

WBJEE - 2016

Answer Keys by

Aakash Institute, Kolkata Centre

PHYSICS & CHEMISTRY

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

* More than one options are correct

** None of options are correct



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Code-+

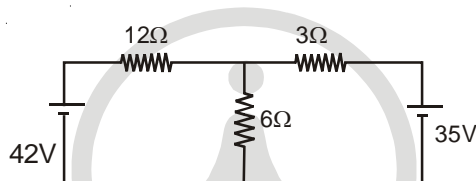
ANSWERS & HINT for WBJEEM - 2016 SUB : PHYSICS & CHEMISTRY

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. The current flowing through the 3Ω resistor in the circuit is,



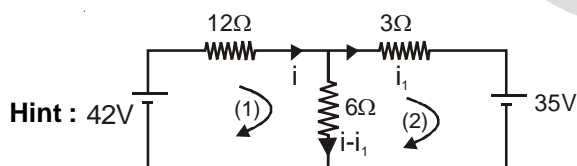
(A) 4.2 A

(B) 3.0 A

(C) 3.5 A

(D) 1.6 A

Ans : (B)



In loop (1)

$$-12i_1 - 6(i - i_1) + 42 = 0$$

In loop(2)

$$-3i_1 - 35 + 6(i - i_1) = 0, \text{ Solving } i_1 = -3A$$

So, current flowing through 3Ω resistor is 3A.

2. A body attached to the lower end of a vertical spring oscillates with time period of 1 sec. The time period when two such springs are connected one below another is approximately

(A) 0.7 sec

(B) 1 sec

(C) 1.4 sec

(D) 2 sec

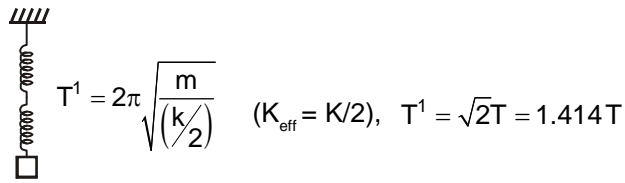
Ans : (C)

Hint :

Case - I

$$T = 2\pi\sqrt{\frac{m}{K}} = 1\text{sec}$$

In case II



3. The minimum and maximum capacitances, which may be obtained by the combination of three capacitors each of capacitance $6 \mu\text{F}$ are
 (A) $6 \mu\text{F}$ and $18 \mu\text{F}$ (B) $2 \mu\text{F}$ and $18 \mu\text{F}$ (C) $2 \mu\text{F}$ and $12 \mu\text{F}$ (D) $6 \mu\text{F}$ and $12 \mu\text{F}$

Ans : (B)

Hint : In series capacitance is minimum

$$C_{\min} = 6/3 = 2 \mu\text{F}$$

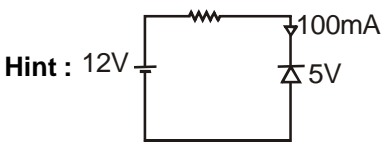
In parallel capacitance is maximum

$$C_{\max} = (6 \times 3) = 18 \mu\text{F}$$

4. A zener diode has break down voltage of 5.0 V . The resistance required to allow a current of 100 mA through the zener in reverse bias when connected to a battery of emf 12 V is

- (A) 50Ω (B) 70Ω (C) 100Ω (D) 150Ω

Ans : (B)



$$V = IR$$

$$(12 - 5)V = 7V = 100 \times 10^{-3} \times R$$

$$7 = 10^{-1} \times R$$

$$R = 70 \Omega$$



5. A series LCR circuit resonates at 10 kHz . If the capacitor is $0.01 \mu\text{F}$, the inductance used is approximately
 (A) 10 mH (B) 25 mH (C) 50 mH (D) 100 mH

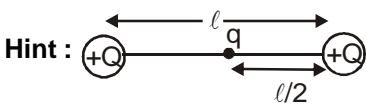
Ans : (B)

$$\text{Hint : } f = \frac{1}{2\pi\sqrt{LC}}, 10^4 = \frac{1}{2\pi\sqrt{L \times 10^{-8}}}, L \approx \frac{1}{40} \text{ H}, L \approx 25 \text{ mH}$$

6. Two charges of equal amount $+Q$ are placed on a line. Another charge q is placed at the mid-point of the line. The system will be in equilibrium if the value of q is

- (A) $-\frac{Q}{4}$ (B) $-\frac{Q}{2}$ (C) $+\frac{Q}{2}$ (D) $+\frac{Q}{4}$

Ans : (A)



For the equilibrium of the system

$$\text{Force on } +Q \text{ charge, } \frac{KQ^2}{\ell^2} = -\frac{KQq}{\ell^2} \times 4$$

$$q = -\frac{Q}{4}$$

7. The increase in electrostatic potential energy of a dipole of moment p when it is taken from parallel to anti-parallel orientation in an electric field E is
- (A) $2pE$ (B) $3pE$ (C) $5pE$ (D) $6pE$

Ans : (A)

Hint : $p =$ dipole moment

$$U = -pE\cos\theta$$

$$U_1 = -pE\cos 0^\circ$$

$$U_2 = -pE\cos 180^\circ$$

$$\Delta U = (U_2 - U_1) = pE + pE = 2pE$$

Increase in potential energy $\Delta U = 2pE$

8. An n-p-n transistor of current gain 80 in common emitter mode gives emitter current equal to 8.1 mA. The base current is
- (A) $0.1 \mu\text{A}$ (B) 0.01 mA (C) 0.1 mA (D) $0.01 \mu\text{A}$

Ans : (C)

Hint : $\beta = 80$

$$I_c = 8.1 \text{ mA}$$

$$\left(\frac{I_c}{I_b}\right) = 80 \quad (I_e = I_b + I_c)$$

$$\left(\frac{I_e - I_b}{I_b}\right) = 80$$

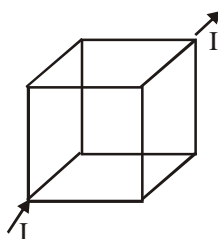
$$I_b = 0.1 \text{ mA}$$

9. If a bar magnet of magnetic moment M is kept in a uniform magnetic field B , its time period of oscillation is T . In the same magnetic field, the time period of another magnet of same dimension and same mass but of moment $M/4$ is,
- (A) T (B) $2T$ (C) $T/2$ (D) $T/4$

Ans : (B)

$$\text{Hint : } T = 2\pi\sqrt{\frac{I}{MB}}, \quad T' = 2\pi\sqrt{\frac{I}{\frac{M}{4}B}} = 2T$$

10. The magnetic field intensity at the centre of cubical cage of identical wires of length 'a' due to a current I flowing as shown in the figure is



- (A) $\frac{2I}{a}$ (B) $\frac{\sqrt{2}I}{a}$ (C) 0 (D) $I/2a$

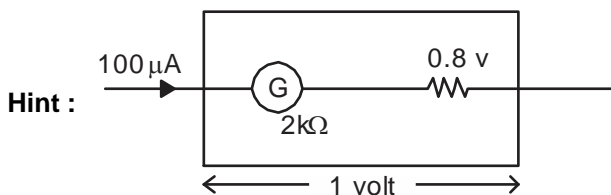
Ans : (C)

Hint : For symmetrical current distribution, magnetic field at the centre due to all current carrying conductors will get cancelled.

$$\text{Hence } B_{\text{net}} = 0$$

11. A micro-ammeter gives full scale deflection at $100 \mu\text{A}$. Its resistance is $2\text{k}\Omega$. The resistance required to convert it to a voltmeter reading 1V is
 (A) $1 \text{ k}\Omega$ in series (B) $8 \text{ k}\Omega$ in series (C) $1 \text{ k}\Omega$ in parallel (D) $8 \text{ k}\Omega$ in parallel

Ans : (B)



$$I \times R = (0.8 \text{ v})$$

$$10^{-4} \times R = 0.8$$

$$R = (8 \times 10^3)\Omega \text{ in series}$$

12. An electron of mass 'm' is accelerated by a potential difference V and the corresponding de-Broglie wavelength is λ . The de Broglie wavelength of a proton of mass M if it is accelerated by the same potential difference is ,

- (A) $\lambda \left(\frac{m}{M}\right)$ (B) $\lambda \left(\frac{M}{m}\right)$ (C) $\lambda \sqrt{\frac{m}{M}}$ (D) $\lambda \sqrt{\frac{M}{m}}$

Ans : (C)

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

For Proton $\lambda_p = \frac{h}{\sqrt{2MeV}}$

$$\frac{\lambda_p}{\lambda} = \sqrt{\frac{m}{M}}$$



13. If I_1 and I_2 be the sizes of real images for two positions of a convex lens between object and screen, then the size of the object is

- (A) $I_1 I_2$ (B) $I_1 I_2$ (C) $\sqrt{I_1 I_2}$ (D) $\sqrt{I_1 / I_2}$

Ans : (C)

Hint : By displacement method, object size = $\sqrt{(I_1 I_2)}$

14. Impedance of a coil having inductance 0.4 H at frequency of 50 Hz will be

- (A) $20\pi\Omega$ (B) $40\pi\Omega$ (C) $2\pi\Omega$ (D) $4\pi\Omega$

Ans : (B)

Hint : $L = 0.4 \text{ H}$ $f = 50 \text{ Hz}$

$$(X_L) = (2\pi fL)$$

$$= (2 \times \pi \times 50 \times 0.4)$$

$$= 40 \pi\Omega$$

15. 1000 drops of water of radius 1 cm each carrying a charge of 10 esu combine to form a single drop. The capacitance increases thereby

- (A) 1 time (B) 10 times (C) 100 times (D) 1000 times

Ans : (B)

Hint : $\frac{1}{n^3 r} = R$

$$n^3 C_{\text{small drop}} = C_{\text{bigger drop}}$$

$$(10)^{3 \times \frac{1}{3}} C_{\text{small drop}} = C_{\text{bigger drop}}$$

Hence capacitance increases thereby 10 times

16. Light is an electromagnetic wave whose

- (A) \vec{E} and \vec{B} are parallel and both are perpendicular to the direction of propagation
 (B) \vec{E} and \vec{B} are mutually perpendicular and the direction of propagation is parallel to \vec{E}
 (C) \vec{E} and \vec{B} and the direction of propagation are mutually perpendicular
 (D) \vec{E} and \vec{B} are mutually perpendicular and the direction of propagation is parallel to \vec{B}

Ans : (C)

Hint : Fact

17. In Bohr model of an atom, two electrons move round the nucleus in circular orbits of radii in the ratio 1 : 4. The ratio of their kinetic energies are

- (A) 1 : 4 (B) 4 : 1 (C) 8 : 1 (D) 1 : 8

Ans : (B)

$$\text{Hint : } E \propto \frac{1}{r} \Rightarrow \frac{E_1}{E_2} = \frac{r_2}{r_1} = \frac{4}{1}$$

18. If a Young's double slit experiment were conducted inside water instead of air, the fringe width would

- (A) increase (B) decrease (C) remain same (D) become zero

Ans : (B)

$$\text{Hint : } \beta_{\text{med}} = \frac{\beta_{\text{air}}}{\mu}$$

$$\therefore \mu > 1 \Rightarrow \beta_{\text{med}} < \beta_{\text{air}}$$

19. A photon of energy 8eV is incident on a metal plate with threshold frequency 1.6×10^{15} Hz. The maximum kinetic energy of the emitted photo electrons is (given $h = 6 \times 10^{-34}$ Js)

- (A) 6 eV (B) 1.6 eV (C) 1.2 eV (D) 2 eV

Ans : (D)

$$\text{Hint : } KE_{\text{max}} = E_{\text{photon}} - \phi = E_{\text{photon}} - h\nu$$

$$= 8\text{eV} - \frac{6 \times 10^{-34} \times 1.6 \times 10^{15}}{1.6 \times 10^{-19}} \text{eV}$$

$$= (8 - 6) \text{eV}$$

$$= 2 \text{eV}$$

20. The ratio of the masses of two planets is 2 : 3 and the ratio of their radii is 3 : 2. The ratio of acceleration due to gravity on these two planets is

- (A) 9 : 4 (B) 4 : 9 (C) 2 : 3 (D) 3 : 2

Ans : None of the options are correct

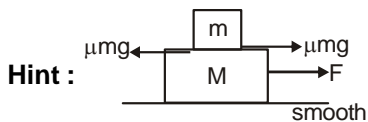
$$\text{Hint : } g = \frac{GM}{R^2}$$

$$\therefore \frac{g_1}{g_2} = \frac{M_1}{M_2} \left(\frac{R_2}{R_1} \right)^2 = \frac{2}{3} \left(\frac{2}{3} \right)^2 = \frac{8}{27}$$

21. A mass m rests on another mass M . The co-efficient of static friction between the surfaces of m and M is μ . M rests on a smooth frictionless horizontal plane. The maximum force applied horizontally on M for which m will move alongwith M without slipping is,

- (A) $mg + \mu mg$ (B) $(M + m)\mu g$ (C) $\frac{mM}{M+m}\mu g$ (D) μmg

Ans : (B)



$$ma_{\max} = \mu mg$$

$$a_{\max} = \mu g$$

$$F_{\max} - \mu mg = Ma_{\max}$$

$$\therefore F_{\max} = (m + M)\mu g$$

22. The dimension of co-efficient of viscosity η is

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

Ans : (D)

Hint : $F = 6\pi\eta r v$

$$[\eta] = \left[\frac{F}{rv} \right] = [ML^{-1}T^{-1}]$$

23. An explosive of mass 9 kg is divided in two parts. One part of mass 3 kg moves with velocity of 16 m/s. The kinetic energy of other part will be

- (A) 192 J (B) 162 J (C) 150 J (D) 200 J

Ans : (A)

Hint : By conservation of linear momentum,

$$0 = 3 \times 16 - 6 \times v$$

$$\therefore v = 8 \text{ m/s for } 6 \text{ kg} \quad \therefore \text{Kinetic energy of } 6 \text{ kg mass} = \frac{1}{2} \times 6 \times 8^2 = 192 \text{ J}$$

24. The length of a wire is l_1 when tension is T_1 and is l_2 when tension is T_2 . The length of the wire without any tension is

- (A) $\frac{l_2 T_1 - l_1 T_2}{T_1 - T_2}$ (B) $\frac{l_1 T_1 - l_2 T_2}{T_1 - T_2}$ (C) $\frac{l_1 T_1}{T_2 - T_1}$ (D) $\frac{l_2 T_2}{T_1 - T_2}$

Ans : (A)

Hint : $T_1 = k[l_1 - x]$

$$T_2 = k[l_2 - x]$$

$$\frac{T_1}{T_2} = \frac{l_1 - x}{l_2 - x}$$

$$\text{Thus we get, } x = \left(\frac{T_1 l_2 - T_2 l_1}{T_1 - T_2} \right)$$

25. A particle of mass m is moving in a circular orbit of radius r in a force field given by $\vec{F} = -\frac{k}{r^2} \hat{r}$. The angular momentum L of the particle about the centre varies as

- (A) $L \propto \sqrt{r}$ (B) $L \propto r^{3/2}$ (C) $L \propto \frac{1}{\sqrt{r}}$ (D) $L \propto r^{1/3}$

Ans : (A)

Hint : $\frac{mv^2}{r} = \frac{k}{r^2} \Rightarrow v = \sqrt{\frac{k}{mr}}$

$L = mvr = \sqrt{mrk}$ Thus we get $L \propto \sqrt{r}$

26. A sphere, a cube and a thin circular plate, all made of the same material and having the same mass, are initially heated to a temperature of 200°C. When left in air at room temperature, the following cools fastest.

- (A) Sphere (B) Cube (C) Plate (D) All of these

Ans : (C)

Hint : $\frac{dT}{dt} \propto$ Surface Area for given mass.

27. Two sound waves of wavelengths 50 cm and 51 cm produce 12 beats per second. The velocity of sound is

- (A) 306 ms⁻¹ (B) 331 ms⁻¹ (C) 340 ms⁻¹ (D) 360 ms⁻¹

Ans : (A)

Hint : $f_1 - f_2 = 12$ $\frac{v}{\lambda_1} - \frac{v}{\lambda_2} = 12$ Thus we get, $v = 306 \text{ ms}^{-1}$

28. Air is expanded from 50 litre to 150 litre at 2 atmospheric pressure (1 atm pressure = 10⁵ kgm⁻²). The external work done is

- (A) 200 J (B) 2000 J (C) 2 × 10⁴ J (D) 2 × 10⁻¹² J

Ans : (C)

Hint : $W = P\Delta V$ [Assuming the atm pressure 10⁵ Nm⁻² instead of 10⁵ kgm⁻²]

Where $\Delta V = (150 - 50) \text{ litre} = 100 \times 10^{-3} \text{ m}^3$

29. The Young's modulus of a metal is 2 × 10¹² dyne/cm² and its breaking stress is 11000 kg/cm². In case of longitudinal strain the maximum energy that can be stored per cubic metre of this metal is approximately (Assume g = 10 m/s²)

- (A) 58.28 × 10⁵ J (B) 30.25 × 10⁵ J (C) 37.15 × 10⁵ J (D) 15.15 × 10⁵ J

Ans : (B)

Hint : Energy density, $\frac{dU}{dV} = \frac{(\text{stress})^2}{2Y}$

Where stress = $\frac{11000g}{10^{-4}} \text{ N/m}^2$

30. When a body moves in a circular orbit its total energy is

- (A) positive (B) negative (C) zero (D) infinite

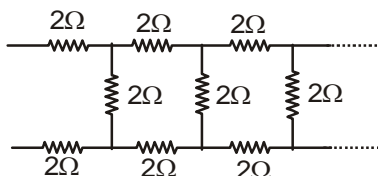
Ans : (B)

Hint : A bound system has negative energy.

Category II (Q31 to Q 35)

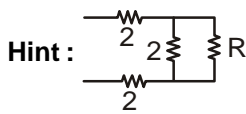
Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer or any combination of more than one answer will fetch – ½ marks

31. Equivalent resistance of the given infinite circuit is



- (A) 4Ω (B) 2Ω
 (C) Infinity (D) Greater than 4Ω but less than 6Ω

Ans : (D)



$$\frac{R \times 2}{R + 2} + 4 = R$$

$$2R + 4R + 8 = R^2 + 2R$$

$$R^2 - 4R - 8 = 0$$

$$R = \frac{4 \pm \sqrt{16 + 32}}{2}$$

$$= \frac{4 + \sqrt{48}}{2} = 5.46\Omega$$

32. The ionization potential of hydrogen is -13.6 eV. The energy required to excite the electron from the first to the third orbit is approximately

- (A) 10.2 J (B) 12.09×10^{-6} J
 (C) 19.94 J (D) 19.34×10^{-19} J

Ans : (D)

Hint : $[E = -13.6/n^2]$

$$\Delta E = 13.6 - \frac{13.6}{9} = 13.6 \times \frac{8}{9} \text{ eV}$$

$$= 12.08 \text{ eV}$$

$$= 12.08 \times 1.6 \times 10^{-19}$$

$$= 19.34 \times 10^{-19} \text{ J}$$

33. Assume that the Earth rotates in a circular orbit round the Sun in 365 days. If the mass of the sun gets doubled but the radius of the orbit remains unchanged, the length of the year would be approximately

- (A) 183 days (B) 258 days (C) 516 days (D) 730 days

Ans : (B)

Hint : $T = 2\pi\sqrt{\frac{R^3}{GM}}$

$$T \propto \frac{1}{\sqrt{M}} \text{ (for given orbital radius)}$$

$$\frac{T_1}{T_2} = \frac{\sqrt{2M}}{\sqrt{M}}$$

$$T_2 = \frac{T_1}{\sqrt{2}} = \frac{365}{\sqrt{2}} \approx 258 \text{ days}$$

34. For the following set(s) of forces (in the same unit) the resultant can never be zero
- (A) 10,10,10 (B) 10,10,20
(C) 10,20,30 (D) 10,20,40

Ans : (D)

Hint : If $\vec{R} = \vec{A} + \vec{B}$ then $|A - B| \leq |\vec{R}| \leq A + B$, $\therefore 10+20 = 30 < 40$ (not possible)

35. A particle of mass 'm' and carrying a charge 'q' enters with a velocity 'v' perpendicular to a uniform magnetic field. The time period of rotation of the particle
- (A) Decreases with increase of velocity v
(B) Increases with increase of radius of the orbit
(C) Depends only on magnetic field
(D) Depends on magnetic field and (q/m) of the particle

Ans : (D)

Hint : $\left(T = \frac{2\pi m}{qB} \right)$

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. At any instant t current i through a coil of self inductance 2 mH is given by $i = t^2 e^{-t}$. The induced e.m.f. will be zero at time
- (A) 1 sec (B) 2 sec (C) 3 sec (D) 4 sec

Ans : (B)

Hint : induced emf = $-L \frac{di}{dt}$

$$= -L \frac{d(t^2 e^{-t})}{dt}$$

$$= -L \{2t e^{-t} + t^2(-1) e^{-t}\}$$

$$= -L \{2t e^{-t} - t^2 e^{-t}\}$$

so, for induced emf to be zero

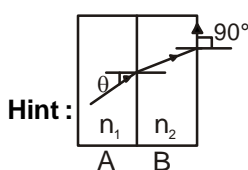
$$e^{-t} (2 - t) = 0$$

$$t = \infty, t = 2 \text{ sec}, t = 0$$

37. A and B are two parallel sided transparent slabs of refractive indices n_1 and n_2 respectively. A ray is incident at an angle θ on the surface of separation of A and B, and after refraction from B into air grazes the surface of B. Then

- (A) $\sin \theta = \frac{1}{n_2}$ (B) $\sin \theta = \frac{1}{n_1}$ (C) $\sin \theta = \frac{n_2}{n_1}$ (D) $\sin \theta = \frac{n_1}{n_2}$

Ans : (B)



From snell's law

$$n_1 \sin \theta = 1$$

$$\sin \theta = \frac{1}{n_1}$$

38. The pair of parameters temperature T, pressure P, volume V and work W characterises the thermodynamic state of matter

- (A) T, P (B) T, V (C) T, W (D) P, W

Ans : (A,B)

Hint : P, V and T are the thermodynamic variables of a state

39. Equation of a wave is given by $y = 10^{-4} \sin(60t + 2x)$, x and y in metre and t is in second. Then

- (A) Wave is propagating along the negative x direction with velocity 30 m/s
 (B) Wavelength is π metre
 (C) Frequency is $30/\pi$ Hz
 (D) Wave is propagating along positive x direction with velocity 60 m/s

Ans : (A,B,C)

Hint : $v = \frac{\omega}{K} = 30 \text{ m/s}$

$$\omega = 60 \text{ rad/sec}$$

$$2\pi f = 60$$

$$f = \frac{30}{\pi} \text{ Hz}$$

$$K = \frac{2\pi}{\lambda} = 2 \text{ m}^{-1}$$

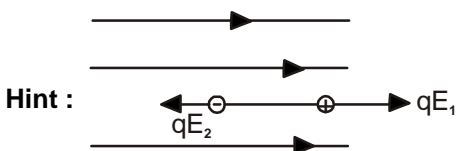
$$\lambda = \pi \text{ m}$$



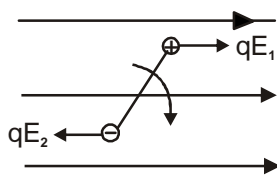
40. An electric dipole is placed in a non-uniform electric field \vec{E} . The electric field is along x direction. The dipole will experience

- (A) A torque when the dipole is parallel to \vec{E}
 (B) A torque when the dipole makes an angle with \vec{E}
 (C) A force perpendicular to \vec{E}
 (D) A force when the dipole is parallel to \vec{E}

Ans : (B,D)



For parallel condition, the line of action of forces is same, so no torque. But $F = q(E_1 - E_2) \neq 0$

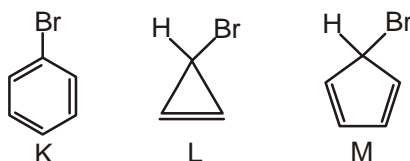


If $E_1 = E_2$ or $E_1 \neq E_2$
 $\tau \neq 0$

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

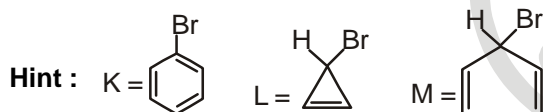
41. Consider the following compounds :



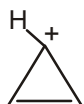
Which one of the following statements is correct?

- (A) Only K forms a precipitate on treatment with alcoholic AgNO_3 solution.
 (B) Only L forms a precipitate on treatment with alcoholic AgNO_3 solution.
 (C) Only M forms a precipitate on treatment with alcoholic AgNO_3 solution.
 (D) K, L, and M form precipitates with alcoholic AgNO_3 solution.

Ans : (B)

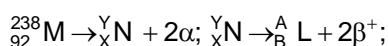


Precipitate is formed by L;



As it is most stable due to aromatic nature

42. Consider the following nuclear reactions :

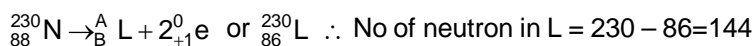
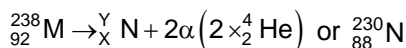


The number of neutrons in the element L is

- (A) 142 (B) 144 (C) 140 (D) 146

Ans : (B)

Hint : Nuclear reaction



43. Of the following atoms, which one has the highest n/p ratio?

- (A) Ne^{16} (B) O^{16} (C) F^{16} (D) N^{16}

Ans : (D)

Hint : Highest n/p ratio

$${}_{10}\text{Ne}^{16} \Rightarrow \frac{n}{p} = \frac{6}{10} = 0.6; {}_8\text{O}^{16} \Rightarrow \frac{n}{p} = \frac{8}{8} = 1$$

$${}_9\text{F}^{16} \Rightarrow \frac{n}{p} = \frac{7}{9}; {}_7\text{N}^{16} \Rightarrow \frac{n}{p} = \frac{9}{7} = 1.2857 = 0.778$$

44. The spin-only magnetic moment of $[\text{CrF}_6]^{4-}$ (atomic number of Cr is 24) is
 (A) 0 (B) 1.73 BM (C) 2.83 BM (D) 4.9 BM

Ans : (D)



F⁻ is a weak field ligand, $\Delta_0 < P$, No pairing



No. of unpaired e⁻ = 4, Spin only magnetic moment (μ)

$$= \sqrt{n(n+2)} = \sqrt{4 \times 6} = \sqrt{24} = 4.9 \text{ BM}$$

45. Among the following groupings, which one represents the set of iso-electronic species?
 (A) $\text{NO}^+, \text{C}_2^{2-}, \text{O}_2^-, \text{CO}$ (B) $\text{N}_2, \text{C}_2^{2-}, \text{CO}, \text{NO}$ (C) $\text{CO}, \text{NO}^+, \text{CN}^-, \text{C}_2^{2-}$ (D) $\text{NO}, \text{CN}^-, \text{N}_2, \text{O}_2^-$

Ans : (C)

Hint : Iso Electronic species

$$\text{CO} = 14e^-$$

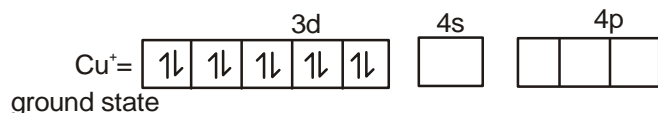
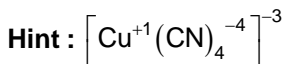
$$\text{NO}^+ = 14e^-$$

$$\text{CN}^- = 14e^-$$

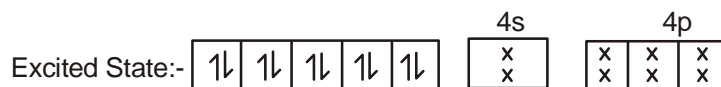
$$\text{C}_2^{2-} = 14e^-$$

46. In the complex ion $[\text{Cu}(\text{CN})_4]^{3-}$ the hybridization state, oxidation state and number of unpaired electrons of copper are respectively
 (A) $dsp^2, +1, 1$ (B) $sp^3, +1, \text{zero}$ (C) $sp^3, +2, 1$ (D) $dsp^3, +2, \text{zero}$

Ans : (B)



CN^- is strong field ligand, Δ is high



Hybridisation = sp^3 ; oxidation state of Cu = +1

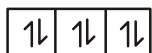
Number of unpaired electron = 0

47. The maximum number of 2p electrons with electronic spin $= -\frac{1}{2}$ are

- (A) 6 (B) 0 (C) 2 (D) 3

Ans : (D)

Hint : Electronic configuration of 2p level



Number of electrons with clock wise spin $m_s = +1/2$ is =3

Number of electrons with anticlockwise spin $m_s = -1/2$ is =3

\therefore Maximum number of electrons with spin $m_s = -1/2$ is 3

48. For $N^{3-} > O^{2-} > F^-$ and Na^+ , the order in which their ionic radii varies is

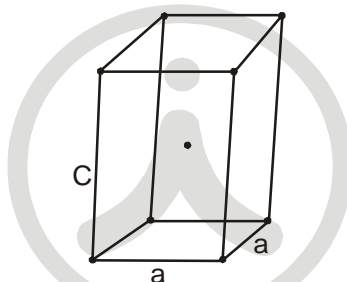
- (A) $N^{3-} > O^{2-} > F^- > Na^+$ (B) $N^{2-} > Na^+ > O^{2-} > F^-$ (C) $Na^+ > O^{2-} > N^{3-} > F^-$ (D) $O^{2-} > F^- > Na^+ > N^{3-}$

Ans : (A)

Hint : N^{3-} , O^{2-} , F^- and Na^+ are all isoelectronic species. As the atomic number increases, nuclear attraction increases, hence the order of ionic radii

$N^{3-} > O^{2-} > F^- > Na^+$

49. Assign the Bravais lattice type of the following unit cell structure.



- (A) Cubic I (B) Orthorhombic I (C) Tetragonal I (D) Monoclinic

Ans : (C)

Hint : In the given lattice the relation between the sides is $a = b \neq c$, and the angles are all 90° i.e. $\alpha = \beta = \gamma = 90^\circ$. Also it is a body-centered lattice i.e. The Bravais notation is I.

\therefore The Bravais lattice is Tetragonal-I

50. The equilibrium constant for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ is 'K'. Then, the equilibrium constant for the reaction

$2N_2 + 6H_2 \rightleftharpoons 4NH_3$ will be

- (A) K (B) K^2 (C) \sqrt{K} (D) 2K

Ans : (B)

Hint : For the reaction

$N_2 + 3H_2 \rightleftharpoons 2NH_3$, equilibrium constant = K. $\therefore K = \frac{[NH_3]^2}{[N_2][H_2]^3}$ Now, for $2N_2 + 6H_2 \rightleftharpoons 4NH_3$, $K' = \frac{[NH_3]^4}{[N_2]^2[H_2]^6} = K^2$

51. Which of the following is the correct option for free expansion of an ideal gas under adiabatic condition?

- (A) $q = 0, \Delta T \neq 0, W = 0$ (B) $q = 0, \Delta T \neq 0, W \neq 0$
 (C) $q = 0, \Delta T = 0, W = 0$ (D) $q = 0, \Delta T = 0, W \neq 0$

Ans : (C)

Hint : For the free expansion of an ideal gas, the opposing force is zero, hence work done = 0.

$$\Delta U = q + w, w = 0, \text{ hence } \Delta U = q$$

But the process is adiabatic, hence $q = 0$

$$\therefore q = 0, \Delta T = 0, W = 0$$

52. 75% of a first order reaction was completed in 32 min. When would 50% of the reaction completed?

- (A) 24 min (B) 16 min (C) 8 min (D) 64 min

Ans : (B)

Hint : The first order rate constant is given as

$$K = \frac{2.303}{t} \log \frac{a_0}{a_0 - x} \quad \text{-----(1)} \quad \text{also, half life } t_{1/2} = \frac{2.303 \log 2}{K} \quad \text{-----(2)}$$

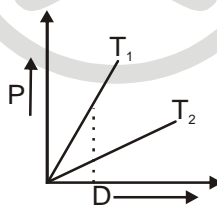
Equating K from equation (1) and (2)

$$\therefore \frac{2.303 \log 2}{t_{1/2}} = \frac{2.303}{t} \log \frac{a_0}{a_0 - x}, \text{ Now given, for 75\% completion of the reaction is 32 minutes}$$

$$\therefore \frac{2.303 \log 2}{t_{1/2}} = \frac{2.303}{32} \log \frac{100}{100 - 75} \quad \text{or, } \frac{\log 2}{t_{1/2}} = \frac{1}{32} \log 4, \quad \text{or } \frac{\log 2}{t_{1/2}} = \frac{1}{32} \times 2 \log 2$$

$$\therefore t_{1/2} = 16 \text{ minutes.}$$

53. Pressure (P) vs. density (D) curve for an ideal gas at two different temperatures T_1 and T_2 is shown below.



Identify the correct statement about T_1 and T_2 :

- (A) $T_1 > T_2$ (B) $T_1 < T_2$ (C) $T_1 = T_2$ (D) Cannot be said

Ans : (A)

54. Which of the following compounds is least effective in precipitating $\text{Fe}(\text{OH})_3$ sol.?

- (A) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (B) K_2CrO_4 (C) KBr (D) K_2SO_4

Ans : (C)

Hint : $\text{Fe}(\text{OH})_3$ is positively charged sol. charge of Br^- anion is least and so KBr is least effective in coagulating $\text{Fe}(\text{OH})_3$ sol.

55. Which statement is incorrect?

- (A) Borazine has a 3D-layer structure like that of graphite
 (B) Boric acid has a hydrogen bonded layer structure in the solid state
 (C) Borazine molecule is $(\text{BN})_3$
 (D) $[\text{Al}_6\text{O}_{18}]^{18-}$ contains a non-planar Al_6O_6 -ring

Ans : (A, C, D)

Hint : Three options are incorrect.

→ Borazine is $B_3N_3H_6$ and its structure is not like that of graphite.

→ $Al_6O_{18}^{18-}$ contains AlO_4^{5-} tetrahedral units.

56. Which one of the following does not produce O_2 as the only gaseous product on heating?

- (A) Lead Nitrate (B) Potassium Chlorate (C) Mercuric Oxide (D) Potassium Nitrate

Ans : (A)

Hint : (A) $Pb(NO_3)_2(s) \xrightarrow{\Delta} PbO(s) + 2NO_2(g) + \frac{1}{2}O_2(g)$

(B) $KClO_3(s) \xrightarrow{\Delta} KCl(s) + \frac{3}{2}O_2(g)$

(C) $HgO(s) \xrightarrow{\Delta} Hg(l) + \frac{1}{2}O_2(g)$

(D) $KNO_3(s) \xrightarrow{\Delta} KNO_2(s) + \frac{1}{2}O_2(g)$

57. Which of the following is true in respect of adsorption?

- (A) $\Delta G < 0; \Delta S > 0; \Delta H < 0$ (B) $\Delta G < 0; \Delta S < 0; \Delta H < 0$ (C) $\Delta G > 0; \Delta S > 0; \Delta H < 0$ (D) $\Delta G < 0; \Delta S < 0; \Delta H > 0$

Ans : (B)

Hint : $\Delta G < 0; \Delta S < 0; \Delta H < 0$ (fact)

58. Which property that polyacetylene exhibits is unusual for an organic polymer?

- (A) Electrical conductivity (B) Flexibility (C) High boiling point (D) Solubility

Ans : (A)

Hint : Due to conjugation it can conduct electricity.

59. Which statement is incorrect about complexes formed by the lanthanoids?

- (A) Hard donor ligands are favoured
(B) High coordination numbers (more than six) are often observed
(C) The 4f atomic orbitals do not play a significant part in metal-ligand bonding
(D) Aqua ions are typically 6-coordinate

Ans : (D)

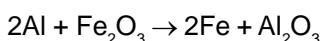
Hint : The coordination number for $[Ln(H_2O)_n]^{+3}$ in aqueous solution is thought to be 9 for the early lanthanoids and for the later, smaller members of the series.

60. In the aluminothermite process, aluminium acts as

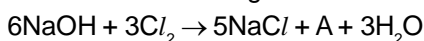
- (A) a reducing agent (B) an oxidizing agent (C) an additive agent (D) a flux

Ans : (A)

Hint : Al reduces oxides of metals like Fe/Cr/Mn at elevated temperature due to its high affinity for oxygen



61. Consider the following reaction:



What is the oxidation number of chlorine in A?

- (A) +5 (B) -1 (C) +3 (D) +1

Ans : (A)

Hint : Balance the equation $6NaOH + 3Cl_2 \rightarrow 5NaCl + A + 3H_2O$

to get, $6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$

∴ A is $NaClO_3$, where Cl is in +5 oxidation state

62. A sudden large difference between the values of second and third ionization energies of elements would be associated with which of the following electronic configurations?

- (A) $1s^2 2s^2 2p^6 2s^1$ (B) $1s^2 2s^2 2p^6 3s^2$ (C) $1s^2 2s^2 2p^6 3s^2 3p^1$ (D) $1s^2 2s^2 2p^6 3s^2 3p^2$

Ans : (B)

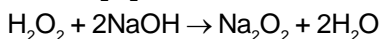
Hint : It is evident that release of 2 electron from the isolated gaseous element shown in option (B) would give rise to highly stable core of Ne. Hence, massive energy is required to remove the 3rd electron

63. Na_2O_2 is produced in reaction between H_2O_2 and NaOH . Here the role of H_2O_2 is

- (A) as an oxidising agent (B) as an acid (C) as a base (D) as a reducing agent

Ans : (B)

Hint : H_2O_2 acts as an acid to produce the salt sodium peroxide from the base NaOH



64. Amongst the following compounds, the one which would not form a white precipitate with ammonical silver nitrate solution is

- (A) $\text{HC} \equiv \text{CH}$ (B) $\text{H}_3\text{C} - \text{C} \equiv \text{C} - \text{CH}_3$ (C) $\text{H}_3\text{C} - \text{C} \equiv \text{CH}$ (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C} \equiv \text{CH}$

Ans : (B)

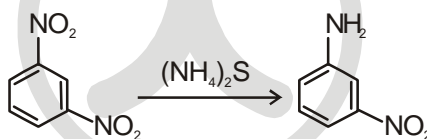
Hint : The structure of but-2-yne shows that there is no acidic hydrogen attached to the sp hybrid carbon atom. Hence no reaction with ammonical AgNO_3 is expected

65. m-dinitrobenzene can be converted to m-nitroaniline by reduction with

- (A) Raney Nickel (B) LiAlH_4 (C) $(\text{NH}_4)_2\text{S}$ (D) $\text{Na/C}_2\text{H}_5\text{OH}$

Ans : (C)

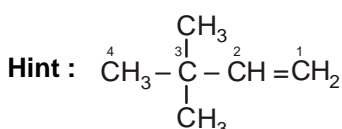
Hint : Ammonium sulphide selectively reduces one- NO_2 to- NH_2 group when two- NO_2 groups are attached to phenyl ring at meta positions.



66. The correct IUPAC name of $\text{H}_3\text{C} - \text{C}(\text{CH}_3)_2 - \text{CH} = \text{CH}_2$ is

- (A) 3, 3, 3-trimethylprop-1-ene (B) 1, 1, 1 trimethyl- α -propene
(C) 3, 3-dimethylbut-1-ene (D) 2, 2-dimethylbut-3-ene

Ans : (C)

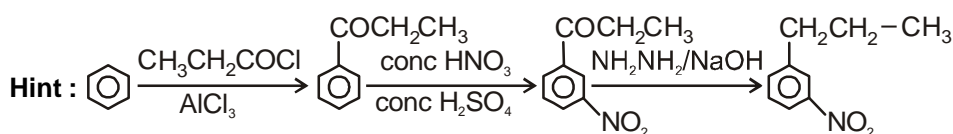


3, 3 - dimethylbut - 1 - ene

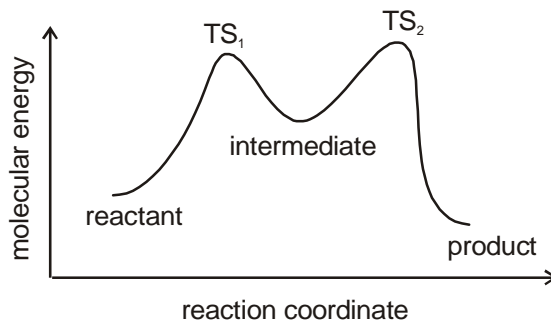
67. Which combination of reagents used in the indicated order will give m-nitropropylbenzene from benzene?

- (A) 1) conc. HNO_3 /conc. H_2SO_4
2) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}/\text{AlCl}_3$
(B) 1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}/\text{AlCl}_3$
2) conc. HNO_3 /conc. H_2SO_4
(C) 1) $\text{CH}_3\text{CH}_2\text{COCl}/\text{AlCl}_3$
2) conc. HNO_3 /conc. H_2SO_4
3) $\text{H}_2\text{NNH}_2/\text{NaOH}$
(D) 1) conc. HNO_3 /conc. H_2SO_4
2) $\text{CH}_3\text{CH}_2\text{COCl}/\text{AlCl}_3$
3) $\text{H}_2\text{NNH}_2/\text{NaOH}$

Ans : (C)



68. Which of the statement (A) - (D) about the reaction profile below is false?



- (A) The product is more stable than the reactant
 (B) The second step is rate determining
 (C) The reaction is exothermic
 (D) The equilibrium constant is greater than 1 if the molar entropy change is negligible

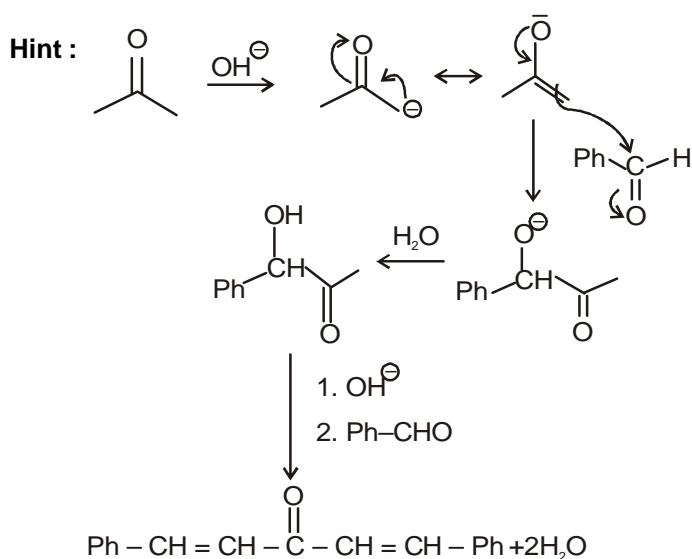
Ans : (B)

Hint : The second step is fast step due to low E_a

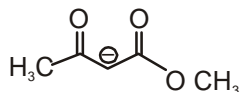
69. Which of the following is the major product when one mole of propanone and two moles of benzaldehyde react in presence of catalytic amount of NaOH?

- (A)  (B) 
 (C)  (D) 

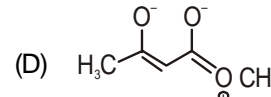
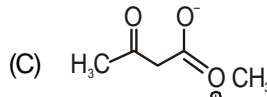
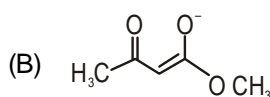
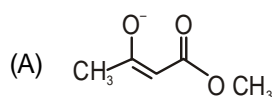
Ans : (D)



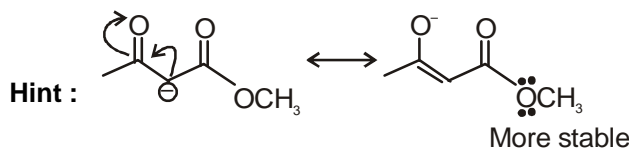
70. For the following anion,



the resonance structure that contributes most is



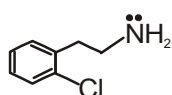
Ans : (A)



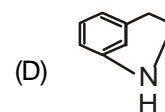
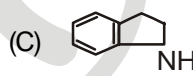
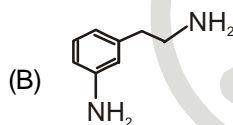
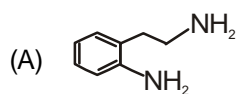
CATEGORY - II (Q71 to Q75)

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.

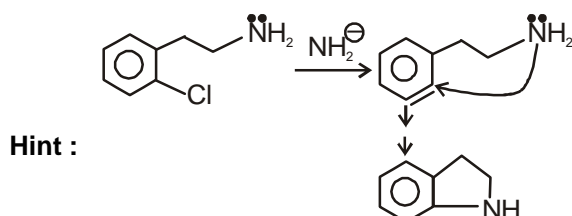
71. The major product obtained upon treatment of



with NaNH_2 and liquid NH_3 is



Ans : (C)



72. Which structure for XeO_3 and XeF_4 are consistent with the VSEPR model?

(A) XeO_3 , trigonal pyramidal; XeF_4 , square planar

(B) XeO_3 , trigonal planar; XeF_4 , square planar

(C) XeO_3 , trigonal pyramidal; XeF_4 , tetrahedral

(D) XeO_3 , trigonal planar; XeF_4 , tetrahedral

Ans : (A)

Hint : XeO_3 ; 3 σ bond and 1 lone pair; sp^3 hybridisation

Shape trigonal pyramidal

XeF_4 ; 4 σ bonds, 2 lone pairs; sp^3d^2 hybridisation

Shape square planar

73. If CO_2 gas is passed through 500 ml of 0.5 (M) Ca(OH)_2 , the amount of CaCO_3 produced is

(A) 10 g

(B) 20 g

(C) 50 g

(D) 25 g

Ans : (D)

Hint : By equating the equivalents

$$\frac{W}{100} \times 2 = \frac{500 \times 0.5 \times 2}{1000}$$

W=25 g (W = mass of CaCO₃)

74. The emf of a Daniel cell at 298 K is E₁. The cell is Zn|ZnSO₄ (0.01M) || CuSO₄ (1M) | Cu

When the concentration of ZnSO₄ is changed to 1M and that of CuSO₄ to 0.01M, the emf changes to E₂. The relationship between E₁ and E₂ will be

- (A) E₁ - E₂ = 0 (B) E₁ < E₂ (C) E₁ > E₂ (D) E₁ = 10²E₂

Ans : (C)

Hint : Zn + CuSO₄ ⇌ ZnSO₄ + Cu

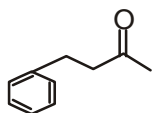
n = 2

$$Q = \frac{Zn^{2+}}{Cu^{2+}}$$

$$E_1 - E_2 = -\frac{0.059}{2} \left(\log \frac{0.01}{1} - \log \frac{1}{0.01} \right) = -\frac{0.059}{2} \left(\log \frac{1}{100} - \log 100 \right) = \frac{0.059}{2} (-\log 100 - \log 100) = +\frac{0.059}{2} \times 2$$

So, E₁ > E₂

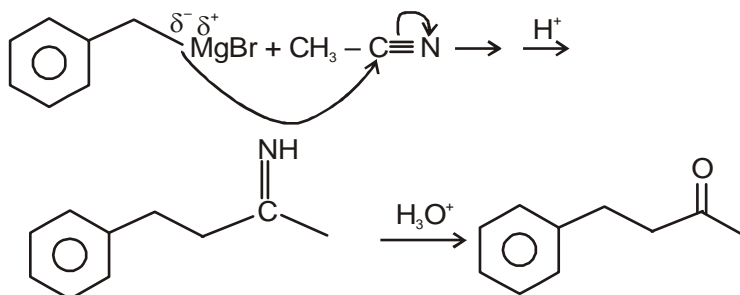
75. Which reaction is not appropriate for the synthesis of the following?



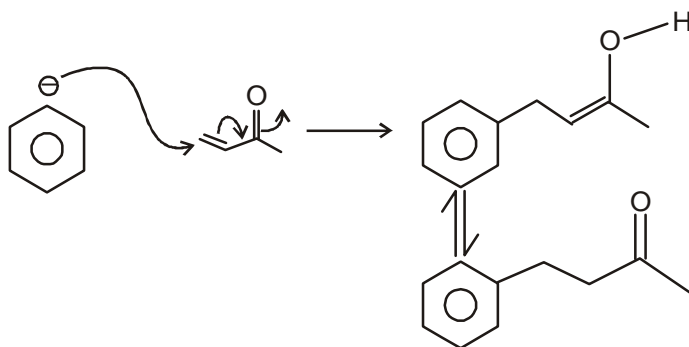
- (A) (B)
- (C) (D)

Ans : (D)

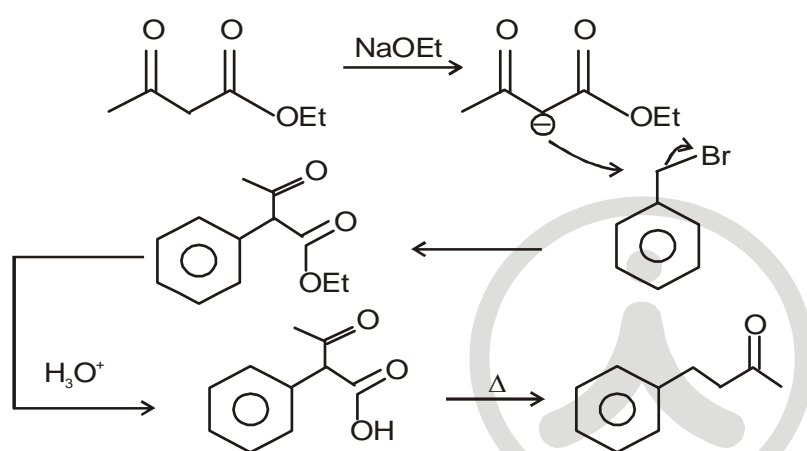
Hint : A) Correct



B) Correct



C) Correct



D) Alkyl Lithium does not undergo 1, 4 addition

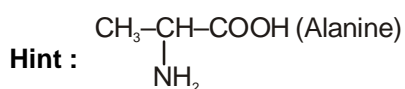
CATEGORY - III (Q76 to Q80)

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 = $2 \times$ number of correct answers marked / actual number of correct answers.

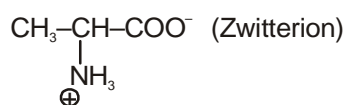
76. Which of the following statements are correct with reference to isoelectric point of alanine?

- (A) At the isoelectric point, alanine bears no net charge
 (B) At the isoelectric point, the concentration of zwitterion is maximum
 (C) It is not the average of pK_{a1} and pK_{a2} value
 (D) Alanine will have a net positive charge at pH below the isoelectric point

Ans : (A, B, D)

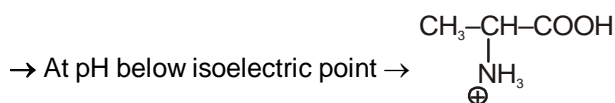


→ At isoelectric point



→ At isoelectric point concentration of zwitterion is maximum

$$\rightarrow \text{pH} = \frac{\text{pK}_{a_1} + \text{pK}_{a_2}}{2} \text{ at isoelectric point}$$



77. Consider the proposed mechanism for the destruction of ozone in the stratosphere



Which of the statements about the mechanism is/are correct?

- (A) Cl is a catalyst
- (B) O₂ is an intermediate
- (C) Equal amounts of Cl and ClO are present at any time
- (D) The number of moles of O₂ produced equals the number of moles of O₃ consumed

Ans : (A,C)

Hint : Cl acts a catalyst

→ Amount of Cl and ClO present at any time are equal

78. Which of the following statements(s) is (are) correct?

- (A) The electronic configuration of Cr (at. no: 24) is [Ar] 3d⁵ 4s¹
- (B) The magnetic quantum number may have a negative value
- (C) In Ag (at. no: 47), 23 electrons have spins of one type and 24 electrons have spins of opposite type
- (D) The oxidation state of nitrogen in HN₃ is -3

Ans : (A,B,C)

Hint : Electronic configuration of Cr → [Ar]3d⁵4s¹

→ Let l = 1, m_l = -1, 0, +1

→ Ag → 1s²2s²2p⁶3s²3p⁶3d¹⁰4s²4p⁶4d¹⁰5s¹

No. of electrons having m_s = + ½ or -½ = 24 and rest 23

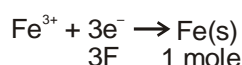
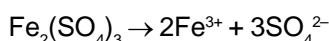
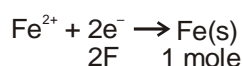
→ oxidation number of N in HN₃ in $-\frac{1}{3}$

79. Equal quantities of electricity are passed through 3 voltameters containing FeSO₄, Fe₂(SO₄)₃ and Fe(NO₃)₃. Consider the following statement:

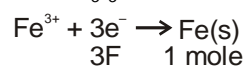
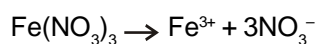
- (1) The amounts of iron deposited in FeSO₄ and Fe₂(SO₄)₃ are equal
- (2) The amount of iron deposited in Fe(NO₃)₃ is 2/3rd of the amount deposited in FeSO₄
- (3) The amount of iron deposited in Fe₂(SO₄)₃ and Fe(NO₃)₃ are equal
- (A) (1) is correct
- (B) (2) is correct
- (C) (3) is correct
- (D) Both (1) and (2) are correct

Ans : (B,D)

Hint : Suppose 2F of electricity passed through FeSO₄, Fe₂(SO₄)₃ and Fe(NO₃)₃ solution



∴ 2F will give = $\frac{2}{3}$ mole

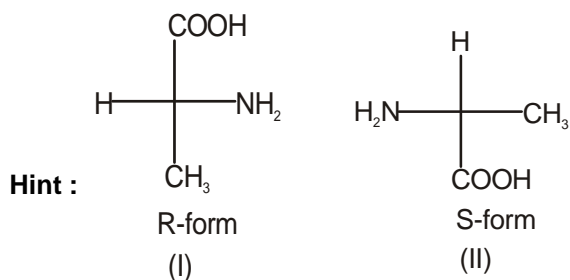


$$\therefore 2F \text{ will give } = \frac{2}{3} \text{ mole}$$

80. Which of the following statements are correct for the following isomeric compounds I and II

- (A) I and II are enantiomers
 (B) I and II are both optically active
 (C) I is D-alanine while II is L-alanine
 (D) I and II are diastereomers

Ans : (A,B,C)



- (I) and (II) are enantiomers
 → (I) and (II) are both optically active
 → (I) is D-alanine while II is L-alanine

