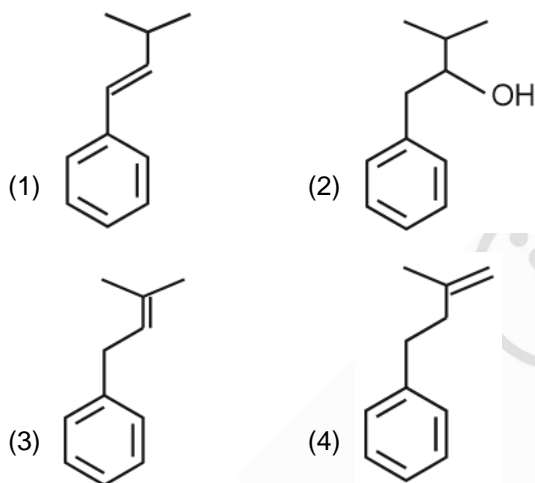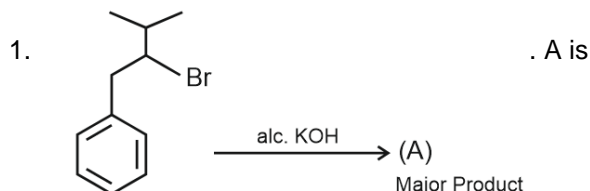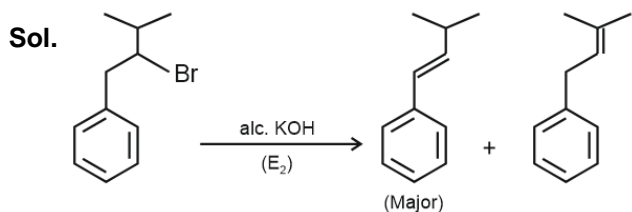# CHEMISTRY

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.
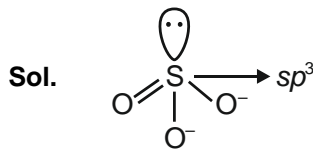
Choose the correct answer :

1. . A is

Answer (1)

Sol.

2. Which one of the following has pyramidal shape?

   (1) $S_2O_3^{2-}$ (2) SO_4^{2-}

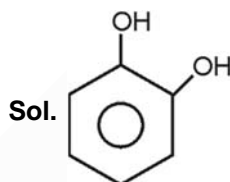   (3) SO_3^{2-} (4) $S_2O_7^{2-}$

Answer (3)

Sol.

Pyramidal shape

3. IUPAC name of Catechol is

   (1) Benzene, 1,2-diol   (2) Benzene, 1,3-diol

   (3) Benzene, 1,4-diol   (4) 3-Hydroxyphenol

Answer (1)

Sol.

Benzene, 1,2-diol

4. Which one of the following has the most negative (highest –ve) electron gain enthalpy?

   (1) Li   (2) Na

   (3) F   (4) Cl

Answer (4)

Sol. Chlorine = -349 kJ mol^{-1}

Sodium = -53 kJ mol^{-1}

Fluorine = -328 kJ mol^{-1}

Lithium = -60 kJ mol^{-1}

5. Consider the following statements.

   Statement I: The number of emitted photoelectrons increases with increase in frequency of incident light.

   Statement II: Kinetic energy of emitted photoelectrons increases with increase in frequency of incident light.

   (1) Statement I is true but Statement II is false

   (2) Statement I is false but Statement II is true

   (3) Both statement I and Statement II are true

   (4) Both statement I and Statement II are false

Answer (2)

Sol. The number of emitted photoelectrons independent of the frequency of incident light but kinetic energy of emitted photoelectrons increases with increase in frequency of incident light.

6. Arrange the following in increasing order of first ionization enthalpy: Al, Ga, In, Tl, B

   (1) Tl < In < Ga < Al < B   (2) In < Al < Ga < Tl < B

   (3) In < Ga < Al < B < Tl   (4) B < Al < Ga < In < Tl

Answer (2)

Sol. Due to poor shielding by electrons in d-subshell of Ga and f-subshell of Tl, their ionization energy increases than the expected value. So, correct order of IE-
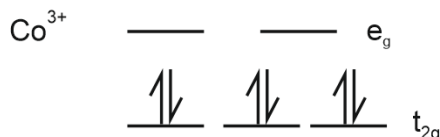
In < Al < Ga < Tl < B

7. Find out number of unpaired electrons in d-subshell for $[Co(H_2O)_6]^{3+}$.

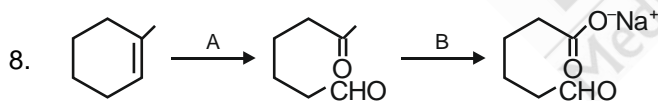   (1) 3   (2) 4

   (3) 0   (4) 2

Answer (3)

Sol. Co^{3+} : $3d^6 4s^0$

Co^{3+} in excited state will undergo pairing with H_2O.

Co^{3+} —— —— e_g

⇅ ⇅ ⇅ t_{2g}
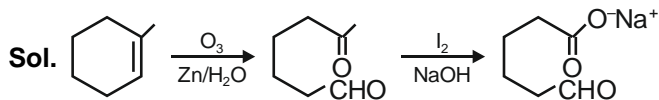
$\boxed{n = 0}$

Correct answer is option (3).

8.

   What are A and B respectively?

   (1) (A) O_3/Zn-H_2O; (B) H_3O^+

   (2) (A) O_3/H_2O; (B) I_2/NaOH

   (3) (A) O_2/Zn-H_2O; (B) I_2/NaOH

   (4) (A) $KMnO_4$/H^+, Δ; (B) $LiAlH_4$

Answer (3)

Sol.

9. Which of the following statement is INCORRECT

   (1) In homogeneous mixture, Composition is uniform

   (2) Compounds are formed when atoms of different elements combine together in any ratio

   (3) Atoms of same element have identical atomic mass and properties

   (4) In heterogeneous mixture, Composition is not uniform

Answer (2)

Sol. Compounds are formed when atoms of different elements combine together in fixed ratio

10. Match the column I and column II.

	Column I		Column II
(i)	α-Glucose and α-Galactose	(a)	Homologues
(ii)	α-Glucose and α-Fructose	(b)	Epimer
(iii)	α-Glucose and β-Glucose	(c)	Anomer
(iv)	α-Ribose and α-Glucose	(d)	Functional isomers

Select the option with correct match.

(1) (i) → (b); (ii) → (d); (iii) → (a), (iv) → (c)

(2) (i) → (b); (ii) → (d); (iii) → (c), (iv) → (a)

(3) (i) → (d); (ii) → (b); (iii) → (c), (iv) → (a)

(4) (i) → (a); (ii) → (c); (iii) → (d), (iv) → (b)

Answer (2)

Sol. α-Glucose and α-Galactose are C–4 epimers

α-Glucose is Aldohexose and α-Fructose is ketohexose hence functional isomers

α-Glucose and β-Glucose are different in configuration at C–1 i.e. Anomeric carbon hence are anomers

α-Ribose is pentose while α-Glucose is hexose hence homologues

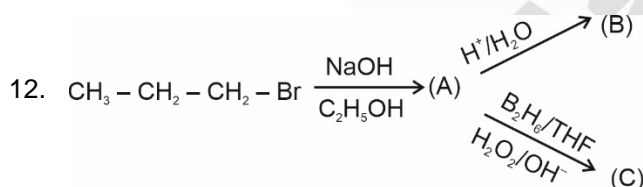11. Arrange the following anions in the decreasing order of their stability.
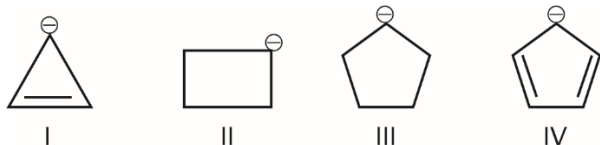
(1) I > II > III > IV

(2) IV > III > II > I

(3) III > II > I > IV

(4) II > IV > III > I

Answer (2)

Sol. Cyclopentadienyl anion (IV) is most stable and cyclopropenyl anion (I) is least stable as (IV) is aromatic and (I) is antiaromatic. Anion (II) is less stable than (III) due to higher angle strain.

$\therefore$ Correct stability order is
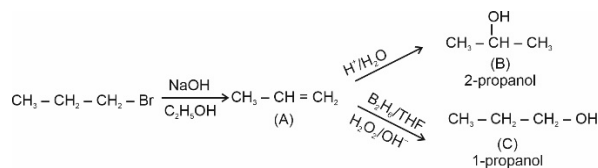
IV > III > II > I

12. $CH_3 - CH_2 - CH_2 - Br \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{NaOH}} (A)$

$\xrightarrow{\text{H}^+/\text{H}_2\text{O}} (B)$

$\xrightarrow[\text{H}_2\text{O}_2/\text{OH}^-]{\text{B}_2\text{H}_6/\text{THF}} (C)$

What are B and C respectively?

(1) Propan-1-ol and propan-2-ol

(2) Propan-2-ol and propan-1-ol

(3) Both are propan-1-ol

(4) Both are propan-2-ol

Answer (2)

Sol.

$CH_3 - CH_2 - CH_2 - Br \xrightarrow[\text{C}_2\text{H}_5\text{OH}]{\text{NaOH}} CH_3 - CH = CH_2$ (A)

$\xrightarrow{\text{H}^+/\text{H}_2\text{O}} \underset{\substack{\text{(B)}\\ \text{2-propanol}}}{CH_3 - \underset{\underset{\text{OH}}{|}}{CH} - CH_3}$

$\xrightarrow[\text{H}_2\text{O}_2/\text{OH}^-]{\text{B}_2\text{H}_6/\text{THF}} \underset{\substack{\text{(C)}\\ \text{1-propanol}}}{CH_3 - CH_2 - CH_2 - OH}$

13. Spin only magnetic moment of V_2O_5 (in BM)

(1) 0

(2) 1

(3) 2

(4) 3

Answer (1)

Sol. $V_2O_5 \Rightarrow V^{+5}$

$V^{+5} = [Ar]3d^0 4s^0$

There is no unpaired electron in V^{+5}

So spin only magnetic moment is zero.

14. $KMnO_4 + \text{conc. } H_2SO_4 \xrightarrow{\text{Salt (X)}}$ Greenish yellow gas is produced

Salt (X) contains

(1) F^-

(2) Cl^-

(3) Br^-

(4) I^-

Answer (2)

Sol. The reaction/oxidation of F^- is not possible by the chemical reagent $KMnO_4/H_2SO_4$.

The oxidation of other halides produces dihalogen.

Cl_2 : Greenish yellow

Br_2 : Red

I_2 : Violet

Hence that salt contains Cl^-.

15. Which of the following represents correct unit of slope of graph between molar conductivity ($\wedge_m$) and (conc)$^{1/2}$:

(1) S cm$^{1/2}$ mol$^{-1/2}$

(2) S cm$^{3/2}$ mol^{-2}

(3) S cm$^{7/2}$ mol$^{-3/2}$

(4) S cm$^{5/2}$ mol$^{-3/2}$

Answer (3)

Sol. Debye-Hückel-Onsager equation

$$\wedge_m = \wedge_m^o - A\sqrt{C}$$

Slope of $\wedge_m$ vs $\sqrt{C}$ = –A

Unit of slope = $\dfrac{\text{Unit of } \wedge_m}{\text{Unit of } \sqrt{C}} = \dfrac{S \text{ cm}^2 \text{mol}^{-1}}{(\text{mol cm}^{-3})^{1/2}}$
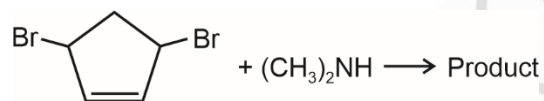
S cm$^{7/2}$ mol$^{-3/2}$

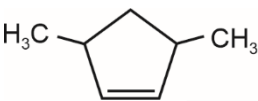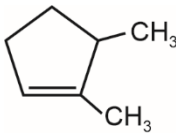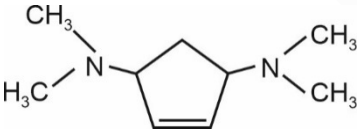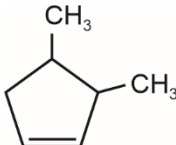16. Which of the following is used as adsorbent in adsorption chromatography?

    (1) Silica gel

    (2) Alumina

    (3) Benzene
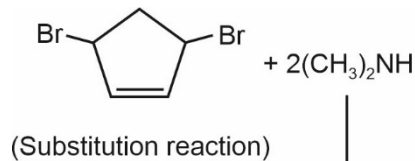
    (4) Both (1) and (2)

Answer (4)

Sol. Commonly used adsorbents are silica gel and alumina.

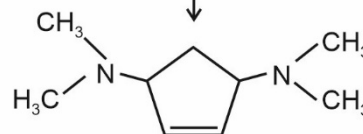17. Identify the correct product formed in the following reaction.
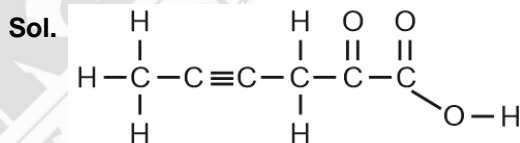

(1)

(2)

(3)

(4)

Answer (3)

Sol.

18.

19.

20.

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.

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21. What is the sum of number of σ and π bonds present in 2-oxo-hex-4-yn-oic acid?

Answer (18)

Sol.

Number of σ bonds : 14

Number of π bonds = 4

Total σ + π bonds = 14 + 4 = 18

22. Find out magnitude of heat (q) for an isothermal irreversible expansion against external pressure of 8 bar if volume increases by 10 L (in joule).

Answer (8000)

Sol. $W = -P_{ext}(\Delta V)$

$= -8 \times 10^5 \text{ N/m}^2 \times (10 \times 10^{-3} \text{ m}^3)$

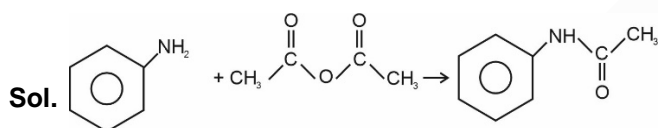$= -8 \times 10^5 \times 10^{-2} \text{ joule}$

$= -8 \times 10^3$

$= -8000 \text{ J}$

$q + W = \Delta E$

$q + W = 0 \Rightarrow q = -W = +8000 \text{ J}$

23. What is the maximum amount of acetanilide formed when acetic anhydride in excess is treated with 18 gm of aniline. (nearest integer)

Answer (26)

Sol.

18 gm.

moles of aniline = $\dfrac{18}{93}$

mass of acetanilide formed = $\dfrac{18}{93} \times 135$

$= 26.129$

$= 26$

24. We have a complex of Fe^{3+} ion having electronic configuration according to crystal field theory is $t_{2g}^5 e_g^\circ$. If complex is $[Fe(NH_3)_x(CN)_y]$, then value of $(x + y)$ is _____

Answer (6)

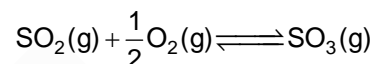**Sol.** Given electronic configuration of Fe^{3+} ion in complex = $t_{2g}^5 e_g^\circ$ then complex should be $[Fe(NH_3)_3(CN)_3]$
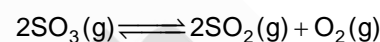
$x = 3, y = 3$

$x + y = 6$

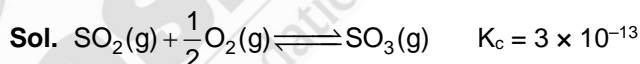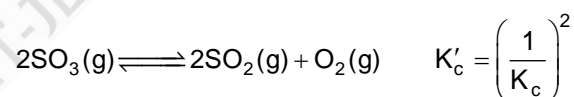25. Consider the following reaction at equilibrium at a certain temperature T Kelvin whose $K_c = 3 \times 10^{-13}$

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

The value of K_c' for the following reaction is a × 10^{+b} (Scientific notation). Find the value of $(a + b)$.

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

Answer (26)

Sol. $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$ $K_c = 3 \times 10^{-13}$

The equilibrium constant (K_c') for the following reaction

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g) \quad K_c' = \left(\frac{1}{K_c}\right)^2$$

$$K_c' = \left(\frac{1}{3 \times 10^{-13}}\right)^2 = 1.11 \times 10^{25}$$

$a = 1.11$ and $b = 25$

$a + b = 26.11$

26. Maximum number of orbitals possible when n = 4 and m = 0?

Answer (4)

Sol.

4g not possible
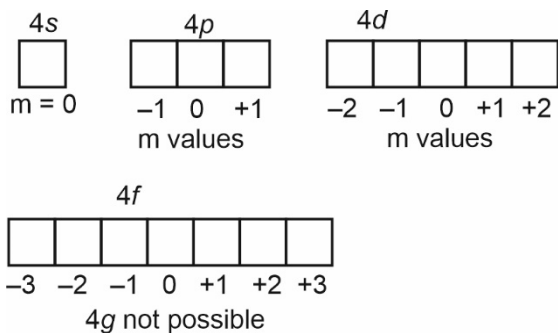
27. How many of the given statements are true for fuel cell?

    (a) It is a type of Galvanic cell

    (b) It is used for providing electrical power in space programme.

    (c) Hydrogen and oxygen are bubbled through porous carbon electrodes into concentrated NaOH solution

    (d) It produces electricity with an efficiency of 40%

    (e) It is pollution free cell

Answer (4)

Sol. Fuel cell produces electricity with an efficiency of 70%

28. An element of d-block (Z) of 4th period has spin only magnetic moment of its Z^{3+} form is 3.9 BM, then find minimum atomic number of element (Z).

Answer (24)

Sol. μ = 3.9 BM

It means there must be 3 unpaired electrons in Z^{3+} ion

$Cr^{+3} \Rightarrow [Ar]\, 3d^3 4s^0$

29. 3 g of acetic acid is dissolved in 500 g of water. Depression in freezing point of solution is $x \times 10^{-1}$K. Value of x to the nearest integer.

    Given : K_a of $CH_3COOH = 1.8 \times 10^{-5}$ and

    K_f of water = 1.86 K/molal

    Density of water = 1 g/mL

Answer (2)

Sol. $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

(Assuming $\alpha << 1$)

$\alpha = \sqrt{\dfrac{K_a}{C}} = \sqrt{\dfrac{1.8 \times 10^{-5}}{10^{-1}}} = \sqrt{1.8 \times 10^{-4}}$

$\qquad\qquad\qquad\qquad = 1.3 \times 10^{-2}$

$\qquad\qquad\qquad\qquad = 0.013$

So, i = 1 + (2 – 1)(0.013)

$\qquad = 1.013$

$\Delta T_f = 1.013 \times 1.86 \times \dfrac{3 \times 1000}{60 \times 500}$

$\qquad = 0.188$

$\qquad = 1.88 \times 10^{-1}$

$\qquad x \simeq 2$

30.