JEE (MAIN)-2025 (Online)

Chemistry Memory Based Answer & Solutions

MORNING SHIFT

DATE : 29-01-2025

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MEMORY BASED QUESTIONS JEE–MAIN EXAMINATION – JANUARY, 2025

(Held On Wednesday 29th January, 2025) TIME : 9 : 00 AM to 12 : 00 PM

CHEMISTRY | TEST PAPER WITH SOLUTION

SECTION-A

1. **Statement I:** Correct order of ionic radius for Mg^{2+}, Na^+, O^{2-} & F^- is $F^- > O^{2-} > Na^+ > Mg^{2+}$.

Statement II: Correct order of magnitude of electron gain enthalpy for 17th group follows order: Cl > F > Br > I (magnitude only)

(1) Statement I and Statement II both are correct.

(2) Statement I is correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement are incorrect.

Ans. **(3)**

Sol. Order of atomic radius $O^{2-} > F^- > Na^+ > Mg^{2+}$

Order of $\lvert\Delta H_{eg}\rvert$ (in kJ/mol)	Cl	>	F	>	Br	>	I
	349		333		325		296

2. Given the following elementary reaction steps:

(i) $A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} C$ (fast)

(ii) $C - \overset{k_2}{\quad} D$ (RDS)

Order of reaction $A + B \longrightarrow D$ is

(1) 1 (2) 1.5

(3) 2 (4) 2.5

Ans. **(3)**

Sol. $\frac{k_1}{k_{-1}} = \frac{[C]}{[B][A]}$

Rate of RDS = Rate of reaction = $k_2[C]$

$$r = \left(\frac{k_1}{k_{-1}}\right) k_2 [A][B]$$

$r = k_{overall}\,[A]\,[B]$

Order of reaction = 1 + 1 = 2

3. Which of the following is the correct order of melting point?

(1) Mn < Fe, Tc < Ru, Re > Os

(2) Mn > Fe, Tc < Ru, Re < Os

(3) Mn < Fe, Tc > Ru, Re < Os

(4) Mn > Fe, Tc > Ru, Re > Os

Ans. **(1)**

Sol.

Element	Melting Point
Mn	1519 K
Fe	1811 K
Tc	2430 K
Re	3460 K
Ru	2607 K
Os	3306 K

4. Consider the following complexes

$[Mn(CN)_6]^{4-}$ (1) $[Fe(CN)_6]^{4-}$ (2) $[Fe(CN)_6]^{3-}$ (3) $[Co(CN)_6]^{3-}$ (4)

Correct order of magnitude of CFSE (Δ_0) will be

(1) 3 > 4 > 2 > 1 (2) 4 > 3 > 2 > 1

(3) 4 > 3 > 1 > 2 (4) 3 > 4 > 1 > 2

Ans. **(2)**

Sol.

$[Co(CN)_6]^{3-} > [Fe(CN)_6]^{3-} > [Fe(CN)_6]^{4-} > [Mn(CN)_6]^{4-}$

(Oxidation number of Central metal atom/ion↑, Δ_o↑)

Also for same oxidation state, Δ_o is to be calculated

$\Delta_o = n_{t_{2g}}(-0.4\Delta_o) + n_{eg}(+0.6\Delta_o) + x.P$

Where, $n_{t_{2g}}$ and n_{eg} are number of electrons in t_{2g} and e_g respectively

x = Number of forced pair(s)

p = Pairing energy

5. Match the following List-I with List-II.

	List-I		List-II
(A)	$[Co(ox)_3]^{3-}$	(i)	sp^3d^2 Paramagnetic
(B)	$[FeF_6]^{3-}$	(ii)	d^2sp^3 Diamagnetic
(C)	$[Ni(CO)_4]$	(iii)	dsp^2 Diamagnetic
(D)	$[PtCl_4]^{2-}$	(iv)	sp^3 Diamagnetic

(1) A–(i), B–(ii), C–(iii), D–(iv)

(2) A–(ii), B–(i), C–(iii), D–(iv)

(3) A–(i), B–(ii), C–(iv), D–(iii)

(4) A–(ii), B–(i), C–(iv), D–(iii)

Ans. **(4)**

Sol.

(A)	$[Co(ox)_3]^{3-}$	d^2sp^3 Diamagnetic
(B)	$[FeF_6]^{3-}$	sp^3d^2 Paramagnetic
(C)	$[Ni(CO)_4]$	sp^3 Diamagnetic
(D)	$[PtCl_4]^{2-}$	dsp^2 Diamagnetic

6. Given : $E^{\circ}_{Ag^+/Ag}$

$E^{\circ}_{Mg^{2+}/Mg}$

Which is the correct representation of cell potential of

$Mg(s) \mid Mg^{2+}(aq) \parallel Ag^{+}(aq) \mid Ag(s)$

(1) $E^{\circ}_{cell} - \frac{0.059}{2}\log\frac{[Ag^+]^2}{[Mg^{2+}]}$

(2) $E^{\circ}_{cell} - \frac{0.059}{2}\log\frac{[Ag^+]}{[Mg^{2+}]}$

(3) $E^{\circ}_{cell} - \frac{0.059}{2}\log\frac{[Mg^{2+}]}{[Ag^+]^2}$

(4) $E^{\circ}_{cell} - \frac{0.059}{2}\log\frac{[Mg^{2+}]}{[Ag^+]}$

Ans. **(3)**

Sol. Cell reaction is

$Mg(s) + 2Ag^{+}(aq) \rightarrow Mg^{2+}(aq) + 2Ag(s)$

Nernst equation

$$E_{cell} = E^{o}_{Cell} - \frac{0.059}{2}\log\frac{\left[Mg^{2+}\right]}{\left[Ag^{+}\right]^2}$$

7. What is the value of Van't Hoff Factor for A_2B. if the percentage dissociation is 30% ?

(1) 1.60 (2) 1.30

(3) 1.50 (4) 1.20

Ans. **(1)**

Sol. $i = 1 + (n - 1)\,\alpha$

For A_2B $n = 3$

Given $\alpha = 0.3$

$i = 1 + (3 - 1)\,0.3$

$i = 1.6$

8. 1/2 mole of Ar gas kept in a closed vessel at 298 K & 1 atm absorbs 500 J heat. Final temperature of gas & change in internal energy is (R = 8.3 J/mol-K)

(1) 346 K, 300 J (2) 346 K, 500 J

(3) 398 K, 500 J (4) 378 K, 300 J

Ans. **(1)**

Sol. $q_p = nC_{p,m}\,\Delta_T$

$$500 = \frac{1}{2}\times\frac{5}{2}R\times\Delta T$$

$\Delta T \approx 48$ K

$T_f = 48 + 298 = 346$

$$q_v = \frac{1}{2}\times\frac{3}{2}\times 8.3\times 48$$

$q_v = \Delta U = 300$ J

9. Degree of dissociation of $AB_2(g)$ into A_2 and B_2 in α.

Total equilibrium pressure = P.

Equilibrium constant of the reaction = K_P.

Correct option is — (α is negligible as compared to unity)

(1) $\left(\frac{2.K_p^2}{P}\right)^{\frac{1}{3}}$ (2) $\left(\frac{4.K_p^3}{P}\right)^{\frac{1}{3}}$

(3) $\left(\frac{K_p^2}{2P}\right)^{\frac{2}{3}}$ (4) $\left(\frac{2.K_p}{P}\right)^{\frac{1}{3}}$

Ans. **(1)**

Sol.

	$AB_2(g)$	$\rightarrow \frac{1}{2}A_2(g)$	+ $B_2(g)$
$t = 0$	1	0	0
$t = t_{eq}$	1-α	$\frac{\alpha}{2}$	α

Total no. of moles at equilibrium = $1-\alpha+\frac{\alpha}{2}+\alpha$

$= (1 + \frac{\alpha}{2}) \approx 1$

$$\text{Now, } kp = \frac{(P_A)^{1/2}.(P_B)}{P_{AB_2}} = \frac{\left(\frac{\alpha}{2}P\right)^{1/2}\times(\alpha\times P)}{\left(\frac{1-\alpha}{1}\times P\right)}$$

$$\Rightarrow k_p = \frac{\alpha^{3/2}\times P^{1/2}}{\sqrt{2}}$$

$$\Rightarrow \alpha^{3/2} = \frac{\sqrt{2}\cdot k_P}{(P)^{1/2}}$$

$$\Rightarrow \alpha = \frac{(2)^{1/3}\times(k_p)^{2/3}}{(P)^{1/3}} = \left(\frac{2\times k_p^2}{P}\right)^{1/3}$$

10. Λ_m v/s $\sqrt{c}$ graph is given with negative slope for an electrolyte, Then molar conductance for the same electrolyte at infinite dilution shows-

(1) Small increase (2) Small decrease

(3) Sharp increase (4) Sharp decrease

Ans. **(1)**

Sol. λ_m V/S $\sqrt{C}$ graph is linear with negative slope for an electrolyte $\Rightarrow$ strong electrolyte.

Then molar conductance for the same electrolyte at infinite dilution show small increase.

11. Given ionisation enthalpy of element E(g) is 300 kJ/mol and electron gain enthalpy of A, B, C and D gaseous atoms are –320 kJ/mol, –340 kJ/mol, –200 kJ/mol and –250 kJ/mol respectively, then what will be the correct order of ionic nature of compounds?

(1) EB > EA > ED > EC

(2) EB > EA > EC > ED

(3) EC > ED > EA > EB

(4) EC > ED > EB > EA

Ans. **(1)**

Sol. Condition for ionic bond:

(i) Low ionisation enthalpy

(ii) High electron affinity

EA: order → B > A > D > C

12. Which of the following ions is strongest oxidizing agent

Given:

$$E^{\circ}_{Al^{3+}/Al} = -2.7V$$

$$E^{\circ}_{Cu^{2+}/Cu} = 0.34V$$

$$E^{\circ}_{Pb^{4+}/Pb^{2+}} = 1.8V$$

$$E^{\circ}_{Ti^{3+}/Ti} = -1.21V$$

(1) Al^{3+} (2) Cu^{2+}

(3) Pb^{4+} (4) Ti^{3+}

Ans. **(3)**

Sol. $E^{\circ}_{Pb^{4+}/Pb^{+2}} = +1.8V$

The element with the highest reduction potential is considered the strongest oxidising agent.

13. If radius of first Bohr's orbit of H-atom is a_0. Then find the radius of 2nd Bohr's orbit of H-atom.

(1) $8a_0$ (2) $4a_0$

(3) $2a_0$ (4) $6a_0$

Ans. **(2)**

Sol. $r = a_o \times \frac{n^2}{Z}$

$n = 2, Z = 1$

$r = a_o \times \frac{2^2}{1}$

$r = 4a_o$

14. Which of the following is animal starch?

(1) Glycogen

(2) Lactose

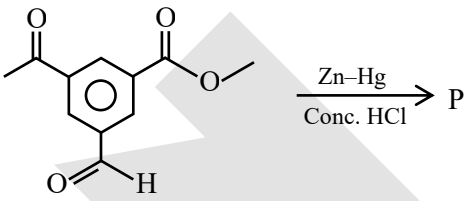
(3) Amylopectin

(4) Amylose

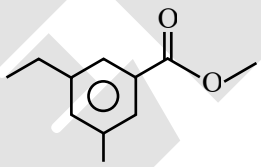
Ans. **(1)**

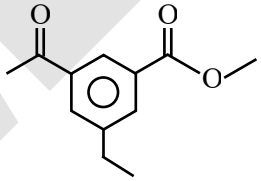
Sol. Glycogen is stored in liver which is called animal starch.

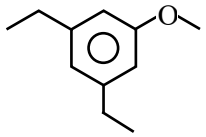
15. Consider the following reaction

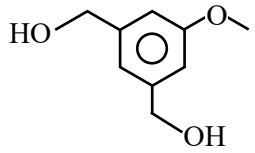


Identify the final product P.

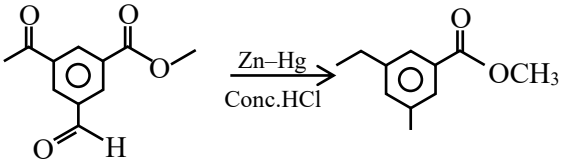
(1) 

(2) 

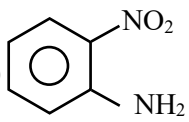
(3) 

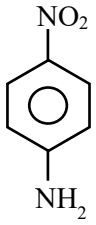
(4) 

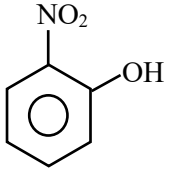
Ans. **(1)**

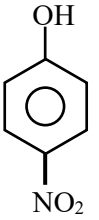
Sol. 

16. Which of the following compounds are steam volatile?

(A) 

(B) 

(C) 

(D) 

(1) A & B (2) A & C

(3) C & D (4) B & D

Ans. **(2)**

Sol. Due to intramolecular H-Bonding in orthonitrophenol, boiling point decreases and due to intermolecular H-Bonding in paranitrophenol, boiling point increases.

They are steam volatile.

17. Match the following column and choose the correct option.

Column-I		**Column-II**	
(A)	Cellulose	(P)	α-1,6-linkage (animal starch)
(B)	Amylopectin	(Q)	α-1,4-linkage
(C)	Maltose	(R)	β-1,4-linkage
(D)	Glycogen	(S)	α-1,6-linkage (Plant starch)

(1) A–(S), B–(R), C–(Q), D–(P)

(2) A–(S), B–(R), C–(P), D–(Q)

(3) A–(R), B–(S), C–(Q), D–(P)

(4) A–(R), B–(Q), C–(S), D–(P)

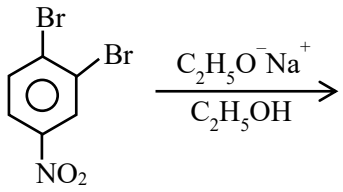
Ans. **(3)**

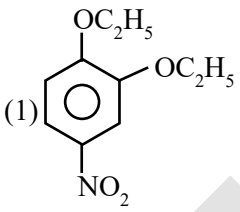
Sol. (A) Cellulose : β-1,4-linkage

(B) Amylopectin : α-1,6-linkage (Plant starch)

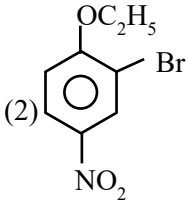
(C) Maltose : α-1,4-linkage

(D) Glycogen : α-1,6-linkage (animal starch)

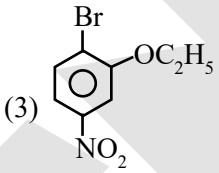
18. 



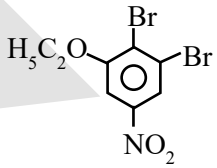
(1)



(2)

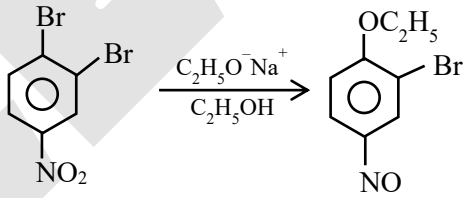


(3)



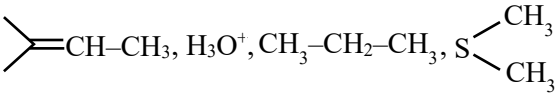
(4)

Ans. **(2)**

Sol. 

19. How many of following species can act as nucleophile?

$Ph–SH$, OH^-, $CH_2 = CH_2$,



(1) 5

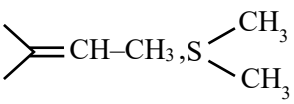
(2) 6

(3) 7

(4) 4

Ans. **(5)**

Sol. Nucleophile = $Ph–SH$, OH^-, $CH_2 = CH_2$,



SECTION-B

1. Chromite ore + Na_2CO_3 + O_2 → Insoluble product containing Fe. Give the molar mass of insoluble product formed. (Given : Molar mass of Cr = 52 g/mol, Na = 23 g/mol, Fe = 56 g/mol, O = 16 g/mol)

Ans. **(160)**

Sol. $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2\uparrow$

(Chromite ore) (Insoluble)

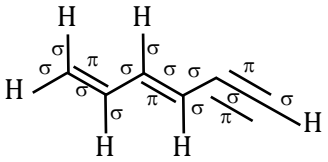
Molar mass of Fe_2O_3 : $56 \times 2 + 16 \times 3 = 160$ g mol^{-1}

2. Calculate the total number of σ and p bond in the given molecule?

Hex-1,3-dien-5-yne

Ans. **(15)**

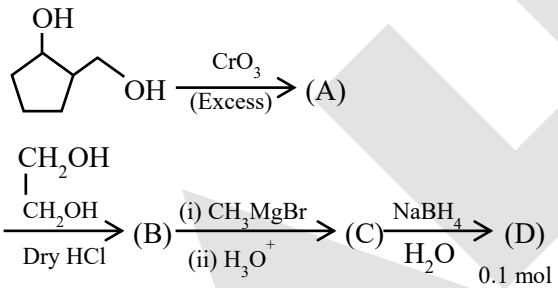
Sol.



Total number of σ-bond = 11

Total number of π-bond = 4

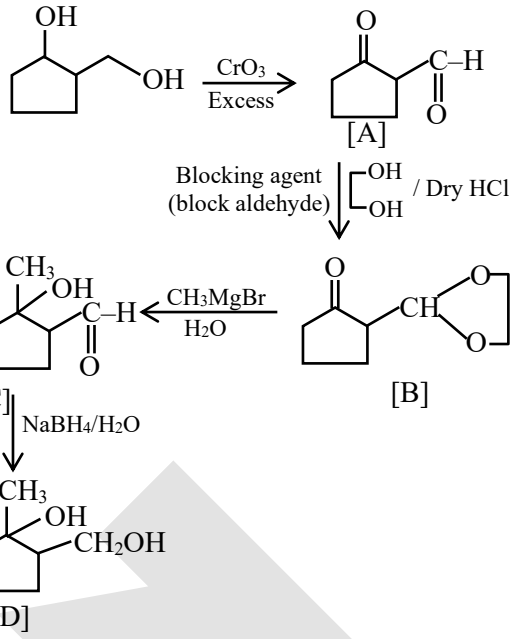
3. Consider the following reaction



Find the mass of final product(D) formed in gm (nearest integer)

Ans. **(13)**

Sol.

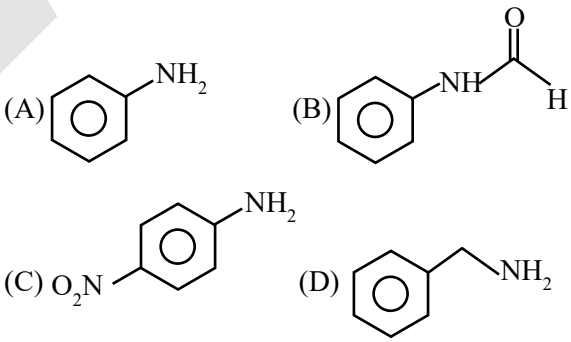


Molecular weight of compound (D) = 130 gm/mole

Mole of compound (D) = 0.1

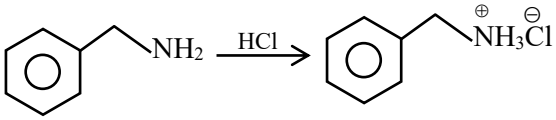
mass of final product (D) = 0.1 × 130 = 13gm

4. One gram of the most basic compound(among the following) reacts with HCl. The mass of HCl consumed in mg is(give your answer as nearest integer):



Ans. **(341)**

Sol.



Mass = 1gm

Mole = $\frac{1}{107}$

Mole of HCl used = $\frac{1}{107}$

Mass of HCl used = $\frac{1}{107} \times 36.5 = 0.341$gm

= 341mg