Total Marks:100

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Name: **Reg. No:** **Section:**

Q1. Answer this question on pages 01 – 03 **(CLO-1) (5+5+5+5) pts**

a) Write the chemical reaction and appropriate conditions for the conversion of metallurgical grade silicon to $HSiCl_3$, and how is the resultant product purified further?

b) Show the schematic diagram for zone refining. What is the purpose of Czochralski method in silicon purification?

c) Why is hydrogen preferred over conventional fossil fuels and other renewable energy sources? Enlist any five reasons.

d) In the ammonia synthesis process 65% of CH_4 is converted to syngas and CO_2 in the primary reformer. Provide the reactions for this conversion.

Q2. Answer this question on pages 04 – 06 **(CLO-2) (5+5+5+5) pts**

a) Enlist the types of coal in order of increasing percentage of carbon.

b) Identify the main contributors to environmental hazards such as acid rain and global warming. Also elaborate on the sources of these pollutants.

c) How is CO_2 captured through a pre-combustion process? Illustrate with a block diagram.

d) How are water and higher-boiling alkanes separated from natural gas before its distribution for household use? Which method is employed to recover the components of LPG during this process?

Q3. Answer this question on pages 07 – 09 **(CLO-2) (2+5+7+6) pts**

a) A gasoline sample tested in the lab exhibits the same amount of knocking as a mixture of 75% isooctane and 25% n-heptane. What is the octane rating of this sample?

b) What is ethyl fluid? Why was it used as an additive for gasoline fuel, and what problems were associated with this additive? (Write reactions where necessary)

c) The wavelength of the photon required to break the bond between two chlorine atoms in a chlorine molecule is 449 nm. Calculate the dissociation energy of the chlorine molecule in $kJmol^{-1}$.

(Given: $c = 3.0 \times 10^8$ m/s, $h = 6 \times 10^{-34}$ Js)

d) You are on a flight from Islamabad to Karachi where the pressure outside the plane is 20400 Pa. Calculate the altitude (above the sea level) in Km.

(Given: $M = 29$ gmol^{-1}, $P^o = 10^5$ Pa, $R = 8.314$ JK^{-1} mol^{-1}, $g = 9.8$ ms^{-2}, $T = 215$ K)

Q4. Answer this question on pages 10 – 12 **(CLO-2) (5+5+5+5) pts**

a) How does the temperature vary with altitude in the troposphere and stratosphere? Explain with the help of temperature profile.

b) Explain the process of ozone formation and destruction in the troposphere with the assistance of chemical reactions.

c) How were chlorofluorocarbons (CFCs) responsible for ozone depletion in the stratosphere? How many molecules of ozone can be destroyed during this process?

d) Differentiate between the dark and a photochemical reaction with the help of examples.

Q5. Answer this question on pages 13 – 16 **(CLO-2) (5+5+10) pts**

a) Reaction A produces 500 kg of product with 100 kg of waste, and Reaction B produces 500 kg of product with 150 kg of waste. Calculate and compare their E-factors.

b) For the reaction: $CO_2 + 3H_2 \rightleftharpoons CH_4 + H_2O$, calculate the percentage atom economy if CH_4 is the desired product. (At. Masses: C = 12 amu, O = 16 amu)

c) The waste from kitchen and toilet in wastewater contains elements such as C, N, S, and P. What are the expected products under aerobic and anaerobic conditions?