CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Molecular orbital σ* is represented by

(1) $\psi_A + \psi_B$ (2) $\psi_A - \psi_B$

(3) $\psi_A - 2\psi_B$ (4) $\psi_A + 2\psi_B$

Answer (2)

Sol. σ* is antibonding molecular orbital which is represented by $(\psi_A - \psi_B)$

2. Consider the given reaction :

$$Cr_2O_7^{2-} \rightleftharpoons CrO_4^{2-}$$

Above reaction shifts in forward direction in

(1) Acidic medium

(2) Basic medium

(3) Neutral medium

(4) Slightly acidic medium

Answer (2)

Sol. $H_2O + Cr_2O_7^{2-} \rightleftharpoons 2CrO_4^{2-} + 2H^+$

As per Le-Chatelier's principle, reaction will shift in forward direction in basic medium.

3. Select the correct options

Statement 1 : Benzene sulphonyl chloride reacts with 1^0, 2^0 and 3^0 amines

Statement 2 : All products of the reaction above are soluble in NaOH

(1) Statement 1 is true, statement 2 is false

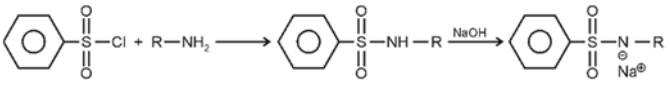
(2) Statement 1 is false, statement 2 is true

(3) Statement 1 and statement 2 both are true

(4) Statement 1 and statement 2 both are false

Answer (4)

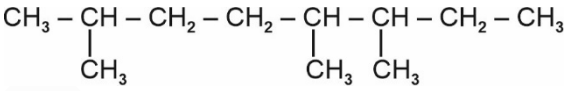
Sol.



1° and 2° amines reacts with benzene sulphonyl chloride.

Product of 1^0 amine only is soluble in NaOH

4. Consider the following compound :



What is IUPAC nomenclature of above compound?

(1) 2, 5, 6-trimethyloctane

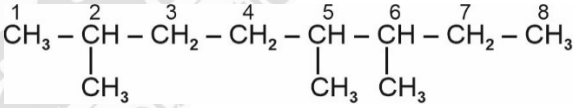
(2) 3, 4, 7-trimethyloctane

(3) 2, 4-ethyl, 3-methyloctane

(4) isopropyl hexane

Answer (1)

Sol.



2, 5, 6-trimethyloctane

5. Which of the following are aromatic compounds?

(1) Only (i) and (ii)

(2) Only (ii) and (iii)

(3) Only (i) and (iii)

(4) All are aromatic

Answer (2)

Sol. (ii) and (iii) are aromatic because they have 4n + 2 π electrons in cyclic resonance or say follow Huckel's rule while in case of (i) resonance is absent.

(ii) and (iii) both are having 6 π electrons in cyclic resonance.

6. If de-Broglie wavelength of electron is equal to de-Broglie of proton. What is the relation between their kinetic energy?

(1) $KE_e > KE_p$

(2) $KE_p > KE_e$

(3) $KE_e = KE_p$

(4) $2KE_e = KE_p$

Answer (1)

Sol. $\lambda_e = \lambda_p$

$\Rightarrow (m \cdot KE)_e = (m \cdot KE)_p$

$\Rightarrow m_e < m_p$

$(KE)_e > (KE)_p$

7. 1 mole of ethylene glycol is dissolved in 9 mol of water. Calculate the mass percentage of ethylene glycol in the resulting solution.

(1) 27.67%

(2) 38.27%

(3) 22.3%

(4) 31.2%

Answer (1)

Sol. Mass of ethylene glycol = 1 × 62 = 62 g

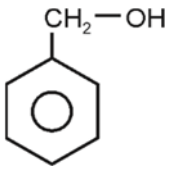
Mass of water = 9 × 18 = 162 g

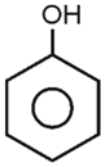
Therefore, % by mass of ethylene glycol

$$= \frac{62}{62+162} \times 100$$

= 27.67%

8. Which of the following reacts with NaOH with maximum rate?

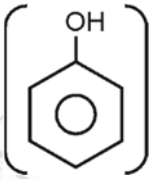
(1) 

(2) 

(3) $CH_3—CH_2—OH$

(4) $CH_3—OH$

Answer (2)

Sol. More the acidic molecule, faster will be reaction with NaOH. Phenol  is most acidic in the given options

9. Which of the following is correct?

(1) Non-metals are generally more electronegative than metals

(2) Non-metallic oxides are generally basic

(3) Metallic oxides are generally acidic or neutral

(4) Non-metallic have always lower ionisation enthalpy than metals

Answer (1)

Sol. EN order:

(Non-metals) > metals

Non-metallic oxides are generally acidic

Metallic oxides are generally basic

10. Consider the following reaction sequence involving first order reactions :

$A \xrightarrow{k_1} B \xrightarrow{k_2} C$

If net rate of formation of B is zero, what would be concentration of B in terms of concentration of A?

(1) $k_1k_2[A]$

(2) $\frac{k_1}{k_2}[A]$

(3) $(k_1 + k_2)[A]$

(4) $\frac{k_2}{k_1}[A]$

Answer (2)

Sol. $A \xrightarrow[r_1]{k_1} B \xrightarrow[r_2]{k_2} C$

Net rate of formation of B, $\frac{d[B]}{dt} = r_1 - r_2$

$$\frac{d[B]}{dt} = k_1[A] - k_2[B] = 0$$

$$\Rightarrow [B] = \frac{k_1[A]}{k_2}$$

11. What is the correct acidic strength order of the following acids?

HCOOH, CH_3COOH, CH_3CH_2COOH, $CH_3CH_2\ CH_2COOH$

(1) HCOOH < CH_3COOH < CH_3CH_2COOH < $CH_3CH_2CH_2COOH$

(2) HCOOH > $CH_3CH_2CH_2COOH$ > CH_3COOH > CH_3CH_2COOH

(3) HCOOH > CH_3COOH > CH_3CH_2COOH > $CH_3CH_2CH_2COOH$

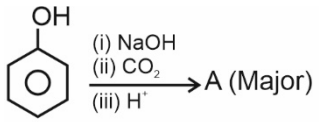
(4) CH_3COOH > HCOOH > $CH_3CH_2CH_2COOH$ > CH_3CH_2COOH

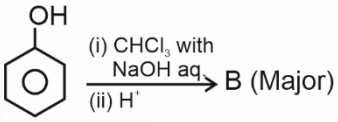
Answer (3)

Sol. Acidic strength of carboxylic acids decreases as the $_+I$ effect of the alkyl group attached to carboxylic group increases. Therefore, the correct order of acidic strength of the given acids is

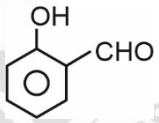
HCOOH > CH_3COOH > CH_3CH_2COOH > $CH_3CH_2CH_2COOH$

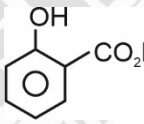
12. Consider the following two reactions

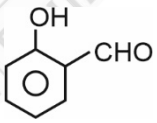


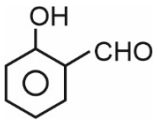


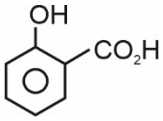
A and B are

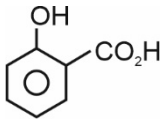
(1) Both are 

(2) A is 

B is 

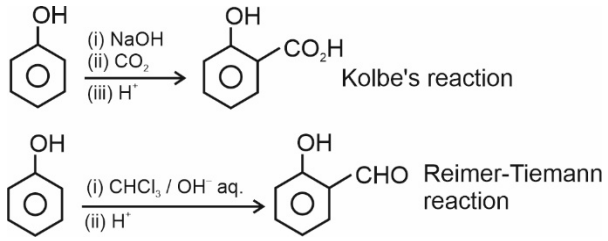
(3) A is 

B is 

(4) Both are 

Answer (2)

Sol.



13. **Assertion:** Kjeldahl method is not used for pyridine.

Reason: Nitrogen of pyridine does not change to ammonium sulphate under these conditions.

(1) Both Assertion and Reason are true and Reason is a correct explanation for assertion

(2) Both Assertion and reason are true but Reason is not a correct explanation for assertion

(3) Assertion is true but Reason is false

(4) Assertion is false but Reason is true

Answer (1)

Sol. (Reference NCERT Page 358)

Kjeldahl method is not applicable to compounds containing nitrogen in the ring (pyridine) as nitrogen of these compounds does not change to ammonium sulphate under these conditions

14. Statement-1 : S_N2 reaction is stereospecific reaction.

Statement-2 : In S_N1 reaction, racemic mixture is obtained.

(1) Statement-1 is true but Statement-2 is false

(2) Statement-1 is false but Statement-2 is true

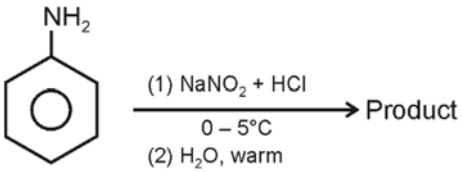
(3) Both Statement-1 and Statement-2 is true

(4) Both Statement-1 and Statement-2 are false

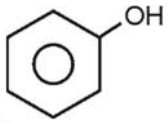
Answer (3)

Sol. Both statements are true as in S_N2 only one product is obtained by inversion and in S_N1 due to carbocation formation, racemic mixture is obtained.

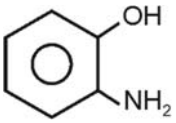
15.



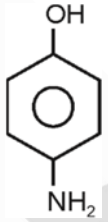
(1)



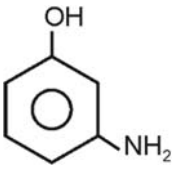
(2)



(3)

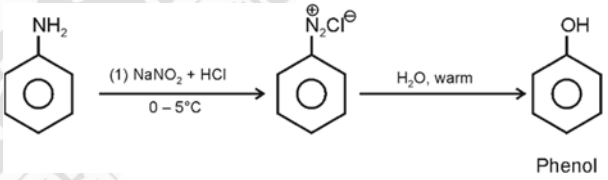


(4)



Answer (1)

Sol.



16. What is the structure of a carbocation?

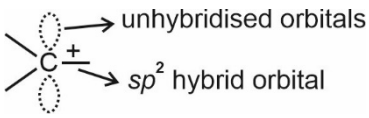
(1) Triangular planar (2) Tetrahedral

(3) Trigonal bipyramid (4) Triangular pyramid

Answer (1)

Sol. The hybridisation of carbocation is sp^2.

Therefore, its structure is triangular planar



17. **S-I:** Blood is a buffer solution, whose pH is maintained at 7.4 by an acidic buffer.

S-II: pH is maintained by $\left[HCO_3^-\right]$ and $\left[H_2CO_3\right]$

(1) S-I and S-II both are correct

(2) S-I and S-II both in correct

(3) S-I is correct and S-II are incorrect

(4) S-I is incorrect and S-II is correct

Answer (1)

Sol. H_2CO_3/HCO_3^- buffer system helps to maintain pH of blood between 7.26 to 7.42.

(Refer NCERT p-block gooup-14)

18. The EMF of the cell is 0.83 V

$$Tl\left|Tl^+\right|\left|Cu^{2+}\right|Cu$$

Then the EMF value will be increased

(1) By increasing conc. of Cu^{2+}, keeping Tl^+ constant

(2) By increasing conc. of Tl^+, keeping Cu^{2+} constant

(3) By increasing conc. of both Tl^+ and Cu^{2+}

(4) By decreasing conc. of both Cu^{2+} and Tl^+

Answer (1)

Sol.

$$\begin{array}{l}(Tl \longrightarrow Tl^+ + e^-) \times 2 \\ Cu^{2+} + 2e^- \longrightarrow Cu \\ \hline 2Tl + Cu^{2+} \longrightarrow 2Tl^+ + Cu\end{array}$$

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{[Tl^+]^2}{[Cu^{2+}]}$$

E_{cell} will increase if we

(i) Decrease Tl^+

(ii) Increase Cu^{2+}

19. For the cell reactions:

$$AgCl_{(S)} + \frac{1}{2}H_{2(g)} \rightarrow Ag_{(S)} + Cl^-_{(aq)} + H^+_{(aq)}$$

which one of the following represents the correct cell representation?

(1) $Pt|H_2|H^+||Cl^-|AgCl|Ag$

(2) $H_2|H^+||Cl^-|AgCl$

(3) $Pt|H_2|H^+||AgCl|Ag$

(4) $Pt|H^+|H_2||Ag|AgCl$

Answer (1)

Sol. At cathode :

$$AgCl_{(S)} \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

$$\begin{array}{l}Ag^+_{(aq)} + e^- \rightarrow Ag_{(S)} \\ \hline AgCl_{(S)} + e^- \rightarrow Ag_{(S)} + Cl^-_{(aq)}\end{array}$$

At anode : $\frac{1}{2}H_{2(g)} \rightarrow H^+_{(aq)} + e^-$

So, cell representation is : $Pt|H_2|H^+||Cl^-|AgCl|Ag$

20. Match the following Column-I and II.

Column-I		Column-II	
(i)	Baeyer's test	(p)	Aldehyde
(ii)	Ceric ammonium nitrate test	(q)	Alcohol
(iii)	Phenolphthalein test	(r)	Phenol
(iv)	Schiff's test	(s)	Unsaturation

(1) i → (p), ii → (q), iii → (r), iv → (s)

(2) i → (s), ii → (q), iii → (r), iv → (p)

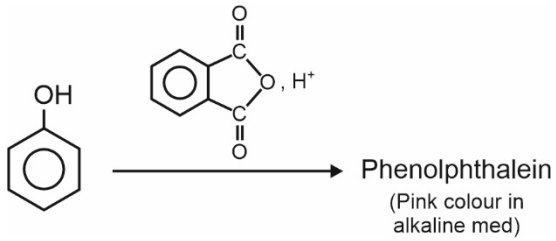
(3) i → (s), ii → (q), iii → (p), iv → (r)

(4) i → (q), ii → (s), iii → (r), iv → (p)

Answer (2)

Sol. Unsaturated compounds decolourise the Baeyer's reagent.

Alcohols give red coloured ppt with ceric ammonium nitrate.



Aldehyde gives pink colour with Schiff's reagent.

SECTION - B

Numerical Value Type Questions: This section contains 10 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. The sum of unpaired electron present in complexes $[Co(NH_3)_6]^{3+}$ and $[NiCl_4]^{2-}$ is

Answer (2)

Sol. $[Co(NH_3)_6]^{3+}$

$Co^{3+} = 3d^6 4s^0 \Rightarrow d^2sp^3 \Rightarrow t_{2g}^6 eg^0$

No. of unpaired electron = 0

$[NiCl_4]^{2-}$

$Ni^{+2} \Rightarrow 3d^8 \Rightarrow sp^3 \Rightarrow e^4 t_2^4$

No. of unpaired electron = 2

Total no. of unpaired e^- = (2 + 0) = 2

22. The total number of compounds having bond order 2 among the following are _____.

F_2, N_2, Ne_2, O_2, Li_2, Be_2

Answer (1)

Sol.

Molecule	Bond order
F_2	1
N_2	3
Ne_2	0
O_2	2
Li_2	1
Be_2	0

23. Wave number of a radiation having 5800Å wavelength is x × 10^4 cm^{-1}. The value of x to nearest integer is :

Answer (2)

Sol. $\bar{\nu} = \frac{1}{\lambda}$

$= \frac{1}{5800 \times 10^{-8}\ cm}$

$= 1.72 \times 10^4\ cm^{-1}$

$x = 1.72 \simeq 2$

24. Molality of aqueous solution of urea is 4.44 m. Then mole fraction of urea is x × 10^{-3}, then value of x is ____

Answer (74)

Sol. $\frac{X_B}{X_A} = \frac{m \times M_A}{1000}$

Where m = molality

M_A = molar mass of solvent

$\frac{X_B}{1 - X_B} = \frac{4.44 \times 18}{1000}$

$$\frac{X_B}{1-X_B} = 0.08$$

$X_B = 0.08 - 0.08X_B$

$1.08 \times B = 0.08$

$X_B = 0.074 = 74 \times 10^{-3}$

$x = 74$

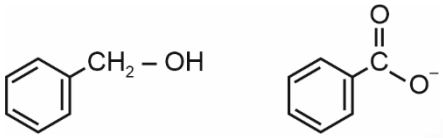
25. 2 moles of benzaldehyde is treated with aq. NaOH. The number of π-bonds present in the resulting compounds is _____ .

Answer (7)

Sol. $Ph-CHO + NaOH(aq)$
(Cannizzaro Reaction)

$$\longrightarrow Ph-CH_2-OH + Ph-COO^-$$

Products are:

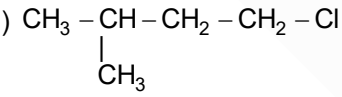


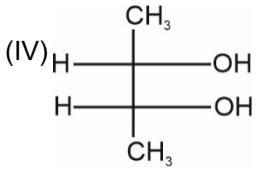
Total number of π-bonds = 3 + 4 = 7

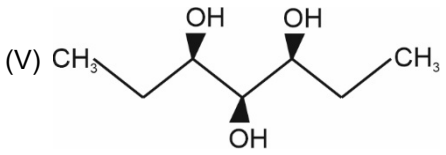
26. How many of the following are optically active?

(I) $CH_3-CH_2-CH_2-Cl$

(II) $CH_3-CH_2-CH_2-OH$

(III) 

(IV) 

(V) 

Answer (0)

Sol. All are optically inactive

27. Consider the following statements :

(i) N_2 is stable in divalent form

(ii) Group-15 exist in +3, –3, +5 oxidation state

(iii) Stability of +5 oxidation state increases down the group

(iv) ΔH_{eq} value for N is positive

How many of the above statement(s) is/are correct

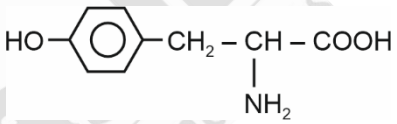
Answer (3)

Sol. Statement (iii) is incorrect

28. How many carbon atoms are there in a molecule of tyrosine?

Answer (9)

Sol. The structures of tyrosine is as given below



It has a carbon atom in its molecule.

29. In the test for phosphorus using ammonium molybdate, yellow precipitate of compound (X) is obtained. What is the oxidation state of molybdenum in (X)?

Answer (6)

Sol. NCERT Page – 355 : Test for Phosphorus

$$H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 \longrightarrow$$

$$\underset{\text{Yellow ppt.}}{(NH_4)_3PO_4 \cdot 12MoO_3} + 21NH_4NO_3 + 12H_2O$$

Oxidation state of Mo = +6

30.