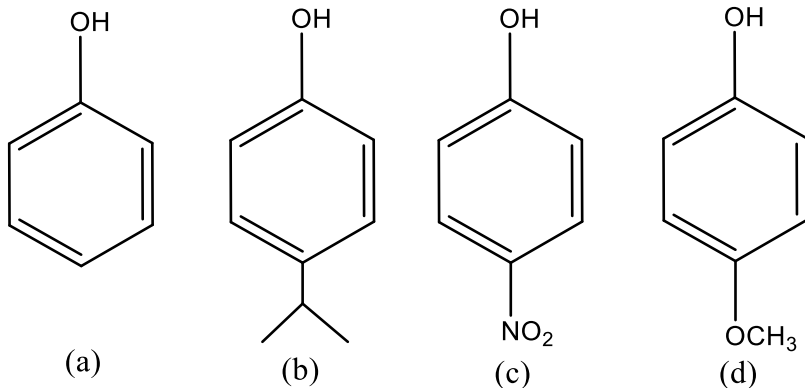**JEE Main 2023 (Memory based)**

30 January 2023 - Shift 2

Answer & Solutions

CHEMISTRY

1. The correct order of acidic strength of the following compounds
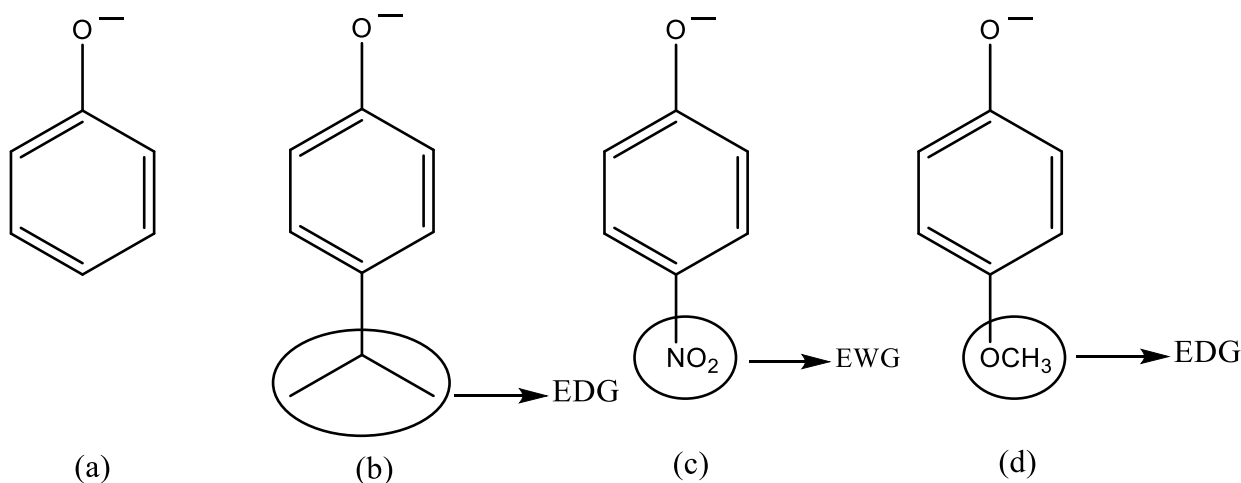

(a)   (b)   (c)   (d)

A.   a > b > c > d

B.   c > a > b > d

C.   d > c > b > a

D.   c > b > a > d

Answer (B)

Solution:

Acidic character stability of conjugate base,

Let's see conjugate base the given molecules.

(a)   (b)   (c)   (d)

Stability of conjugate base increases due to the presence of electron withdrawing group (EWG) on the aromatic ring. Similarly, stability of conjugate base decreases in the presence of electron donating group (EDG).

The presence of -NO_2 (EWG) in (c) makes it most acidic.

Comparing (a) (b) and (c), absence of EDG in (a) makes it more acidic than others.

Although (b) and (d) have electron donating group, since +M effect in (d) is more powerful than the hyperconjugation effect in (b), makes (b) more acidic than (d).
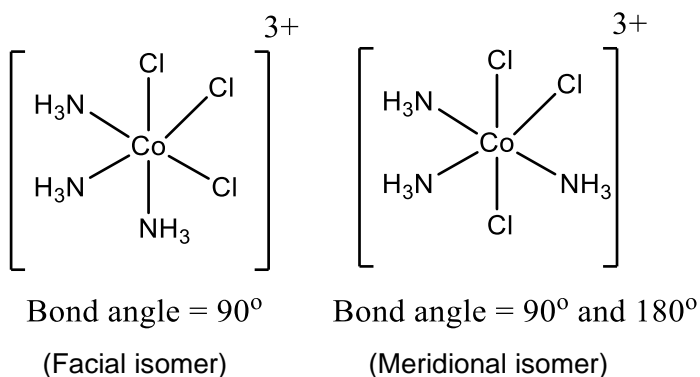
The correct acidic order is: c > a > b > d

**2.** What is the $Cl - Co - Cl$ bond angle in $[Co(NH_3)_3Cl_3]$

A. $20^o \ and \ 90^o$

B. $90^o \ and \ 180^o$

C. 90°

D. 180°

Answer (B)

Solution: Since $[Co(NH_3)_3Cl_3]$ has 6 ligands, the structure octahedral structure. The molecule is of type [MA₃B₃], thus, it has two geometrical isomers namely facial and meridional isomers.

Bond angle = 90⁰   Bond angle = 90⁰ and 180⁰

(Facial isomer)   (Meridional isomer)

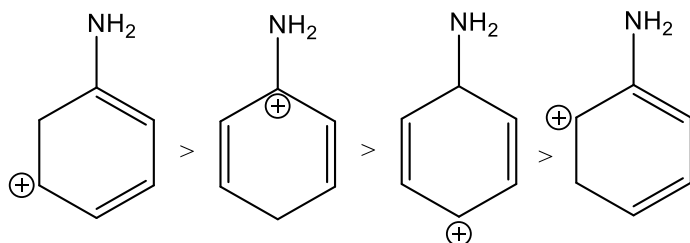**3.** The correct order of decreasing stability of the following compounds is
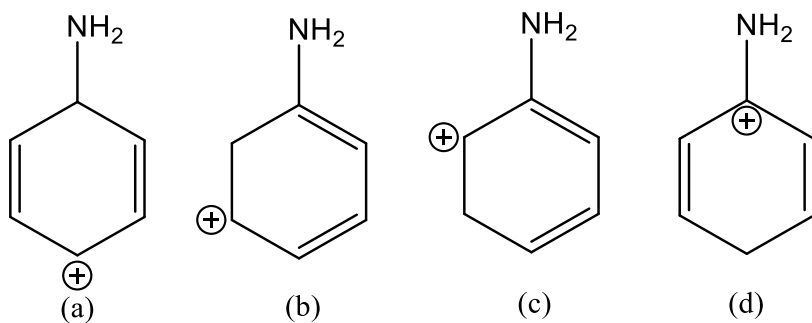
A. a > b > c > d

B. d > b > c > a
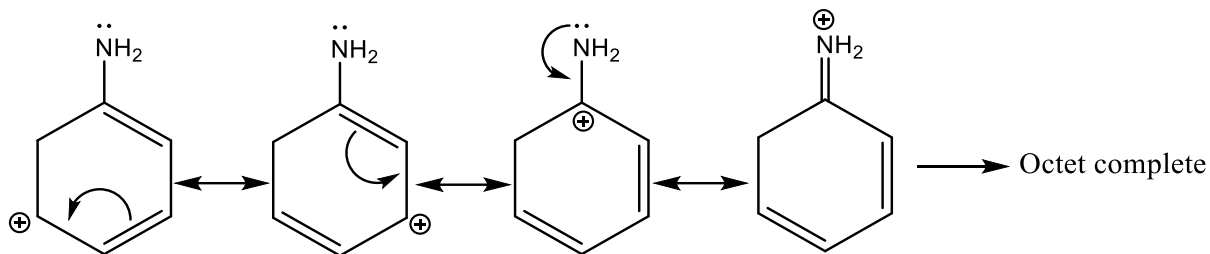
C. b > d > a > c

D. b > a > d > c

Answer (C)

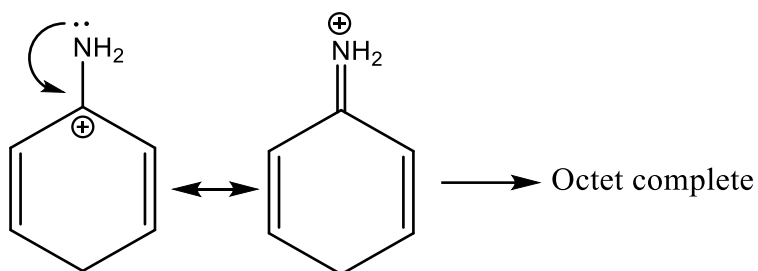**Solution:**

The correct acidic order is

In (b) conjugated alkenes as well as +ve charge will be next to nitrogen in one of its resonating structure due to Which completion of octet of every atom (Duplet of hydrogen) is seen.

(b)

Octet complete

(d)

Octet complete

But in (a) and (c) only resonance is seen and no completion of octet.

In (c) +ve charge is next to NH_2 group which shows -I effect.

4. Which of the following is correct order of S_N1 reaction
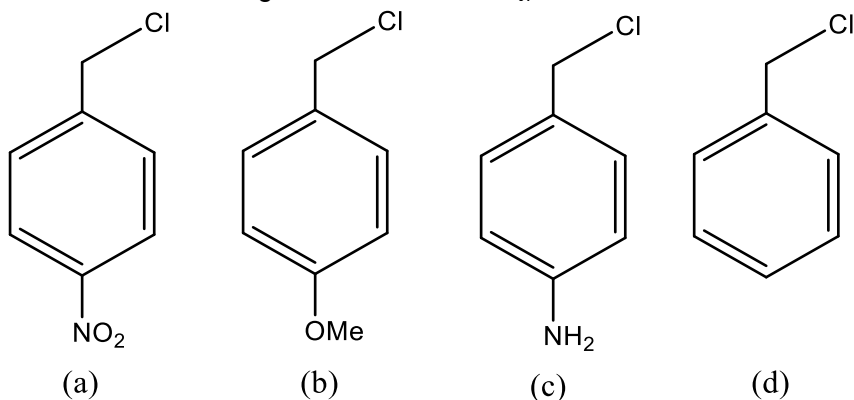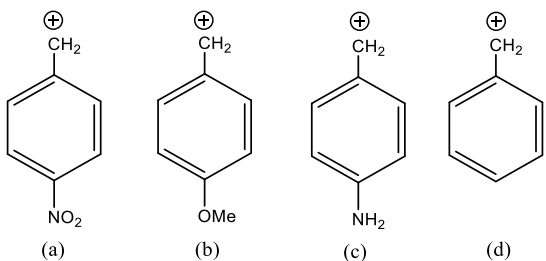

A. a > b > c > d

B. c > b > d > a

C. c > a > b > d

D. d > a > b > c

Answer (B)

Solution:

The reactivity order of the given aryl halides towards S_N1 reaction will be decided by the stability of their corresponding carbocations.

The benzyl carbocation is stabilized by resonance. The presence of $-NH_2$ group at the p – position promotes the resonance due to +R effect. The -OMe group also promotes but to a lesser extent due to higher electronegativity of O – atom than N – atom. The $-NO_2$ group opposes the resonance stabilization due to its -R effect.

Therefore, the correct order is c > b > d > a.

5. Statement 1: Antihistamines prevent the secretion of acid in the stomach
    Statement 2: Antiallergic and antacid work on same receptors

    A. Statement 1 is correct and Statement 2 is incorrect
    B. Statement 1 and Statement 2 both are correct
    C. Statement 1 is incorrect and Statement 2 is correct
    D. Statement 1 and Statement 2 both are incorrect

Answer (D)

Solution:

Antihistamines do not affect the secretion of acid in stomach. Antiallergic and antacid drugs work on different receptors.

Therefore, both the statements are incorrect.

6. Statement 1: During Hall-Heroult process, mixing of CaF_2 and Na_3AlF_6 decreases the M.P. of Al_2O_3
    Statement 2: During electrolytic refining, anode is pure and cathode is impure.

    A. Statement 1 is correct and Statement 2 is incorrect
    B. Statement 1 is correct and Statement 2 is incorrect
    C. Statement 1 and Statement 2 both are incorrect
    D. Statement 1 is incorrect and Statement 2 is correct

Answer (B)

Solution:

Mixture of CaF_2 and Na_3AlF_6 decreases the melting point of Al_2O_3. During electrolytic refining of alumina (Al_2O_3) impure metal is taken in anode and pure metal in cathode. At the end of the process, impurities get deposited below anode as anode mud.

7. 1 mole of gas undergoes adiabatic process, given that
    $C_v = 20 \, JKmol^{-1}, W = 3 \, KJ, T_1 = 27^oC, T_2 =?$

Answer (177)

Solution:

$$W = nC_v(T_2 - T_1)$$
$$3000 = 1 \times 20 \times (T_2 - 300)$$
$$150 = (T_2 - 300)$$
$$T_2 = 450K$$
$$T_2 = 177^oC$$

8. Volume strength of H_2O_2 solution is 60. Strength of solution in _____ g/L (round of to the nearest integer)

Answer (182)

Solution:

Volume strength of H_2O_2 = 60 Volume

Molarity of H_2O_2 solution = $\frac{60}{11.2} M$

Strength of H_2O_2 solution = $\frac{60 \times 34}{11.2}$

$= 182.14 \ g/L$

$\approx 182 \ g/L$

9. For 1st order reaction, 540 s takes for 60% completion, and the time taken for 90% completion is 1.35 x 10^x s. Find x. (log4 = 0.6)

Answer (3)

Solution:

$$\frac{t_{90}}{t_{60}} = \frac{\log\frac{100}{100-90}}{\log\frac{100}{100-60}} = \frac{1}{\frac{\log 10}{4}} = \frac{1}{1-0.6} = \frac{1}{0.4}$$

$$t_{90} = \frac{540}{0.4} = 1350 \ sec$$

$$1350 = 1.35 \times 10^x$$

x = 3

10. Find the number of formula units of FeO per unit cell. Given that: density = 4 g/cm³ , $a = 5A^o$, $N_A = 6 \times 10^{23}$

Answer (4)

Solution:

$$\text{Density} = \frac{ZM}{N_A \ X \ a^3} \Rightarrow Z = \frac{density \times N_A \times a^3}{M}$$

$$= \frac{4 \times 6.0 \times 10^{23} \times (5 \times 10^{-8})^3}{(56+16)}$$

$$= \frac{4 \times 6 \times 125 \times 10^{-1}}{72}$$

$$= 4.16$$

11. Maximum no. of e⁻ in n = 4 shell is

A. 72
B. 50
C. 16
D. 32

Answer (D)

Solution:

Maximum number of e⁻ in a shell = 2n²

$$= 2(4)^2$$
$$= 32$$

12. BOD value of a water sample is 3 ppm. Select the correct option about the given sample of water.

A. It is highly polluted water
B. It is clear water

C. Concentration of oxygen in the given sample is very less

D. None of these

Answer (B)

Solution:

The given sample of water is clean water as BOD value of clean water ranges between 3 to 5.

13. Which of the following chloride is more soluble in organic solvent?

A. Be

B. K

C. Ca

D. Mg

Answer (A)

Solution:

Out of the given elements, the chlorides of K and Ca are largely ionic. So, they will be more soluble in water and less soluble in organic solvents. $BeCl_2$ has higher covalent character than $MgCl_2$. Therefore, $BeCl_2$ is more soluble in organic solvents than $MgCl_2$.

14. The correct order of bond strength of H_2O, H_2S, H_2Se, H_2Te

A. $H_2O > H_2S > H_2Se > H_2Te$

B. $H_2S > H_2O > H_2Se > H_2Te$

C. $H_2Te > H_2Se > H_2S > H_2O$

D. $H_2Te > H_2S > H_2O > H_2Se$

Answer (A)

Solution:

As moving down in the hydrides of 16th group elements, the bond length between central atom and hydrogen increases and the bond strength decreases. Therefore, the correct order of bond strength is $H_2O > H_2S > H_2Se > H_2Te$

15. Lead storage battery have 38% (w/w) H_2SO_4. Find the temperature at which the liquid of battery will freeze (i = 2.67) ; K_f of water = 1.86 $\frac{K.kg}{mol}$

A. -3.1°C

B. -31°C

C. -0.31°C

D. -0.031°C

Answer (B)

Solution:

$\Delta T_f = i \times K_f \times m$

$= 2.67 \times 1.86 \times m$

$m = \frac{38 \times 1000}{98 \times 62} = 6.25$

$\Delta T_f = 2.67 \times 1.86 \times 6.25$

$= 31.06°C$

Freezing point $= 31.06°C$

$\approx -31°C$

16. $KMnO_4$ oxidises I⁻ in acidic and neutral medium in which form respectively.

    A. IO_3^-/IO^-

    B. IO_3^-/IO_3^-

    C. IO_3^-/I_3^-

    D. I_2/IO_3^-

Answer (D)

Solution:

In acidic medium:
$$10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$$

In neutral medium:
$$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$
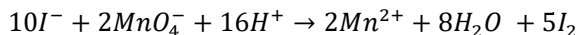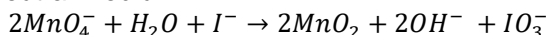
I⁻ Converts to I_2 in acidic medium and converts to IO_3^- in neutral medium.

17. Which of the following equation is correct?
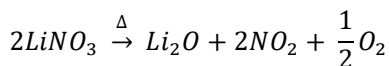   1) $LiNO_3 \rightarrow Li + NO_2 + O_2$
    2) $LiNO_3 \rightarrow LiNO_2 + O_2$
    3) $LiNO_3 \rightarrow Li_2O + NO_2 + O_2$
    4) $LiNO_3 \rightarrow Li_2O + N_2O_4 + O_2$

    A. 1

    B. 2

    C. 3

    D. 4

Answer (C)

Solution:

$LiNO_3$ is thermally unstable. It decomposes to give lithium oxide, nitrogen dioxide and oxygen.

$$2LiNO_3 \xrightarrow{\Delta} Li_2O + 2NO_2 + \frac{1}{2}O_2$$

    =

18. The option containing the correct match is given as :

List - I	List - II
A. Ni(CO)₄	i. sp³
B. [Ni(CN)₄]²⁻	ii. sp³d²
C. [Cu(H₂O)₆]²⁺	iii. d²sp³
D. [Fe(CN)₆]⁴⁻	iv. dsp²

    A. (A)-(i) ; (B)-(iv) ; (C)-(ii) ; (D)-(iii)

    B. (A)-(iii) ; (B)-(ii) ; (C)-(iv) ; (D)-(i)

    C. (A)-(ii) ; (B)-(iii) ; (C)-(iv) ; (D)-(i)

    D. (A)-(iv) ; (B)-(ii) ; (C)-(i) ; (D)-(iii)

Answer (A)

Solution:

	Coordination complex	Number of ligands	Oxidation state of central metal	Type of ligand	Hybridisation
A.	$Ni(CO)_4$	4	0	Strong field	sp^3
B.	$[Ni(CN)_4]^{2-}$	4	+2	Strong field	dsp^2
C.	$[Cu(H_2O)_6]^{2+}$	6	+2	Weak field	sp^3d^2
D.	$[Fe(CN)_6]^{4-}$	6	+2	Strong field	d^2sp^3

19. Nessler's Reagent is

A. $K_2[HgI_4]$

B. $K_3[HgI_4]$

C. Hg_2I_2

D. HgI_2

Answer (A)
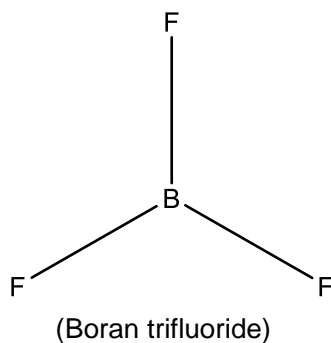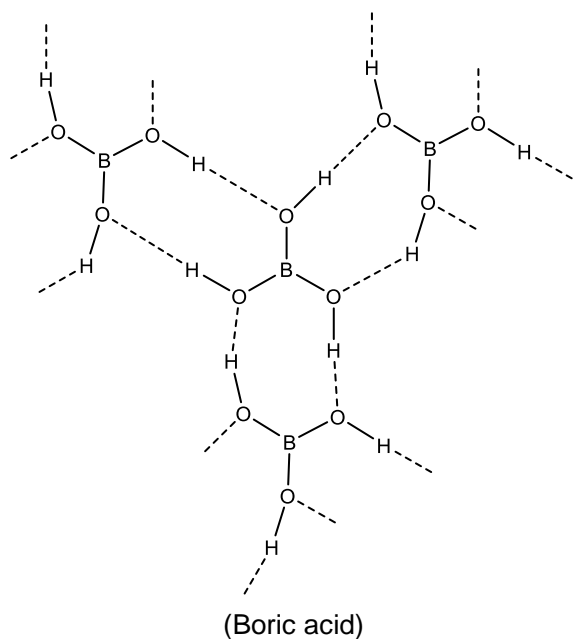
Solution:

Nessler's Reagent is $K_2[HgI_4]$.

20. Boric acid is present in solid state while BF_3 is gas at room temperature, because of?

A. Hydrogen bonding is present in boric acid

B. Boric acid has more molar mass as compared to BF_3
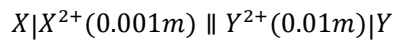
C. BF_3 is polymeric in nature

D. Both (B) and (C)

Answer (A)

Solution:

Due to H-bonding boric acid is solid at room temperature.

(Boric acid)   (Boran trifluoride)

21. For the given electrochemical cell,

$$X|X^{2+}(0.001m) \parallel Y^{2+}(0.01m)|Y$$

at $298k$

$E^o_{X^{2+}/X} = -0.76$

$E^o_{Y^{2+}/Y} = +0.34$

$\dfrac{2.303RT}{F} = 0.06$

If $E_{cell} = t$, find $5t$ (closest Integer)

Answer (6)

Solution:

$$E_{cell} = E^O_{cell} - \frac{0.06}{2} \times \log\frac{10^{-3}}{10^{-2}}$$

$$= 1.10 - 0.03 \times (-1)$$

$$= 1.10 + 0.03$$

$t = 1.13\,V$

$5t = 5.65$

The nearest integer is 6.