**Core questions – Atomic Structure and the Periodic Table – paper 1**

| No. | Question | My answer | My answer | Answer |
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| 1 | Define atom | | | The smallest part of an element that can still be recognised as that element |
| 2 | Define element | | | A substance made of only one type of atom |
| 3 | Define compound | | | A substance made of two or more different atoms chemically bonded together |
| 4 | Define molecule | | | A substance made of more than one atom chemically bonded together (can be atoms of the same type!) |
| 5 | Define mixture | | | A substance made of more than one thing ***not*** chemically bonded together |
| 6 | Approximately how many elements are there? | | | 100 |
| 7 | How are elements represented on the periodic table? | | | Chemical symbols |
| 8 | How are chemical symbols written? | | | The first letter is always upper case. The second letter always lower case |
| 9 | Name four methods of separating mixtures | | | Crystallisation, filtration, distillation and chromatography |
| 10 | What is filtration used to separate? | | | An insoluble solid from a liquid |
| 11 | What is meant by the term filtrate? | | | A liquid which has passed through a filter |
| 12 | What is meant by the term residue? | | | A solid which has not passed through a filter |
| 13 | How is filtration used to separate a mixture? | | | A mixture of an insoluble solid and liquid is added to a funnel containing filter paper. The liquid will pass through the pores in the filter paper leaving behind the insoluble solid. |
| 14 | What is evaporation? | | | Evaporation is the change of state from a liquid to a gas |
| 15 | What is evaporation used to separate? | | | A soluble solid from a liquid it is dissolved in |
| 16 | How is evaporation used to separate a mixture? | | | The mixture of a soluble solid and liquid is heated until the liquid evaporates leaving behind a solid |
| 17 | What is crystallisation? | | | The formation of a soluble solid after a liquid has evaporated |
| 18 | What is distillation used for? | | | To separate liquids with different boiling points |
| 19 | What are the two changes of state involved with distillation? | | | Evaporation and condensation |
| 20 | How is distillation used to separate a mixture? | | | Heat a mixture of liquids, the liquid with the lowest boiling point evaporates then condenses first, leaving the second liquid behind |
| 21 | What is chromatography used for? | | | To separate mixtures of different chemicals |

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| 22 | How does chromatography work to separate mixtures? | | | A spot of a mixture is placed near the bottom of a piece of chromatography paper and the paper is then placed upright in a suitable solvent. As the solvent soaks up the paper, it carries the mixture with it. Different components of the mixture will move at different rates and the mixture separates out |
| 23 | What did scientists think about atoms before the discovery of the electron? | | | They were tiny spheres that could not be broken up |
| 24 | Which sub-atomic particle did JJ Thomson discover? | | | Electrons |
| 25 | What model did JJ Thomson use, following the discovery of an electron, to describe the structure of an atom? | | | Plum pudding model |
| 26 | How did JJ Thomson describe an atom? | | | Spheres of positive charge with tiny negative electrons stuck in them |
| 27 | Which sub atomic particle was discovered by Rutherford and Marsden? | | | Protons |
| 28 | Describe the experiment Rutherford and Marsden did | | | Fired alpha particles at a thin piece of gold foil. |
| 29 | If the plum pudding model was correct what should have happened to the alpha particles when fired at the gold foil? | | | Pass straight through or be deflected only slightly |
| 30 | What did happen to the alpha particles when fired at the gold foil? | | | Most passed straight through, some were deflected more than expected and some were deflected backwards off the foil. |
| 31 | What new ideas about the atom were concluded from the gold foil experiment? | | | 1. Most of the mass was in the centre of atom in a tiny nucleus<br>2. The nucleus had a positive charge<br>3. Most of the atom is empty space |
| 32 | What name was given to the model of the atom following the gold foil experiment? | | | The nuclear model |
| 33 | How was the atom described in the first nuclear model? | | | A positively charged nucleus surrounded by a *cloud* of electrons |
| 34 | How did the work of Niels Bohr improve the nuclear model? | | | He suggested that electrons orbit the nucleus at specific distances |
| 35 | How did Bohr realise that his suggestions were correct? | | | His theoretical calculations agreed with experimental observations |
| 36 | What did later experiments show that led to the understanding of protons? | | | Scientists discovered that the positive charge of a nucleus can be divided into a whole number of smaller particles that each have the same positive charge. |

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| 37 | Which sub-atomic particle was identified by James Chadwick? | | | The neutron |
| 38 | What is the current model of an atom? | | | There is a positively charged nucleus (made up of protons and neutrons), surrounded by negatively charged electrons. |
| 39 | In what order were the sub-atomic particles discovered? | | | Electrons, protons, neutrons |
| 40 | What are the three sub-atomic particles that make up an atom? | | | Protons, neutrons and electrons |
| 41 | What is the relative mass of a proton? | | | 1 |
| 42 | What is the relative mass of an electron? | | | Very small |
| 43 | What is the relative mass of a neutron? | | | 1 |
| 44 | What is the relative charge of a proton? | | | +1 |
| 45 | What is the relative charge of an electron? | | | -1 |
| 46 | What is the relative charge of a neutron? | | | 0 (neutral) |
| 47 | Why is the overall charge of an atom zero? | | | An atom has the same number of protons and electrons |
| 48 | What is 'atomic number?' | | | The number of protons in an atom |
| 49 | What is 'atomic mass number?' | | | The number of protons and neutrons added together |
| 50 | Where is most of the mass of the atom? | | | In the nucleus |
| 50 | What is the average radius of an atom | | | $1 \times 10^{-10}$ m or 0.1nm (nanometres) |
| 51 | How big is the radius of the nucleus? | | | It is less than 1/10,000th of the radius of the atom. |
| 52 | What are energy levels? | | | The electrons are arranged at different distances from the nucleus in "energy levels" which are sometimes called "shells". |
| 53 | How many electrons can the first shell hold? | | | 2 |
| 54 | How many electrons can the second & third shell hold? | | | 8 |
| 55 | How can the electronic structure of an atom be represented? | | | Diagram or numbers |
| 56 | How are elements in the modern periodic table ordered? | | | By atomic number |
| 57 | What are groups in the periodic table? | | | The columns, numbered 1, 2, 3, 4, 5, 6, 7, 0 |
| 58 | How are elements in the **same group** similar to each other? | | | They all have similar chemical properties |
| 59 | What can the group tell you about the electrons in an atom? | | | How many electrons in the outer shell. E.g. carbon is in group 4 so has 4 electrons in the outer shell |
| 60 | What are periods in the periodic table? | | | The rows in the periodic table |
| 61 | What can the period tell you about the electrons in an atom? | | | How many shells an atom has. E.g. carbon is in the second period so has two shells |

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| 62 | What is an isotope? | | | Atoms of the same element with a different number of neutrons |
| 63 | What is the relative atomic mass of an element? | | | The average value that takes account of the abundance of the isotopes of the element |
| 64 | Why is the relative atomic mass of chlorine 35.5? | | | 75% of chlorine has a mass of 35. 25% of chlorine has a mass of 37.<br>0.75 x 35 = 26.25<br>0.25 x 37 = 9.25<br>9.25 + 26.25 = 35.5 |
| 65 | How were elements arranged in the early periodic tables? | | | By atomic weight |
| 66 | What did Mendeleev do differently? | | | He still arranged them by weight, but left gaps where the properties didn't quite fit |
| 67 | Why did Mendeleev put some elements in groups? | | | Because they had similar chemical properties (e.g. they reacted violently with water) |
| 68 | Why did Mendeleev leave gaps in his periodic table? | | | For elements that had not been discovered yet |
| 69 | What is an ion? | | | An atom that has lost or gained electrons |
| 70 | If an atom has gained electrons, what charge will it have? | | | Negative |
| 71 | If an atom has lost electrons, what charge will it have? | | | Positive (because they have lost a negative!) |
| 72 | Which elements react to form positive ions? | | | Metals |
| 73 | Which elements react to form negative ions? | | | Non-metals |
| 74 | Which side of the periodic table has the metals? | | | The left hand side |
| 75 | Define inert | | | Unreactive |
| 76 | What is a trend? | | | A pattern in properties |
| 77 | What group are the noble gases located? | | | Group 0 |
| 78 | Why are the noble gases inert? | | | Their outer electron shell is full, so do not need to lose or gain electrons |
| 79 | What is the trend in boiling points as you move **down** group 0? | | | They increase |
| 80 | In terms of electrons, what do group 1 elements have in common? | | | 1 electron in the outer shell |
| 81 | What are the group 1 metals called? | | | Alkali metals |
| 82 | Why are the group 1 metals called alkali metals? | | | They are metals that form alkalis when they react with water |
| 83 | How does the reactivity of alkali metals change as you move down the group? | | | They become more reactive |

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| 84 | Why does the reactivity of alkali metals increase as you move down the group? | | | Their outer electron is easier to lose if it is further away from the nucleus, and if the atom has more shells |
| 85 | What is produced when group 1 metals react with water? | | | Metal hydroxide (alkali) and hydrogen gas |
| 86 | What is produced when group 1 metals react with chlorine? | | | Metal chloride |
| 87 | What is produced when group 1 metals react with oxygen? | | | Metal oxide |
| 88 | What is the common name for group 7 elements? | | | The halogens |
| 89 | In terms of electrons, what do group 7 elements have in common? | | | 7 electrons in the outer shell |
| 90 | What kind of ion will a halogen form? | | | A halide ion ($X^-$) with a single negative charge |
| 91 | What is the trend in reactivity of group 7 elements as you move down the group? | | | They become less reactive |
| 92 | Why do group 7 elements become less reactive as you move down the group? | | | It is harder to attract an electron if the outer shell is further away from the nucleus (or if the atom has more shells) |
| 93 | What is the trend in melting points and boiling points as you move down group 7? | | | They increase |
| 94 | What is displacement? | | | A more reactive element replacing a less reactive element from an aqueous solution of its salt |
| 95 | Why is chlorine able to displace a bromine ion in sodium bromide? | | | Chlorine is more reactive than bromine |

**Core questions – Bonding and Structure – paper 1**

| No. | Question | My answer | My answer | Answer |
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| 1 | Where does ionic bonding occur? | | | In compounds formed from metals combined with non-metals |
| 2 | Where does covalent bonding occur? | | | Non-metallic elements and in compounds of non-metals |
| 3 | Where does metallic bonding occur? | | | In metallic elements and alloys |
| 4 | What charge does an ion have when an atom has lost electrons? | | | Positive |
| 5 | What charge does an ion have when an atom has gained electrons? | | | Negative |
| 6 | Describe ionic bonding | | | The attraction between oppositely charged ions |
| 7 | How are ionic compounds held together? | | | With strong electrostatic forces of attraction between the oppositely charged ions |

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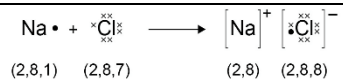
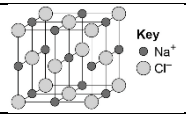
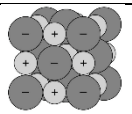
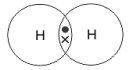
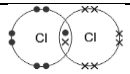
| 8 | What does a dot cross diagram look like for sodium and chlorine reacting to form sodium chloride (only including the outer shell)? | | |   |
| 9 | What does a ball and stick model of sodium chloride look like? | | |   |
| 10 | What are the disadvantages of using a ball and stick model to represent ionic compounds? | | | The model doesn't show the relative sizes of of the ions and it shows gaps between the ions, whereas in reality, there are no gaps between the ions |
| 11 | How can you calculate the empirical formula from a 3D diagram of an ionic lattice? | | | STEP 1: Look at the diagram to work out what ions are in the compound (e.g potassium ions and oxide ions)<br><br>STEP 2: Work out what charges the ions will form<br><br>STEP 3: Balance the charges so the charge of the empirical formula is zero<br><br>  <br>Potassium is in group 1 so forms 1+ ions<br>Oxygen is in group 6 so forms 2- ions<br><br>A potassium ion only has a 1+ charge, so you'll need two of them to balance out the 2- charge of an oxide ion.<br><br>The empirical formula is $K_2O$ |
| 12 | What charge do ions formed from group 1 elements have? | | | 1+ |
| 13 | What charge do ions formed from group 2 elements have? | | | 2+ |
| 14 | What charge do ions formed from group 6 elements have? | | | 2- |
| 15 | What charge do ions formed from group 7 elements have? | | | 1- |
| 16 | What is a covalent bond? | | | A shared pair of electrons |
| 17 | Name 8 simple covalent molecules? | | | Hydrogen; chlorine; oxygen; nitrogen; hydrogen chloride; water; ammonia; methane |
| 18 | What does a dot cross diagram for hydrogen look like? | | |   |
| 19 | What does a dot cross diagram for chlorine look like? | | |   |

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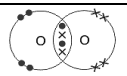
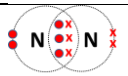
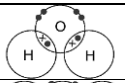
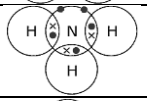
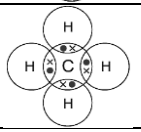
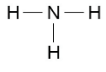
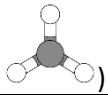
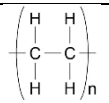
| 20 | What does a dot cross diagram for oxygen look like? | | |  |
| 21 | What does a dot cross diagram for nitrogen look like? | | |  |
| 22 | What does a dot cross diagram for hydrogen chloride look like? | | |  |
| 23 | What does a dot cross diagram for water look like? | | |  |
| 24 | What does a dot cross diagram for ammonia look like? | | |  |
| 25 | What does a dot cross diagram for methane look like? | | |  |
| 26 | How else can simple covalent structures be represented other than dot and cross diagrams? | | | Displayed formula (e.g.  )<br>3D structure (e.g  ) |
| 27 | What is a polymer? | | | Long chains of repeating units (monomers) |
| 28 | How are the atoms in a polymer held together? | | | With covalent bonds |
| 29 | How can polymers be represented? | | |  <br>poly(ethene) |
| 30 | What is metallic bonding? | | | A lattice of positively charged metal ions surrounded by delocalised electrons |
| 31 | How are atoms held together in metallic bonding? | | | Electrostatic attraction between the delocalised electrons and the positive metal ions |
| 32 | Name the process of a solid turning into a liquid | | | Melting |
| 33 | Name the process of a liquid turning into a solid | | | Freezing |
| 34 | Name the process of a liquid turning into a gas | | | Boiling |
| 35 | Name the process of a gas turning into a liquid | | | Condensing |
| 36 | Name the process of a solid turning into a gas | | | Subliming |

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| 37 | How is the strength of the forces between particles and the melting and boiling point of a substance related? | | | The stronger the forces the higher the melting/boiling point |
| 38 | What are the limitations of the particle model? | | | In the model there are no forces, particles are represented as spheres, the spheres are solid |
| 39 | What does the state symbol (s) represent? | | | Solid |
| 40 | What does the state symbol (l) represent? | | | Liquid |
| 41 | What does the state symbol (g) represent? | | | Gas |
| 42 | What does the state symbol (aq) represent? | | | Aqueous |
| 43 | What does aqueous mean? | | | Dissolved in water |
| 44 | What are the properties of ionic compounds? | | | High melting and boiling points; can conduct electricity when molten (or dissolved), but not as a solid |
| 45 | Why do ionic compounds have high melting/boiling points? | | | Large amount of energy is needed to break the strong attractions between oppositely charged ions |
| 46 | Why don't solid ionic compounds conduct electricity? | | | The ions are not free to move |
| 47 | Why do aqueous and liquid ionic compounds conduct electricity? | | | The ions are free to move |
| 48 | What are the properties of simple molecules? | | | Low melting and boiling points; do not conduct electricity |
| 49 | Why are simple molecules usually gases or liquids at room temperature? | | | They have low melting and boiling points |
| 50 | Why do simple molecules have low melting /boiling points? | | | The forces **between** the molecules are weak (intermolecular forces) and so require little energy to break |
| 51 | What is broken when simple molecules are melted/boiled? | | | The forces **between** the molecules (the intermolecular forces) |
| 52 | Why do larger molecules have higher melting points? | | | Larger molecules have stronger intermolecular forces |
| 53 | Why don't simple molecules conduct electricity? | | | The molecules do not have an overall electric charge AND do not have free flowing electrons |
| 54 | Why are polymers solid at room temperature? | | | Polymers are very large molecules and so have strong intermolecular forces |
| 55 | What is a giant covalent structure? | | | One where all the atoms in the structure are covalently bonded to other atoms |
| 56 | Name three giant covalent structures. | | | Diamond, graphite, silicon dioxide |

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| 57 | Why do giant covalent structures have high melting points? | | | Lots of energy is needed to break the covalent bonds between the atoms |
| 58 | What are the properties of pure metals? | | | High melting and boiling points; easily bent and shaped |
| 59 | Why do metals have high melting/boiling points? | | | The strong electrostatic attraction between the positive metal ions and the delocalised electrons needs lots of energy to be broken |
| 60 | Why can pure metals be easily bent and shaped? | | | The atoms are arranged in layers, which allows the atoms to slide over each other easily |
| 61 | What is an alloy? | | | A substance made of two or more elements, at least one of which is a metal |
| 62 | Why are alloys harder than pure metals? | | | The layers of metal ions are distorted by the differing size of the other atoms, which prevents the layers from sliding over each other as easily |
| 63 | Why are metals good conductors of electricity? | | | Because the delocalised electrons can carry electrical charge throughout the structure |
| 64 | Why are metals good conductors of heat? | | | Because thermal energy can be transferred by the delocalised electrons |
| 65 | Describe the structure of diamond. | | | Each carbon atom is covalently bonded to four others |
| 66 | What are the properties of diamond? | | | High melting point, hard, doesn’t conduct electricity |
| 67 | Why does diamond have a high melting point? | | | The strong covalent bonds between each atom takes a lot of energy to break |
| 68 | Why is diamond hard? | | | Because each carbon atom forms four covalent bonds with other carbon atoms |
| 69 | Why doesn't diamond conduct electricity? | | | Because it does not have free electrons that are able to move |
| 70 | Describe the structure of graphite. | | | Each carbon atom is covalently bonded to three others to form layers of hexagonal rings |
| 71 | How are the layers in graphite held together? | | | Intermolecular forces |
| 72 | What are the properties of graphite? | | | High melting point; soft; can conduct thermal and electrical energy |
| 73 | Why does graphite have a high melting point? | | | The strong covalent bonds between each atom takes a lot of energy to break |
| 74 | Why can graphite conduct electricity? | | | One electron from each carbon atom is delocalised and can carry charge through the structure |
| 75 | Why is graphite soft and slippery? | | | Because the layers are held by weak intermolecular forces, so are able to slide over each other easily |
| 76 | What is graphene? | | | A single layer of graphite |
| 77 | What are the properties of graphene? | | | Very light; very strong; can conduct electricity |

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| 78 | What real life applications can graphene be used for? | | | Composite materials and in electronic equipment |
| 79 | Why can graphene be used in composite materials? | | | It makes materials very strong without adding too much weight |
| 80 | Why can graphene be used in electronics? | | | It has delocalised electrons meaning it can conduct electricity |
| 81 | What is a fullerene? | | | A molecule of carbon atoms with a hollow shape |
| 82 | Describe the structure of a fullerene? | | | Mainly made of carbon atoms arranged in hexagons. They can also contain pentagon (5) or heptagon (7) rings |
| 83 | What was the first fullerene to be discovered? | | | Buckminsterfullerene ($C_{60}$) and forms a hollow sphere |
| 84 | Give two uses of fullerenes? | | | They can be used to 'cage' other molecules, meaning they could be used to deliver drugs to inside the body<br>They have can be used as catalysts because they have huge surface areas |
| 85 | What is a carbon nanotube? | | | Cylindrical fullerenes with very high length to diameter ratios |
| 86 | What do the properties of carbon nanotubes makes them useful for? | | | Nanotechnology, electronics, materials |

**Core questions – Chemical changes – paper 1**

| No. | Question | My answer | My answer | Answer |
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| 1 | What is reduction in terms of electrons? | | | Gain of electrons |
| 2 | What is oxidation in terms of electrons? | | | Loss of electrons |
| 3 | What is reduction in terms of oxygen? | | | Loss of oxygen from a compound |
| 4 | What is oxidation in terms of oxygen? | | | Gain of oxygen in a compound |
| 5 | What is formed when a metal reacts with oxygen? | | | A metal oxide |
| 6 | How is the reactivity of a metal defined? | | | Its tendency to lose electrons to form positive ions |
| 7 | What is the order of reactivity of metals? | | | Potassium, sodium, lithium, calcium, magnesium, zinc, iron, copper |
| 8 | Which non-metals are often in included in the reactivity series? | | | Hydrogen & carbon |
| 9 | How can metal reactions with water and acid be used to determine the order of reactivity? | | | The more reactive the metal, the faster the reaction will go (e.g more bubbles, higher temperature change) |
| 10 | What is a displacement reaction? | | | A more reactive metal can displace a less reactive metal from a compound |

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| 11 | Why is pure gold found naturally in the Earth? | | | Because it is not reactive enough to form a compound |
| 12 | How are metals that are less reactive than carbon extracted? | | | Their oxides are reduced using carbon (to form carbon dioxide and the pure metal) |
| 13 | What happens during the reaction of oxides, using carbon? | | | Oxygen is removed from the metal ore and carbon gains oxygen making carbon dioxide |
| 14 | What is formed when a metal reacts with an acid? | | | A salt and hydrogen |
| 15 | What sort of salt is formed when the acid used is hydrochloric acid? | | | Chloride salts (for example, sodium chloride) |
| 16 | What sort of salt is formed when the acid used is sulfuric acid? | | | Sulfate salts (for example, magnesium sulfate) |
| 17 | What sort of salt is formed when the acid used is nitric acid? | | | Nitrate salts (for example, ammonium nitrate) |
| 18 | What is the salt that is formed when magnesium reacts with hydrochloric acid? | | | Magnesium Chloride |
| 19 | What is the salt that is formed when zinc reacts with hydrochloric acid? | | | Zinc Chloride |
| 20 | What is the salt that is formed when iron reacts with hydrochloric acid? | | | Iron Chloride |
| 21 | What is the salt that is formed when magnesium reacts with sulfuric acid? | | | Magnesium Sulfate |
| 22 | What is the salt that is formed when zinc reacts with sulfuric acid? | | | Zinc Sulfate |
| 23 | What is the salt that is formed when iron reacts with sulfuric acid? | | | Iron Sulfate |
| 24 | What is formed when an acid is neutralised by an alkali? | | | Salt and water |
| 25 | What is formed when an acid is neutralised by a metal carbonate? | | | Salt, water and carbon dioxide |
| 26 | What does the particular salt produced in a reaction depend on? | | | The acid used & the positive ions in the base, alkali or carbonate |
| 27 | What is the formula of the chloride ion? | | | $Cl^-$ |
| 28 | What is the formula of the sulfate ion? | | | $SO_4^{2-}$ |
| 29 | What is the formula of the nitrate ions? | | | $NO_3^-$ |
| 30 | What ion is present in acids? | | | Hydrogen ions ($H^+$) |
| 31 | What ion is present in alkalis? | | | Hydroxide ions ($OH^-$) |
| 32 | What is the pH scale? | | | A measure of the acidity or alkalinity of a solution |

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|---|---|---|---|---|
| 33 | What does is the range of the pH scale? | | | From 0 to 14 |
| 34 | How can the pH of a substance be measured? | | | Using universal indicator or a pH probe |
| 35 | What pH is neutral? | | | Seven (7) |
| 36 | What pH values do acids have? | | | Less than 7 |
| 37 | What pH values do bases have? | | | More than 7 |
| 38 | What is a base? | | | A substance with a pH greater than 7 |
| 39 | Give two examples of bases? | | | Metal oxides and metal hydroxides |
| 40 | What is an alkali? | | | A base that will dissolve in water |
| 41 | How can neutralisation between acids and alkalis be represent in terms of $H^+$ and $OH^-$ ions? | | | $H^+ + OH^- \rightarrow H_2O$ |
| 42 | How can a soluble salt be prepared from an insoluble oxide or carbonate reacting with an acid? | | | 1. Warm the acid using a Bunsen burner<br>2. Add the insoluble base to the acid until no more reacts (add to **excess)**<br>3. **Filter** the excess solid to get the salt solution<br>4. Gently heat the solution to **evaporate** some water. Leave the rest for the salt to form (**crystallisation**) |
| 54 | What is an electrolyte? | | | A liquid or solution that is able to conduct electricity due to the presence of ions |
| 55 | What is the cathode? | | | The negative electrode |
| 56 | What is the anode? | | | The positive electrode |
| 57 | What is electrolysis? | | | Splitting up a compound with electricity |
| 58 | What is attracted towards the cathode during electrolysis? | | | The positive ions (the cations) |
| 59 | What is attracted towards the anode during electrolysis? | | | The negative ions (the anions) |
| 60 | What happens to the ions at each electrode? | | | They turn back into atoms |
| 61 | What happens to the positive ions at the cathode? | | | They gain electrons |
| 62 | What happens to the negative ions at the anode? | | | They lose electrons |
| 63 | When is electrolysis used to extract metals? | | | When the metal is more reactive than carbon OR if the metal reacts with carbon |
| 64 | What is aluminium oxide dissolved in during the electrolysis of aluminium oxide? | | | Cryolite |
| 65 | Why is aluminium oxide dissolved in cryolite for its electrolysis? | | | Its lowers the melting point needed and therefore reduces the amount of energy required |

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| 66 | What are the electrodes made of for the electrolysis of aluminium oxide? | | | Carbon |
| 67 | Why does the anode need replacing during the electrolysis of aluminium oxide? | | | It is made of carbon, and reacts with oxygen to produce carbon dioxide |
| 68 | Why would hydrogen be produced at the cathode during the electrolysis of an ionic compound in solution? | | | If the metal is more reactive than hydrogen |
| 69 | What is produced at the anode during the electrolysis of an ionic compound in solution when halide ions aren't present? | | | Oxygen |

**Core questions – Quantitative chemistry – paper 1**

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What is conservation of mass? | | | No atoms are lost or made during a chemical reaction - mass of the reactant = the mass of the products |
| 2 | Why can it appear that mass is not conserved? | | | If an experiment is completed in an open system, then gases can either enter or leave the system |
| 3 | Give an example of a reaction where mass may appear to increase | | | When a metal reacts with oxygen (gas) in an unsealed container, the mass of the container increases<br>Metal $_{(s)}$ + oxygen $_{\mathbf{(g)}}$ → metal oxide $_{(s)}$ |
| 4 | Give an example of a reaction where mass may appear to increase | | | When a metal carbonate thermally decomposes, carbon dioxide (gas) is given off<br>Metal carbonate $_{(s)}$ → metal oxide $_{(s)}$ + carbon dioxide $_{\mathbf{(g)}}$ |
| 5 | What is a word equation? | | | A way of using the names of substances to show what is happening during a chemical reaction |
| 6 | What are the products in a chemical reaction? | | | The new substances formed in a chemical reaction |
| 7 | What are the reactants in a chemical reaction? | | | The substances required for a chemical reaction |
| 8 | Why must all symbol equations be balanced? | | | All atoms must be conserved |
| | What does a balanced symbol equation show? | | | The number of moles of each compound that takes part in a chemical reaction |
| 9 | How do we know a symbol equation is balanced? | | | There is the same number of each atom on both sides of the arrow |
| 10 | What do the big numbers before the molecules in a symbol equation represent? | | | The number of units (or moles) of that molecule |
| 11 | Why must equations be balanced? | | | Because atoms cannot be created or destroyed |

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| 12 | What is relative formula mass? | | | The sum of the relative atomic masses of the atoms in the numbers shown in the formula (e.g. $O_2$ = 16 +16 = 32) |
| 13 | What is the symbol for relative formula mass? | | | $M_r$ |
| 26 | What is a solvent? | | | A liquid that dissolves a solute |
| 27 | What is a solute? | | | The solid that is being dissolved |
| 28 | What is a solution? | | | A mixture of a solute dissolved in a solvent |
| 29 | What is concentration? | | | The amount of substance in a certain volume of a solution |
| 30 | What is the formula for calculating concentration ($g/dm^3$)? | | | concentration ($g/dm^3$) = $\frac{\text{mass of solute (g)}}{\text{volume of solvent } (dm^3)}$ |

**Core questions – Energy changes – paper 1**

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What is an exothermic reaction? | | | One that transfers energy to the surroundings (energy is given out) |
| 2 | What happens to the temperature of the surroundings in an exothermic reaction? | | | It increases |
| 3 | What types of chemical reactions are exothermic? | | | Combustion, oxidation reactions, neutralisation |
| 4 | What is an endothermic reaction? | | | One that takes in energy from the surroundings |
| 5 | What happens to the temperature of the surroundings in an endothermic reaction? | | | It decreases |
| 6 | What types of chemical reactions are endothermic? | | | Thermal decompositions. The reaction of citric acid and sodium hydrogencarbonate |
| 7 | Give two uses of exothermic reactions. | | | Self-heating cans, hand warmers |
| 8 | Give a use of endothermic reactions | | | Instant cold pack for sports injuries |
| 9 | How can the energy transfer in a chemical reaction be measured? | | | Using a thermometer to measure the temperature change |
| 10 | How can we avoid energy being lost to the surroundings when measuring the temperature change of a chemical reaction? | | | Use insulation (like cotton wool) |
| 11 | What is the activation energy of a reaction? | | | The minimum amount of energy that particles must have when they collide in order to react |

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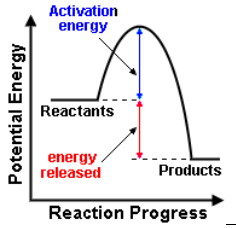
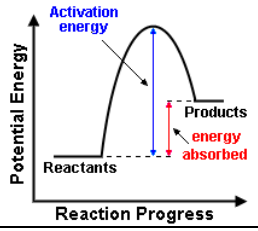
| 12 | What does the energy level diagram look like for an exothermic reaction? | | |  |
| 13 | What does the energy level diagram look like for an endothermic reaction? | | |  |
| 14 | What happens to the activation energy when a catalyst is used? | | | It is lower |

## Core questions – Chemistry of the atmosphere – paper 2

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What gases are present in today's atmosphere on Earth? | | | Nitrogen, oxygen, carbon dioxide, water vapour |
| 2 | What are the proportions of the gases in the current atmosphere on Earth? | | | About 80% nitrogen<br>About 20% oxygen<br>Small amounts of carbon dioxide, water vapour and noble gases |
| 3 | How long have the proportions of different gases in the atmosphere been the same? | | | 200 million years |
| 4 | Why is the evidence about the Earth's early atmosphere limited? | | | The time scale of 4.6 billion years |
| 5 | How the Earth's early atmosphere was formed? | | | Intense volcanic activity that released gases |
| 6 | How were the oceans formed? | | | Water vapour that condensed |
| 7 | What was the main gas in the early atmosphere? | | | Carbon dioxide |
| 8 | What other gases were present in the early atmosphere? | | | Small amount of methane and ammonia |
| 9 | What was the Earth's early atmosphere compared to? | | | Atmospheres of Mars and Venus today - mainly carbon dioxide with little or no oxygen gas |

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| 10 | How did the amount of nitrogen in the atmosphere increase? | | | Volcanoes produced nitrogen |
| 11 | Where did the oxygen in the atmosphere come from? | | | Photosynthesis of algae and plants |
| 12 | How long ago did algae evolve? | | | 2.7 billion years ago |
| 13 | Why did the amount of carbon dioxide in the atmosphere decrease? | | | • Photosynthesis<br>• Locked up in carbonate rocks (limestone)<br>• Locked up in fossil fuels (oil, coal, gas)<br>• Dissolved into the oceans |
| 14 | What are the greenhouse gases? | | | Water vapour, carbon dioxide, methane |
| 15 | What is the greenhouse effect? | | | Short wavelength radiation (light) passes through the atmosphere<br>Long wave radiation (thermal) is reflected back, buts gets trapped by greenhouse gases |
| 16 | Why are greenhouse gases important? | | | The maintain temperatures on Earth high enough to support life |
| 17 | What have humans done to increase the amount of carbon dioxide in the atmosphere? | | | Deforestation<br>Burning fossil fuels |
| 18 | What have humans done to increase the amount of methane in the atmosphere? | | | Agriculture – farm animals release methane<br>Landfill sites release methane and carbon dioxide |
| 19 | How are human activities affecting the temperature of the Earth's atmosphere? | | | It is increasing, which increases the surface temperature |
| 20 | What does an increase in the surface temperature of the Earth cause? | | | Climate change |
| 21 | Why do scientists believe that climate change is happening? | | | It is based on **peer reviewed evidence** |
| 22 | Why is it hard to fully understand the Earth's climate? | | | It is complex, and there are many variables, meaning it's difficult to make models that aren't over simplified |
| 23 | What are the consequences of climate change? | | | • Polar ice caps melting<br>• Changes in rainfall patterns<br>• More extreme weather events<br>• Differences in the distributions of wildlife |

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| 24 | What is the consequence of the polar ice caps melting? | | | It will cause a rise in sea levels, increased flooding and coastal erosion |
| 25 | What is the consequence of changes in rainfall patterns? | | | Some regions may get too much of too little water making it more difficult to make food |
| 26 | What is a carbon footprint? | | | The total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event |
| 27 | What can be done to reduce the carbon footprint? | | | • Use renewable energy sources instead of fossil fuels<br>• Avoid putting waste into landfill sites<br>• Tax products, services or events that produce large amount of carbon dioxide<br>• Use carbon capture and storage in power stations |
| 28 | Why is making reductions in the carbon footprint difficult? | | | • Lots more research needs to be done with renewable fuels<br>• Governments are worried making changes will affect the economic growth of communities<br>• Individuals don't want to make changes to their lifestyles |
| 29 | What is a fossil fuel? | | | A substance that contains a mixture of hydrocarbons |
| 30 | What are the products when fossil fuels are burnt? | | | Carbon dioxide, water vapour, carbon monoxide, sulfur dioxide, oxides of nitrogen, particulates |
| 31 | What is the equation for complete combustion? | | | fuel + oxygen → carbon dioxide + water |
| 32 | What is the equation for incomplete combustion? | | | fuel + oxygen → carbon dioxide + carbon monoxide + water + carbon |
| 33 | What is carbon monoxide? | | | Carbon monoxide is a toxic gas. It is colourless and odourless |
| 34 | What are the consequences of sulfur dioxide and nitrous oxides being released into the atmosphere? | | | They can cause respiratory problems if breathed in and acid rain when mixed with clouds |
| 35 | What are particulates? | | | Solid particles of soot (carbon) |
| 36 | What health problems are associated with particulates? | | | If they are inhaled, they can cause respiratory problems |

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| 37 | What environmental problems are associated with particulates? | | | They can reflect sunlight back into space, causing **global dimming** |

**Core questions – Rate and extent of chemical change – paper 2**

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What is the rate of a chemical reaction? | | | The speed at which the reactants are changed into products |
| 2 | What equations can we use to calculate the rate of reaction? | | | *mean rate of reaction = quantity of reactant used / time taken*<br><br>*mean rate of reaction = quantity of product formed / time taken* |
| 3 | What units are used to measure the quantity of reactant or product? | | | Mass in grams (if it is a solid), or volume in $cm^3$ (if it is a gas) |
| 4 | What units can be used to represent the rate of reaction? | | | Grams per second (g/s) or cubic centimetres per second ($cm^3/s$) |
| 5 | What is 'collision theory'? | | | Chemical reactions only occur when the reacting particles collide with each other a with sufficient energy |
| 6 | What is the 'activation energy'? | | | The minimum amount of energy the particles need to collide with to react |
| 7 | What four factors can affect the rate of reaction? | | | Temperature, concentration or pressure, surface area, use of a catalyst |
| 8 | What happens to the rate of reaction if the temperature is increased? | | | Increases |
| 9 | Why does the rate of reaction increase if the temperature of the reactants is increased? | | | There are more **successful** collisions because the particles have more energy<br>There are more **frequent** collisions because they are moving faster |
| 10 | What happens to the rate of reaction if concentration or pressure is increased? | | | Increases |
| 11 | Why does the rate of reaction increase if the concentration or pressure of the reactants is increased? | | | There are more **frequent** collisions because there are more particles in the same space |
| 12 | What happens to the rate of reaction if the surface area of the reactant is increased? | | | Increases |
| 13 | How can you increase the surface area of a reactant? | | | Cut it into smaller pieces |

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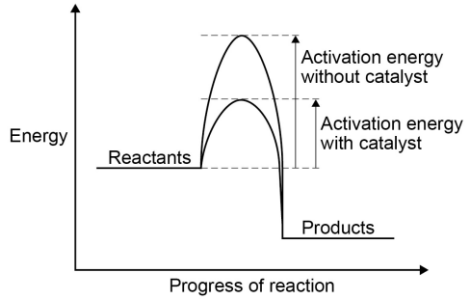
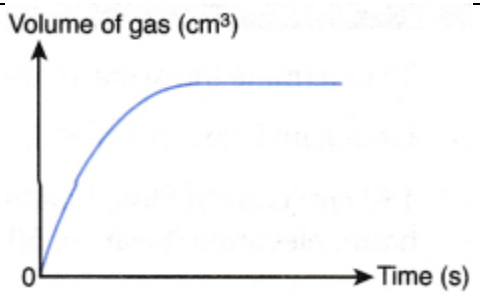
| 14 | Why does the rate of reaction increase if the surface area of the reactant is increased? | | | There are more **<u>frequent</u>** collisions because there is a higher surface area to volume ratio meaning there are more particles exposed |
| 15 | What is a catalyst? | | | A substance used to speed up a chemical reaction |
| 16 | Why does using a catalyst increase the rate of reaction? | | | They provide an alternative reaction pathway with a lower activation energy |
| 17 | What happens to a catalyst during a reaction? | | | Nothing, they are not used up |
| 18 | Draw a reaction profile for an exothermic reaction before and after a catalyst has been used? | | |  |
| 19 | What are three different ways we can measure the rate of a reaction? | | | Time how long it takes for the colour of a solution to change<br>Time how long it takes for a substance to lose mass (if a gas is given off)<br>Time how long it takes to collect gas in a gas syringe |
| 20 | Why might the colour of a solution change during a reaction? | | | If one of the products of the reaction is a precipitate (a solid) |
| 21 | What would be plotted on the axis of a graph if you were recording the volume of gas produced at regular time intervals? | | | Time on the x - axis, volume of gas on the y - axis |
| 22 | Draw a sketch graph of the volume of gas produced over time during a chemical reaction? | | |  |
| 23 | How do we tell when the reaction has stopped on a rate of reaction graph? | | | The line becomes horizontal (the line is flat – no more gas is produced) |
| 24 | How can you calculate the rate of a chemical reaction at a certain point, from a graph? | | | The gradient of the graph at that point |

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| 25 | What is a reversible reaction? | | | A reaction in which the products of the reaction react to produce the original reactants |
| 26 | What is the symbol for a reversible reaction? | | | ⇌ |
| 27 | How are reversible reactions represented? | | | $A + B \rightleftharpoons C + D$ |
| 28 | When does a reversible reaction reach 'equilibrium'? | | | When the forward and reverse reactions occur at exactly the same rate |
| 29 | What is needed for equilibrium to be achieved in a reaction? | | | A closed system – none of the reactants can escape, and nothing else can get in |
| 30 | What happens to the concentration of the products if the equilibrium of a reaction lies to the right? | | | The concentration of products is greater than that of the reactants |
| 31 | What happens to the concentration of the products if the equilibrium of a reaction lies to the left? | | | The concentration of the products is less than that of the reactants |
| 32 | What factors can change the position of equilibrium? | | | Temperature, pressure, changing the concentration of reactants or products |
| 33 | What sort of energy transfers take place in a reversible reaction? | | | If it is exothermic in one direction (gives out energy), it is endothermic in the opposite direction (takes in energy) |
| 34 | What happens to the total amount of energy in the forward and backward reaction in a reversible reaction? | | | It remains the same |

## Core questions – Chemical analysis – paper 2

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What is a pure substance in everyday life? | | | A substance that has had nothing added to it |
| 2 | What is a chemically pure substance? | | | A single element or compound |
| 3 | What information can be used to determine purity? | | | Melting and boiling point |
| 4 | What is a formulation? | | | A mixture that has been designed as a useful product |
| 5 | What are 7 examples of formulations? | | | Fuels, cleaning agents, paints, medicines, alloys, fertilisers, foods |
| 6 | How are formulations made? | | | By mixing components in carefully measured quantities |
| 7 | What is chromatography used for? | | | Separation and identification of substances |

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| 8 | What is the visible record that shows the results from chromatography called | | | Chromatogram |
| 9 | What is the stationary phase? | | | The solid or liquid that the mobile phase passes through. In paper chromatography, this is the paper. |
| 10 | What is the mobile phase? | | | The solvent that moves through the stationary phase. E.g water |
| 11 | What is the $R_f$ value? | | | Retention factor – used to calculate how far different substances have travelled |
| 12 | How do you calculate retention factor? | | | Rf = Distance moved by substance / Distance moved by solvent |
| 13 | How are different substance identified using chromatography? | | | By visual comparison or comparing $R_f$ values with known substances |
| 14 | How is a pure substance identified using chromatography? | | | Only a single spot is visible |
| 15 | What are the key features when carrying out paper chromatography? | | | Start line drawn in pencil, use a suitable solvent, start line has to be above solvent level |
| 16 | How is carbon dioxide tested for? | | | Bubble it through limewater |
| 17 | What is the positive result for presence of carbon dioxide? | | | Limewater turns cloudy |
| 18 | How is chlorine tested for? | | | Use litmus paper |
| 19 | What is the positive result for the presence of chlorine? | | | Litmus paper is bleached (turns white) |
| 20 | How is hydrogen tested for? | | | Burning splint is held at the open end of a test tube |
| 21 | What is the positive result for presence of hydrogen? | | | A squeaky pop |
| 22 | How is oxygen gas tested for? | | | Glowing splint inserted into a test tube |
| 23 | What is a positive result for the presence of oxygen? | | | Glowing splint re-ignited |

## Core questions – Organic chemistry – paper 2

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What is an organic compound? | | | Something that contains carbon atoms |
| 2 | How did crude oil form? | | | From the remains of ancient biomass consisting mainly of plankton that was buried in mud |
| 3 | What is crude oil a mixture of? | | | Hydrocarbons |

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| 4 | What is a hydrocarbon? | | | Molecules made up of hydrogen and carbon atoms only |
| 5 | What is an alkane? | | | A saturated hydrocarbon |
| 6 | What is the general formula for an alkane? | | | $C_nH_{2n+2}$ |
| 7 | What is a saturated hydrocarbon? | | | Contains only single covalent bonds between atoms |
| 8 | What is displayed formula? | | | Represents the covalent bonds present in a molecule as lines |
| 9 | How do we name alkanes? | | | Look at the carbon chain length, apply the right prefix and add 'ane' on the end |
| 10 | What is the prefix for 1 carbon? | | | Meth- |
| 11 | What is the prefix for 2 carbons? | | | Eth- |
| 12 | What is the prefix for 3 carbons? | | | Prop- |
| 13 | What is the prefix for 4 carbons? | | | But- |
| 14 | How are the hydrocarbons in crude oil separated? | | | Fractional distillation |
| 15 | What is a fractional distillation 'fraction'? | | | Contains molecules with a similar number of carbon atoms |
| 16 | Describe temperature changes in the fractional distillation column? | | | Hotter at the bottom, colder at the top |
| 17 | Why do the different fractions condense at different temperatures? | | | Different chain lengths have different boiling points |
| 18 | What are the 2 physical changes involved in fractional distillation? | | | Evaporation and condensation |
| 19 | What can crude oil fractions be used for? | | | Fuels and as a raw material for the petrochemical industry |
| 20 | What different fuels come from crude oil? | | | Petrol, diesel, kerosene, heavy fuel oil, petroleum gases |
| 21 | What substances are made from crude oil, other than fuels? | | | Solvents, lubricants, polymers, detergents |
| 22 | What properties are affected by hydrocarbon chain length? | | | Boiling point, viscosity, flammability |
| 23 | How does hydrocarbon chain length affect boiling point? | | | The longer the chain, the higher the boiling point |
| 24 | What is flammability? | | | How easily a substance ignites or burns |
| 25 | How does hydrocarbon chain length affect the flammability? | | | The longer the chain, the less flammable it is |

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|---|---|---|---|---|
| 26 | What is viscosity? | | | How thick a liquid is |
| 27 | How does hydrocarbon chain length affect viscosity? | | | The longer the chain length, the more viscous it is |
| 28 | Why do we burn hydrocarbon fuels? | | | To release energy |
| 29 | What type of reaction is combustion? | | | Oxidation |
| 30 | What are the two products when a hydrocarbon undergoes complete combustion? | | | Carbon dioxide, water |
| 31 | What is cracking? | | | Breaking down large hydrocarbons to smaller, more useful molecules |
| 32 | Why are smaller hydrocarbons more useful than larger molecules? | | | Make better fuels |
| 33 | What are the two types of cracking? | | | Catalytic cracking, steam cracking |
| 34 | What conditions are needed for catalytic cracking? | | | Vapour passed over a hot catalyst at high temperature |
| 35 | What conditions are needed for steam cracking? | | | Mix vapours with steam at high temperature |
| 36 | What are the products of cracking? | | | Alkane(s) and alkene(s) |
| 37 | What is an alkene? | | | An unsaturated hydrocarbon with a carbon-carbon double bond |
| 38 | What is the test for an alkene? | | | Turns bromine water from orange to colourless |
| 39 | What are alkenes used for? | | | Producing polymers and other chemicals |

**Core questions – Using resources – paper 2**

| No. | Question | My answer | My answer | Answer |
|---|---|---|---|---|
| 1 | What do human's use the Earth's resources for? | | | To provide warmth, shelter, food and transport |
| 2 | What is a natural resource? | | | Something that forms without human input |
| 3 | What is a synthetic product? | | | A man made product |
| 4 | Give an example of a natural product that can be replaced by a synthetic product? | | | Rubber can be replaced with polymers |
| 5 | How does agriculture play a role in human development? | | | It can provide conditions where natural resources can be enhanced for our needs |
| 6 | Give an example of how agriculture can enhance natural resources? | | | Fertilisers mean we can produce a higher yield of crops |
| 7 | What is a finite resource? | | | A resource that will run out |

| | | | | |
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| 8 | What is a renewable resource? | | | Reforms at a similar rate to, or faster than, we use them |
| 9 | What is sustainable development? | | | Development that meets the needs of current generations without compromising the ability of future generations to meet their own needs |
| 10 | What is potable water? | | | Water that is safe to drink |
| 11 | What is 'safe' water? | | | Water that doesn't have high levels of dissolved salts or microbes |
| 12 | Why is potable water not chemically pure? | | | Because it contains a mixture of ions and other dissolved substances |
| 13 | What is 'pure' water? | | | Water that contains only $H_2O$ |
| 14 | How is potable water produced? | | | • Choosing an appropriate source of fresh water (rainwater in lakes, rivers and reservoirs)<br>• Passing the water through filter beds – this removes big solids bits<br>• Sterilising – to kill any harmful microbes |
| 15 | What methods are used to sterilise water? | | | Chlorine, ozone or ultraviolet light |
| 16 | How is potable water produced in dry countries? | | | Desalination of salty water or sea water |
| 17 | What methods are used to desalinate salty water? | | | Distillation or reverse osmosis |
| 18 | How is water distilled? | | | • Heat a flask of salty water<br>• The water boils to produce steam, leaving dissolved salts in the flask<br>• The steam then condenses back to liquid |
| 19 | Why is distillation and reverse osmosis expensive? | | | They require large amounts of energy |
| 20 | What is waste water? | | | Water that has been used in agriculture, industry or domestically and released into sewers |
| 21 | What needs to be removed from waste water? | | | Organic matter and harmful microbes and chemicals |
| 22 | What processes are involved in the treatment of sewage? | | | 1. Screening and grit removal<br>2. Sedimentations to produce sewage sludge and effluent<br>3. Anaerobic digestion of sewage sludge<br>4. Aerobic biological treatment of effluent |
| 29 | What is a life cycle assessment (LCA)? | | | It looks at every stage of a product's life to assess the impact it would have on the environment |

| | | | | |
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| 30 | What stages are looked at during the life cycle assessment? | | | • Extracting and processing raw materials<br>• Manufacturing and packaging<br>• Use and operation during its lifetime<br>• Disposal at the end of its useful life, including transport and distribution at each stage |
| 31 | What problems are there with life cycle assessments? | | | It's difficult to allocate numerical values to the effect of some pollutants<br>LCAs can be biased, depending on who is doing the assessment<br>Selective LCAs can be used to only show some of the impacts of a product |
| 32 | How can the use of finite resources be reduced? | | | Using less, reuse products and recycling materials |
| 33 | Give examples of materials that are made from finite materials? | | | Metals, glass, building materials, clay ceramics, plastics |
| 34 | Why is recycling a product better than making it from scratch? | | | • Mining and extracting metals uses lots of energy whereas recycling uses less energy<br>• Conserves finite resources |
| 35 | How are metals recycled? | | | By melting them and then casting them into the shape of the new product |
| 36 | How is glass recycled? | | | It is separated by colour and chemical composition then crushed and melted to make different glass products |