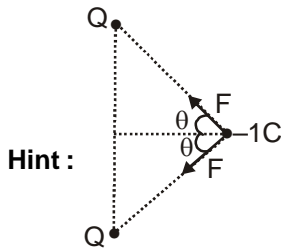
Hint :

$$F_{net} = -2\ F\cos\theta = -2 \times \frac{KQ \times 1}{\left(x^2 + a^2\right)} \times \frac{x}{\sqrt{x^2 + a^2}} = \frac{-2KQ}{\left(x^2 + a^2\right)^{3/2}} x$$

$$\therefore F_{net} \approx -\left(\frac{2KQ}{a^3}\right)x$$

$$freq = \frac{1}{2\pi}\sqrt{\frac{2KQ}{ma^3}} = \frac{1}{2\pi}\sqrt{\frac{2 \times \frac{1}{4\pi \in} Q}{ma^3}} = \frac{1}{2\pi}\sqrt{\frac{Q}{2\pi \in_0 ma^3}}$$

(Note: None of the options given are correct)

35.

Consider the circuit given here. The potential difference V_{BC} between the points B and C is

(A) 1 V (B) 0.5 V (C) 0 (D) −1 V

Ans : (B)

Hint : $i = \dfrac{3}{6 \times 10^3} = 0.5 \times 10^{-3}$

$V_{AD} = iR = 0.5 \times 10^{-3} \times 3 \times 10^3 = 1.5$ V

$Q = \dfrac{2 \times 1\cdot5}{3} = 2 \times 0.5 = 1\ \mu C$

KVL from B to C,

$V_B - 0.5 \times 10^{-3} \times 2 \times 10^3 + \dfrac{1}{2} = V_C$

$V_B - V_C = 1 - \dfrac{1}{2} = 0.5$ V

Category III (Q36 to Q40)

One or more answer(s) is (are) correct. Correct answer(s) will fetch full marks 2. Any combination containing one or more incorrect answer will fetch 0 marks. Also no 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 answer marked + actual number of correct answers.

36. If the pressure, temperature and density of an ideal gas are denoted by P, T and ρ, respectively, the velocity of sound in the gas is

   (A) proportional to $\sqrt{P}$, when T is constant.　　　(B) proportional to $\sqrt{T}$.

   (C) proportional to $\sqrt{P}$, when ρ is constant.　　　(D) proportional to T.

   Ans : (B, C)

   Hint : $v = \sqrt{\dfrac{\gamma RT}{M}} = \sqrt{\dfrac{\gamma P}{\rho}}$

37. Two long parallel wires separated by 0.1 m carry currents of 1 A and 2 A respectively in opposite directions. A third current-carrying wire parallel to both of them is placed in the same plane such that it feels no net magnetic force. It is placed at a distance of

   (A) 0.5 m from the 1st wire, towards the 2nd wire.

   (B) 0.2 m from the 1st wire, towards the 2nd wire.

   (C) 0.1 m from the 1st wire, towards the 2nd wire.

   (D) 0.2 m from the 1st wire, away from the 2nd wire.

   Ans : (C)

   Hint :
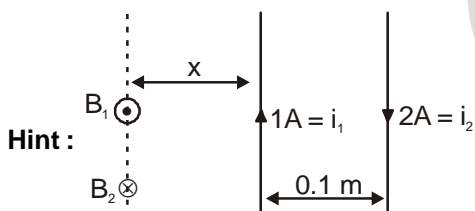
   $$B_1 = B_2$$

   $$\frac{\mu_0(1)}{2\pi x} = \frac{\mu_0(2)}{2\pi(0.1 + x)}$$

   $$x = 0.1 m$$

38. If χ stands for the magnetic susceptibility of a substance, μ for its magnetic permeability and μ_0 for the permeability of free space, then

   (A) for a paramagnetic substance : $\chi > 0$, $\mu > 0$

   (B) for a paramagnetic substance : $\chi > 0$, $\mu > \mu_0$

   (C) for a diamagnetic substance : $\chi < 0$, $\mu < 0$

   (D) for a ferromagnetic substance : $\chi > 1$, $\mu < \mu_0$

   Ans : (B,D)

   Hint : $\chi = \mu_r - 1$, $\mu_r = \dfrac{\mu}{\mu_0}$

   For paramagnetic, $\chi > 0$　　$\therefore \mu_r > 1$　　$\therefore \mu > \mu_0$

   For diamagnetic, $\chi < 0$　　$\therefore \mu_r < 1$　　$\therefore \mu < \mu_0$

   For ferromagnetic, $\chi >> 1$　　$\mu >> \mu_0$

   Note: If $0 < \mu < \mu_0$ then substance will not be paramagnetic. Hence option A is incorrect.

39. Let v_n and E_n be the respective speed and energy of an electron in the nth orbit of radius r_n, in a hydrogen atom, as predicted by Bohr's model. Then

   (A) plot of $E_n r_n / E_1 r_1$ as a function of n is a straight line of slope 0.

   (B) plot of $r_n v_n / r_1 v_1$ as a function of n is a straight line of slope 1.

   (C) plot of $\ln\left(\dfrac{r_n}{r_1}\right)$ as a function of ln(n) is a straight line of slope 2.

   (D) plot of $\ln\left(\dfrac{r_n E_1}{E_n r_1}\right)$ as a function of ln(n) is a straight line of slope 4.

   Ans : (A,B,C,D)

   Hint : $v_n \propto \dfrac{1}{n}$ $\qquad\qquad$ $E_n \propto \dfrac{1}{n^2}$ $\qquad\qquad$ $r_n \propto n^2$

   $\therefore E_n r_n \propto n^0$ $\qquad\quad$ $\therefore E_n r_n \propto E_1 r_1$ $\qquad\quad$ $\dfrac{E_n r_n}{E_1 r_1} = \text{constant}$ $(\therefore \text{slope} = 0)$

   $r_n v_n \propto n^2 \times \dfrac{1}{n} \propto n$ $\qquad$ $\therefore \dfrac{r_n v_n}{r_1 v_1} = n$ $\qquad\qquad$ $(\therefore \text{slope} = 1)$

   $r_n \propto n^2$ $\qquad\qquad\qquad$ $\therefore \dfrac{r_n}{r_1} = n^2$ $\qquad\qquad$ $\ln\left(\dfrac{r_n}{r_1}\right) = 2\ln(n)$ $\quad (\therefore \text{slope} = 2)$

   $\dfrac{r_n}{E_n} \propto n^4$

   $\therefore \dfrac{r_n}{E_n} \times \dfrac{E_1}{r_1} = n^4$ $\qquad$ $\ln\left(\dfrac{r_n E_1}{E_n r_1}\right) = 4\ln(n)$ $\qquad$ $(\therefore \text{slope} = 4)$

40. A small steel ball bounces on a steel plate held horizontally. On each bounce the speed of the ball arriving at the plate is reduced by a factor e (coefficient of restitution) in the rebound, so that

   $$V_{upward} = eV_{downward}$$

   If the ball is initially dropped from a height of 0.4 m above the plate and if 10 seconds later the bouncing ceases, the value of e is

   (A) $\sqrt{\dfrac{2}{7}}$ $\qquad\qquad$ (B) $\dfrac{3}{4}$ $\qquad\qquad$ (C) $\dfrac{13}{18}$ $\qquad\qquad$ (D) $\dfrac{17}{18}$

   Ans : (D)

   Hint : $h_n = e^{2n}.h$

   $$\therefore t = \sqrt{\dfrac{2h}{g}} + 2\sqrt{\dfrac{2he^2}{g}} + 2\sqrt{\dfrac{2he^4}{g}} + ... = \sqrt{\dfrac{2h}{g}}\left[1 + 2e + 2e^2 + ...\right]$$

   $$= \sqrt{\dfrac{2h}{g}}\left[\dfrac{1+e}{1-e}\right] \quad \therefore 10 = \sqrt{\dfrac{2(0.4)}{10}}\left(\dfrac{1+e}{1-e}\right) \therefore e = \dfrac{25\sqrt{2}-1}{25\sqrt{2}+1} \approx \dfrac{17}{18}$$

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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 –1/4 marks. No answer will fetch 0 marks.

41. For same mass of two different ideal gases of molecular weights M_1 and M_2, plots of log V vs log P at a given constant temperature are shown. Identify the correct option
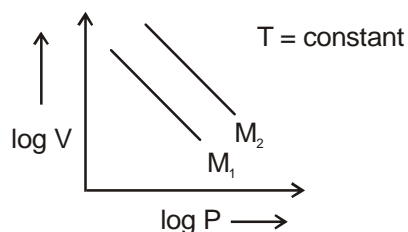
(A) $M_1 > M_2$ (B) $M_1 = M_2$

(C) $M_1 < M_2$ (D) Can be predicted only if temperature is known

Ans : (A)

Hint :
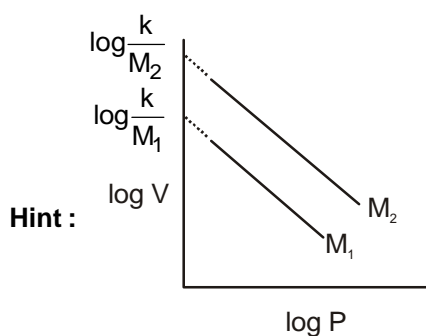
$\because PV = nRT = \dfrac{w}{M}RT$ or, $PV = \dfrac{k}{M}$ where k = wRT

Now taking log both sides, we get,

$\log P + \log V = \log \dfrac{k}{M}$

or, $\log V = - \log P + \log \dfrac{k}{M}$ (y = mx + C)

From the intercepts, $\log \dfrac{k}{M_2} > \log \dfrac{k}{M_1}$ or, $\dfrac{k}{M_2} > \dfrac{k}{M_1} \Rightarrow M_1 > M_2$

42. Which of the following has the dimension of ML^0T^{-2}?

(A) Coefficient of viscosity (B) Surface tension   (C) Vapour pressure   (D) Kinetic energy

Ans : (B)

Hint : Surface tension $\gamma = \dfrac{\delta w}{dA} = \dfrac{F.dx}{dA}$

$= FL^{-1} = MT^{-2} = ML^0T^{-2}$

43. If the given four electronic configurations

(i) $n = 4, l = 1$ (ii) $n = 4, l = 0$ (iii) $n = 3, l = 2$ (iv) $n = 3, l = 1$

are arranged in order of increasing energy, then the order will be

(A) (iv) < (ii) < (iii) < (i)   (B) (ii) < (iv) < (i) < (iii)   (C) (i) < (iii) < (ii) < (iv)   (D) (iii) < (i) < (iv) < (ii)

Ans : (A)

Hint : (i) $n = 4, l = 1$ 4p orbital

(ii) $n = 4, l = 0$ 4s orbital

(iii) $n = 3, l = 2$ 3d orbital

(iv) $n = 3, l = 1$ 3p orbital

44. Which of the following sets of quantum numbers represents the 19th electron of Cr (Z = 24)?

(A) $\left(4, 1, -1, +\dfrac{1}{2}\right)$ (B) $\left(4, 0, 0, +\dfrac{1}{2}\right)$ (C) $\left(3, 2, 0, -\dfrac{1}{2}\right)$ (D) $\left(3, 2, -2, +\dfrac{1}{2}\right)$

Ans : (B)

Hint : $_{24}Cr = [_{18}Ar]\, 4s^1 3d^5$

19th electron is $4s^1$

45. 0.126 g of an acid is needed to completely neutralize 20 ml 0.1 (N) NaOH solution. The equivalent weight of the acid is

(A) 53   (B) 40   (C) 45   (D) 63

Ans : (D)

Hint : Number of equivalents of acid = number of equivalents of base

$$= \frac{N \times V}{1000}$$

$$= \frac{0.1 \times 20}{1000}$$

$$= 2 \times 10^{-3}$$

2×10^{-3} equivalents have mass = 0.126 g

1 equivalent has mass $= \dfrac{0.126}{2 \times 10^{-3}}\, g = 63g$

46. In a flask, the weight ratio of CH_4 (g) and SO_2(g) at 298 K and 1 bar is 1 : 2. The ratio of the number of molecules of SO_2(g) and CH_4(g) is

(A) 1 : 4   (B) 4 : 1   (C) 1 : 2   (D) 2 : 1

Ans : (C)

Hint : Weight ratio $w_{CH_4} : w_{SO_2} = 1 : 2$

Number of moles, $n = \dfrac{w}{M}$, $\dfrac{n_1}{n_2} = \dfrac{w_1}{M_1} \times \dfrac{M_2}{w_2}$

$\dfrac{n_{SO_2}}{n_{CH_4}} = \dfrac{w_{SO_2}}{M_{SO_2}} \times \dfrac{M_{CH_4}}{w_{CH_4}} = \dfrac{2}{64} \times \dfrac{16}{1} = \dfrac{1}{2}$ ∴ mole ratio $SO_2 : CH_4 = 1 : 2$

∴ ratio of number of molecules of SO_2 and CH_4 = 1 : 2

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47. $C_6H_5F^{18}$ is a F^{18} radio-isotope labelled organic compound. F^{18} decays by positron emission. the product resulting on decay is

(A) $C_6H_5O^{18}$ (B) $C_6H_5Ar^{19}$ (C) $B^{12}C_5H_5F$ (D) $C_6H_5O^{16}$

Ans : (A)

Hint : $_9F^{18} \rightarrow {}_xE^y + {}_{+1}e^0$

x = 8, y = 18, $\therefore {}_xE^y = {}_8O^{18}$

$C_6H_5O^{18}$
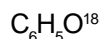
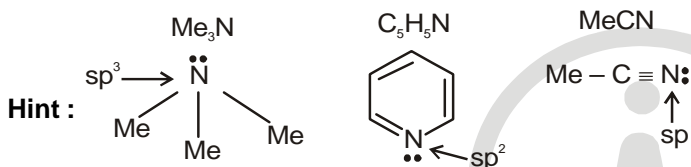48. Dissolving NaCN in de-ionized water will result in a solution having

(A) pH < 7   (B) pH = 7   (C) pOH = 7   (D) pH > 7

Ans : (D)

Hint : $CN^- + H_2O \rightleftharpoons OH^- + HCN$

Hence solution will be alkaline due to anionic hydrolysis

49. Among Me_3N, C_5H_5N and MeCN (Me = methyl group) the electronegativity of N is in the order

(A) $MeCN > C_5H_5N > Me_3N$ (B) $C_5H_5N > Me_3N > MeCN$

(C) $Me_3N > MeCN > C_5H_5N$ (D) Electronegativity same in all

Ans : (A)

Hint :

As % S - character increases, electronegativity increases

$\therefore$ $MeCN > C_5H_5N > Me_3N$

50. The shape of XeF_5^- will be

(A) Square pyramid   (B) Trigonal bipyramidal   (C) Planar   (D) Pentagonal bipyramid

Ans : (C)

Hint : Shape of XeF_5^- will be planar

No. of electron pair = $\dfrac{8+5+1}{2} = 7$, No. of bond pair = 5, No. of Lone pair = 2
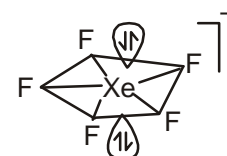
geometry: Pentagonal bipyramid

As lone pairs are present axially, hence the shape is planar

51. The ground state magnetic property of B_2 and C_2 molecules will be

(A) B_2 paramagnetic and C_2 diamagnetic   (B) B_2 diamagnetic and C_2 paramagnetic

(C) Both are diamagnetic   (D) Both are paramagnetic

Ans : (A)

Hint : C_2 : $\sigma1s^2 \ \sigma^*1s^2 \ \sigma2s^2 \ \sigma^*2s^2 \ \pi2p_x^2 = \pi2p_y^2$

There is no unpaired electron.

C_2 is diamagnetic in nature

B_2 : $\sigma1s^2 \ \sigma^*1s^2 \ \sigma2s^2 \ \sigma^*2s^2 \ \pi2p_x^1 = \pi2p_y^1$

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There is two unpaired electrons.

B_2 is paramagnetic in nature

52. The number of unpaired electrons in $[NiCl_4]^{2-}$, $Ni(CO)_4$ and $[Cu(NH_3)_4]^{2+}$ respectively are :

(A) 2, 2, 1   (B) 2, 0, 1   (C) 0, 2, 1   (D) 2, 2, 0
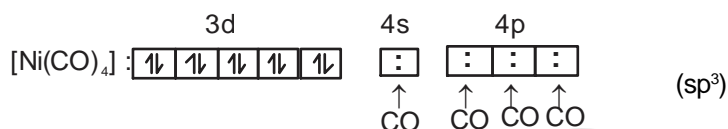
Ans : (B)

Hint : Ni^{2+} :

$[NiCl_4]^{2-}$:

(sp³)
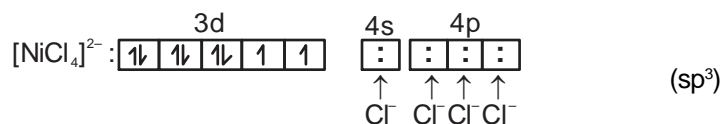
∵ Cl^- is a weak ligand. So, there is no pairing of electrons.

No. of unpaired $e^- = 2$

$[Ni(CO)_4]$:

(sp³)

CO is a strong ligand. So there is pairing of electrons

No. of unpaired electron = 0

$[Cu(NH_3)_4]^{2+}$:

(sp²d)
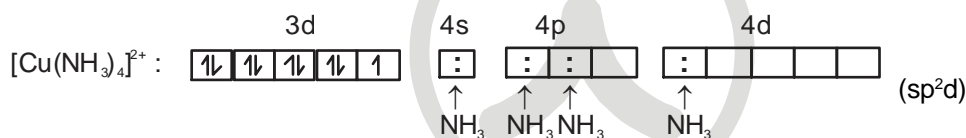
No. of unpaired electron = 1

53. Which of the following atoms should have the highest 1st electron affinity?

(A) F   (B) O   (C) N   (D) C

Ans : (A)

Hint : Electron affinity of 'F' is the 2nd highest amongst periodic table after 'Cl'

54. $PbCl_2$ is insoluble in cold water. Addition of HCl increases its solubility due to

(A) Formation of soluble complex anions like $[PbCl_3]^-$

(B) Oxidation of Pb(II) to Pb (IV)

(C) Formation of $[Pb(H_2O)_6]^{2+}$

(D) Formation of polymeric lead complexes

Ans : (A)

Hint : $PbCl_2 (s) + Cl^{\ominus} \rightarrow [Pb Cl_3]^{\ominus} (aq)$

$PbCl_2 (s) + 2Cl^{\ominus} \rightarrow [Pb Cl_4]^{2-} (aq)$
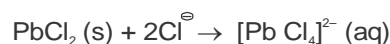
Addition of chloride ions to a suspension of $PbCl_2$ gives rise to soluble complex ion. In these reactions the additional chlorides break up the chloride bridges that comprise the polymeric framework of solid $PbCl_2$ (s)

55. Of the following compounds, which one is the strongest Bronsted acid in aqueous solution?

(A) $HClO_3$ (B) $HClO_2$ (C) $HOCl$ (D) $HOBr$

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(17)

Ans : (A)
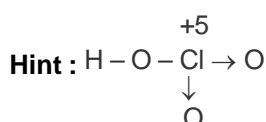
Hint :
$$\overset{+5}{H-O-Cl} \rightarrow O$$
$$\underset{O}{\downarrow}$$

(Due to high oxidation state, Electronegativity of Cl-atom is very high)

56. The correct basicity order of the following lanthanide ions is

(A) $La^{3+} > Lu^{3+} > Ce^{3+} > Eu^{3+}$

(B) $Ce^{3+} > Lu^{3+} > La^{3+} > Eu^{3+}$

(C) $Lu^{3+} > Ce^{3+} > Eu^{3+} > La^{3+}$

(D) $La^{3+} > Ce^{3+} > Eu^{3+} > Lu^{3+}$

Ans : (D)

Hint : As size decreases, hence basicity also decreases.

57. When $BaCl_2$ is added to an aqueous salt solution, a white precipitate is obtained. The anion among CO_3^{2-}, SO_3^{2-} and SO_4^{2-} that was present in the solution can be :

(A) CO_3^{2-} but not any of the other two

(B) SO_3^{2-} but not any of the other two

(C) SO_4^{2-} but not any of the other two

(D) Any of them

Ans : (D)

Hint : $BaCO_3$, $BaSO_3$ and $BaSO_4$ are all white precipitate in aqueous solution.

58. In the IUPAC system, $PhCH_2CH_2CO_2H$ is named as

(A) 3-phenylpropanoic acid

(B) benzylacetic acid

(C) carboxyethylbenzene

(D) 2-phenylpropanoic acid

Ans : (A)
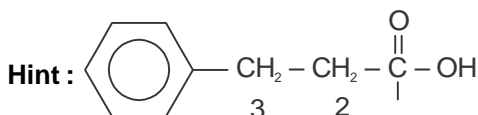
Hint :

3 -Phenylpropanoic acid

59. The isomerisation of 1-butyne to 2-butyne can be achieved by treatment with

(A) hydrochloric acid

(B) ammoniacal silver nitrate

(C) ammoniacal cuprous chloride

(D) ethanolic potassium hydroxide

Ans : (D)

Hint : Terminal to non-terminal alkyne is promoted by ethanolic KOH.

60. The correct order of acid strengths of benzoic acid (X), peroxybenzoic acid (Y) and p-nitrobenzoic acid (Z) is

(A) Y > Z > X

(B) Z > Y > X

(C) Z > X > Y

(D) Y > X > Z

Ans : (C)

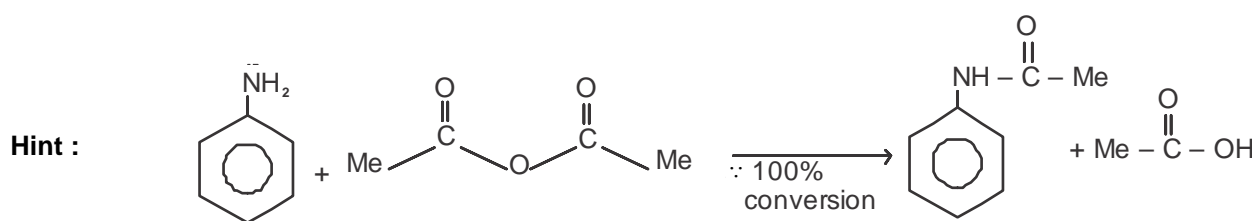Aakash Institute - *Regd. Office:* Aakash Tower, 8, Pusa Road, New Delhi-110005, Ph.: 011-47623456 Fax : 011-47623472

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Hint :

(Z)
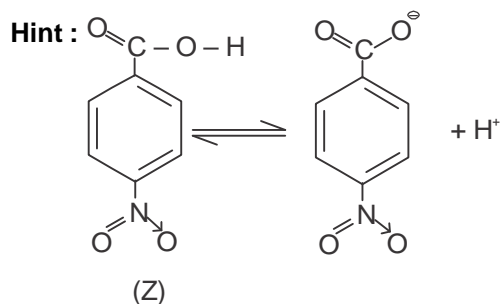
(- NO_2 is strong electron withdrowing group, which stabalizes the negative charge)

(Y)   (Not resonance stabilized)

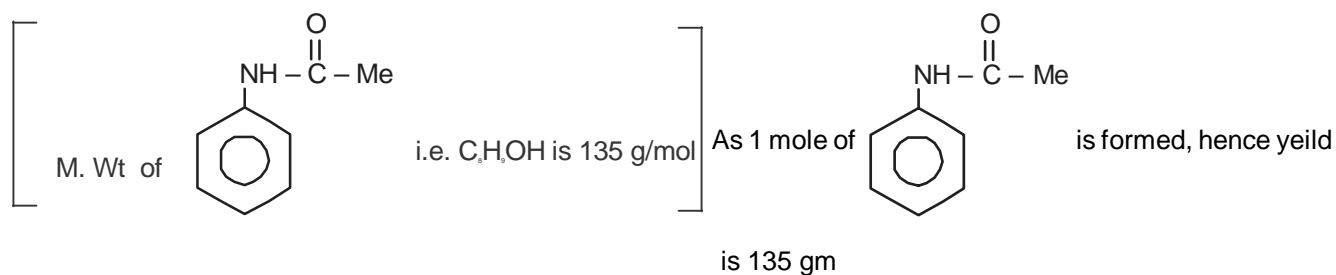(X)   (Resonance stabilized)
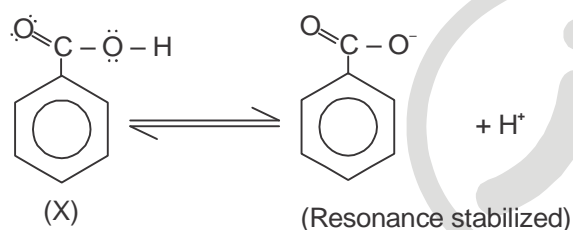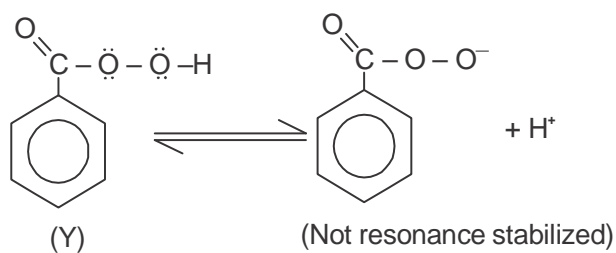
61. The yield of acetanilide in the reaction (100% conversion) of 2 moles of aniline with 1 mole of acetic anhydride is

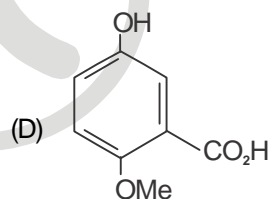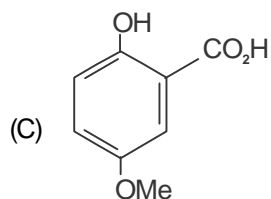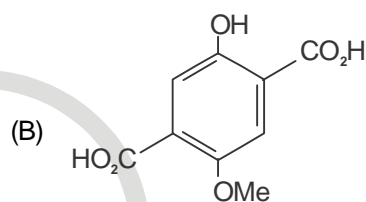(A) 270 g   (B) 135 g   (C) 67.5 g   (D) 177 g
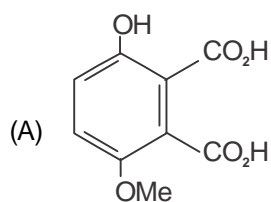
Ans : (B)

Hint :

| Initial mole taken : | 2 | 1 | | 0 | 0 |
| Final mole present : | 1 | 0 | | 1 | 1 |

As

is Limiting Reagent

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M. Wt of $\left[\begin{array}{c} \text{NH} - \overset{\overset{\displaystyle O}{\|}}{C} - \text{Me} \\ \bigcirc \end{array}\right.$ i.e. C_8H_9OH is 135 g/mol $\left.\begin{array}{c} \text{As 1 mole of} \end{array}\right.$ $\begin{array}{c} \text{NH} - \overset{\overset{\displaystyle O}{\|}}{C} - \text{Me} \\ \bigcirc \end{array}$ is formed, hence yeild

is 135 gm

62. The structure of the product P of the following reaction is

$\bigcirc$ (OH, OMe) + NaOH $\xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } CO_2\text{(high temperature and high pressure)}}$ P

(A)

(B)

(C)

(D)

Ans : (C)

Hint : + $\overset{\ominus}{O}H$ $\xrightarrow[\text{reaction}]{\text{Acid base}}$ + H_2O

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$$P = $$
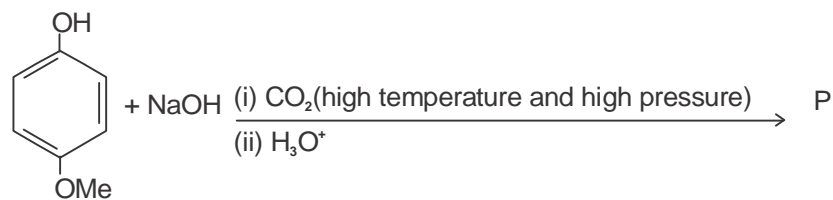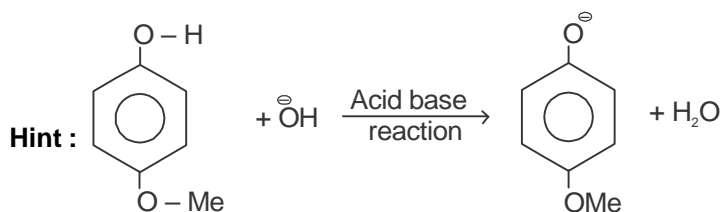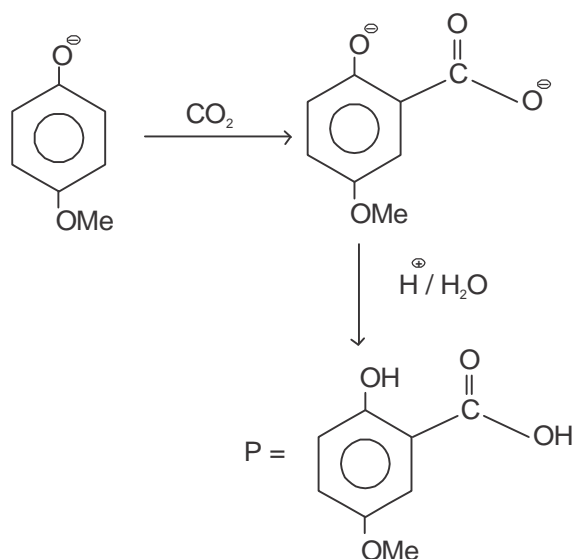
As $-\overset{\ominus}{O}$ is relatively strong activator than –OMe. Hence $-\overset{\ominus}{O}$ will activate its Ortho and Para position more effectively. Since its Para is blocked due to presence of –OMe. Hence Major product will be at ortho wr.t. $-\overset{\ominus}{O}$.

63. ADP and ATP differ in the number of

(A) phosphate units   (B) ribose units   (C) adenine base   (D) nitrogen atom

Ans : (A)

Hint : ADP $\Rightarrow$ Adenosine diphosphate

ATP $\Rightarrow$ Adenosine triphosphate

ADP has 2 phosphate groups

ATP has 3 phosphate groups

64. The compound that would produce a nauseating smell/odour with a hot mixture of chloroform and ethanolic potassium hydroxide is

(A) $PhCONH_2$ (B) $PhNHCH_3$ (C) $PhNH_2$ (D) PhOH

Ans : (C)

Hint : Carbyl - Amine reaction

1° Aliphatic / Aromatic amine $\dfrac{CHCl_3}{KOH(alc.)}$ Isocyanide

And Isocyanide has Nauseating smell/odour

$$Ph-NH_2 \xrightarrow[KOH]{CHCl_3} Ph-N \overset{\rightarrow}{\cong} C$$

(Nauseating smell)

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65. For the reaction below

$\xrightarrow{\text{(i) PhMgBr, THF}}_{\text{(ii) H}_3\text{O}^+}$ Q
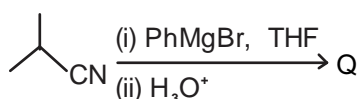
the structure of the product Q is

(A)   (B)   (C)   (D)
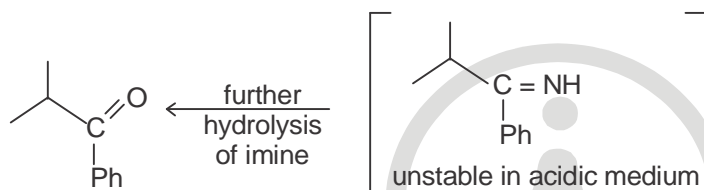
Ans : (B)
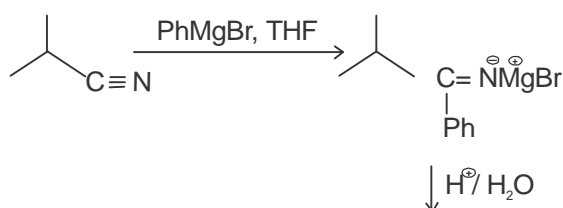
Hint :

66. You are supplied with 500 ml each of 2N HCl and 5N HCl. What is the maximum volume of 3M HCl that you can prepare using only these two solutions?

(A) 250 ml   (B) 500 ml   (C) 750 ml   (D) 1000 ml

Ans : (C)

Hint : ∵ We have to prepare maximum volume solution of 3N. (3N is same as 3M for HCl) Hence we will take all 500 ml of 2N solution and x ml of 5N solution.

∴   500 × 2 + x × 5 = 3 (x + 500)

1000 + 5x = 3x + 1500

2x = 500

x = 250 ml

∴   Final volume = 500 + x

= 500 + 250

= 750 ml

67. Which one of the following corresponds to a photon of highest energy?

(A) λ = 300 nm   (B) ν = 3 × 10⁸ s⁻¹   (C) ν = 30 cm⁻¹   (D) ε = 6.626 × 10⁻²⁷ J

Ans : (A)

Hint : Option (a) : $E = 6.626 \times 10^{-34} \text{ J.s} \times 3 \times 10^8 \text{ m/s} \times \dfrac{1}{300 \times 10^{-9}\,\text{m}}$

$= 6.626 \times 10^{-19}\,\text{J}$

Option (b) : $E = 6.626 \times 10^{-34}\text{ J.s} \times 3 \times 10^8 = 1.9878 \times 10^{-25}$ J

Option (c) : $E = 6.626 \times 10^{-34}\text{ J.s} \times 3 \times 10^8\,\text{m/s} \times 30 \times 10^2\,\text{m}^{-1} = 5.9634 \times 10^{-22}$ J

Option (d) : $E = 6.626 \times 10^{-27}$ J

Among these, maximum energy is 6.626×10⁻¹⁹ J.

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68. Assuming the compounds to be completely dissociated in aqueous solution, identify the pair of the solutions that can be expected to be isotonic at the same temperature :

(A) 0.01 M Urea and 0.01 M NaCl

(B) 0.02 M NaCl and 0.01 M Na_2SO_4

(C) 0.03 M NaCl and 0.02 M $MgCl_2$

(D) 0.01 M Sucrose and 0.02 M glucose

Ans : (C)

Hint : For isotonic at same temperature $\pi_1 = \pi_2$

$i_1 c_1 RT = i_2 c_2 RT$

$i_1 c_1 = i_2 c_2$

option (C) 0.03M NaCl and 0.02M Mg Cl_2

$\qquad\qquad\qquad i = 2 \qquad\qquad i = 3$

$i_1 c_1 = 2 \times 0.03 \qquad\qquad i_2 c_2 = 3 \times 0.02$

$\qquad = 0.06 \qquad\qquad\qquad = 0.06$

$\therefore i_1 c_1 = i_2 c_2$, Hence isotonic

69. How many faradays are required to reduce 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} in acid medium?

(A) 2 　　　　　　(B) 3 　　　　　　(C) 5 　　　　　　(D) 6

Ans : (D)

Hint :

$$\overbrace{\phantom{\text{Change in O.N per mol = 6}}}$$
Change in O.N per mol = 6 $\downarrow$

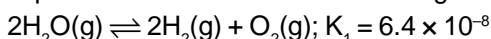$\underset{\underset{1 \text{ mol}}{Cr_2O_7^{2-}}}{+6} \longrightarrow \underset{Cr^{3+}}{+3}$
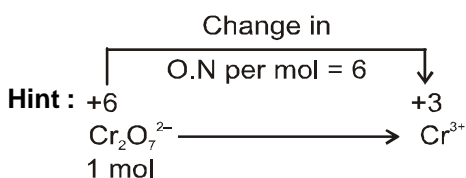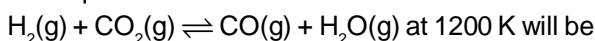
1 mol $Cr_2O_7^{2-}$ requires 6 mol electron $\equiv$ 6F charge

$\therefore$ Number of Faraday's required = 6

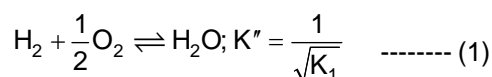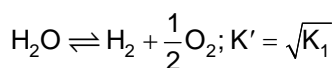70. Equilibrium constants for the following reactions at 1200 K are given :

$2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$; $K_1 = 6.4 \times 10^{-8}$

$2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g)$; $K_2 = 1.6 \times 10^{-6}$
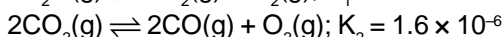
The equilibrium constant for the reaction

$H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)$ at 1200 K will be

(A) 0.05 　　　　　(B) 20 　　　　　(C) 0.2 　　　　　(D) 5.0

Ans : (D)

Hint : $\dfrac{1}{2} \times \left[2H_2O \rightleftharpoons 2H_2 + O_2;\ K_1 \right]$

$H_2O \rightleftharpoons H_2 + \dfrac{1}{2}O_2;\ K' = \sqrt{K_1}$

$H_2 + \dfrac{1}{2}O_2 \rightleftharpoons H_2O;\ K'' = \dfrac{1}{\sqrt{K_1}}$ -------- (1)

$\dfrac{1}{2} \times \left[2CO_2 \rightleftharpoons 2CO + O_2;\ K_2 \right]$

$CO_2 \rightleftharpoons CO + \dfrac{1}{2}O_2;\ \sqrt{K_2} = K'''$ -------- (2)

From equations (1) and (2),

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$$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O; \quad K'' = \frac{1}{\sqrt{K_1}}$$

$$CO_2 \rightleftharpoons CO + \frac{1}{2}O_2; \quad K''' = \sqrt{K_2}$$

$$\overline{H_2 + CO_2 \rightleftharpoons H_2O + CO}$$
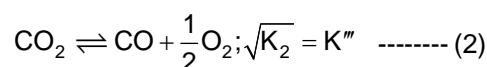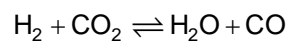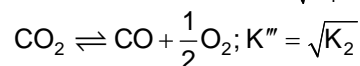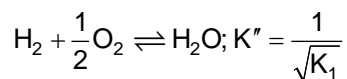
$$K = K'' \times K'''$$

$$= \frac{1}{\sqrt{K_1}} \times \sqrt{K_2}$$

$$= \sqrt{\frac{K_2}{K_1}} \quad = \sqrt{\frac{1.6 \times 10^{-6}}{6.4 \times 10^{-8}}} \quad = \sqrt{\frac{1}{4} \times 10^2} \quad = \sqrt{25} \quad = 5$$

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 –1/2 marks. No answer will fetch 0 marks.

71. In a close-packed body-centred cubic lattice of potassium, the correct relation between the atomic radius (r) of potassium and the edge-length (a) of the cube is

(A) $r = \dfrac{a}{\sqrt{2}}$ 　　(B) $r = \dfrac{a}{\sqrt{3}}$ 　　(C) $r = \dfrac{\sqrt{3}}{2}a$ 　　(D) $r = \dfrac{\sqrt{3}}{4}a$

Ans : (D)

Hint : In bcc lattice, 4r is $\sqrt{3}\,a$

72. Which of the following solutions will turn violet when a drop of lime juice is added to it?

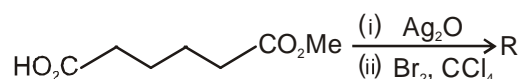(A) A solution of NaI 　　　　　　　　(B) A solution mixture of KI and $NaIO_3$

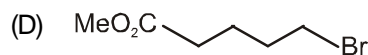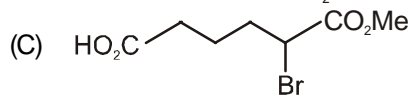(C) A solution mixture of NaI and KI 　　(D) A solution mixture of KIO_3 and $NaIO_3$
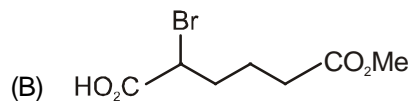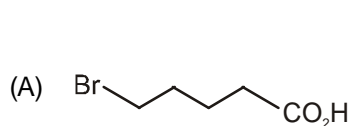
Ans : (B)

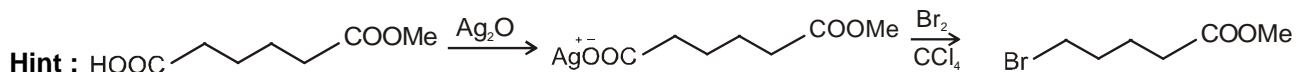**Hint :** $I^- + IO_3^- + H^+ \longrightarrow I_2 + H_2O$

73. The reaction sequence given below gives product R
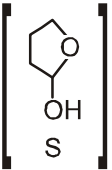
The structure of the product R is

Ans : (D)

Hint :
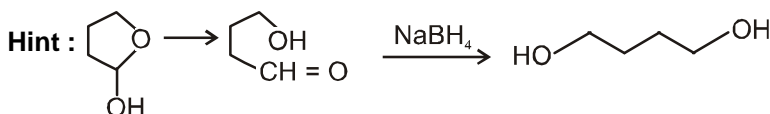

(Borodine Hunsdiecker reaction)

74. Reduction of the lactol S $\left[\begin{array}{c} \text{(structure: tetrahydrofuran ring with OH)} \\ \text{S} \end{array}\right]$ with sodium borohydride gives

(A) (tetrahydrofuran ring with O)

(B) (γ-butyrolactone structure)

(C) HO—CH$_2$CH$_2$CH$_2$CH$_2$—OH

(D) CH$_3$CH$_2$CH$_2$CH$_2$—OH

Ans : (C)

Hint : tetrahydrofuran-2-ol $\rightarrow$ open chain with OH and CH=O $\xrightarrow{NaBH_4}$ HO—(CH$_2$)$_4$—OH
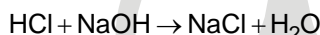
75. What will be the normality of the salt solution obtained by neutralizing x ml y (N) HCl with y ml x (N) NaOH, and finally adding (x + y) ml distilled water?

(A) $\dfrac{2(x+y)}{xy}N$ (B) $\dfrac{xy}{2(x+y)}N$ (C) $\left(\dfrac{2xy}{x+y}\right)N$ (D) $\left(\dfrac{x+y}{xy}\right)N$

Ans : (B)

Hint :

$$HCl + NaOH \rightarrow NaCl + H_2O$$

	HCl	NaOH	NaCl	H$_2$O
number of m.e added	xy	xy	0	0
number of m.e left	0	0	xy	xy

Normality of salt solution = $\dfrac{\text{number of milliequivalent}}{\text{Volume of solution in mL}} = \dfrac{xy}{(x+y)+(x+y)}N = \dfrac{xy}{2(x+y)}N$

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. Also no 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. During electrolysis of molten NaCl, some water was added. What will happen?

(A) Electrolysis will stop   (B) Hydrogen will be evolved

(C) Some amount of caustic soda will be formed   (D) A fire is likely

Ans : (B,C,D)

Hint : Na + H$_2$O $\rightarrow$ $\underset{(caustic\ soda)}{NaOH}$ + $\dfrac{1}{2}$H$_2$ + Q
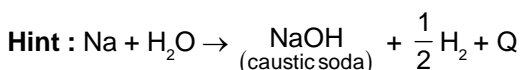
A fire is likely to take place due to vigorous reaction of sodium with water

77. The role of fluorspar, which is added in small quantities in the electrolysis reduction of alumina dissolved in fused cryolite, is

(A) as a catalyst   (B) to make fused mixture conducting

(C) to lower the melting temperature of the mixture   (D) to decrease the rate of oxidation of carbon at anode
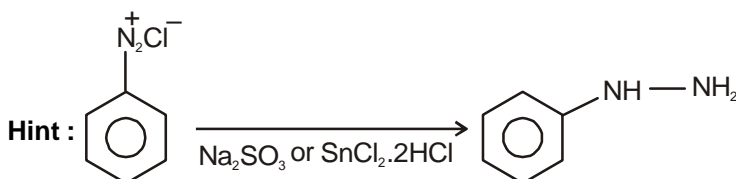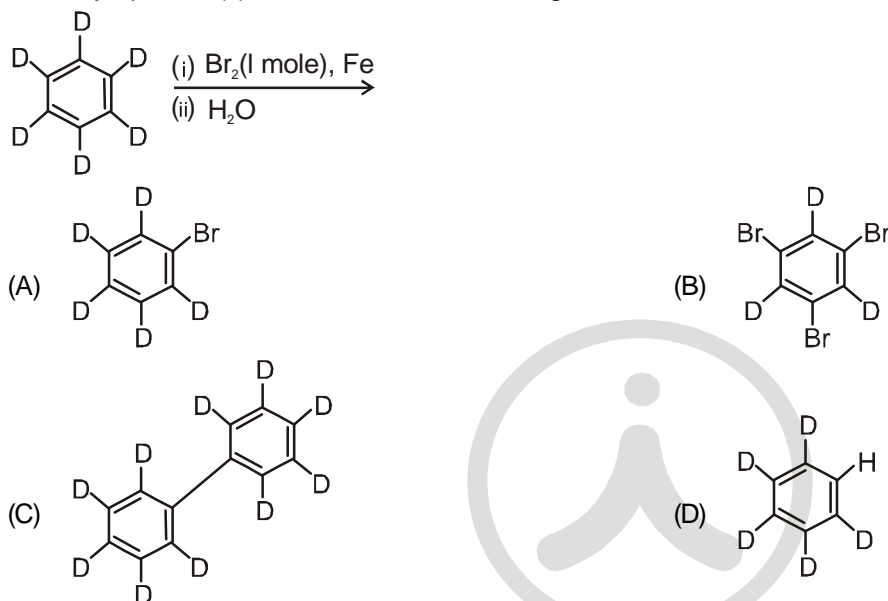
Ans : (B,C)

Hint : Fact

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78. The reduction of benzenediazonium chloride to phenyl hydrazine can be accomplished by

    (A) $SnCl_2$, HCl   (B) Na_2SO_3 (C) CH_3CH_2OH (D) H_3PO_2
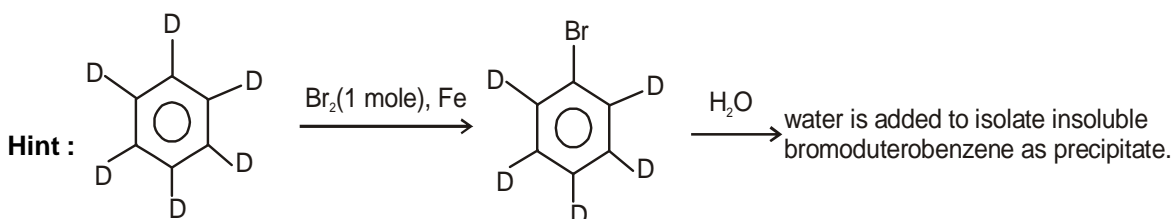
    Ans : (A,B)

    Hint :

79. The major product(s) obtained from the following reaction of 1 mole of hexadeuteriobenzene is/are

    (A)   (B)

    (C)   (D)

    Ans : (A)

    Hint :

    water is added to isolate insoluble bromoduterobenzene as precipitate.

    When water is added it helps to isolate insoluble bromoduterobenzene.

80. Identify the correct statement(s) :

    The findings from the Bohr model for H-atom are

    (A) Angular momentum of the electron is expressed as integral multiples of $\dfrac{h}{2\pi}$

    (B) The first Bohr radius is 0.529A°

    (C) The energy of the n-th level E_n is proportional to $\dfrac{1}{n^2}$

    (D) The spacing between adjacent levels increases with increase in 'n'

    Ans : (A,B,C)

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Hint : (A) Angular Momentum $= \dfrac{nh}{2\pi}$ n = 1, 2, 3   (Fact)

(B) $a_0 = 0.529 \text{Å}$ (Fact)

(C) $E_n = \dfrac{(-13.6 \text{ev / atom}) z^2}{n^2}$ (Fact) $\therefore E_n \, \alpha \, \dfrac{1}{n^2}$

(D) $(E_2 - E_1) > (E_3 - E_2) > (E_4 - E_3)$ ..... (Fact)

As here levels means energy levels and the difference between the sucuessive levels decreases as 'n' increases

❑   ❑   ❑

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