CBSE
CLASS – XI
CHEMISTRY
SAMPLE PAPER 2

Time: 3 Hours **Marks: 70**

General Instructions

- All questions are compulsory.
- Section A: Q.no. 1 to 5 are very short answer questions and carry 1 mark each.
- Section B: Q.no. 6 to 12 are short answer questions and carry 2 marks each.
- Section C: Q.no. 13 to 24 are also short answer questions and carry 3 marks each.
- Section D: Q.no. 25 to 27 are long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of one mark, two questions of two marks, four 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.
- Use of log tables if necessary, use of calculators is not allowed.

Section A

1. Arrange the isomers of pentane in increasing order of their boiling point. [1]

2. Predict the shape of ClF3 and BF3 on the basis of VSEPR theory. [1]

OR

What is meant by bond pairs of electrons?

3. Although benzene is highly unsaturated it does not undergo addition reactions. [1]

4. What is the composition of London smog? [1]

OR

List the gases which are responsible for greenhouse effect.

5. Why do alkali metals give characteristic flame colouration? [1]

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Section B

6. What is mean by iso-electronic species? Name the species that will be iso-electronic with each of the F^-, Ar atoms/ ions? [2]

7. Considering the atomic number and position in the periodic table, arrange the following elements in increasing order of metallic character: Si, Be, Mg, Na, P. [2]

8. Yellow light emitted from a sodium lamp has a wavelength (λ) of 580 nm. [2]

9. Calculate the root mean square speed of methane molecules at 27^0C. [2]

10. Calculate the oxidation number of Mn in K_2MnO_4 and N in HNO_3 [2]

OR

Explain which one is oxidised and which one is reduced in the given equation

$$3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$$

11. Yellow light emitted from a sodium lamp has a wavelength (λ) of 580 nm. Calculate frequency (ν) and wave number of the yellow light? [2]

12. Calculate the volume of oxygen at N.T.P that would be required to convert 5.2 L of carbon monoxide to carbon dioxide. [2]

OR

What will be the mass of one ^{12}C atom in g?

Section C

13. An element with atomic number 7 has following given configurations [3]

(a) $1s^2\ 2s^2 2p_x^2 2p_y^1\ 2pz^0$

(b) $1s^2\ 2s^2 2p_x^1 2p_y^1\ 2pz^1$

Which of the two is correct and why?

OR

How would you justify the presence of 18 elements in the 5th period of the Periodic table?

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14. [3]

(a) What is the hybridization of central atom in following? NH_3 , C_2H_2

(b) Define dipole moment.

What is the dipole moment of CCl_4 molecule? Account for your answer.

OR

Describe the hybridization in case of PCl_5. Why are axial bonds longer as compared to the equatorial bonds? ?

15. Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation: [3]

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$

(i) Calculate the mass of ammonia produced if 2.00×10^3 g dinitrogen reacts with 1.00×10^3 g diydrogen.

(ii) Will any of the two reactants remain unreacted?

(iii) If yes, which one and what would be its mass?

16.

(a) Define: [3]

(i) Intensive properties

(ii) Adiabatic process

(b) Starting with thermodynamic relationship G = H- TS derive the following relationship $\Delta G = -T\Delta S_{total}$

17. [3]

(a) Define Le chatelier's principle.

(b) Following reactions occurs in a blast furnace.

$$F_2O_{3(s)} + 3CO_{(g)} \rightleftharpoons 2Fe_{(s)} + 3CO_{2(g)}$$

Use Le chatelier's principle to predict the direction of reaction when equilibrium mixture is distributed by

(i) Adding Fe_2O_3

(ii) Removing CO_2

(iii) Removing CO

OR

18. Depict the galvanic cell in which reaction, $Zn_{(s)} + 2Ag^+_{(aq)} \rightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)}$ takes place Further show, [3]

(i) Which of the electrode is negatively charged?

(ii) The carrier of the current in the cell

(iii) Individual reaction at each electrode

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OR

Identify the substance oxidised, reduced, oxidising agent and reducing agent for each of the following reactions:

(i) $2AgBr_{(s)} + C_6H_6O_{2(aq)} \rightarrow 2Ag_{(s)} + 2HBr_{(aq)} + C_6H_4O_{2(aq)}$

(ii) $HCHO_{(l)} + 2\left[Ag(NH_3)_2\right]^+_{(aq)} + 3OH^-_{(aq)} \rightarrow 2Ag_{(s)} + HCOO^-_{(aq)} + 4NH_{3(aq)} + H_2O_{(l)}$

(iii) $N_2H_{4(l)} + 2H_2O_{2(l)} \rightarrow N_{2(g)} + 4H_2O_{(l)}$

19. Write balanced equations or reactions between: [3]

(i) Na_2O_2 and water

(ii) KO_2 and water

(iii) Na_2O and CO_2

20. Give IUPAC names of following: [3]

(a) $C_6H_5CH_2COOH$

(b)

CH_2-OH
|
CH-OH
|
CH_2-OH

(c)

Br   O
| ||
CH_3-CH-CH_2-C-Cl

21. [3]

(a) What conclusion would you draw if the Lassaigne's extract gives a blood red colouration with $FeCl_3$?

(b)

$$\dot{C}H_2CH_3 < \dot{C}H(CH_3)_2 < \dot{C}(CH_3)_3$$

Which of the given free radicals is most stable and why?

(c) Why is an organic compound fused with metallic sodium for testing for N, S and halogens?

22. Define: [3]

(i) Biochemical Oxygen Demand (BOD)

(ii) Ozone Hole

(iii) Green Chemistry

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23. Write a short note on the following: [3]

(a) Wurtz Reaction

(b) Friedel-crafts alkylation

24. Write the balanced equations: [3]

(a) $H_3BO_3 \xrightarrow{\Delta}$

(c) $NH_3 + B_2H_6 \longrightarrow$

Section D

25. [5]

(a) For the reaction $2A_{(g)} + B_{(g)} \rightarrow 2D_{(g)}$

$\Delta u^0 = -10.5$ kJ and $\Delta S^0 = -44$ J/K

Calculate ΔG^0 for the reaction and predict whether the reaction may occur spontaneously.

(Given: R= 8.314 $JK^{-1}mol^{-1}$, T = 298 K)

(b) Calculate the number of kJ of heat necessary to raise the temperature of 60 g of aluminium from 35 to 55 °C. Molar heat capacity of Al is 24 $JK^{-1}mol^{-1}$.

OR

(a) What is bond energy? Why is it called enthalpy of atomisation?

(b) Calculate the bond energy of C-H bond, given that the heat of formation of CH_4, heat of sublimation of carbon and heat of dissociation of H_2 are -74.8, +719.6, 435.4 $kJmol^{-1}$ respectively.

26. Give reasons for the following: [5]

(a) $[SiF_6]^{2-}$ is known whereas $[SiCl_6]^{2-}$ is not known.

(b) Diamond is covalent, yet has high melting point.

(c) PbX_2 is more stable than PbX_4 (X= Cl, Br)

(d) Boron is unable to form BF_6^{3-} ion.

(e) BF_3 behaves as Lewis acid.

OR

(a) Give one method for industrial preparation and one for laboratory preparation of CO and CO_2 each.

(b) Select the member(s) of group 14 that (i) forms the most acidic dioxide (ii) used as semiconductors.

(c) Explain structure of Diborane.

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27. Assign structures for the following: [5]

(a) An alkyne (X) has molecular formula C_5H_8. It reacts neither with sodamide nor with ammoniacal cuprous chloride.

(b) A hydrocarbon 'Y' decolourises bromine water. On ozonolysis it gives 3-Methylbutanal and formaldehyde. Give the name of the compound.

(c) A hydrocarbon (Z) has molecular formula C_8H_{10}. It does not decolourise bromine water and is oxidized to benzoic acid on heating with $K_2Cr_2O_7$. It can also have three other isomers A, B and C. Write the structure of Z, A, B and C.

OR

One mole of a hydrocarbon (A) reacts with one mole of bromine giving a dibromo compound, $C_5H_{10}Br_2$. Substance (A) on treatment with cold dilute alkaline $KMnO_4$ solution forms a compound $C_5H_{12}O_2$. On ozonolysis (A) gives equimolar quantities of propanone and ethanal. Deduce the structural formula of (A).

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Class XI Chemistry
Sample Paper – 2 Solution

Section A

1. 2,2 Dimehylpropane< 2-methylbutane < Pentane.

2. ClF_3: T- shape
BF_3: Trigonal planar

OR

The electron pairs involved in the bond formation are known as bond pairs or shared pairs.

3. It is due to delocalization of π- electrons in benzene it is highly stable.

4. London smog consists of H_2SO_4 deposited on the particulates suspended in the atmosphere.

Gases responsible for green house effect are CO_2, methane, nitrous oxide, chlorofluro hydrocarbons and ozone.

5. Alkali metals due to low ionization energy absorbs energy from visible region to radiate complementary colour.

Section B

6. Iso electronic species are those species (atoms/ions) which have same number of electrons.
The iso electronic species for F^- is Na^+ and for Ar is K^+.

7. Metallic character increases down the group and decreases across the period as we move from left to right. Hence the increasing order of metallic character is: P<Si<Be<Mg<Na.

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9. Given:

Wavelength of the radiation $= 580\ nm = 580 \times 10^{-9}\ m$
$= 5.8 \times 10^{-7}\ m$

Velocity of radiation, $c = 3 \times 10^{8}\ m/s$
$c = \nu$

$$= \frac{3 \times 10^{8}\ m/s}{5.8 \times 10^{-7}\ m}$$
$$= 5.17 \times 10^{14}\ s^{-1}$$

Wave number $\bar{\nu} = \frac{1}{\lambda}$

$$= \frac{1}{5.8 \times 10^{-7}\ m}$$

$= 1.72 \times 10^{6}\ m^{-1}$

10. Root mean square speed is given as:

$$u_{r.m.s} = \sqrt{\frac{3RT}{M}}$$

Here,

T =273 + 27 =300 K

M = 16 g mol-1

R= 8.314 x 10^7

$$u_{r.m.s} = \sqrt{\frac{3x8.314x10^{7}x300}{16}}$$
$$= 683.9\ x10^{2}\ cm\,sec^{-1}$$
$$= 683.9\ m\,sec^{-1}$$

OR

The given equation is;
$3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$
Change in oxidation numbers:
Mn: 4 to 0, Al: 0 to 2 and O: -2 to 2
Thus MnO_2 is reduced and Al is oxidized.

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11.

For K_2MnO_4, let the oxidation number of Mn be y

Oxidation Number of each Oxygen atom = -2

Oxidation Number of each K atom = +1

In a molecule, sum oxidation number of various atoms must be equal to zero

$\therefore$ 0= 2+ y + 4(-2) = y-6

$\therefore$ y-6 = 0

y = 6

For HNO_3, let the oxidation number of N be y

Oxidation Number of each O atom = -2ss

Oxidation Number of each H atom = +1

In a molecule, sum oxidation number of various atoms must be equal to zero.

12. The balanced chemical equation is

$$\begin{array}{lll} 2CO & + \; O_2 & \longrightarrow 2CO_2 \\ 2\,mol & 1\,mol & \\ 2x22.4L & 22.4L & \end{array}$$

Volume of oxygen required to convert 2 x 22.4 L of CO at N.T.P. = 22.4 L

Volume of oxygen required to convert 5.2 L of CO at N.T.P. = $\frac{22.4}{2x22.4} x5.2 = 2.6$ L

OR

1 mole of ^{12}C atoms = 6.022×10^{23} atoms = 12 g

$\therefore 6.022 \times 10^{23}$ atoms of ^{12}C have mass 12g

$\therefore$ 1 atom of ^{12}C would have mass $\frac{12}{6.022 \times 10^{23}}$ g

$= 1.99 \times 10^{-23}$ g

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13. Configuration (b) is correct.

According to Hund's rule of maximum multiplicity, pairing of electrons in the orbitals of a particular subshell does not take place until all the orbitals of the subshell are singly occupied. Since in the configuration (a) two electrons are present in $2p_x$ and no electron is present in $2p_z$, it is incorrect as per Hund's Rule.

OR

When $n = 5$, $l = 0, 1, 2, 3, 4$. The order in which the energy of the available orbital's 4*d*, 5*s* and 5*p* increases is $5s < 4d < 5p$. The total number of orbital's available is 9. The maximum number of electrons that can be accommodated is 18; and therefore18 elements are there in the 5th period.

14.

(a) NH_3: sp^3

(b)C_2H_2 : *sp*

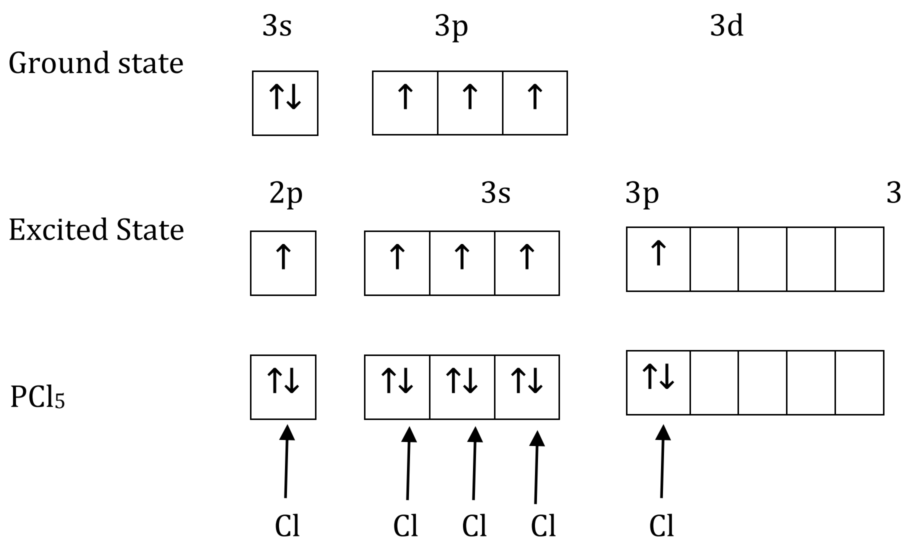
Dipole moment of CCl_4 molecule is zero. Dipole moment is a vector quantity. In symmetrical molecule dipoles of individual bonds cancel each other giving resultant dipole moment as zero.

OR

In the formation of PCl_5, one s, three p and one d orbitals are involved in hybridization and give sp^3d hybrid state.

The ground state and excited state outer electronic configuration of phosphorus (15) are as:

(a) P (ground state)



sp^3d hybrid orbitals filled by electron pairs donated by five Cl atoms.

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The longer nature of axial bonds is due to stronger repulsive interactions experienced by the axial bond pairs from equatorial bond pairs.

15.

(i) 1 mole of N_2 is 28 g react with 3 mol of H_2 which is 3 g of H_2

28 g react of N_2 with 3 g of H_2

$$\therefore 2000 \text{ g of } N_2 \text{ react with } H_2 = \frac{2000 \times 6}{28}$$

$$= 428.6 \text{ g}$$

N_2 is the limiting agent while H_2 is the excess reagent.

$$28 \text{ g of } N_2 \text{ gives } 2\text{mol } NH_3 = 34 \text{ g } NH_3$$

$$\therefore 2000 \text{ g of } N_2 \text{ will produce } NH_3 = \frac{34}{28} \times 2000 \text{ g}$$

$$= 2428.57 \text{ g}$$

(ii) H_2 will left unreacted.

(iii) Mass left unreacted = 1000 g – 428.6 g

= 2428.57 g

16.

(a) Intensive properties: The properties which depends only on the nature of the substance and not on the amount of the substance are called intensive properties

Example: Density

Adiabatic process: A process in which no heat flows between the system and the surroundings is called an adiabatic process i.e. q= 0.

G= H-TS

Change in Gibbs energy, $\Delta G = G_2 - G_1$,

Enthalpy change, $\Delta H = H_2 - H_1$,

Entropy change, $\Delta S = S_2 - S_1$

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

$$\Delta S_{total} = \Delta S_{system} + \Delta S_{surrounding}$$

$$\Delta S_{total} = \Delta S_{system} - \frac{\Delta H_{sys}}{T}$$

$$\left[\text{Since } \Delta S_{surr} = \frac{\Delta H_{surr}}{T}, \Delta H_{surr} = -\Delta H_{sys}\right]$$

Dropping subscript system:

$$\Delta S_{total} = \Delta S - \frac{\Delta H}{T}$$

Multiply by T

$$T\Delta S_{total} = T\Delta S - \Delta H$$

$$-T\Delta S_{total} = \Delta H - T\Delta S = \Delta G$$

$$\Delta G = -T\Delta S_{total}$$

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17.

(a) When a system under equilibrium be subjected to a change in temperature, pressure or concentration, then the equilibrium shifts in such a direction so as to undo the effect of change.

(b)

(i) On adding Fe_2O_3 the equilibrium will remain unaffected.

(ii) By removing CO_2, the equilibrium will be shifted in the forward direction

(iii) By removing CO, the equilibrium will be shifted in the backward direction.

OR

(a) The equilibrium will shift the backward direction as the increase in temperature will be compensated by absorbing heat. It is an exothermic reaction.

(b) The equilibrium will shift in the forward direction since the reaction will shift to the direction of lesser number of moles.

(c) The equilibrium will shift in the forward direction so that additional SO_2 is used up.

18. The given redox reaction is

$Zn_{(s)} + 2Ag^+_{(aq)} \rightarrow Zn^{2+}_{(aq)} + 2Ag_{(s)}$

Since Zn gets oxidized to Zn^{2+} ions, and Ag^+ gets reduced to Ag metal, therefore oxidation occurs at the zinc electrode and reduction occurs at the silver electrode.

Thus, galvanic cell corresponding to the above reaction may be depicted as:

$Zn | Zn^{2+}_{(aq)} || Ag^+_{(aq)} | Ag$

(i) Since oxidation occurs at the zinc at the zinc electrode, therefore, electrons accumulate on the zinc electrode and hence, zinc electrode is negatively charged.

(ii) The ions carry current. The electrons flow from Zn to Ag electrode while the current flows from Ag to Zn electrode.

(iii) The reactions occurring at the two electrodes are:

$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$

$Ag^+_{(aq)} + e^- \rightarrow 2Ag_{(s)}$

OR

	Substance oxidized	Substance reduced	Oxidising agent	Reducing agent
(i)	$C_6H_6O_{2(aq)}$	$AgBr_{(s)}$	$AgBr_{(s)}$	$C_6H_6O_{2(aq)}$
(ii)	$HCHO_{(l)}$	$[Ag(NH_3)_2]^+_{(aq)}$	$[Ag(NH_3)_2]^+_{(aq)}$	$HCHO_{(l)}$
(iii)	$N_2H_{4(l)}$	$H_2O_{2(l)}$	$H_2O_{2(l)}$	$N_2H_{4(l)}$

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19.

(a) $Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$

(b) $2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2$

(c) $Na_2O + CO_2 \rightarrow Na_2CO_3$

20.

(a) 2-Phenylethanoic acid
(b) Propane-1, 2, 3-triol
(c) 3-Bromobutanoyl chloride

21.

(a) If the Lassaigne's extract gives a blood red colouration with $FeCl_3$, it indicates that the compound contains both N and S. During fusion, sodium thiocyanate is formed which gives blood red colouration.

$$3NaSCN + FeCl_3 \rightarrow \underset{\text{Blood red}}{Fe(SCN)_3} + 3NaCl$$

(b) $\dot{C}(CH_3)_3$ is most stable since it is a tertiary free radical and therefore has the maximum hyper conjugation .Larger the number of alkyl groups attached to the carbon atom carrying the odd electron, greater is the delocalisation of the odd electron and hence more stable is the free radical.

(c) The organic compound is fused with sodium because it reacts with some of the elements present in the organic compound and form corresponding sodium salts.

22.

(i) Biochemical Oxygen Demand (BOD): It is a measure of dissolved oxygen that would be needed by the micro-organisms to oxidize organic and inorganic compounds present in polluted water.

(ii) Ozone Hole: Depletion of ozone layer over Antarctica leading to the formation of a hole in the stratosphere over Antarctica is called ozone hole.

(iii) Green Chemistry: Chemistry and chemical processes involving the minimum use and generation of harmful substances is called green chemistry.

23.

(a) Wurtz reaction: Alkyl halides on treatment with sodium in dry ether give higher alkanes. This is called Wurtz reaction and is used to prepare higher alkanes with even number of carbon atoms.

Example:

$$\underset{\text{Bromomethane}}{CH_3Br} + 2Na + BrCH_3 \xrightarrow{\text{Ether}} \underset{\text{Ethane}}{CH_3-CH_3} + 2NaBr$$

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(b) Friedel –Crafts alkylation reaction: It is the reaction of benzene with alkyl halide in presence of anhydrous aluminium chloride. The reaction results in the formation of alkyl benzene

Example:

$$\underset{\text{Benzene}}{C_6H_6} + CH_3Cl \xrightarrow[AlCl_3]{\text{Anhydrous}} \underset{\text{Toluene}}{C_6H_5CH_3} + HCl$$

24.

(a) $$\underset{\text{Orthoboric acid}}{H_3BO_3} \xrightarrow{\Delta} \underset{\text{Metaboric acid}}{HBO_2} + H_2O$$

$$4HBO_2 \xrightarrow[-H_2O]{\Delta} \underset{\text{tetraboric acid}}{H_2B_4O_7} \longrightarrow \underset{\text{boron trioxide}}{2B_2O_3} + H_2O$$

(b) $$2NH_3 + B_2H_6 \longrightarrow \underset{\text{Borane ammonia complex}}{2BH_3 \bullet NH_3}$$

25.

(a) $2A_{(g)} + B_{(g)} \rightarrow 2D_{(g)}$

$\Delta u0 = -10.5$ kJ

$\Delta S^0 = -44$ J/K

$R = 8.314\ JK^{-1}mol^{-1}$

$T = 298$ K

$\Delta H = \Delta u - \Delta n_g RT$

$\Delta n_g = 2-(2+1)$

$= -1$

Substituting values in equation;

$\Delta H = -10.5 \times 10^3 + (-1) + 8.314 \times 298$

$= 10500 - 2477.57$

$= -12977.57\ J$

We have,

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

$= -12977.57 - [(298) \times (-44)]$

$= -12977.57 + 13112$

$= 134.43\ J$

The reaction will be non-spontaneous. This is because the value of ΔG is positive.

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No. of moles of Al $= \frac{60}{27}$

$= 2.22 \text{ mol}$

Molar heat capacity $(C) = 24 \text{ J mol}^{-} \text{K}^{-}$

Rise in temperature $(\Delta T) = 55 - 35$

$= 20\ ^{\circ}C$

Heat evolved $(q) = C \times m \times T$

$= 24 \times 2.22 \times 20$

$q = 1065.6 \text{ J}$

Heat evolved $(q) = 1.06 \text{ kJ}$

OR

(a) Bond energy is the amount of energy required to dissociate one mole of bonds present between the atoms in the gaseous phase. As molecules dissociate completely into atoms in the gaseous phase therefore bond energy of a diatomic molecule is called enthalpy of atomization.

(b) $C_{(s)} + 2H_{2(g)} \rightarrow CH_{4(g)}$ $\quad \Delta_rH = -74.8$ kJ

$C_{(s)} \rightarrow C_{(g)}$ $\quad \Delta_rH^0 = +719.6$ kJ

$H_{2(g)} \rightarrow 2H_{(g)}$ $\quad \Delta_rH^0 = +435$ kJ

$C_{(s)} + 2H_{2(g)} \rightarrow C_{(g)} + 4H_{(g)}$

$C_{(s)} - 2H_{2(g)} - CH_{4(g)}$

$0 = C_{(g)} + 4H_{(g)} - CH_{4(g)}$

$\Delta_rH = 719.6 + 2(435.4) + 74.8$

$\Delta_rH = +1665.2$ kJ

This gives the enthalpy of dissociation of four moles C-H bons.

Hence bond energy for C-H bond

$= \frac{1665.2}{4}$

$= 416.3 \text{ kJ/mol}$

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(a) $[SiF_6]^{2-}$ is known whereas $[SiCl_6]^{2-}$ is not known since six large size atoms i.e. six chlorine atoms cannot be accommodated around Si but six small size atoms (F atoms) can be comfortably accommodated.

(b) Diamond is a covalent solid but has a high melting point due to its three dimensional network structure involving strong C-C bonds. These bonds are difficult to break and therefore diamond has high melting point.

(c) Due to inert pair effect, lead shows an oxidation state of +2. Hence PbX_2 is more stable than PbX_4.

(d) Boron is unstable to form BF_6^{3-} ion due to non- availability of d-orbitals in the valence shell. Therefore the maximum covalency of boron cannot exceed 4 and thus does not form BF_6^{3-} ion.

(e) The Boron atom in BF_3 has only six electrons in the valence shell and thus needs 2 more electrons to complete its octet. Therefore, it easily accepts a pair of electrons from nucleophiles. Thus BF_3 can act as a Lewis acid.

OR

(a)

Carbon monoxide:

Industrial Preparation:

$$2C_{(s)} + O_{2(g)} \xrightarrow[\text{Air}]{\text{Limited}} 2CO_{(g)}$$

Lab preparation:

$$HCOOH \xrightarrow{\text{Conc.} H_2SO_4} CO + H_2O$$

Carbon dioxide:

Industrial preparation:

$$C_{(s)} + O_{2(g)} \xrightarrow[\text{Air}]{\text{Excess}} CO_{2(g)}$$

Lab Preparation:

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

(b) Member of group 14 that

(i) forms the most acidic oxide = Carbon (i.e. CO_2)

(ii) is used as semiconductor = Silicon and Germanium

(c) Structure of Diborane:

Each boron atom in diborane is sp^3 hybridised. Four sp^3 hybrid orbitals adopt tetrahedral arrangement. Two hybrid orbitals of each B atom overlaps with 1s

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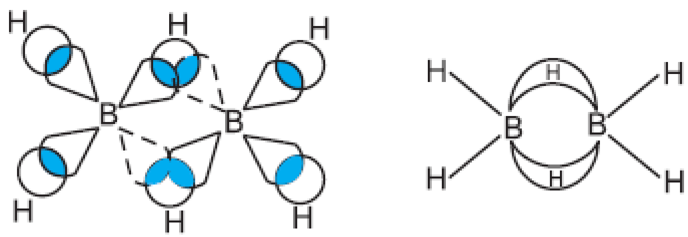
orbital of two H atoms. Of the two hybrid orbitals left on each B atom one contains an unpaired electron while other is vacant. Hybrid orbital containing unpaired electron of one boron atom and vacant hybrid orbital of second boron atom overlaps simultaneously with 1s orbital of H atom to form B-H-B bond, a three centre electron pair bond. The four terminal B-H bonds are regular two centre-two electron bonds while the two bridge (B-H-B) bonds can be described in terms of three centre–two electron bonds



27.

(a) Alkyne X is C_5H_8. Since it does not react with sodamide or ammoniacal cuprous chloride, the triple bond must not be terminal.

Therefore, X = CH_3-CH_2-C≡C-CH_3 (Pent-2-yne)

Hydrocarbon 'Y' is an alkene because it decolourises bromine water.

From the product of ozonolysis, the structure of alkene can be predicted.

CH_3-CH(CH_3)-CH_2-CH=O + O=CH-H ⟶ CH_3-CH(CH_3)-CH_2CH=CH_2

3-Methylbutanal   Formaldehyde   4-Methylpent-1-ene (Y)

(b) Since it does not decolourise bromine water, it is an arene.

Its formula is $C_6H_5CH_2CH_3$

$$C_6H_5CH_2CH_3 \xrightarrow[K_2Cr_2O_7]{[O]} C_6H_5COOH$$

(Z)   Benzoic acid

The other three isomers are:

o-Xylene , m- Xylene and p-Xylene

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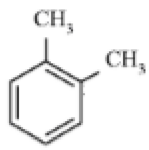
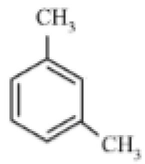


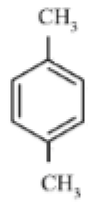
o-Xylene

A



m-Xylene

B



p-Xylene

C

OR

One mole of the hydrocarbon (A) adds on one mole of bromine to form $C_5H_{10}Br_2$ therefore, (A) must be an alkene having molecular formula C_5H_{10}.

The position of double bond is indicated by ozonolysis as:

$$\underset{\text{Propanone}}{CH_3-\overset{\overset{\displaystyle CH_3}{|}}{C}=O} \quad + \quad \underset{\text{Ethanal}}{O=\overset{\overset{\displaystyle H}{|}}{C}-CH_3} \longrightarrow \underset{\substack{\text{2-Methylbut-2-ene} \\ \text{(A)}}}{CH_3-\overset{\overset{\displaystyle CH_3}{|}}{C}=CH-CH_3}$$

Therefore, compound (A) is 2-Methylbut-2-ene. With alkaline $KMnO_4$, it forms a compound $C_5H_{12}O_2$.

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{C}=CH-CH_3 \xrightarrow{\text{alk } KMnO_4} \underset{(C_5H_{12}O_2)}{CH_3-\underset{\underset{\displaystyle OH}{|}}{\overset{\overset{\displaystyle CH_3}{|}}{C}}-CHOH-CH_3}$$

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