

# Answers To Revision Questions For Higher Chemistry

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This document provides detailed answers to common revision questions for Higher Chemistry. It is designed to aid students in their understanding of key concepts and to help them prepare for assessments. The answers are structured around the key topic areas covered in the Higher Chemistry syllabus.

**I Atomic Structure and Bonding**

**1 What are the subatomic particles and their properties?**  
Protons: Positively charged particles found in the nucleus. They determine the element's atomic number.  
Neutrons: Neutral particles found in the nucleus. They contribute to the atom's mass number.  
Electrons: Negatively charged particles orbiting the nucleus in specific energy levels or shells. They are responsible for chemical bonding and reactivity.

**2 Explain the difference between isotopes.**  
Isotopes are atoms of the same element that have the same number of protons (atomic number) but different numbers of neutrons. This results in different mass numbers. For example, Carbon-12 and Carbon-14 are isotopes of carbon.

**3 Describe the types of chemical bonding.**  
Ionic Bonding: Formed by the electrostatic attraction between oppositely charged ions. Occurs between metals and nonmetals.  
Covalent Bonding: Formed by the sharing of electrons between nonmetal atoms. Can be polar or nonpolar depending on the electronegativity difference between atoms.  
Metallic Bonding: Formed by the delocalisation of electrons in a sea of electrons surrounding positively charged metal ions. This accounts for the properties of metals such as conductivity and malleability.

**4 What are the different types of intermolecular forces and how do they affect the properties of substances?**

**2 Hydrogen Bonding:** Strongest intermolecular force. Occurs between molecules containing hydrogen bonded to highly electronegative atoms like oxygen, nitrogen, or fluorine.

**Dipole-Dipole Interactions:** Occur between polar molecules due to the attraction between opposite partial charges.

**London Dispersion Forces:** Weakest intermolecular force. Occurs between all molecules due to temporary fluctuations in electron distribution. These forces influence the melting point, boiling point, and solubility of substances. Stronger intermolecular forces lead to higher melting and boiling points and less solubility in nonpolar solvents.

**II Chemical Reactions and Energetics**

**1 Define the terms enthalpy change and activation energy.**  
Enthalpy Change ( $\Delta H$ ): The heat energy change accompanying a chemical reaction at constant pressure.  
Activation Energy ( $E_a$ ): The minimum amount of energy required for reactants to collide effectively and form products.

**2 Explain the difference between exothermic and endothermic reactions.**  
Exothermic Reactions: Reactions that release heat energy to the surroundings.  $\Delta H$  is negative. The products have lower energy than the reactants.  
Endothermic Reactions: Reactions that absorb heat energy from the surroundings.  $\Delta H$  is positive. The products have higher energy than the reactants.

**3 Describe the factors affecting the rate of a chemical reaction.**

Concentration Increasing the concentration of reactants increases the frequency of collisions leading to a faster rate Temperature Increasing the temperature provides more energy for collisions leading to more effective collisions and a faster rate Surface Area Increasing the surface area of a solid reactant increases the area exposed for collisions leading to a faster rate Catalyst A catalyst provides an alternative pathway with lower activation energy speeding up the reaction without being consumed itself

III Chemical Equilibria 1 What is dynamic equilibrium Dynamic equilibrium is a state where the rates of the forward and reverse reactions are equal resulting in no net change in the concentrations of reactants and products This is a reversible process not a static one 2 Explain Le Chateliers principle and its application in predicting the effect of changes in conditions on equilibrium Le Chateliers principle states that if a change of condition is applied to a system in equilibrium the system will shift in a direction that relieves the stress These changes include Temperature Increasing temperature favors the endothermic reaction while decreasing temperature favors the exothermic reaction Pressure Increasing pressure favors the side with fewer moles of gas while decreasing pressure favors the side with more moles of gas Concentration Increasing the concentration of reactants shifts the equilibrium to favor product formation while increasing the concentration of products shifts it to favor reactant formation

IV Acids Bases and Salts 1 Define acids and bases according to the BrnstedLowry theory Acid A substance that donates a proton  $H^+$  Base A substance that accepts a proton  $H^+$  2 Explain the concept of pH and its relationship to the strength of an acid or base pH is a measure of the hydrogen ion concentration in a solution It ranges from 0 to 14 with lower pH values indicating a higher hydrogen ion concentration and thus a stronger acid Conversely higher pH values indicate a lower hydrogen ion concentration and thus a stronger base 3 What are the properties of acids and bases Acids Sour taste react with metals to produce hydrogen gas turn blue litmus paper red Bases Bitter taste feel slippery turn red litmus paper blue 4 Describe the process of neutralization and write the equation for the reaction between a strong acid and a strong base Neutralization is the reaction between an acid and a base to form salt and water The equation for the reaction between a strong acid HCl and a strong base NaOH is  $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

4 V Organic Chemistry 1 Define the term functional group and give examples A functional group is a specific group of atoms within a molecule responsible for its characteristic chemical properties Examples include Alkanes  $CH$  bonds only Alkenes  $CC$  double bond Alkynes  $CC$  triple bond Alcohols  $OH$  group Carboxylic Acids  $COOH$  group Amines  $NH_2$  group Ketones  $CO$  group attached to two carbon atoms Aldehydes  $CO$  group attached to one carbon atom and a hydrogen atom 2 Describe the reactions of alkanes alkenes and alkynes Alkanes Relatively unreactive due to strong  $CH$  bonds Undergo combustion and substitution reactions Alkenes More reactive than alkanes due to the  $CC$  double bond Undergo addition reactions where atoms or groups are added across the double bond Alkynes Even more reactive than alkenes due to the  $CC$  triple bond Undergo addition reactions similar to alkenes 3 Explain the concept of isomerism and its types Isomers are molecules with the same molecular formula but different structural arrangements Structural Isomerism Different arrangement of atoms in the carbon chain Geometric Isomerism Different arrangement of groups around a double bond Optical Isomerism Nonsuperimposable mirror images of a chiral molecule

VI Redox Reactions 1

Define oxidation and reduction in terms of electron transfer Oxidation Loss of electrons Reduction Gain of electrons 2 Explain how to identify oxidizing and reducing agents Oxidizing agent Accepts electrons and gets reduced 5 Reducing agent Donates electrons and gets oxidized 3 Describe the use of standard electrode potentials  $E^\circ$  to predict the spontaneity of a redox reaction Standard electrode potentials measure the tendency of a halfcell to gain electrons A more positive  $E^\circ$  value indicates a stronger tendency to gain electrons and therefore a stronger oxidizing agent A redox reaction is spontaneous if the overall  $E^\circ$  value is positive 4 Explain the importance of redox reactions in everyday life Redox reactions are fundamental to many processes including Respiration Breakdown of glucose to produce energy Corrosion Degradation of metals by oxidation Batteries Conversion of chemical energy to electrical energy Electroplating Coating metal surfaces with other metals VII Nuclear Chemistry 1 What are the main types of radioactive decay Alpha decay Emission of an alpha particle Helium nucleus Beta decay Emission of a beta particle electron Gamma decay Emission of gamma radiation highenergy photons 2 Explain the concept of half-life and its use in radioisotope dating Half-life is the time taken for half of the radioactive nuclei in a sample to decay This constant value can be used to determine the age of ancient objects by comparing the current amount of a radioactive isotope with its initial amount 3 Describe the uses and dangers of radioactive isotopes Uses Medical imaging Diagnosing and treating diseases Industrial applications Tracing and gauging Research Studying chemical processes Dangers Radiation exposure Can cause tissue damage and cancer Environmental contamination Radioactive materials can persist in the environment for long periods 6 This document provides a starting point for revision and does not encompass every aspect of the Higher Chemistry syllabus Students are encouraged to consult their textbooks notes and teachers for a comprehensive understanding of the topics covered

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