

Chemistry - 2020

Full Marks : 70

(Time: 3 Hours)

Pass Marks : 23

General Instructions :

- (i) All questions are compulsory.
- (ii) Question Nos. 1 to 8 are Multiple Choice Type which carry 1 mark each.
- (iii) Question Nos. 9 to 15 are Very Short Answer Type which carry 1 mark each.
- (iv) Question Nos. 16 to 23 are Short Answer Type-I which carry 2 marks each.
- (v) Question Nos. 24 to 31 are Short Answer Type-II which carry 3 marks each.
- (vi) Question Nos. 32 to 34 are Long Answer Type which carry 5 marks each.

(Multiple Choice Type Questions)

1. In a orthorhombic crystal system axis angles, $\alpha = \beta = \gamma$ are
 - (a) equal to 90°
 - (b) Less than 90°
 - (c) greater than 90°
 - (d) None of these
 Ans.(a)
2. An example of trimolecular reaction is
 - (a) $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$
 - (b) $2NI \rightarrow H_2 + I_2$
 - (c) $2NO + Br_2 \rightarrow 2NOBr$
 - (d) None of these
 Ans.(c)
3. The reaction is
 - (a) Friedel-Crafts reaction
 - (b) Gattermann-Koch reaction
 - (c) Rosenmund reduction
 - (d) None of these
 Ans.(a)
4. Malachite is an ore of
 - (a) Al
 - (b) Cu
 - (c) Fe
 - (d) Zn
 Ans.(b)
5. Ethyl bromide + KOH(aq) $\xrightarrow{\text{Boil}}$ A

'A' is

 - (a) Ethyl alcohol
 - (b) Ethylene
 - (c) Propyl alcohol
 - (d) None of these
 Ans.(a)
6.

$$\begin{array}{l} H_3C \\ \diagdown \\ CHO \\ \diagup \\ H_3C \end{array} + [O] \xrightarrow{\text{Oxidation}} A$$

'A' is

 - (a) Acetone
 - (b) Propene
 - (c) Propionaldehyde
 - (d) None of these
 Ans.(a)
7. Glucose is an example of
 - (a) Aldohexoses
 - (b) Aldopentoses
 - (c) Aldotetroses
 - (d) None of these
 Ans.(a)
8. Benzaldehyde + [O] $\xrightarrow{\text{Air}}$ A

'A' is

 - (a) Benzene
 - (b) Benzoic acid
 - (c) Benzyl alcohol
 - (d) None of these
 Ans.(c)

Very Short Answer Type Question

9. Calculate the rate of the reaction, $A + 2B \rightarrow 2C + D$.

Ans. Given reaction is $A + 2B \rightarrow 2C + D$

Rate of reaction = $[A][B]^2$
10. Write the source of Vitamin A.

Ans. Source of vitamin A is egg.
11. Write dispersed phase and dispersion medium of dust, a colloidal solution.

Ans. The dispersed medium for dust is gas while the dispersed phase is solid.
12. Which polymer is prepared by the monomer, styrene?

Ans. Polystyrene
13. Write IUPAC name of $CH_3C(Cl)(C_2H_5)CH_2CH_3$

Ans. 3-Chloro-3-methyl pentane
14. What is the three-letter symbol of the amino acid, Proline?

Ans. Pro
15. Give an example of Tranquillizer.

Ans. Haldol

(Short Answer-I Type Questions)

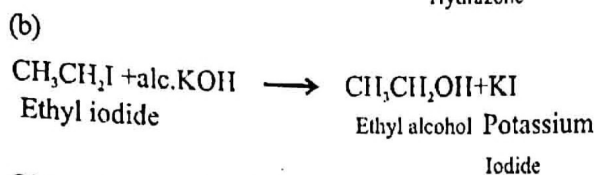
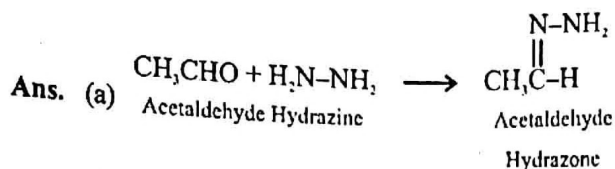
16. What is salt bridge? Mention its functions.

Ans. A salt bridge is a laboratory device used to connect the oxidation and reduction half-cells of a galvanic cell. Function of salt bridge:

 - (i) It completes the cell circuit by connecting the solutions of two cells, without allowing them to mix with each other.
 - (ii) It maintains the electrical neutrality of the solutions in the two half cells because of the flow of ions.
17. What is the role of silica in the metallurgy of copper?

Ans. The role of silica in the metallurgy of copper is to remove the iron oxide obtained during the process of roasting as 'slag'. If the supplied ore of copper contains iron, then silica (SiO_2) is added as flux before roasting, then FeO combines with silica to form iron silicate $FeSiO_3$ (slag)

18. What happens when -
 (a) Acetaldehyde is treated with hydrazine?
 (b) Ethyl iodide reacts with alcoholic KOH solution?

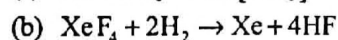
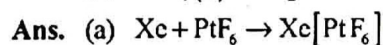
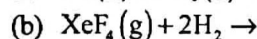
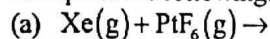


19. Give reasons for the following:
 (a) Transition metal and many of their compounds show magnetic behaviour.
 (b) The enthalpy of atomisation of transition metals is high.

Ans. (a) Most of the transition elements show paramagnetic behavior. The unpaired electrons in (n-1)d orbitals are responsible for the magnetic properties. The magnetic properties decrease with the decrease in the number of unpaired electrons.

(b) Transition elements have high effective nuclear charge and a large number of valence electrons. Therefore, they form very strong metallic bonds. As a result, the enthalpy of atomization of transition metal is high.

20. Complete the following:



21. What are nucleic acids? Mention their two important functions.

Ans. Nucleic acids are naturally occurring chemical compounds that are capable of being broken down to yield phosphoric acid, sugars and a mixture of organic bases. The main classes of nucleic acid are DNA and RNA. Functions of nucleic acid:

The DNA

(i) Carries the code for making protein.

(ii) The RNA serves as a travelling copy of the information in DNA polymer.

22. Write any two differences between thermoplastics and thermosetting polymers.

Ans. (i) Thermoplastic polymer can be remelted back into liquid whereas thermosetting polymer always remains in a permanent solid state.

(ii) Thermoplastic polymer has a low melting point while the thermosetting polymer has a comparably high melting point.

(iii) Thermoplastic is synthesized by an addition process while the thermosetting is synthesized by a condensation process.

23. What is tincture of iodine? What is its use?

Ans. Tincture of iodine is a solution of alcohol water and 2-3 percent of iodine. It is used as an antiseptic.

(Short Answer-II Type Questions)

24. Silver metal crystallises with a face centred cubic lattice. The length of the edge of unit cell is found to be 4.077×10^{-8} cm. Calculate the atomic radius and density of silver.

Ans. For face centered cubic unit cell,

$$a = 2\sqrt{2}r$$

$$a = 4.077 \times 10^{-8} \text{ cm}$$

$$\text{So, } r = \frac{4.077 \times 10^{-8}}{2\sqrt{2}} = 1.44 \times 10^{-8} \text{ cm}$$

$$\therefore v = a^3 = (4.077 \times 10^{-8})^3 = 67.77 \times 10^{-24} \text{ cm}^3$$

$$\text{We know, } v = \frac{Z \times M}{N_0 \times d}$$

$$d = \frac{Z \times M}{N_0 \times v} = \frac{4 \times 108}{6.023 \times 10^{23} \times 67.77 \times 10^{-24}}$$

$$= \frac{432}{40.82} = 10.58 \text{ g cm}^{-3}$$

25. A reaction is of second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is doubled?

Ans. If the concentration of the reactant is doubled i.e.,

$$[A] = 2a$$

Then the rate of reaction would be.

$$R = k(2a)^2$$

$$= 4ka^2 = 4R$$

Therefore, the rate of the reaction would increase by 4 times.

26. Explain the following terms:

(a) Peptization

(b) Electro-osmosis.

Ans. (a) Peptization:

Peptization is the process responsible for the formation of a stable dispersion of colloidal particles in a dispersion medium. It may be defined as a process of converting a precipitate into a colloidal sol by shaking it with a dispersion medium in the presence of a small amount of electrolyte.

(b) Electro-osmosis:-

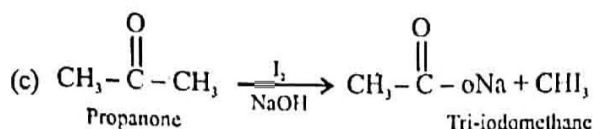
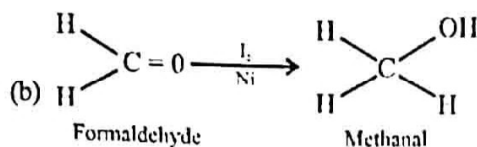
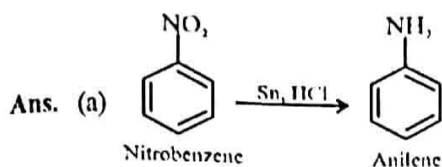
It is the flow of liquid that is in contact with a charged solid surface when an electric field is applied and it becomes an important consideration with the increased surface area to volume ratio associated with diameter capillaries.

27. How will you bring about the following transformations?

(a) Nitrobenzene to Aniline

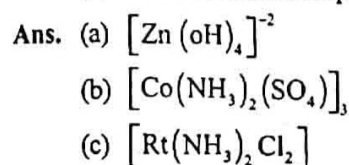
(b) Formaldehyde to Methyl alcohol

(c) Propanone to Tri-iodomethane.



28. Using IUPAC norms write the formulae for the following:

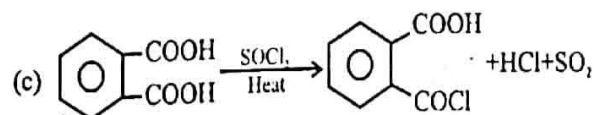
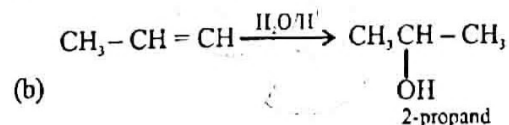
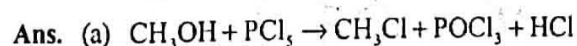
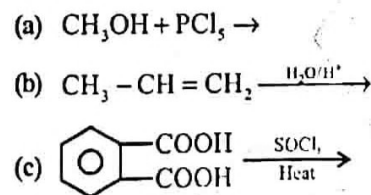
- (a) Tetrahydrozincate (II)
 (b) Hexa amine cobalt (III) sulphate
 (c) Diamine dichloridoplatinum (II)



29. Discuss standard hydrogen electrode.

Ans. A standard hydrogen electrode (SHE) is an electrode that scientists use for reference on all half-cell potential reactions. The value of the standard electrode potential is zero, which forms the basis one needs to calculate cell potentials using different electrodes or different concentrations. SHE is composed of a 10 M $m^+(aq)$ solution containing a square piece of Platinized inside a tube.

30. Predict the product in the following:



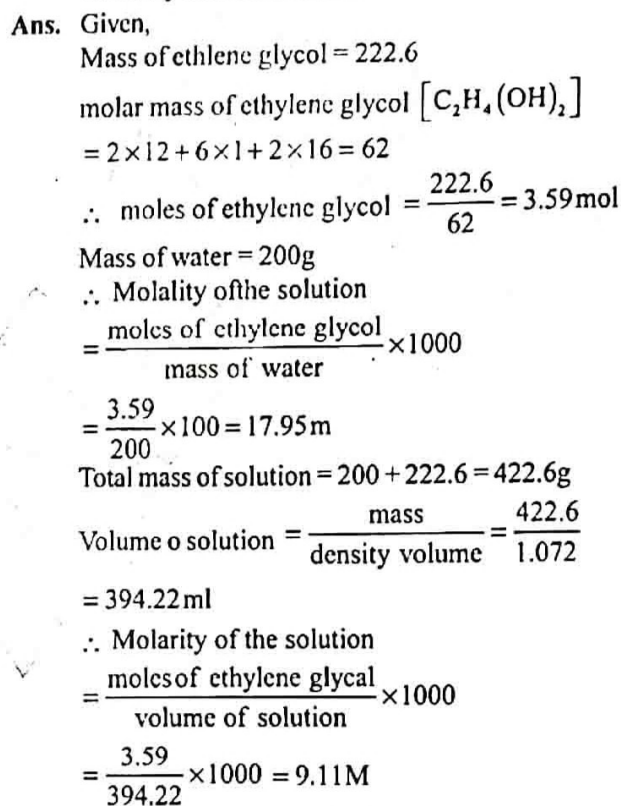
31. Complete the following:

- (a) $Br_2 + NaI \rightarrow$
 (b) $CaF_2 + H_2SO_4 \rightarrow$
 (c) $NH_4Cl(aq) + NaNO_2(aq) \rightarrow$

- Ans. (a) $Br_2 + NaI \rightarrow NaBr + I_2$
 (b) $CaF_2 + H_2SO_4 \rightarrow HF + CaSO_4$
 (c) $NH_4Cl + NaNO_2 \rightarrow N_2 + NaCl + 2H_2O$

(Long Answer Type Questions)

32. An antifreeze solution is prepared from 222.6 g of ethylene glycol, $C_2H_4(OH)_2$ and 200 g of water. Calculate the molality of the solution. If the density of the solution is 1.072 g ml^{-1} then what shall be the molarity of the solution?

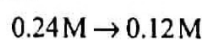


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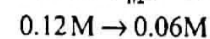
In a particular reduction process, the concentration of a solution that is initially 0.24 M is reduced to 0.12 M in 10 hours and 0.06 M in 20 hours. What is the rate constant of the reaction?

[Given that, $\log 2 = 0.3010$]

Ans. The concentration of the solution changes as shown below:



Time taken = 10 hours
 Half life ($t_{1/2}$) = 10 hours



Time taken = 10 hours
 Half life period, ($t_{1/2}$) = 10 hr.

$\therefore t_{1/2} = C_0^{1-n}$

$t_{1/2} = \left[\frac{(C_0)_1}{(C_0)_2} \right]^{1-n}$

$$\frac{10}{10} = \left(\frac{0.24}{0.12}\right)^{1-n}$$

$$2^{1-n} = 1$$

$$\Rightarrow n = 1$$

Order of reaction = 1

$$\text{Rate constant, } k = \frac{2.303}{t} \log \frac{C_0}{C_t}$$

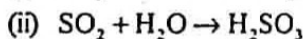
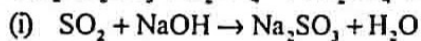
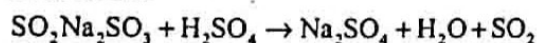
$$= \frac{2.303}{10} \log \frac{0.24}{0.12}$$

$$= 0.0693 \text{ hr}^{-1}$$

33. Give the principle involved in preparation of sulphur dioxide in the laboratory. How does SO_2 react with

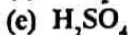
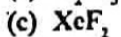
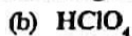
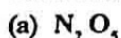
(i) NaOH and (ii) H_2O ?

Ans. In the laboratory, sulphur dioxide is prepared by the reaction of metallic sulphite or a metallic bisulphite with dilute acid. For example, a reaction between the dilute sulphuric acid and sodium sulphite will result in the formation of

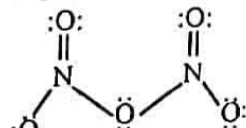


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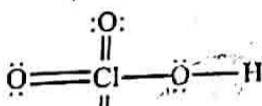
Draw the structures of the following compounds:



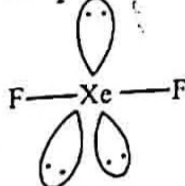
Ans. (a) N_2O_5



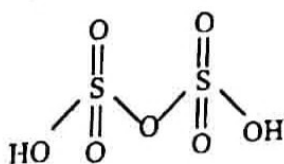
(b) HClO_4



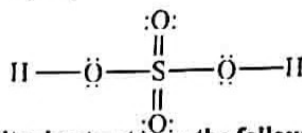
(c) XeF_2



(d) $\text{H}_2\text{S}_2\text{O}_7$



(e) H_2SO_4



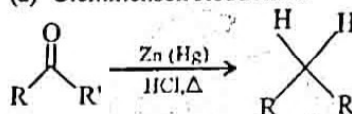
34. Write short notes on the following:

(a) Clemmensen reduction

(b) Wurtz reduction

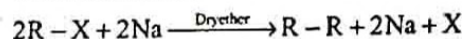
(c) Hell-Vollhard-Zelinsky reaction

Ans. (a) Clemmensen Reduction:



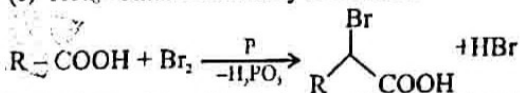
Clemmensen reduction is a chemical reaction described as a reduction ketone or aldehydes to alkanes using zinc amalgam and hydrochloric acid.

(b) Wurtz Reaction:



Wurtz reaction is an organic chemical coupling reaction wherein sodium metal is reacted with two alkyl halides in the environment provided by a solution of dry ether in order to form a higher alkane along with a compound containing sodium and the halogen.

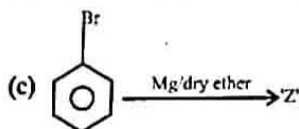
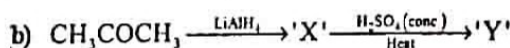
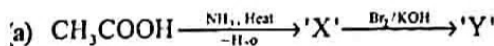
(c) Hell-Vollhard-Zelinsky Reactions:



In the Hell-Vollhard-Zelinsky reaction, a carboxylic acid is treated with bromine in the presence of a catalytic amount of phosphorus which gives the selective alpha-brominating of carboxylic acids.

OR

Identify 'X', 'Y' and 'Z' in the following:



Ans.

