

Enlightism
Spreading Inspiration

AS Chemistry

All Chapters

Contributed By Hassan Ilyas

Chapter 2: Atomic Structure

	Ionisation Energies kJmol^{-1}			
	Fifth	sixth	seventh	Eight
X	6542	9362	11018	33606

Q State and explain the group number of element X?

Ans The group number is 7, because there is a big difference between the 7th and 8th ionisation energy compared to the 6th and 7th indicating the change to a different electron shell meaning the outer shell holds 7 valance electrons. (Group no. = No. of valance electrons)

Q General trend of ionisation energy across a period?

Ans Ionisation energy increases as nuclear charge increases due to increase in proton number across the period. But atomic radius and shielding effect remain similar as the electron shell number are the same across the period. Leading to increase in nuclear attraction across the period.

Q General trend of ionisation energy down a group?

Ans Ionisation energy decreases down the group even though nuclear charge increases, shielding and atomic radii also increases due to increase in electron shell causing the effective nuclear charge to decrease leading to a decrease of nuclear attraction.

Q Why is there a large increase from 7th to 8th ionisation energies of element X?

Ans Moving down an orbital energy shell level decreases, so shielding and atomic radii decreases, but nuclear charge remains constant so there is a large increase in nuclear attraction so there is a large increase in ionisation energy.

Q Explain why sodium has a lower first ionisation energy than magnesium?

Ans Mg has a greater nuclear charge (more protons) than Na and in both atoms the electrons are in the 3s orbital (same energy shell) so same shielding and atomic radii. So overall nuclear attraction is greater for magnesium.

Q Explain why magnesium has a higher first ionisation energy than aluminum?

Ans In Al the outermost electron is in the 3p orbital, whereas in Mg it is in the 3s orbital, 3p is in a higher energy level than 3s. Thus shielding and atomic radii increase and thus easier to remove. So overall nuclear attraction is greater for magnesium.

Q Explain why phosphorus has a higher first ionisation energy than sulfur?

Ans In S the electron is being paired with another electron so there is spin-pair repulsion whereas in phosphorus there is no spin pair repulsion as 3p orbitals are singly filled. Since paired electors repel they are easier to remove.

Chapter 3: Chemical Bonding

Q Explain how sp^2 and sp^3 hybridisation can occur in carbon atoms? State bond angles.

Ans sp^2 : one 2s orbital plus two 2p orbitals (120)
 sp^3 : one 2s orbital plus three 2p orbitals (109)

Q Suggest why HF has a much higher boiling point than the boiling points of other hydrogen halides?

Ans HF has the strongest permanent dipole-dipole bonding (biggest electronegative difference F_2 has zero) and has hydrogen bonding which require more energy to overcome than the weaker dipole-dipole binding of the other halides.

Q Suggest an explanation for the increase in boiling points from methane to butane?

Ans Number of electrons increase as you move from methane to butane. As number of electrons increase there are greater and stronger van der waal's forces and thus require more heat to break thus boiling point increases.

Q Suggest an explanation for the increase in boiling points from iso-butane to butane?

Ans Straight chain molecules (butane) can pack more closely and therefore have greater van der waal's forces and thus require more energy to break.
Branched molecules (iso-butane) have less contact points and cannot pack more closely and thus have weaker van der waal's forces and thus require less energy to break.

Q Suggest an explanation for existence of IF_7 and for the non-existence of ClF_7 ?

Ans The iodine atom is larger than the chlorine atom so iodine is able to pack the 7 fluorine around its atom whereas chlorine can so it is non-existent.

Q Suggest why N_2 has a lower boiling point than CO (isoelectronic)?

Ans Nitrogen has induced dipoles whereas carbon monoxide has permanent dipole-dipole which are stronger than the induced dipoles.

Q Suggest why X cannot fully dissolve in water?

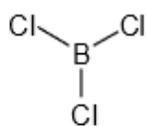
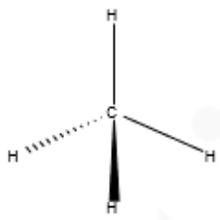
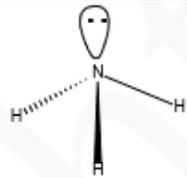
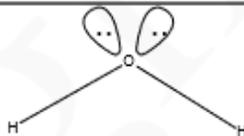
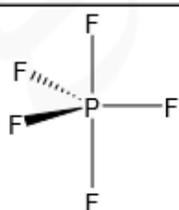
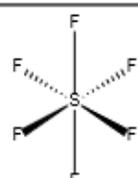
Ans Hydrogen bonding does not exist in X whereas hydrogen bonding does exist between water so they are not soluble in each other.

Q How are two atoms in a covalent bond held together?

Ans Attraction between bonding electrons and nuclei keep the molecule together, the attraction is electrostatic.

Q Explain why XH is polar?

Ans Big difference in electronegativity between X and H.

Name	No bonding pairs	No lone pairs	Diagram	Bond angle	Examples
linear	2	0	$\text{Cl}-\text{Be}-\text{Cl}$	180	CO_2 , CS_2 , HCN , BeF_2
Trigonal planar	3	0		120	BF_3 , AlCl_3 , SO_3 , NO_3^- , CO_3^{2-}
Tetrahedral	4	0		109.5	SiCl_4 , SO_4^{2-} , ClO_4^- , NH_4^+
Trigonal pyramidal	3	1		107	NCl_3 , PF_3 , ClO_3^- , H_3O^+
Bent	2	2		104.5	OCl_2 , H_2S , OF_2 , SCl_2
Trigonal Bipyramidal	5	0		120 and 90	PCl_5
Octahedral	6	0		90	SF_6

Chapter 4: States of Matter

Q State what is happening to the energy and movement of the particles when it is being cooled?

Ans Kinetic energy is decreasing as temperature is decreasing. $KE = \frac{1}{2}mv^2$ so as kinetic energy decreases movement of molecules decrease.

Q Explain why temperature is constant during freezing?

Ans Temperature stays constant because energy is being given out (released) due to bond formation as bond formation is exothermic.

Q State and explain which temperature is lowest in a pV versus p graph?

Ans The lowest one is the one that shows the greatest deviation from the ideal gas behaviour. As the lowest temperature would have the least kinetic energy and the intermolecular forces become more significant and the gas moves away from the ideal gas behavior.

Q State and explain the effect of pressure on the extent to which a gas deviates from ideal gas behaviour?

Ans High pressure means volume decrease so volume of particles become more significant and thus the gas deviates greatly at high pressure.

Q Explain why a liquid eventually becomes a gas as the temperature is increased?

Ans With increasing temperature the kinetic energy of molecules increases causing the intermolecular forces to be more easily broken and causing the molecules to break away and become a gas.

Q State the basic assumptions of the kinetic theory as applied to an ideal gas?

Ans For an ideal gas, the molecules behave as rigid spheres. There are negligible intermolecular forces between the molecules. Collisions between the molecules are perfectly elastic. The molecules have negligible volume. The molecules move in random motion. The molecules move in a straight line in between collisions. The kinetic energy of the molecules is directly proportional to the temperature. The pressure exerted by the gas is due to the collisions between the gas molecules and the walls of the container.

Q Graphite is the form of carbon that is a conductor of electricity, why?

Ans Graphite has delocalised electrons that act as charge carriers, so it can conduct electricity.

Q Explain why X remains solid at Y temperature and why Z remains a liquid?

Ans X has strong bonding due to permanent dipole-dipole bonds (covalent)/ strong ionic lattice (ionic)/ delocalised electrons (metallic). They are strong bonds that are not easily broken.

Y is held together by weak van der Waals' forces and are easily broken.

Chapter 5/6/7/8

Variable	Type of Change	Response of System
concentration	increase	shifts to consume some of the added reactant or product
	decrease	shifts to replace some of the removed reactant or product
temperature	increase	shifts to consume some of the added thermal energy
	decrease	shifts to replace some of the removed thermal energy
volume	increase (decrease in pressure)	shifts toward the side with the larger total amount of gaseous entities
	decrease (increase in pressure)	shifts toward the side with the smaller total amount of gaseous entities
Variables That Do Not Affect Chemical Equilibria		
catalysts	–	no effect
inert gases	–	no effect

Q Explain why the total pressure of the system does not need to be known for K_p to be calculated for this experiment?

Ans Because there are equal number of moles on either side of the equation.

Q With reference to Le Chatelier's principal and reaction kinetics, state and explain one advantage and one disadvantage of using a higher temperature?

Ans Advantage: Higher rate

As temperature increases, kinetic energy increases, which increases the frequency of collisions and more particles have energy greater than the activation energy, thus proportion of successful collisions increase.

Disadvantage: Reduced yield

Forward reaction is exothermic, so as temperature is increased, due to Le Chatelier's the equilibrium shifts to oppose the increase in temperature, causing the reaction to move to the left, more endothermic, leading to reduced yield.

Q What will be the effect on the rate of the reaction of increasing the pressure at which it is carried out?

Ans The rate of reaction will increase as increase in pressure will lead to decrease in volume and collisions will occur more frequently, thus proportion of successful collisions increase.

Q Explain, in terms of electron transfer, the meaning of the term oxidise?

Ans The anion cause the cation to lose electrons.

Q X reacts with Y but not with Z, why?

Ans The activation energy of Z is too high as compared to Y and thus X prefers to react with Y as it is easier.

Q What would be the effect on the amount of product A present if product B is removed?
Ans More of product A will be formed in order to maintain the value of K_c and to restore the system to equilibrium.

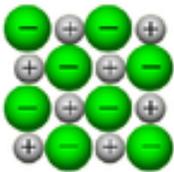
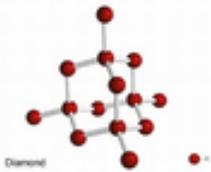
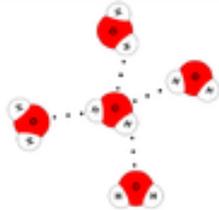
Q Is the forward reaction endothermic or exothermic?
Ans It is endothermic because K_c increases with increasing temperature.
Or It is exothermic because K_c decreases with increasing temperature.

Q Uncontrolled use of these fertilisers has led to environmental problems, briefly describe and explain these problems?
Ans Excess, uncontrolled, nitrates leach out of the fields into the rivers. Which causes the bacteria to grow uncontrollably in the rivers and forms an algae layer which uses up the oxygen in the water when the algae dies and destroying the balance, causing life below the algae layer in the river to die out. This process is called eutrophication.

Q State the benefit of using a catalyst in a reaction?
Ans Using a catalyst creates an alternative pathway with lower E_a so more molecules have energy greater than E_a . So rate of successful collisions occur per unit time increase. Using a catalyst increases the rate of reaction and this is more economic benefit (as less heat is required for the reaction).

Q Explain why reactions occur faster at a higher temperature?
Ans There is now a greater area to the right of the E_a line due to the higher temperature. Number of molecules with energy greater than E_a are increased so rate of successful collisions increases so rate of reaction is faster.

Chapter 9: Periodicity

Giant Ionic Structure	Giant covalent structure	Simple covalent structure
		
Description of Structure: Regular 3D arrangement of positive and negative ions	Description of Structure: Repeating 3D structure with strong bonds between atoms	Description of Structure: Isolated molecules with weak forces between molecules
Bonding: Strong electrostatic attraction between positive and negative ions	Bonding: Strong bonds between atoms, electrons are shared	Bonding: Strong bonds between atoms, electrons are shared
Melting Temp: High melting points, always solid at room temp	Melting Temp: High melting points, always solid at room temp	Melting Temp: Low melting points, gases and liquids at room temp
Conductivity: Conduct electricity when molten and in solution	Conductivity: Most don't conduct electricity (except graphite)	Conductivity: Don't conduct electricity
Arrangement: Regular crystal lattice arrangement	Arrangement: Regular crystal lattice arrangement	Arrangement: Shape of molecule varies
Example: Sodium chloride	Example: Diamond	Example: Water

Q	The radii of a cation and anion in a period have vastly great difference in the radii of their most common ion?
Ans	X ⁺² has a lesser number of shells (it loses its valence electrons and moves down a shell number) to Y ⁻² (gains electrons in its valence shell and has the same number of shells to its un-ionised form).
Q	Chlorine forms three chlorides, MgCl₂, AlCl₃, and SiCl₄, state and explain the pattern shown by the formulae of these three chlorides?
Ans	The number of chlorines increases by one each time because the oxidation of the cation is increasing (due to increasing number of valence electrons).
Q	Magnesium is a better electrical conductor than sodium which is a better electrical conductor than phosphorus?
Ans	Magnesium donates two electrons into the sea of electrons compared to sodium which donates only one electron, as it has one more valence electrons (also gives magnesium stronger bond). Sodium has metallic bonding and thus has delocalised electrons, which are able to carry the electric charge. Phosphorus has simple covalent bonding, and thus no delocalised electrons to carry the electric charge.
Q	Explain why the melting point of Si is very much greater than those of the other three elements?
Ans	Si has a giant covalent structure whereas P, S, and Cl have a simple molecular which have weaker bonds.

Q	Suggest why the melting points of the other three elements are in the order $S > P > Cl$?
Ans	From S_8 , to P_4 , to Cl_2 number of electrons decrease, and due to a decrease in electrons the van der Waal forces decrease, which leads to a weaker bond that breaks at a lower temperature. S has the greatest number of electrons and thus the strongest bonds and takes more energy to break.
Q	Explain why there is no visible reaction when a piece of magnesium ribbon is exposed to air?
Ans	The activation energy is too high and molecules having energy greater than the activation energy (the molecules capable of a successful reaction) are too little.
Q	State the trend in temperature of thermal decomposition of group 2 carbonates and nitrates?
Ans	It increases down the group. This is because the group 2 ion has lower charge density, down the group and thus distorts the carbonate ion less. The less distorted the carbonate ion is, the more stable it is, and so a higher temperature is required to decompose the carbonate.
Q	Describe the trend in reactivity of Mg, Ca, and Ba with cold water?
Ans	Reactivity increases down the group because the ease with which they lose electrons increases down the group. Due to the increase in distance between nucleus and valence electrons and shielding effect increases which outweighs the increase in nuclear charge.
Q	Atomic radii of group 2 elements increase down the group?
Ans	As you go down the group number of shells increase, so distance and shielding increases, this causes the effective nuclear charge to decrease even though it has increased so overall nuclear attraction decreases and the shell goes further away.
Q	Explain why the strontium ion is smaller than the strontium atom?
Ans	The number of electrons has decreased and the number of shells decrease by one, so shielding and atomic radii decrease. Nuclear charge is the same and thus nuclear attraction has increased.
Q	Explain why volatility of halogens decreases down the group?
Ans	Less volatility as number of electrons increases which increases the strength of the van der Waal's forces. Thus more energy is needed to overcome the force and makes the halogen less volatile as you move down the group.
Q	Explain the trend in oxidising power of the halogens?
Ans	Oxidising power decreases down the group because increase in size and shielding effect reduces the effective nuclear charge. Leading to overall decrease in nuclear attraction and valence electrons can more easily escape the nucleus.
Q	Describe the relative thermal stabilities of the hydrogen halides?
Ans	The thermal stabilities decrease down the group because the size of the halogen atom increases. The shielding effect and atomic radii increase which reduce the effective nuclear charge even though it has increased causing the nuclear attraction to decrease. The H-X bond become longer and the bond is now more easily broken, and thus require lesser energy.

Q	Explain why the reaction of concentrated sulfuric acid and sodium iodide is not suitable for the preparation of hydrogen iodide?
Ans	H ₂ SO ₄ is a very strong oxidising agent and as such I ₂ will be formed rather than HI.
Q	Explain the trend in the reactivity of the halogens with hydrogen?
Ans	The reactivity of halogens decreases down the group, because the bond length increase so bond strength and bond energy decrease and thus it takes more energy to take in electrons and complete the octet.

Enlightism

Spreading Inspiration

CONTACT US FOR QUERIES OR SUGGESTIONS

Email us at: contact@enlightism.com

FOLLOW US AT:
@ENLIGHTISM



All rights reserved 2023

No part of this document may be copied or re-uploaded to another website without the express, written permission of the copyright owner. Under no conditions may this document be distributed under the name of false author(s) or sold for financial gain; the document is solely meant for educational purposes and it is to remain a property available to all at no cost.

ENLIGHTISM.COM

Copyright © 2023 Enlightenment