Additional Science Chemistry

C2

Core Questions and Keywords and Definitions

Core Questions

Question	Answer
How did Mendeleev arrange the elements known at the time into a periodic table?	By using the mass number and other properties of the elements and the properties of their compounds.
How did Mendeleev use his table?	To predict the existence and properties of some elements that were still to be discovered.
Where are the non-metals found in the periodic table?	At the top on the right hand side.
Name 3 sub-atomic particles.	Protons, neutrons and electrons.
Describe the structure of an atom.	A nucleus containing protons and neutrons, surrounded by electrons in shells.
How does the size of the nucleus compare to the overall size of the atom.	The nucleus is very small. (if an atom were the diameter of the London Eye, the nucleus would be the size of a pea at the centre!)
What are the relative charges and masses of protons, neutrons and electrons.	Protons: mass 1, charge +1 Neutrons: mass 1, charge 0 Electrons: mass almost zero, charge -1.
Which particle gives the atom its identity?	The number of protons present.
If an atom contains 12 protons, how many electrons will it have?	12.
What is the atomic number of an element?	The number of protons.
What is the mass number of an element?	The total number of protons and neutrons.
What is the relative atomic mass, (A_r)?	The relative mass of an atom compared to the mass of an atom of carbon-12.
In what order are elements arranged in the periodic table?	In order of increasing atomic number.
What do we call the rows and columns of the periodic table.	Rows are periods and groups are columns
1 What do all elements in the same row of the periodic table have in common?	They have the same number of shells of electrons.*
What do all elements in the same column of the periodic table have in common?	They have the same number of electrons in their outer shell (and therefore have similar chemical properties).
Lithium has a mass number of 7 and an atomic number of 3; work out the number of protons, neutrons and electrons present.	3 protons, 3 electrons and 4 neutrons.
4 What is an isotope?	Two or more atoms of the same element (the same number of protons) but with a different number of neutrons.
What are the maximum numbers of electrons that can be present in the first three electron shells of an atom?	1^{st} shell = 2 2^{nd} shell = 8 3^{rd} shell = 8
What is the electronic configuration of silicon (atomic number 14)?	2,8,4
3 What is the electron configuration of calcium (atomic number 20)?	2,8,8,2
Why are some atomic masses not whole numbers?	Some naturally occurring elements are made up of 2 or more isotopes so their relative atomic mass is an average of these isotopes.

2 What is the formula for calculating relative atomic mass of an element from the relative mass and abundance of its isotopes?	$\frac{(\%\text{ abundance} \times \text{atomic mass}) + (\%\text{ abundance} \times \text{atomic mass})}{100} = \text{relative atomic mass}$ **
3 Why do atoms join together to form compounds?	To get a full outer shell of electrons.
Describe an ionic bond.	A metal loses electron(s) to a non-metal. This results in the metal becoming a positively charged ion and the non-metal a negatively charged ion. These oppositely charged ions then attract.
1) How is sodium chloride formed?	The sodium atom transfers its outer electron to the chlorine atom, producing a pair of oppositely charged ions that stick together by electrostatic attraction.
Name 3 types of bonding?	Ionic, covalent and metallic.
What is an ion?	A charged atom or group of atoms.
What charge do metal ions (cations) carry?	Positive charge
How does a Sodium atom form the Na^+ ion?	The sodium atom loses its one outer electron.
What is the formula of the compound formed from Mg^{2+} and Cl^- ions, and from Na^+ and O^{2-}?	$MgCl_2$ Na_2O
2 What are the names of: 1) MgS $MgSO_4$	1) Magnesium sulphide Magnesium sulphate
What do the compound endings: 1) ide 2) ate mean?	1) ide – a compound of only the named substances ate – a compound of the named substances and oxygen
2) Describe how to prepare a pure dry sample of an insoluble salt.	2) Mix together the soluble salts that will produce an insoluble salt as a precipitate. Filter, wash and dry the precipitate.
Describe the structure of ionic substances.	2) Ionic substances are a regular arrangement of oppositely charged ions held together in a lattice structure by strong electrostatic forces.
4 List and explain two physical properties of ionic compounds.	1. They have **high melting** because there are strong electrostatic forces holding the oppositely charged ions in place, therefore a lot of energy to separate them. They can **conduct electricity when molten or in aqueous solution** (dissolved in water) because the ions are free to move and carry their charge.***
List the general rules that describe the solubility of common types of substances in water.	All common sodium, potassium and ammonium salts are soluble. All nitrates are soluble. Common chlorides are soluble, except silver and lead. Common sulfates are soluble, except lead, barium and calcium. Common carbonates and hydroxides are insoluble, except sodium, potassium and ammonium.
What is a precipitate?	A solid that is formed from two reacting solutions.
What is the name of the insoluble precipitate formed when lead nitrate reacts with potassium chloride?	2. Lead chloride
What is the insoluble salt barium sulphate used for?	Barium sulphate is opaque to X-rays. It is given to patients as a "barium meal" in order to take X-ray images of the gut. (It is toxic, but because it is insoluble it does not enter the blood stream, and therefore not harmful.)
3) Describe the flame colours seen for sodium,	Sodium - Yellow, potassium - lilac, calcium - red and copper blue/green.

potassium, calcium, and copper.	
5 What is a test for the carbonate ion $(CO_3)^{2-}$ ion?***	Add an acid and the carbon dioxide is given off turns limewater milky.
What is a test for the sulphate ion $(SO_4)^{2-}$ ion?	Add a few drops of hydrochloric acid and then some barium chloride solution. A white precipitate forming is a positive result.
What is a test for a Cl^- ion?	Add a few drops of nitric acid then silver nitrate solution. A white precipitate forming is a positive result.
6 How were rubidium and caesium discovered?***	Spectroscopy
Describe what happens in covalent bonding?	Two non-metals overlap their outer electron shells and share at least one pair of electrons.
What does covalent bonding result in the formation of?	molecules
5 Do simple molecular covalent compounds conduct electricity?	No, because they don't have free electrons or ions to carry the charge.
Explain why simple molecular substances have low melting points?	There are only weak forces of attraction between the molecules (even though the covalent bonds within the molecule are strong).
Why is diamond used in cutting tools?	Diamond is very hard because all the carbon atoms are joined by 4 strong covalent bonds.
Why does diamond have such a high melting point?	In diamond each carbon atom is held in place by 4 strong covalent bonds and it takes a lot of energy to break these bonds.
Why does graphite conduct electricity?	In graphite each carbon forms 3 bonds, this leaves one electron left over from each carbon atom which sits between the graphite layers and is free to move and carry a charge.
6 Why can graphite act as a lubricant?	The layers of carbon atoms in graphite are only very weakly joined and are therefore free to slide past each other.
Describe the bonding in metals?	All metals form positive ions and their outer electrons are lost and sit between the metal ions (forming a 'sea of electrons').
Why do metals conduct electricity?	There are free electrons in the metallic structure that can move.
Why are metals malleable?	They bend because the ions can slide over one another.
What is an exothermic reaction and give an example?	A reaction that gives out heat energy. For example combustion.
What is an endothermic reaction and give an example?	A reaction that takes in heat energy. For example photosynthesis.
Is the breaking of bonds exothermic or endothermic?	Endothermic.
Is the making of bonds exothermic or endothermic?	Exothermic.
Why is a reaction exothermic?	In an exothermic reaction less energy is needed to break bonds than is given out when new bonds are made.
If a reaction is to occur what 2 things need to happen between reacting particles?	The particles must collide and the collision must have enough energy.
How does increasing the temperature speed up a reaction?	It gives the particles more energy so they collide more often and the collisions have more energy.
How does increasing the concentration of a solution speed up a reaction?	It means there are more particles present so it will increase the number of collisions.
Explain how breaking up a solid reactant increases the rate of reaction.	It increases the surface area of the solid meaning that more collisions can occur because there are more particles exposed to the other reactant in the smaller pieces. This increases the likelihood of a successful collision.
Explain how adding a catalyst speeds up the reaction.	It speeds up the reaction because the catalyst provides an alternative route for the reaction that requires less energy.

What does a catalytic converter do, and how is the rate of reaction maximized?	They react carbon monoxide and unburned fuel (from exhausts) with oxygen to give carbon dioxide and water. The rate of reaction is maximized by having a high surface area and operating at high temperature.
How can two immiscible liquids be separated?	By the use of a separating funnel.
4) How can liquid air be separated to produce nitrogen and oxygen?	By fractional distillation.
Complete the following gaps: _____ gas leaves at the top of the fractionating column because it has a _____ boiling point.	**Nitrogen** gas leaves at the top of the fractionating column because it has a **lower** boiling point.
In chromatography, define the R_f value.	R_f = distance moved by the component / distance moved by the solvent
1) What is chromatography used for?	Separation and identification of components in mixtures in a variety of contexts, such as the food industry and forensic science.
What do we call group 1, group 7 and group 0 in the periodic table?	The Alkali metals, the Halogens and the Noble gases.
Explain why metals are malleable.	The ions are all the same size so they slide over each other if a force is applied to the metal.
Explain why metals can conduct electricity.	They have free (delocalized) electrons that can move and carry the charge.
What are the two typical properties of the transition metals?	1. High melting points They form coloured compounds(e.g. copper sulphate)
How are the Alkali metals different from transition metals?	1. They are soft (can be cut with a knife). They have comparatively low melting points.
5) Describe the reaction of sodium with water.	1) The metal reacts and moves around the surface of the water. 2) The reaction gives of a gas. The product of the reaction is soluble in the water.
What two products are formed when alkali metals are added to water?	A hydroxide and hydrogen gas.
6) State the order of reactivity in group one and explain it.	Reactivity increases as you go down the group. This is because the outer electron is further away from the nucleus and is therefore more easily lost.
Describe the physical properties of the halogens at room temperature.	2. Fluorine is a pale yellow gas. Chlorine is a yellow/green gas. Bromine is a brown liquid. Iodine is a grey solid.
What is formed when halogens react with hydrogen?	2. Hydrogen halides. These can dissolve in water to from acids e.g. HCl, hydrogen chloride dissolves in water to form hydrochloric acid.
What is formed when halogens react with metals?	3) Metal halides. E.g. $2Fe + 3Cl_2 = 2FeCl_3$ (iron(III)chloride)
State the order of reactivity of the halogens and explain it.	Reactivity decreases as you go down the group.
If chlorine is added to sodium bromide solution what happens?	A displacement reaction takes place forming sodium chloride solution and bromine. This is because the chlorine is more reactive than the bromine.
Why are the noble gases unreactive?	They already have a full outer shell of electrons.
What are the properties of the noble gases?	1. Inertness (so used in welding and filament lamps) 2. Low density (used in balloons) non-flammability.
How were the noble gases discovered?	Scientists realised the density of nitrogen made in a reaction was different to the density of nitrogen obtained from air. This made them predict other more dense gases were present which they then found by performing experiments.

What is an empirical formula?	The simplest ratio of the elements in a compound.
Why do reactions never give the full theoretical yield of products?	1. incomplete reactions 2. small losses during the preparation competing, unwanted reactions.
Define the percentage yield of a reaction.	% yield = (actual yield/theoretical yield) x 100%
What factors do chemists in industry look for when designing a process to produce a commercial product?	1. High percentage yield 2. All the products of the reaction are commercially useful. 3. The reaction occurs at a suitable speed.

Keywords and Definitions

keyword	**Definition**
Atomic number	The number of protons in an element.
Atoms	The smallest part of an element that can take part in nuclear reactions.
Electronic configuration	The pattern of the electrons in their shells.
Electrons	The sub-atomic particles with a negative charge that orbit the nucleus.
Energy levels	Another name for shells or orbitals, relating to the energy electrons have.
Groups	The columns on the Periodic table.
Isotopes	An atom with a different number of neutrons from the mean.
Mass number	The number showing how much mass an element has.
Mean	A form of average where we add the numbers up and divide by how many there are.
Metals	A compound that is a good conductor of heat and electricity (found on the left of the Periodic table).
Neutrons	The particles in the nucleus with no charge.
Non-metals	An element that is not a metal and is found to the right of the Periodic table.
Nucleus	The centre of the atom consisting of protons and neutrons.
Periodic table	The table in which all elements are found in an organised way.
Periods	The rows on the Periodic table.
Protons	The positively charged sub-atomic particles found in the nucleus.
Relative abundance	This means "in comparison there are a lot more of these"
Relative atomic mass	The mass of a compound, for example.
Relative Charge	The charge of a particle relative to other particles.
Relative mass	The mass of a particle relative to other particles.
Shells	Another name for orbitals - the pathways of the electrons around the nucleus.
Anions	An ion with a negative charge.
Aqueous solution	When something is dissolved in water.
Barium meal	A drink containing barium sulphate.
Boiling point	The temperature at which something boils.
Bonds	The name for the attraction between particles in a compound.
Cations	An ion with a positive charge.
Compound ions	Ions that contain one or more elements.
Dissolves	When a solute splits up and mixes with a solvent.
Electrolysis	A process of splitting up compounds using electrical current.
Filtration	Separating larger molecules from smaller ones using a partially permeable membrane.
Flame tests	A test to detect the ions in a substance by observing their colour in a Bunsen flame.
Formula	A way of writing down a substance with symbols where it is made of two or more atoms.
Insoluble	Not able to be dissolved.
Ion	An atom that has gained or lost electrons to give it an overall charge.

Ionic bonds	The type of bond that is caused by opposite charges.
Ionic compounds	A compound bonded due to ions of opposite charge.
Lattice structure	The name of the structure that is caused by ionic bonding.
Melting point	The temperature at which something melts.
Molten	Melted to form a liquid.
Precipitate	An insoluble solid formed when two solutions are mixed together during precipitation.
Precipitation reaction	A reaction between two solutions to form an insoluble solid.
Salt	A compound formed by the neutralisation of an acid and an alkali.
Soluble	Able to be dissolved.
Spectroscopy	Analysis of the light from a particular source.
State symbols	The letters after an element in an equation, showing whether it is a solid, liquid, gas or in solution etc.
Toxic	Poisonous.
Chromatogram	The result of a chromatography test.
Chromatography	A process of separating mixtures to identify them (sometimes using paper and a solvent).
Covalent bonds	A bond formed by non-metal atoms held together by sharing electrons.
Diamond	A very hard substance made from carbon atoms.
Dissolve	What happens to a solute when placed in a solvent.
Dot and cross diagram	A diagram used to model covalent bonding.
Double bond	The type of bond where two pairs of electrons are shared.
Fraction	A certain part of crude oil that comes out of a fractionating column at the same point.
Fractional distillation	The process of separating fractions using a column and heat to separate by boiling point.
Fractionating column	A column used to separate fractions based upon their boiling points.
Giant molecular covalent substances	Lots of non-metals atoms held together in lattices to form bigger structures.
Graphite	A substance made from carbon that is arranged in layers.
Immiscible	Where liquids will not mix together completely.
Liquefied	Turned to liquid.
Lubricant	Something that reduces friction between two objects.
Miscible	If liquids can be mixed together to form another substance.
Molecule	More than one atom bonded together by covalent bonds.
Rf value	A comparison value for points on a chromatogram
Separating funnel	A piece of glassware used to separate two immiscible liquids.
Simple molecular covalent substances	A few atoms held together by very strong covalent bonds.
Solubilities	How soluble something is.
Solution	The result of a solute being dissolved in a solvent.
Solvent	Something which dissolves a solute.
Alkali metals	The metals found in group 1 of the Periodic table.
Delocalised electrons	Electrons that can move away from the original nucleus.
Displacement reaction	A reaction where one reactant takes the place of another element in the compound it is reacted with.
Elements	The most basic materials found in the Periodic table.
Halides	A compound of which one part is a halogen.
Halogens	Group VII of the Periodic table.
Inert	Non-reactive.
Malleable	Can be hammered into another shape without breaking.

Metallic bonds	The bonds formed between metal atoms.
Noble gases	The gases found in
Reactivity	How readily something takes part in a chemical reaction.
Transition metals	Metals in the centre of the Periodic table.
Concentration	How much of a substance is present in a dilution.
Endothermic	Takes in heat during a reaction.
Exothermic	Gives out heat during a reaction.
Rate of a chemical reaction	How quickly a reaction happens.
Surface area	The total area of an object or chemical.
Actual yield	The amount of product we make when the reaction is carried out (not the theoretical amount).
By-products	The products of a reaction that are not desired or intended.
Percentage	How much of something as a fraction out of one hundred.
Percentage by mass	The amount of an element as an amount of the total mass (as a percentage).
Percentage yield	The percentage of how much desirable product we obtain from a reaction.
Relative atomic mass	The total mass of a compound.
Theoretical yield	The amount of product we should have based on the equation for the reaction.
Waste products	Undesirable products from a reaction that are not needed.
Yield	The amount of product from a reaction.