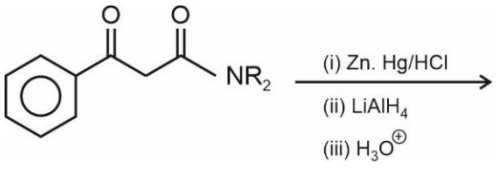
CHEMISTRY

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.

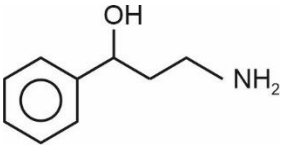
Choose the correct answer :

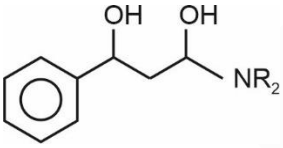
1. Consider the following sequence of reactions:

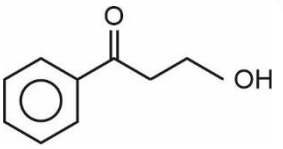


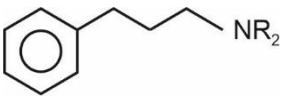
Product 'P'

The product 'P' is

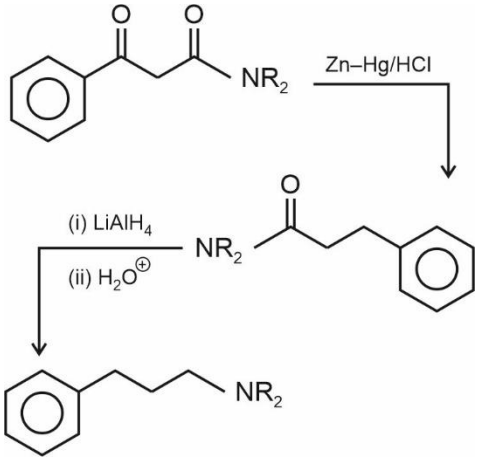
(1) 

(2) 

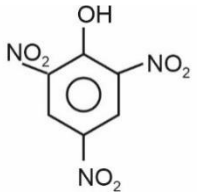
(3) 

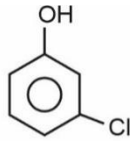
(4) 

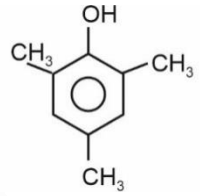
Answer (4)

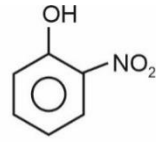
Sol. 

2. Following compounds are given

(I) 

(II) 

(III) 

(IV) 

Compare pK_a values

(1) I > IV > II > III (2) I > IV > III > II

(3) III > II > IV > I (4) IV > I > III > II

Answer (3)

Sol. Acidic Strength $\propto$ – I, – M Groups

$$\propto = \frac{1}{+I, +M} \text{ groups}$$

Acidic strength order

I > IV > II > III

pKa order

III > II > IV > I

3. Which of the following molecules has the highest bond dissociation energy?

(1) I_2 (2) F_2

(3) Cl_2 (4) Br_2

Answer (3)

Sol. Cl_2 has the highest bond dissociation energy among the halogens.

4. Select the correct statement among the following.

(1) Photochemical smog has high concentration of oxidising agent

(2) Classical smog has high concentration of oxidising agent

(3) Classical smog contains NO_2

(4) None of these

Answer (1)

Sol. Photochemical smog has high concentration of oxidising agent.

5. Which of the following compound(s) is/are paramagnetic?

(a) NO_2

(b) NO

(c) K_2O

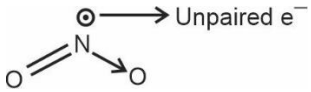
(d) Na_2O_2

(1) a & b only (2) a, b, c only

(3) a, b, c, d (4) a, b, d only

Answer (1)

Sol. NO_2



NO (N_e = 15)

1 unpaired electron as per MOT

6. Find out the magnetic character of Li_2O, KO_2 and MgO in that order.

(1) Diamagnetic, Paramagnetic and Diamagnetic

(2) Paramagnetic, Paramagnetic and Diamagnetic

(3) Diamagnetic, Paramagnetic and Paramagnetic

(4) Diamagnetic, Diamagnetic and Diamagnetic

Answer (1)

Sol. Li_2O has Li^+ and O^{2-}. Both the cation and anion have all their electrons paired. So, it is diamagnetic

KO_2 has K^+ and O_2^-. It is paramagnetic as O_2^- has one unpaired electron.

$$O_2^- : \sigma_{1s}^2\sigma_{1s}^{*2}\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2p_z}^2\pi_{2p_x}^2 = \pi_{2p_y}^2\pi_{2p_x}^{*2} = \pi_{2p_y}^{*1}$$

MgO has Mg^{2+} and O^{2-}. It is diamagnetic as Mg^{2+} and O^{2-} have all their electrons paired.

7. Which of the following option contains the correct decreasing order of hydration energy of the following ions?

$K^+, Mg^{2+}, Cs^+, Ca^{2+}, Rb^+$

(1) $Mg^{2+} > Ca^{2+} > K^+ > Rb^+ > Cs^+$

(2) $Ca^{2+} > Mg^{2+} > Cs^+ > Rb^+ > K^+$

(3) $Mg^{2+} > Ca^{2+} > Cs^+ > Rb^+ > K^+$

(4) $Cs^+ > Rb^+ > K^+ > Ca^{2+} > Mg^{2+}$

Answer (1)

Sol. Hydration energy $\propto$ charge density

$\therefore$ correct order is : - $Mg^{2+} > Ca^{2+} > K^+ > Rb^+ > Cs^+$

8. How many of the following compounds are odd electron species?

NO_2, NO_2^+, ICl_4^-, BrF_3, NO

(1) 3 (2) 2

(3) 5 (4) 4

Answer (2)

Sol. NO and NO_2 are the odd electron species.

9. Which of the following reaction corresponds to Mond process?

(1) $ZrI_4 \xrightarrow{1800\ K} Zr + 2I_2$

(2) $Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$

(3) $2\left[Au(CN)_2\right]^-(aq) + Zn(s) \longrightarrow 2Au(s) + \left[Zn(CN)4\right]^{2+}(aq)$

(4) $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$

Answer (2)

Sol. Mond process for refining Nickel.

$$Ni + 4CO \xrightarrow{300-350\ K} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$$

10. Cannizzaro reaction is an example of disproportionation reaction. What is the catalyst used in Cannizzaro reaction?

(1) $FeCl_3$

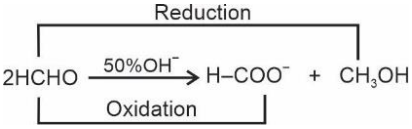
(2) $NaOH/H_2O$

(3) $ZnCl_2/H^+$

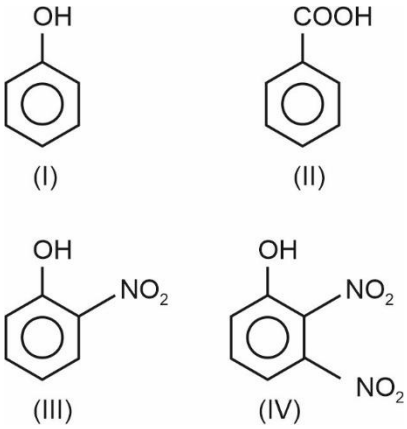
(4) $H_2/Pd/BaSO4$

Answer (2)

Sol.



11. Arrange the following in increasing pK_a value



(1) IV > III > II > I

(2) I > III > IV > II

(3) IV > III > I > II

(4) IV > II > III > I

Answer (2)

Sol. Acidity $\propto \frac{1}{pK_a}$

The order of acidity is : II > IV > III > I

$\therefore$ Their value of pK_a will be : II < IV < III < I

12. Which of the following option contains the correct match

List-I	List-II
(A) Clemmensen reduction	(i) Con. KOH
(B) Reimer tiemann Reaction	(ii) Br_2/NaOH
(C) Cannizzaro reaction	(iii) $CHCl_3$/KOH
(D) Hoffmann bromamide degradation reaction	(iv) Zn-Hg/HCl

(1) A $\rightarrow$ (i); B $\rightarrow$ (ii); C $\rightarrow$ (iii); D $\rightarrow$ (iv)

(2) A $\rightarrow$ (iv); B $\rightarrow$ (iii); C $\rightarrow$ (i); D $\rightarrow$ (ii)

(3) A $\rightarrow$ (ii); B $\rightarrow$ (iii); C $\rightarrow$ (iv); D $\rightarrow$ (i)

(4) A $\rightarrow$ (iii); B $\rightarrow$ (iv); C $\rightarrow$ (i); D $\rightarrow$ (ii)

Answer (2)

Sol. Clemmensen reduction $\rightarrow$ Zn-Hg/HCl

Reimer tiemann reaction $\rightarrow$ $CHCl_3$/KOH

Cannizzaro reaction $\rightarrow$ Con. KOH/Δ

Hoffmann bromamide degradation reaction $\rightarrow$ Br_2/KOH, Δ

13. **Assertion :** First law of thermodynamics has equation : $\Delta U = q + w$

Reason : First law of thermodynamics is based on the law of conservation of energy

(1) 'A' is correct and 'R' is correct and 'R' is the correct explanation of 'A'

(2) 'A' and 'R' both are correct and 'R' is not the correct explanation of 'A'

(3) 'A' is correct while 'R' is incorrect

(4) 'A' is incorrect while 'R' is correct

Answer (1)

Sol. First law of thermodynamics is based on the law of conservation of energy and it has equation as $\Delta U = q + w$

14. Match the column

(A) Siderite	(i) $ZnCO_3$
(B) Galena	(ii) $FeCO_3$
(C) Calamine	(iii) PbS

(1) A(i), B(ii), C(iii) (2) A(ii), B(iii), C(i)

(3) A(iii), B(ii), C(i) (4) A(ii), B(i), C(iii)

Answer (2)

Sol. Siderite — $FeCO_3$

Galena — PbS

Calamine — $ZnCO_3$

15. Number of cyclic tripeptides are formed with two amino acids A and B are

(1) 2

(2) 3

(3) 4

(4) 5

Answer (2)

Sol. Cyclic tripeptide contains 2 amino acids.

AA
BB
AB

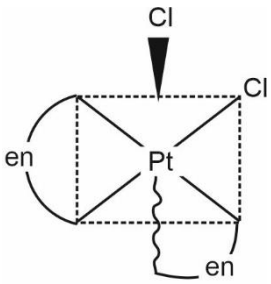
16. Which of the following complex is optically active?

(1) Cis-$[Pt(NH_3)_2Cl_2]$ (2) Trans-$[Pt(NH_3)_2Cl_2]$

(3) Cis-$[Pt(en)_2Cl_2]$ (4) Trans-$[Pt(en)_2Cl_2]$

Answer (3)

Sol.



It does not have POS and COS, so it is optically active.

17. Which of the following will give positive Lassaigne test

(1) NH_4OH (2) NH_4Cl

(3) N_2H_4 (4) $CH_3\text{-}NH_2$

Answer (4)

Sol. Only 4th compound has C and N. So, it gives positive Lassaigne's test.

18. Following compounds are given

I :

II :

III :

IV :

(1) I > II > III > IV (2) I > II > IV > III

(3) III > IV > II > I (4) III > IV > I > II

Answer (3)

Sol. BP $\propto$ Molecular mass

R – I > R – Br > R – Cl > R – F

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

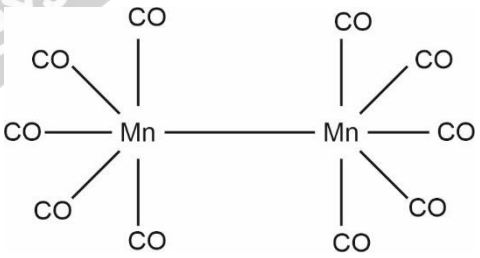
21. X : Number of Bridge bonds present in compound $Mn_2(CO)_{10}$

Y : Number of Bridge bonds present in compound $W(CO)_6$

Find out (X + Y)

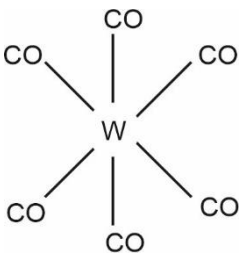
Answer (00.00)

Sol. $Mn_2(CO)_{10}$



$\boxed{X = 0}$

$W(CO)_6$



$\boxed{Y = 0}$

(X + Y) = 0

22. For a Hypothetical reaction

$A \rightleftharpoons B;\ K_{eq} = 10^2$

(Use T = 27° C, R = 8.3 $JK^{-1}mol^{-1}$ log 10 = 2.3)

If the value of ΔG^o for the above reaction is – x kJ, the value of 2x will be (Round off to the nearest integer)

Answer (23)

Sol. $\Delta G^o = -RT \ln K_{eq}$

$= -8.3 \times 300 \times 2.3 \log (10^2)$

$\Delta G^\circ = -11454\ J$

$2\Delta G^o = -22908\ J$

23. A radioactive substance decays into products with half life of 30 min. The fraction left after 90 min. is given by $\left(\frac{1}{2t}\right)$. Find out 't'.

Answer (04.00)

Sol. $N_0 \xrightarrow{30\ min.} \frac{N_0}{2} \xrightarrow{30\ min.} \frac{N_0}{4} \xrightarrow{30\ min.} \frac{N_0}{8}$

$\Rightarrow \frac{1}{8} = \frac{1}{2t}$

$\boxed{t = 4}$

24. An element $^{239}_{92}X$ decays as

$^{239}_{92}X \rightarrow {}^{231}_{Z}Y + 2\alpha + 1\beta$

Then find the value of Z in the above reactions.

Answer (89)

Sol. $^{239}_{92}X \rightarrow {}^{231}_{89}Y + 2\,{}^{4}_{2}He^{2+} + {}^{0}_{-1}e$

$\therefore$ Value of Z = 89

25. The shortest wavelength in Lyman series of H-atom is λ. The longest wavelength in Balmer series of He^+ is $\frac{x\lambda}{5}$. Find the value of x.

Answer (9)

Sol. The shortest wavelength in Lyman series of H-atom is given by

$\frac{1}{\lambda} = R_H\left[\frac{1}{(1)^2} - \frac{1}{(\infty)^2}\right] = R_H$

$\Rightarrow \quad \lambda = \frac{1}{R_H}$

The longest wavelength in Balmer series of He^+ ion is given by

$\frac{1}{\lambda'} = (2)^2 R_H\left[\frac{1}{(2)^2} - \frac{1}{(3)^2}\right] = \frac{5R_H}{9}$

$\lambda' = \frac{9}{5R_H} = \frac{9\lambda}{5}$

$\therefore$ x = 9

26. How many elements can liberate H_2 from dilute acids?

V, Cr, Mn, Fe, Co, Ni, Cu

Answer (6)

Sol. Except Cu, all other elements have negative $E^o_{M^{+2}/M}$

Hence, they can liberate H_2 from dilute acids.

Number of elements = 6

27. Consider the following reaction

$H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$

If K_{eq} = 2 × 10^{-3} at 2300 K and initial pressure of $H_2O(g)$ is 1 atm, then degree of dissociation of above reaction will be x × 10^{-2}, the value of x is

Answer (2)

Sol. $K_{eq} = \frac{(P_{H_2})(P_{O_2})^{1/2}}{(P_{H_2O})} = \frac{(\alpha)\left(\frac{2}{2}\right)^{1/2}}{(1-\alpha)} = 2 \times 10^{-3}$

$\Rightarrow \alpha^{3/2} = 2^{3/2} \times \left(10^{-2}\right)^{3/2}$

$\Rightarrow \alpha = 2 \times 10^{-2}$

$\therefore$ x = 2

28.

29.

30.