CBSE Class 11 chemistry

Sample Paper- 05

Time Allowed: 3Hrs M.M. : 70

General Instructions :

i. All questions are compulsory.
ii. Q. No. 1 to 5 are very short answer type questions and carry one mark each.
iii. Q. No. 6 to 10 are very short answer type questions and carry two marks each.
iv. Q. No. 11 to 22 are short answer type questions and carry three marks each.
v. Q. No. 23 is value based questions carries four marks.
vi. Q. No. 24 to 26 are long answer type questions and carry five marks each.
vii. Use log tables, if necessary, use of calculator is not allowed.

1. Define limiting reagent
2. Write the general electronic configuration of d-block elements?
3. Write vander Waal's equation for n moles of a real gas.
4. What is the state of hybridisation of each carbon atom in C_6H_6?
5. Predict the sign of the entropy change (ΔS) for the following:
   $H_2O(g) \rightarrow H_2O(l)$
6.
   i. Define Pauli's exclusion principle.
   ii. Write electronic configuration of an atom having 2K, 8L, 5M electrons.

   Or

   The mass of an electron is 9.1 x 10^{-31} kg. If its kinetic energy is 3.0 x 10^{-25} J. Calculate its wavelength. (Given h = 6.626 x 10^{-34} Js)
7. The concentration of hydrogen ion in a sample of soft dark is 3.8 x 10^{-3} M. What is its pH ? (log 3.8 = 0.58)
8. What happens when (write equation only):
   i. Beryllium carbide reacts with water.
   ii. Sodium sulphate solution is added to an aqueous solution of barium nitrate.

9. Propanal and Pentan-3-one are the ozonolysis product of an alkene. What is the structural formula of the alkene?
10. Write reactions to justify amphoteric nature of aluminium.
11.
    a. Write the IUPAC name of the following:
    i. 

    ii. $CH_3 - \underset{\underset{CH==CH_2}{|}}{CH} - CH_2 - CH == CH_2$
    b. Which isomerism is shown by following pair of compounds:
    CH_3COOH and $HCOOCH_3$
12. Account for the following:
    a. An anion is always bigger than its present atom.
    b. Chlorine (Cl) has move negative electron gain enthalpy the fluorine (F).
    c. Noble gases have positive electron gain enthalpy.
13. Give the shapes of following covalent molecules using VSEPR theory:
    i. PCI_5
    ii. BrF_3
    iii. H_2O
14. A sample of drinking water was found to be severely contaminated with chloroform $CHCl_3$, supposed to be carcinogen. The level on contamination was 15 ppm (by mass).
    i. Express this in percent by mass.
    ii. Determine the molality of chloroform in the water sample.
15.
    a. State Hess's law.
    b. Use standard enthalpies of formation, calculate the value of ΔrH^{Θ} for the reaction.
    $2H_2S\,(g) + 3O_2\,(g) \rightarrow 2H_2O\,(l) + 2SO_2\,(g)$

$\Delta f H^{\Theta}\left[H_2O\left(l\right)\right] = -285.83 kJ/mol$
$\Delta f H^{\Theta}\left[H_2S\left(g\right)\right] = -21.17 kJ/mol$
$\Delta f\ H^{\Theta}\left[SO_2\left(g\right)\right] = -296.86\ kJ/mol$

16.

a. The molecular orbital theory to predict why the BE molecule does not exist.
b. Compare the stability of O_2^+ and O_2 on the basis of M.O. theory.

17.

a. Calculate the total pressure in a mixture of 8g of oxygen and 4g of hydrogen confined in a vessel of 1 dm^3 at 27°C.
   Given R = 0.083 bar dm^3 K^{-1} mol^{-1}
b. Criticial temperature of CO_2 and CH_4 are 31.1°C and - 81.9°C respectively. Which of there has stronger intermolecular forces and why?

Or

a. What would be the S.I. units of a quantity PV^2T^2/n ?
b. Calculate the temperature of 4.0 moles of a gas occupying 5 dm^3 at 3.32 bar (R= 0.083 bar dm^3 K^{-1} mol^{-1})

18.

a. What is the oxidation no. of Cr. in $Cr_2O_7^{2-}$?
b. Balance the equation:$MnO_4^- + Fe^{2+} \rightarrow Fe^{3+} + Mn^{2+} + H^+$ (Acidic medium)

19. Complete the following chemical reactions.
a. $PbS(s) + H_2O_2(aq) \rightarrow$
b. $MnO_4^-(aq) + H_2O_2(aq) \rightarrow$
c. $Ca_3N_2 + H_2O \rightarrow$

20. Give reason for the following:
a. $PbCl_4$ is a powerful oxidising agent.
b. Graphite acts as a good lubricant.
c. Boron halides don't dimerise like BH_3

21.

a. Draw the structure of (i) $BeCl_2$ (vapour) and (ii) $BeCl_2$ solid
b. Complete the equation:

$Cl_2 + Ca(OH)_2 \rightarrow$

22. Arrange the following in order of property mentioned against each:
    a. $(CH_3)_3\overset{\oplus}{C}, CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{\overset{\oplus}{C}}H, CH_3 - CH_2 - CH_2 - \overset{\oplus}{C}H_2$

    (increasing order of stability)
    b. HCOOH, CH_3COOH, CH_3CH_2COOH (Increasing acidic strength)
    c. $\overset{\bullet}{C}H_3, CH_3 - \overset{\bullet}{C}H - CH_3 - \underset{\underset{CH_3}{|}}{\overset{CH_3}{\overset{|}{C}}}$

Value Based Questions

23. Environmental pollution is causing a serious threat on the earth. Due to combustion of fossil fuels, a number of poisonous and harmful gases enter into the atmosphere. Every country has made strict laws for industries and individual citizens to keeps pollution under control.

    Now answer the following questions:
    a. Why is it advised not to sleep with burning coke angithi in a closed room on winter nights?
    b. What does the combustion of motor fuels cause pollution of the atmosphere?
    c. Name one natural source and one human activity by which SO_2, enters into atmosphere?

24.
    a. Explain the following with example:
        i. Common ion effect
        ii. Buffer solution.
    b. At a certain temperature and total pressure of 10^5 Pa, iodine vapours contains 40% by volume of I atoms.

    $I_2(g) \rightleftharpoons 2I\,(g)$

    Calculate K_p for the equilibrium.

Or

a. Define Le- Chatelier's principle.
b. Define pH.
c. Equilibrium constant for the reason is 4.0. What will be the equilibrium constant for the reverse reaction.
d. Calculate the pH of 10^{-8} M HCl solution.

25.

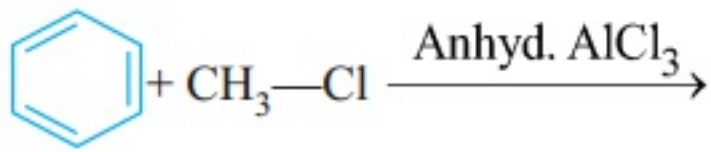
a. Define Heisenberg's uncertainty principle. Write its mathematical expression.
b. Calculate the uncertainty in the velocity of a cricket ball on mass 150 g. If the uncertainty in its position is of the order of 1 $\overset{o}{A}$.
(h = 6.6 x 10^{-34} Kg m^2s^{-1})

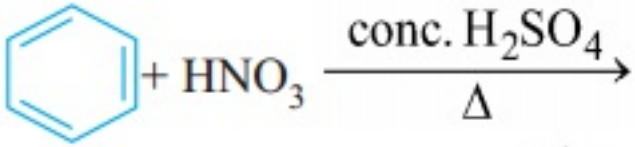
Or

a. Which of the following orbitals are not possible
1p, 2s, 2p, 3S
b. Which of the following sets of quantum number are not possible? Give reasons.
i. n = 0, l = 0, ml = 0, ms = +1/2
ii. n = 1, l = 0, ml = 0, ms = -1/2
c. Electrons are emitted with zero velocity from a metal surface when it is expressed to radiation of wavelength $6800\overset{o}{A}$. Calculate threshold frequency (υ_0) and work function (ω_0) of the metal.

26.

a. Define the following with example:
i. Wurtz reaction
ii. Markovnikoff's Rule.
b. Give the main product of the region:

i. 

ii. 

iii. $CH_3 - \underset{\underset{CH_3}{|}}{C} = CH_2 + H_2O \xrightarrow{\Delta}$

Or

a. How can you convert the following:
   i. Propan-1-ol to propan-2-ol
   ii. Ethyl chloride to n-Butane

b. Complete the following reactions:
   i. $CH_3 - CH = - = CH_2 + HBr \xrightarrow{Peroxide}$
   ii. $CH_3 - Cl + Na \xrightarrow[Ether]{Dry}$
   iii. $CH_3 - \underset{\underset{Cl}{|}}{C}H == CH_2 - CH_3 \xrightarrow[\Delta]{alc.KOH}$

Answers

1. The reactant which is completely consumed during the reaction is called limiting reagent.
2. (n - 1)$d^{1\text{-}10}$ $ns^{1\text{-}2}$.
3. $\left[P + \frac{an^2}{V^2}\right](V - nb) = nRT$
4. sp^2 hybridisation.
5. -ve, as randomners decrease.
6.
   a. No two e^- in an atom can have same set of all the four quantum numbers.
   b. Total e^- = 15

      E.C. = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

      Or

      $K.E. = \frac{1}{2}mv^2$

      $V = \left(\frac{2 \times K.E.}{m}\right)^{1/2} = \left(\frac{2 \times 3 \times 10^{-25} kg\ m^{+2} s^{-2}}{9.1 \times 10^{-31} kg}\right)^2$

      $V = 8.12 \times 10^2\ m/s = 812\ m/s$

      $\lambda = \frac{h}{mv}$

      $= \frac{6.626 \times 10^{-34} Js}{(9.1 \times 10^{-31} kg)(812 ms^{-1})} = 896.7\ nm$

pH = -log [H^+]

$= -\log\left(3.8 \times 10^{-3}\right)$

= -log 3.8 = 3 = 3 - 0.58

=2.42

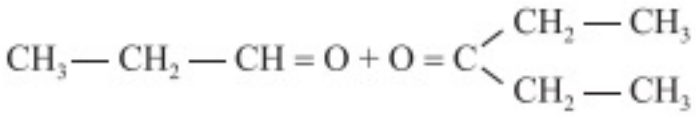
i. $Be_2C + 4H_2O \rightarrow 2Be(OH)_2 + CH_4$

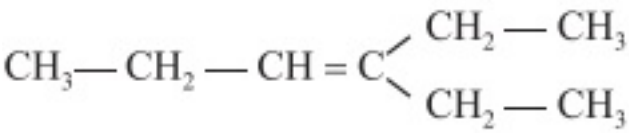
ii. $Na_2SO_4 + Ba(NO_3)_2 \rightarrow BaSO_4\downarrow + 2NaNO_3$

7.

8.

9.





10. $\Delta H^\circ = \Delta E^\circ + \Delta ngRT$

$\Delta H^\circ = -10500 - 2477.57\ J$

$\Delta H^\circ = -12977.57\ J/mol$

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

= -12977.57 + 13141.8

$\Delta G^\circ = 0.164\ KJ$, Process is non-spontaneous

11.

a.

i. 4-Nitro benzoi acid

ii. 3-Methyl hexa-1, 5-diene

b. Functional isomerism

12.

a. Because nuclear charge decrease/e^- increase.

b. Because of bigger size of chlorine/less e^- - e^- repulsion as compared to fluorine.

c. Because they have fully filled orbitals.

13.

a. Trigonal bipyramidal.

b. Bent T-shape

c. Bent/V-shape

14.

a. 15 ppm means 15 parts in million (10^6) parts.a
$\therefore\ \%\ by\ mass = \frac{15}{10^6} \times 100 = 15 \times 10^{-4} = 1.5 \times 10^{-3}\%$

b. Molar mass of $CHCl_3$ = 119.5 g/mol

100 g of sample contain chloroform = $1.5 \times 10^{-3}\ g$
$\therefore$ 1000 g of sample contain = $\frac{1.5 \times 10^{-3}}{100} \times 100 = 1.5 \times 10^{-3} g$
Molality of chloroform = $\frac{1.5 \times 10^{-2}}{119.5 \times 1} = 1.255 \times 10^{-4}$
$\therefore$ Molality $1.255 \times 10^{-4} m$

15.

a. $2Al(s) + 3H_2SO_4\ (aq) \rightarrow Al_2(SO_4)_3\ (aq) + 3H_2(g)$

b. $2Al(s) + 2NaOH\ (aq) + 6H_2O(l) \rightarrow 2Na^+[Al(OH)_4]^-\ (aq) + 3H_2(g)$ Sodium tetrahydroxo aluminate (III)

16.

a. Be: $\sigma 1s^2 \sigma * 1s^2 \sigma 2s^2 \sigma * 2s^2$
Bond order = $\frac{N_b - N_a}{2} = \frac{4-4}{2} = 0$
As bond order of Be_2 is zero and does not exist.

b. $O_2 : B.O = \frac{N_b - N_a}{2}$
$= \frac{10-6}{2} = 2$
$O_2^+ : B.O = \frac{N_b - N_a}{2}$
$= \frac{10-5}{2} = 2.5$
$O_2^+ > O_2$
Greater the bond order, move will be stability.

17.

a. $n_{O_2} = \frac{8}{32} = 0.25 mol$
$n_{H_2} = \frac{4}{2} = 2 mol$
Total no of moles = 2+ 0.25 = 2.25 mol

V = 1 dm^3, T = 300 K, R = 0.083 bar dm3 K^{-1} mol^{-1}

PV = nRT
$P = \frac{nRT}{V}$
$= \frac{2.25 mol \times 0.083 bar\ dm^3 K^{-1} mol^{-1} \times 300 K}{1 dm^3}$
P = 56.025 bar

b. CO_2 has stronger intermolecular forces because it can be liquiefied at temperature upto $31.1^\circ C$ but CH_4 can be liquefied only upto $-81.9^\circ C$.

$$\frac{PV^2T^2}{V} = \frac{(Nm^{-2})(m^3)^2(K^2)}{mol} = Nm^4K^2mol^{-1}$$

$$PV = nRT \text{ or } T = \frac{PV}{nR}$$

$$T = \frac{3.32\times5}{4\times0.083} = 50\ K$$

18.

a. x = 6

b. $5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{+2} + 4H_2O$

19.

a. $PsB + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

b. $2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{+2} + 8H_2O + 5O_2$

c. $Ca_3N_2 + 6H_2O \rightarrow Ca(OH)_2 + 2NH_3$

20.

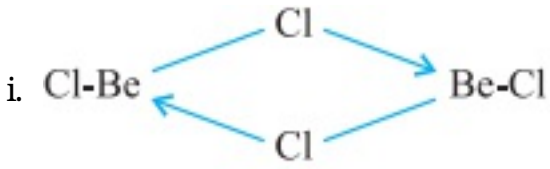
a. Because Pb^{+4} is reduced to more stable Pb^{+2}.

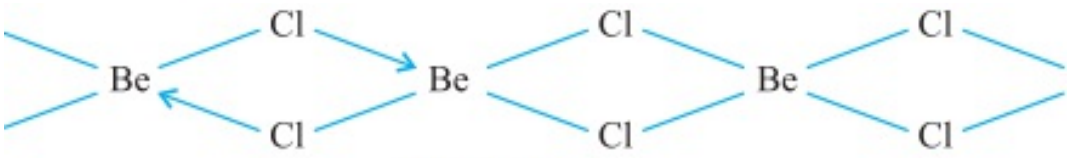
b. Because of its soft and slippery nature.

c. Boron due its small size cannot four large size chlorine atoms around it and hence exists as monomer.

21.

a.

i. 

ii. 

Solid State

b. $Cl_2 + \underset{Slaked\ lime\ powder}{2Ca(OH)_2} \rightarrow \underset{Bleaching}{Ca(OCl)_2} + H_2O + CaCl_2$

22.

a. $CH_3CH_2CH_2\overset{\oplus}{C}H_2 < CH_3CH_2\overset{\oplus}{\underset{CH_3}{\underset{|}{C}}}H < (CH_3)_3C^+$

$\longrightarrow$

$Increasing\ acidic\ strength$

b. $\xrightarrow[increasing\ acidic\ strength]{CH_3CH_2COOH<CH_3COOH<HCOOH}$

c. $\xrightarrow[increasing\ order\ of\ stablity]{\dot{C}H_3<CH_3\dot{C}HCH_3<CH_3-\underset{CH_3}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}}\bullet}$

23.

a. On burning coke, a lot of CO is produced which causes anoxia.
b. On burning motal-fuels, toxic oxides of nitrogen is formed which affect respiratory system.
c. Due to volcanic eruption and through combustion of sulphur containing fuels.
d. Concern for environment

24.

a.

i. It is the shift in an ionic equilibrium caused by the addition of a solute that provides caused by the addition of a solute that provides an ion that takes part in the equilibrium.
ii. The solution which resist the change in pH on dilution/addition of acid or alkali.

b. Partial pressure of I atom (P_I) $= \frac{40}{100} \times 10^5 = 0.4 \times 10^5 Pa$

Partial pressure of I_2 atom (P_{I2}) $= \frac{60}{100} \times 10^5 = 0.6 \times 10^5 Pa$

$$K_P = \frac{[P_I]^2}{[P_{I_2}]} = \frac{(0.4\times10^5)^2}{(0.6\times10^5)} = 2.67 \times 10^4\ Pa$$

i. Correct statement.
ii. negative logarithm of hydrogen ion concentration.
iii. $\frac{1}{4}$
iv. 10^{-8} M HCl

$[H^+] = 10^{-8} + 10^{-7}$

[$\because$ $[H^+]$ conc. due to water = 10^{-7}]

Or $[H^+] = 11 \times 10^{-8} \Rightarrow$ PH = - log[11 x 10^{-8}]

= 8 - 1.02 = 6.98

25.

a. It is impossible to measure simultaneously both the position and velocity of a microscopic particle with accuracy or certainty.

Mathematically expression $\Delta x \times \Delta p \geqslant \frac{h}{4\pi}$

b. Mass of ball m = 150 g

= 150 x 10^{-3} kg = 0.150 kg

Uncertainty in position $\Delta x = 1\overset{o}{A} = 10^{-10}m$

$\Delta x.\Delta V \times m = \frac{h}{4\pi}$

$\Delta V = \frac{h}{4\pi \times \Delta x \times m}$

$= \frac{6.626 \times 10^{-34} kg\ m^2 s^{-1}}{4 \times 3.14 \times 10^{-10} m \times 0.150 kg}$

= 3.52 x 10^{-24} m s^{-1}.

Or

a. 1p as n = l, not possible.

b. (i) n = 0, l = 0, ml = 0, ms = +1/2 not possible because n cannot be zero.

c. Energy of photon $= \frac{hc}{\lambda}$

$= \frac{6.63 \times 10^{-34} Js \times 3 \times 10^8 ms^{-1}}{6800 \times 10^{-10} m}$

= 2.93 x 10^{-19} J

Energy of photon = K.E. + W_0 = 0 + W_0 = W_0

W_0 = 2.93 x 10^{-19} J

Threshold frequency $v_0 = \frac{c}{\lambda_0} = \frac{3 \times 10^8 ms^{-1}}{6800 \times 10^{-10} m} = 4.41 \times 10^{14} s^{-1}$

26.

a.

i. It involves the chemical reaction between alkylhalides and metallic sodium in presence of dry ether and from alkanes.

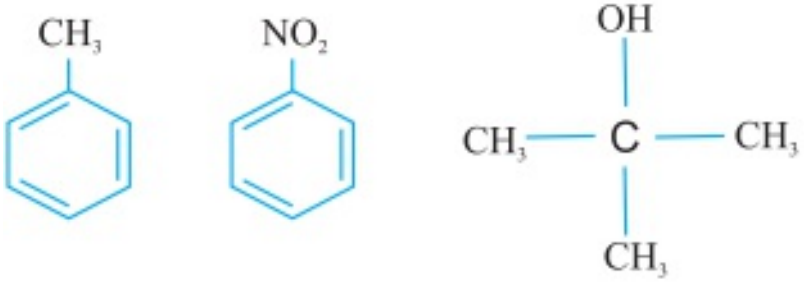
$2R \rightarrow X + 2Na \xrightarrow{Dry\ ether} R - R + 2NaX$

ii. It states that more electronegative part of the addendum adds to that carbon of double bond which contains lesser no. of H-atoms.

$CH_3 - CH = CH_2 \xrightarrow{HCl} CH_3 - \overset{\overset{Cl}{|}}{C}H - CH_3$

b.

i.



Or

a.

i. C{H_3}C{H_2}C{H_2}OH\xrightarrow[\Delta]{{alc.KOH}}C{H_3}CH = C{H_2

$\xrightarrow[H_2O,\Delta]{} CH_3 - \overset{OH}{\overset{|}{C}}H - CH_3$

ii. $2C_2H_5Cl + 2Na \xrightarrow{dry\ ehter} CH_3CH_2CH_2CH_3$

b.

i. $CH_3CH_2CH_2BR$

ii. CH_3 - CH_3

iii. CH_3-CH=CH-CH_3