

Answers To Revision Questions For Higher Chemistry

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Answers to Revision Questions for Higher Chemistry 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 elements atomic number

Neutrons Neutral particles found in the nucleus They contribute to the atoms 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 Carbon¹² and Carbon¹⁴ 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 ΔH 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 ΔH is negative The products have lower energy than the reactants

Endothermic Reactions Reactions that absorb heat energy from the surroundings ΔH 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 $\text{HCl(aq)} + \text{NaOH(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$

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 NH₂ 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
- 3 Reducing agent Donates electrons and gets oxidized
- 3 Describe the use of standard electrode potentials E to predict the spontaneity of a redox reaction
 Standard electrode potentials measure the tendency of a halfcell to gain electrons
 A more positive E value indicates a stronger tendency to gain electrons and therefore a stronger oxidizing agent
 A redox reaction is spontaneous if the overall E 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 halflife and its use in radioisotope dating
 Halflife 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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