CBSE Class 11 Chemistry

Sample Paper 10 (2019-20)

Maximum Marks: 70

Time Allowed: 3 hours

General Instructions:

a. All questions are compulsory.
b. Section A: Q.no. 1 to 16 are very short answer questions (objective type) and carry 1 mark each.
c. Section B: Q.no. 17 to 23 are short answer questions and carry 2 marks each.
d. Section C: Q.no. 24 to 30 are long answer questions and carry 3 marks each.
e. Section D: Q.no. 31 to 33 are also long answer questions and carry 5 marks each.
f. There is no overall choice. However, an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
g. Use log tables if necessary, use of calculators is not allowed.

Section A

1. The molecular orbital theory is based on the principle of a linear combination of atomic orbitals. According to this approach when atomic orbitals of the atoms come closer, they undergo constructive interference as well as destructive interference giving molecular orbitals, i.e., two atomic orbitals overlap to form two molecular orbitals, one of which lies at a lower energy level (bonding molecular orbital). Each molecular orbital can hold one or two electrons in accordance with Pauli's exclusion principle and Hund's rule of maximum multiplicity. For molecules up to N_2, the order of filling of orbitals is:
$\sigma(1s)^*_\sigma(1s), \sigma(2s)^*_\sigma(2s), \pi(2p_x) = \pi(2p_y), \sigma(2p_z), ^*_\pi(2p_x) = \overset{*}{\pi}(2p_y), \overset{*}{\sigma}(2p_z)$
and for molecules after N_2, the order of filling is:
$\sigma(1s)^*_\sigma(1s), \sigma(2s)^*_\sigma(2s), \sigma(2p_z), \pi(2p_x) = \pi(2p_y), ^*_\pi(2p_x) = \overset{*}{\pi}(2p_y), \overset{*}{\sigma}(2p_z)$

Bond order $= \frac{1}{2}$ [bonding electrons - antibonding electrons]
Bond order gives the following information:

I. If bond order is greater than zero, the molecule/ion exists otherwise not.
II. Higher the bond order, higher is the bond dissociation energy.
III. Higher the bond order, grater is the bond stability.
IV. Higher the bond order, shorter is the bond length.

Answer the following question:

i. Arrange the following negative stabilities of CN, CN^+ and CN^- in increasing order of
[Hint: Bond order: CN = $\frac{9-4}{2} = 2.5; CN^- = \frac{10-4}{2} = 3; CN^+ = \frac{8-4}{2} = 2$]
ii. The molecular orbital theory is preferred over valence bond theory. Why?
iii. O_2^{2-} will have bond order ________ than O_2 and bond order ________ to H_2.
iv. In which set of molecules all the species are paramagnetic?
   a. B_2, O_2, N_2
   b. B_2, O_2, NO
   c. B_2, F_2, O_2
   d. B_2, O_2, Li_2
v. Bonding molecular orbital is lowered by a greater amount of energy than the amount by which antibonding molecular orbital is raised. (True/False)

2. An electron beam after hitting a neutral crystal produces a diffraction pattern? What do you conclude?

3. The radius of Na^+ cation is less than that of Na atom. Give reason.

4. Predict the sign of ΔS for the following reaction
$$\mathrm{CaCO_3(s) \xrightarrow{heat} CaO(s) + CO_2(g)}$$

5. What happens when gypsum is heated to 390K?

6. Which is the largest air pollutant in the urban atmosphere?

7. In the following reaction sequence:

$Cl - Cl \rightarrow \dot{C}l + \dot{C}l$ .... (i)

$CH_4 + \dot{C}l \rightarrow \dot{C}H_3 + HCl$ .... (ii)

$\dot{C}H_3 + Cl_2 \rightarrow CH_3Cl + \dot{C}l$ ... (iii)

$\dot{C}H_3 + \dot{C}H_3 \rightarrow CH_3 - CH_3$ .... (iv)

The terminating step is:

a. Reaction (iv)

b. Reaction (i)

c. Reaction (ii)

d. Reaction (iii)

8. Hydrogen is prepared from H_2O by adding

a. AI, which acts as oxidising agent

b. Au, which acts as oxidising agent

c. Ca, which acts as reducing agent

d. Ag, which acts as reducing agent

9. Which of the following gases will have the lowest rate of diffusion?

a. F_2

b. O_2

c. N_2

d. H_2

10. Consider the elements: Cs, Ne, I and F. Identify the element(s) that exhibits only Positive oxidation state

a. Cs

b. Ne

c. I

d. Cs and I

11. During hearing of a court case, the judge suspected that some changes in the documents had been carried out. He asked the forensic department to check the ink used at two different places. According to you which technique can give the best results?

    a. Thin-layer chromatography

    b. Distillation

    c. Solvent extraction

    d. Column chromatography

12. **Assertion:** Carbon dioxide has linear geometry involving sp hybridisation of C.
    Reason: Dry ice is solid CO_2.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    c. Assertion is CORRECT but, reason is INCORRECT.

    d. Assertion is INCORRECT but, reason is CORRECT.

13. **Assertion:** Both 32 g of SO_2 and 8 g of CH_4 contain the same number of molecules.
    Reason: Equal moles of two compounds contain the same number 0 molecules.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

14. **Assertion:** Oxidation number of phosphorus in P_4 is zero.

    Reason: Phosphorus has oxidation state zero in all its compound.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    c. Assertion is CORRECT but, reason is INCORRECT.

    d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** Acetylene is more acidic than ethylene.
    Reason: Acetylene has sp character of carbon and, therefore, more s-character.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    c. Assertion is CORRECT but, reason is INCORRECT.

    d. Assertion is INCORRECT but, reason is CORRECT.

16. **Assertion:** Liquefaction of H_2 and He are very difficult.

    Reason: Critical temperature of H_2 and He gases are high.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. Compare the relative stabilities O_2^- and N_2^+ and comment on their magnetic (paramagnetic or diamagnetic) behaviour.

18. Arrange the following metals in the order in which they displace each other from the solution of their salts.
Al Cu, Fe, Mg, and Zn

19. In what ways lithium shows similarities to magnesium in its chemical behaviour?

20. Cyclobutane is less reactive than cyclopropane. Justify.

21. The concentration of H^+ in a soft drink is 3.8×10^{-3} M. What is its pH?

OR

Using VSEPR theory, draw the molecular structures of OSF_4 and XeF_4 indicating the location of lone pair(s) of electrons and hybridization of central atoms.

22. Why does SO_3 act as an electrophile?

OR

Explain how is enthalpy related to spontaneity of a reaction.

23. All the four C-H bonds in methane are identical. Give reasons.

Section C

24. Two moles of an ideal gas initially at $27^\circ C$ and one atmospheric pressure are compressed isothermally and reversibly till the final pressure of the gas is 10 atm. Calculate q, W and ΔU for the process.

25. Arrange the following compounds in the increasing order of bond length of O-O bond O_2, O_2[As F6], KO_2.

Explain on the basis of the ground-state electronic configuration of dioxygen in these molecules.

OR

Assuming complete dissociation, calculate the pH of the following solutions: (a) 0.003 M HCl (b) 0.005 M NaOH (c) 0.002 M HBr (d) 0.002 M KOH

26. Consider the elements:
Cs, Ne, I and F

i. Identify the element that exhibits only a negative oxidation state.
ii. Identify the element that exhibits only a positive oxidation state.
iii. Identify the element that exhibits neither the negative nor does the positive oxidation state.

27. Give reasons for the following:

i. The size of weather balloon becomes larger and larger as it ascends into higher altitudes.
ii. Tyres of automobiles are inflated to lesser pressure in summer than in winter.

28. i. Calculate the gram molecular mass of sugar having molecular formula $C_{12}H_{22}O_{11}$.
ii. Calculate
   a. The mass of 0.5 g molecule of sugar and
   b. Gram molecule of sugar in 547.2 g.

29. The first (IE_1) and the second (IE_2) ionization enthalpies (kJ mol-1) of a few elements designated by Roman numerals are shown below:

Element	**IE_1**	**IE_2**
I	2372	5251
II	520	7300
III	900	1760

IV	1680	3380

Which of the above elements is likely to be

i. a reactive metal
ii. a reactive non-metal
iii. a noble gas
iv. a metal that forms a stable binary halide of the formulae AX_2 (X = halogen).

OR

The electronic configuration of some elements are given below:

a. $1s^2, 2s^2, 2p^6, 3s^2$
b. $1s^2, 2s^2, 2p^6$
c. $1s^2, 2s^2, 2p^2$
d. $1s^2, 2s^2, 2p^6, 3s^1$
e. $1s^2, 2s^2, 2p^5$

Answer the following questions:

i. Name the elements.
ii. Which of these have the lowest Ionization enthalpy?
iii. Which is a halogen?
iv. Which is an alkali metal?
v. Which is an inert gas?

30. What are the major causes of water pollution? Explain.

Section D

31. Predict the product of electrolysis in each of the following:

i. An aqueous solution of $AgNO_3$ with silver electrodes
ii. An aqueous solution of $AgNO_3$ with platinum electrodes
iii. An aqueous solution of H_2SO_4 with platinum electrodes

iv. An aqueous solution of $CucI_2$ with platinum electrodes

OR

Complete the following equations:

i. Fe (s) + H_2O (g) $\rightarrow$

ii. Pbs (s) + H_2O_2 (aq) $\rightarrow$

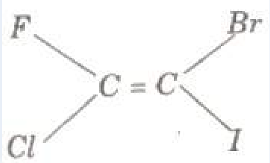
iii. MnO_4^- (aq) + H_2O_2 (aq) $\rightarrow$

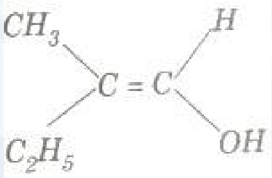
iv. CuO (s) + H_2 (g) $\rightarrow$

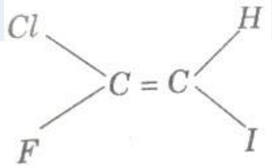
v. CO (s) + H_2 (g) $\rightarrow$

32. i. Draw cis and trans isomers of hex-2-ene. Which isomer will have higher boiling point and why?

ii. Classify the following as Z or E isomers:

a. 

b. 

c. 

OR

i. Arrange the following alkenes in the decreasing order of stability:

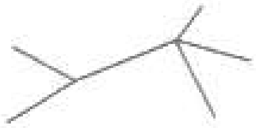
a.
$$\begin{array}{l} \quad\quad CH_3 \\ \quad\quad | \\ CH_3C = CHCH_3 \end{array}$$

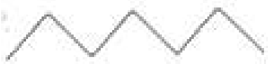
b.
$$\begin{array}{l} \quad\quad CH_3 \\ \quad\quad | \\ CH_3CHCH = CH_3 \end{array}$$

c.
$$\begin{array}{l} \quad\quad CH_3 \\ \quad\quad | \\ CH_3 = CCH_2CH_3 \end{array}$$

ii. Arrange the following in decreasing order of their release of energy on combustion:

a. 

b. 

c. 

d. 

iii. Arrange the following set of compounds in order of their decreasing relative reactivity with an electrophile, E^+.

a. chlorobenzene, 2,4 -dinitrochlorobenzene, p -nitrochloro benzene
b. toluene, p-H_3C-C_6H_4-CH_3, p-H_3C-C_6H_4-NO_2, p-O_2N-C_6 H_4-NO_2

33. In the Rydberg equation, a spectral line corresponds to n_1 = 3 and n_2 = 5

i. Calculate the wavelength and frequency of this spectral line.
ii. To which spectral series does this line belong?
iii. In what region of the electromagnetic spectrum, will this line fall?

OR

i. Calculate the atomic mass (average) of chlorine using the following data :

	% natural abundance	Molar mass
^{35}CI	75.77	34.9689
CI	24.23	36.9659

ii. In three moles of ethane (C_2H_6), calculate the following:

a. Number of moles of carbon atoms
b. Number of moles of hydrogen atoms
c. Number of molecules of ethane

Solution
Section A

1. i. The increasing order of negative stabilities of CN, CN^+ and CN^- is $CN^+ > CN > CN^-$.
   ii. The molecular orbital theory is preferred over valence bond theory because molecular orbital theory explains the magnetic nature of the molecule.
   iii. Lower than O_2 and equal to H_2.
   iv. Option (b) B_2, O_2, NO is correct where all the species are paramagnetic.
   v. The given statement is false because the bonding molecular orbital is lowered by a lesser amount of energy than the amount by which antibonding molecular orbital is raised.

2. Electron has wave nature.

3. The cations are smaller than their parent atom because they have lesser electron than parent atom but nuclear charge remain same. Therefore, remaining electrons held more tightly by the nucleus and thus their radii are smaller than parent atoms.

4. ΔS is positive.

5. When gypsum is heated to 390K, Plaster of paris is formed.
   Reaction
   $2(CaSO_4.2H_2O) \xrightarrow{390K} 2(CaSO_4).H_2O + 3H_2O$

6. Carbon monoxide is the largest air pollutant in the urban atmosphere.

7. (a) Reaction (iv)
   Explanation: Reaction (iv)
8. (c) Ca, which acts as reducing agent
   Explanation: Calcium is a silvery-white metal; it is relatively soft, but much harder than sodium metal. Calcium is a member of the alkaline-earth metals (Group II on the periodic table); these metals react vigorously with water, although not as violently as

the Group I metals such as sodium or potassium:

$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$

9. (a) F_2

   Explanation: This question is based on the application of Graham's law for rate of diffusion of gases. According to Graham's law, "Diffusion rate of a gas is inversely proportional to the square root of its molar mass (molecular weight)".

10. (a) Cs

    Explanation: Cs is alkali metal so will show positive oxidation state of +1.

11. (a) Thin-layer chromatography

    Explanation: Thin-layer chromatography (TLC) is an adsorption chromatography, which involves separation of substances of a mixture over a thin layer of an adsorbent coated on glass plate. It is used to separate the pigments of the ink and will give the best results.

12. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

13. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

14. (c) Assertion is CORRECT but, reason is INCORRECT.

    Explanation: Assertion is CORRECT but, reason is INCORRECT.

15. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

16. (c) Assertion is CORRECT but, reason is INCORRECT.

    Explanation: Assertion is CORRECT but, reason is INCORRECT.

Section B

17. i. O_2^-

    Number of electrons = 17

Electronic configuration = $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$
$\pi 2p_x^2 \approx \pi 2p_y^2, \pi^* 2p_x^2 \approx \pi^* 2p_y^1$
Bond order = $\frac{1}{2}$ (10 - 7) = 3/2 = 1.5
Magnetic property: Paramagnetic.

ii. N_2^+
Number of electrons = 13
Electornic configuration = $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_2^1$
Bond order = $\frac{1}{2}$ (9 - 4) = 5/2 = 2.5
Magnetic property: Paramagnetic.

It is evident from the above calculation that the bond order of N_2^+ (2.5) is greater than the bond order of O_2^- (1.5). Hence, N_2^+ is more stable than O_2^- . Again each of them contains an unpaired electron, hence both are paramagnetic.

18. It is based upon the relative positions of these metals in the activity series.

The correct order of the metals in which they displace each other from their salt solution is

Mg, Al, Zn, Fe,Cu

19. i. Li and Mg both react with nitrogen to form nitrides, Li_3N and Mg_3N_2 respectively.
ii. Li and Mg both react with O_2 to form monoxides.
iii. Li and Mg have the tendency to form covalent compounds.
iv. The carbonates of Li and Mg decompose easily on heating to form the oxides and CO_2.

20. In cyclobutane molecule, the C-C-C bond angle is 90^0 while it is 60^0 in cyclopropane. Thus, the deviation from the tetrahedral bond angle (109^0 28') in cyclobutane is less than in cyclopropane. Therefore, cyclobutane has less bond strain as compared to cyclopropane and thus, cyclobutane is less reactive as compared to cyclopropane.

21. Given , $[H^+] = 3.8 \times 10^{-3}$ M
We know that,

pH = - log $[H^+]$

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

= - [log 3.8 + log 10^{-3}]

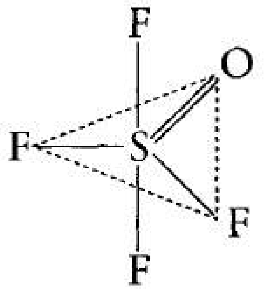
= - [0.5798 - 3]

= - 0.5798 + 3

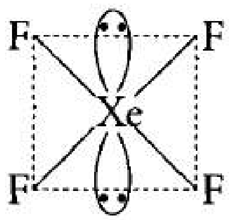
= 2.42

OR

The structures of OSF_4 and XeF_4 are shown below:



Trigonal bipyramidal
(sp^3d hybridisation)



Square planar
(sp^3d^2 hybridisation)

22. SO_3 acts as an electrophile because three highly electronegative oxygen atoms are attached to Sulphur atom in SO_3 which makes sulphur atom electron deficient.

OR

Enthalpy (H) is a measure of how much energy is released or absorbed during a chemical reaction. A spontaneous reaction may involve an increase or decrease in enthalpy.
The burning of a substance is a spontaneous process.
Example:
C(s) +O_2(g) $\rightarrow CO_2(g); \Delta \mathrm{H} = -394 \mathrm{kJmol}^{-1}$
The majority of the exothermic reactions are spontaneous because there is a decrease in energy.
Many spontaneous reactions proceed with the absorption of heat. Conversion of water into water vapour is an endothermic spontaneous change.
Thus, change in enthalpy is not the only criterion for deciding the spontaneity of a reaction.

23. In case of methane, each H atom has an equal share of the electrons bonding them to the C atom and are formed by the overlapping of the same type of orbital i.e; hybrid orbital's of carbon and s-orbital of hydrogen. This means all four H atoms that are separated from each other by the same angle and separated from the C atom by the same distance. Hence, all the C-H bonds in methane are identical to one another.

Section C

24. According to the question, n = 2, T = 27°C = 300 K, p_1 = 1 atm, p_2 = 10 atm

We know that, W(compression) = $2.303nRT\log\frac{p_2}{p_1}$

$= 2.303 \times 2 \times 8.314\mathrm{JK}^{-1}mol^{-1} \times 300\mathrm{K} \times \log\frac{10}{1}$

$= 11488.28$ J

We know that, $\Delta U = q + W$

For isothermal compression of ideal gas, $\Delta U = 0$

$\therefore q = -W$

$= -11488.28$ J

25. $O_2[AsF_6]$ has O_2^+ ion while KO_2 has O_2^- ion.

E.C. of O_2 = $KK\sigma(2s)^2\dot{\sigma}(2s)^2\sigma(2p_z)^2\pi(2p_x)^2\pi(2p_y)^2\ \pi(2p_x)^1\pi(2p_y)^1$

E.C. of O_2^+ = $KK\ \sigma(2s)^2\dot{\sigma}(2s)^2\sigma(2p_z)^2\pi(2p_x)^2\pi(2p_y)^2\ \dot{\pi}(2p_x)^1$

E.C. of O_2^- = $KK\ \sigma(2s)^2\dot{\sigma}(2s)^2\sigma(2p_z)^2\pi(2p_x)^2\pi(2p_y)^2\pi(2p_x)^2\pi(2p_y)^1$

B.O.	O_2 = 1/2 (8 - 4) = 2
B.O.	O_2^+ = 1/2 (8 - 3) = 2.5
B.O.	O_2^- = 1/2 (8 - 5) = 1.5

Higher is the B.O. smaller is the bond length. Hence, order of O-O bond length is

$O_2^+ > O_2 > O_2^-$, i.e.

$O_2[AsF_6] > O_2 > KO_2$

OR

a. $HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$

$\therefore [HCl] = [H^+] = 3 \times 10^{-3}M; pH = -\log[H^+]$

$-\log 3 \times 10^{-3} = 3 - 0.4771 = 2.52$

b. $NaOH(aq) \rightarrow Na^{+}(aq) + OH^{-}(aq)$

$\therefore [NaOH] = [OH^{-}] = 5 \times 10^{-3} M; pOH = -\log[OH^{-}]$

$-\log\left(5 \times 10^{-3}\right) = 3 - 0.6989 = 2.3010$

$\Rightarrow pH = 14 - 2.3010 = 11.69$

c. $HBr(aq) \rightarrow H^{+}(aq) + Br^{-}(aq)$

$\therefore [HBr] = [H^{+}] = 2 \times 10^{-3} M; pH = -\log[H^{+}]$

$= -\log\left(2 \times 10^{-3}\right) = 3 - 0.3010 = 2.699 \simeq 2.7$

d. $KOH(aq) \rightarrow K^{+}(aq) + OH^{-}(aq)$

$\therefore [KOH] = [OH^{-}] = 2 \times 10^{-3} M; pOH = -\log[OH^{-}]$

$= -\log\left(2 \times 10^{-3}\right) = 3 - 0.3010 = 2.699$

26. i. F: being most electronegative; shows only a -ve oxidation state of -1.
 ii. Cs: Alkali metals have only one electron in their valence shell and hence exhibit only +1 oxidation state.
 iii. Ne: It is an inert gas and therefore, does not exhibit-ve or +ve O.S.

27. i. As we go to higher altitudes, the atmospheric pressure decreases. So, the pressure outside the balloon decreases. To regain equilibrium with the external pressure, the gas inside expands to decrease its pressure. Therefore, the size of the weather balloon becomes larger and larger as it ascends into higher altitudes.
 ii. In summer, due to the higher temperature, the average kinetic energy of the air molecules inside the tyre increases. Hence, the pressure on the walls of the tube increases. If pressure inside is not kept low at the time of inflation, at the higher temperature, the pressure may become so high that the tyre may burst. Hence, tyres of automobiles are inflated to lesser pressure in summer than in winter.

28. i. Molecular mass of sugar ($C_{12}H_{22}O_{11}$) = 12 $\times$ atomic mass of C + 22 $\times$ atomic mass of H + 11 $\times$ atomic mass of O = 12 $\times$ 12 + 22 $\times$1 + 11$\times$ 16 = 342 g
 ii.
  a. Since, 1 gram molecule of sugar = 342 g (Molecular Mass of Sugar,$C_{12}H_{22}O_{11}$=342 g)

  $\therefore$ 0.5 gram molecule of sugar = 342$\times$ 0.5 = 171 g
  b. Since, 342 g of sugar = 1 gram molecule (Molecular Mass of sugar, $C_{12}H_{22}O_{11}$ =342 g)

547.2 g of sugar = $\frac{1}{342} \times 547.2 = 1.6$ gram molecule

29. i. Element II
    ii. Element IV
    iii. Element I
    iv. Element III

OR

i. (a) Magnesium, (b) Neon (c) Carbon (d) Sodium (e) Flourine
ii. $1s^2$, $2s^2$, $2p^6$, $3s^1$ (Sodium)
iii. $1s^2$, $2s^2$, $2p^5$ (Flourine)
iv. $1s^2$, $2s^2$, $2p^6$, $3s^1$ (Sodium)
v. $1s^2$, $2s^2$, $2p^6$ (Neon)

30. **Causes of water pollution:**
(i) **Pathogens:** Pathogens include bacteria and other microorganism that enter water from domestic sewage and animal excreta.
Human excreta contain bacteria such as Escherichia coli and streptococcus faecalis which cause gastrointestinal diseases.
(ii) **Organic wastes:** Organic wastes when added to water, as these are biodegradable, bacteria decompose organic matter and consume dissolved oxygen in water. When the concentration of dissolved oxygen of water is below 6 ppw, the growth of fish gets inhibited. Breakdown of the organic wastes by anaerobic bacteria produces chemicals that have a foul smell and are harmful to human health.
(iii) **Chemical pollutants:** Some inorganic chemicals as an industrial wastes dissolve in water like cadmium, mercury nickel etc. These metals are dangerous to humans and other animals. These metals can damage kidneys and central nervous system, lever etc. Petroleum products pollute many sources of water.

Section D

31. i. Electrolysis of aqueous solution of $AgNO_3$ using silver electrodes:

$$AgNO_3(s) + nH_2O \longrightarrow Ag^+(aq) + NO_3^-(aq)$$
$$H_2O \rightleftharpoons H^+ + OH^-$$

At cathode: Ag^+ ions have lower discharge potential than H^+ ions.

Hence Ag^+ ions will be deposited as silver (in preference to H^+ ions).

At anode: Since the silver electrode is attacked by NO_3^- ions, Ag anode will dissolve to form Ag^+ ions in the solution.

$$Ag \longrightarrow Ag^+ + e^-$$

ii. Electrolysis of aqueous solution of $AgNO_3$ using platinum electrodes:

At cathode: same as above.

At anode: Since silver is not attackable, out of OH^- and NO_3^- ions, OH^- ions have lower discharge potential and hence OH^- ions will be discharged in preference to NO_3^- The OH^- will decompose to give 0_2.

$$OH^-(aq) \longrightarrow OH + e^-$$
$$4OH^-(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

iii. Electrolysis of H_2SO_2 with Pt electrodes:

$$H_2SO_4(aq) \longrightarrow 2H^+(aq) + SO_4^{2-}(aq)$$
$$H_2O \rightleftharpoons H^+ + OH^-$$

At cathode: $H^+ + e^- \longrightarrow H$

$$H + H \longrightarrow H_2(g)$$

At anode: $OH^- \longrightarrow OH + e^-$

$$4OH \longrightarrow 2H_2O + O_2(g)$$

iv. Electrolysis of aqueous solution of $CuCl_2$ with platinum electrodes:

$$CuCl_2(s) + (aq) \longrightarrow Cu^{2+}(aq) + 2Cl^-(aq)$$
$$H_2O \rightleftharpoons H^+ + OH^-$$

At cathode: Cu^{2+} will be reduced in

$$Cu^{2+} + 2e^- \longrightarrow Cu$$

At anode: Cl^- ions will be oxidised in preference to OH-ions

$$Cl^- \longrightarrow Cl + e^-$$
$$Cl + Cl \longrightarrow Cl_2$$

Thus copper will be deposited on the cathode and Cl, will be liberated at anode.

OR

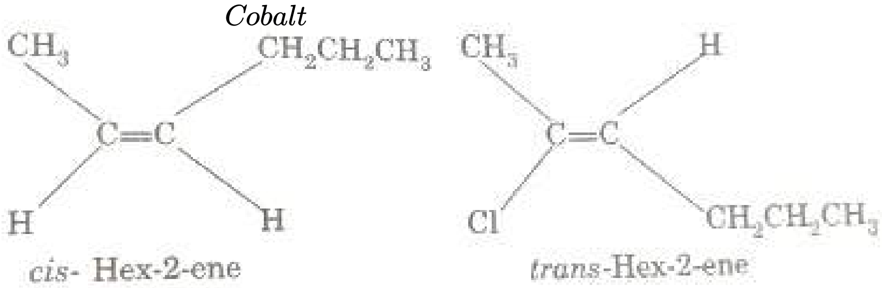
i. Fe (s) + H_2O (g) $\rightarrow$ Fe_3O_4 (s) + $4O_2$ (g)

ii. PbS (s) + H_2O_2 (aq) $\rightarrow$ $PbSO_4$ (s) + $4H_2O$ (aq)

iii. $2MnO_4^-$ (aq) + $5H_2O_2$ (aq) $\rightarrow$ $2Mn^{2+}$ + $8H_2O$ + $5O_2$

iv. CuO (s) + H_2 (g) $\rightarrow$ H_2O + Cu

v. CO (s) + H_2 (g) $\xrightarrow[Cobalt]{Catalyst}$ CH_3OH (l)

32. i. 

The cis form will have a higher boiling point due to the more polar nature of the molecular leading to strong intermolecular dipole-dipole interactions. As a result of stronger intermolecular interactions, it requires more energy to separate the molecules.

ii. a. Z

b. Z

c. E

OR

i. a > c > b

ii. largest the number of carbon atoms having maximum hydrogens (i.e., CH_3 groups), greater is the heat of combustion.

Thus, the increasing order of heat of combustion

(c) < (d) < (a) < (b)

iii.

a. Chloro benzene, p -nitrochloro benzene, 2,4 -dinitrochloro benzene.

b. p-CH_3-C_6H_4-CH_3 > toluene > p-CH_3-C_6H_4-NO_2-C_6H_4-NO_2

33. i. According to the Rydberg equation.

$$\frac{1}{\lambda} R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

Where R = 109677 cm^{-1}, n_1 = 3 and n_2 = 5

Substituting the values

$$\frac{1}{\lambda} = 109677 \left(\frac{1}{3^2} - \frac{1}{5^2} \right) cm^{-1}$$

= 109677 $\left(\frac{1}{9}-\frac{1}{25}\right)$ cm^{-1}

or = 109677 $\times \frac{16}{225}$ cm^{-1}

$\therefore \lambda$ = $\frac{225}{109677 \times 16}$cm

= 12.82 $\times$ 10^{-5} cm = 1282 $\times$ 10^{-9} m

or λ = 1282 nm

Now $\lambda \times$ v = c or v = $\frac{c}{\lambda}$

where c = 3.0 $\times$ 10^{8} m s^{-1}, λ = 1282 nm = 1282 $\times$ 10^{-9} m

v = $\frac{3.0 \times 10^{8} \mathrm{ms}^{-1}}{1282 \times 10^{-9} \mathrm{m}}$ = $\frac{3}{1282}$ $\times$ 10^{17} s^{-1}

= 2.34 $\times$ 10^{14} s^{-1}

ii. Since this line corresponds to n2 =3, it belongs to Paschen series.

iii. The spectral line will fall in the infra-red region.

OR

i. The average atomic mass of CI

= $\frac{75.77 \times 34.9689+24.23 \times 36.9659}{100}$

= 35.453

ii.

a. 1 mole of C_2H_6 contains 2 moles of carbon

$\therefore$ Number of moles of carbon in 3 moles of C_2H_6 = 6

b. 1 mole of C2H6 contain 6-mole atoms of hydrogen

$\therefore$ Number of moles of hydrogen atoms in 3 moles of C_2H_6 = 3 $\times$ 6 = 18

c. 1 mole of C_2H_6 = 6.022 $\times$ 10^{23} molecules

$\therefore$ Number of molecules in 3 months of C2H6 = 3 $\times$ 6.022 $\times$ 10^{23}

= 1.807 $\times$ 10^{24} molecules