A. Atoms, Elements, Compounds and Mixtures part 1 – Atoms, Elements, Compounds, Word and Symbol Equations

1. Describe the differences between an element and a compound. (2)

   element: all atoms same type, [1]
   compound: more than one type of atom chemically combined [1]

2. Explain what information can be deduced from the chemical formula of carbon dioxide CO_2. (2)

   twice as many oxygen atoms as carbon atoms / carbon and oxygen atoms in carbon dioxide bond to each other in the ratio 1:2 (carbon:oxygen) [2]

3. Sodium reacts with water to make sodium hydroxide, NaOH. Write a balanced symbol equation, including the state symbols for the reaction. (2)

   $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$ [2]

B. Atoms, Elements, Compounds and Mixtures part 2 – Separating Techniques

1. What is a mixture? (2)

   two or more substances (elements or compounds) [1] not chemically combined [1]

2. Explain how the process of distillation can be used to remove dissolved impurities from a sample of water. (4)

   Heat water in flask attached to condenser. [1] Steam moves into condenser. [1] Pure water condenses and is collected in beaker. [1] Solid impurities left in flask. [1]

3. **Extended response question:**
   Sulfur is soluble in the flammable liquid xylene but not in water. Sodium nitrate is soluble in water but not xylene. Describe and explain two ways to separate a mixture of sulfur powder and sodium nitrate to collect pure samples of each solid. (6)

- ***Level 3 (5-6 marks)***
  TWO methods described AND explained.
- ***Level 2 (3-4 marks)***
  ONE method described AND explained.
- ***Level 1 (1-2 marks)***
  ONE method, but insufficient explanation.

Method A – any three from: add water to mixture, [1] stir and filter, [1] S insoluble in water so left as residue on filter paper, [1] wash S with distilled water to remove impurities then leave to dry,

[1] evaporate NaNO3 solution [1] by heating on water bath until point of crystallisation, [1] leave to dry, crystallising NaNO3 [1]

Method B – any three from: add xylene to mixture, [1] stir and filter, [1] NaNO3 insoluble in xylene so left as residue on filter paper, [1] wash NaNO3 with xylene and leave to dry, [1] evaporate xylene from filtrate of S solution [1] by warming on water bath (electrically heated / no naked flame [1]) in fume cupboard to crystallise S [1]

4. A mixture of inks is thought to contain three pure inks. The colours of these inks are red, green and blue. Describe using a diagram how a student could prove this. (4)

A diagram and explanation to show – One spot of ink [1] near bottom of chromatography paper, [1] place in solvent, [1] allow solvent to soak up the paper, past ink, to (3) separate dyes. [1]

C. Atomic Model part 1 – History of the Atom

1. Describe JJ. Thomson's plum pudding model of the atom (2)

cloud of positive charge [1] with tiny negatively charged electrons spread throughout [1]

2. State two ways in which Rutherford changed Thomson's model of the atom (3)

positive charge [1] concentrated into very small volume at centre of atom (nucleus) [1] electrons orbit nucleus [1]

3. Explain why Niels Bohr revised Rutherford's model of the atom. (2)

Electrons gave out the same energies [1] as they moved from one energy level to another so they must be in electron shells/orbits [1]

D. Atomic Model part 2 – Size and Mass of Atoms and Atomic Structure

1. Explain how to calculate the numbers of protons, neutrons and electrons in an atom. (3)

The number of protons is the atomic number (1) This is the same as the number of electrons (1) To calculate the number of neutrons you have to minus the atomic number from the mass number (1)

2. Explain the overall charge on any atom (2)

   neutral (1)
   same number of protons (+) and electrons (–) (1)
   so charges cancel out (1)

3. Explain how an atom can become an ion with a 2+ charge (2)

   losing two electrons (1)
   two more positive charges than negative charges so overall charge is 2+ (1)

4. Describe the differences in the atomic structures of a hydrogen atom and a helium atom (3) (Hydrogen has a mass number of 1 and atomic number of 1 and helium has a mass number of 4 and a mass number of 2).

   hydrogen has one proton whereas helium has two protons (1)
   hydrogen has one electron whereas helium has two electrons (1)
   hydrogen has no neutrons or helium has two neutrons (1)

5. Explain why isotopes of the same element have identical chemical properties. (2)

   same electronic structures [1] so same number of electrons in highest energy level / outermost shell [1]

6. There are two principal stable isotopes of chlorine - ^{35}Cl and ^{37}Cl. The relative atomic mass of chlorine is 35.5. Explain what this shows about the abundance of the two isotopes. (2)

   the relative atomic mass is a (weighted) average [1]

   there must be more of chlorine–35 because the relative atomic mass is closer to 35 than 37 [1]

E. Periodic Table part 1 – History of the Periodic Table

1. Explain how Dmitri Mendeleev constructed his periodic table. (2)

   arranged elements in order of atomic weight [1]
   started new rows to allow elements with similar properties to be in the same column/group [1]

2. Explain how the scientific community were influenced to accept Dmitri Mendeleev's version of the periodic table (4).

   Mendeleev predicted properties of 'as yet undiscovered' elements in gaps left in his table
   so that similar elements would line up [1]
   When new elements discovered [1]
   they closely matched properties predicted [1]
   this was powerful evidence Mendeleev's table was valid [1]

3. Explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms. (2)

The elements group is the same as the number of electrons in its highest energy level (1)
The period number indicates how many energy levels there are (1)

4. Explain why elements in many groups of the periodic table have similar chemical properties. (1)

same number of electrons in highest energy level / outermost shell [1]

F. Periodic Table part 2 – Group 0, group 1 and group 7

1. Explain why the Noble gases have stable electronic arrangements. (1)

They have full outer shell/they are unreactive [1]

2. **Extended response question:**
Place the halogens including Astatine, in order of reactivity, with the most reactive element first. Explain your answer, making sure you include the trend in reactivity and how the reactivity can be explained, referring to halide ions. (6)

- ***Level 3 (5-6 marks)***
  Order correct and the trend in reactivity explained in reference to ions.
- ***Level 2 (3-4 marks)***
  Order correct and the trend in reactivity explained.
- ***Level 1 (1-2 marks)***
  Order correct and trend explained.

Level 1:
F, Cl, Br, I, At, [1]
The smaller the halogen atom, the more readily it accepts/ gains extra electron into its outermost shell [1]
Level 2:
becomes halide ion with single negative charge [1]
the stronger the electrostatic force of attraction between nucleus and extra electron [1]
entering smaller atom's outermost shell as electron closer to nuclear charge [1]
Level 3:
and it becomes less shielded from nuclear charge than larger atoms with more inner shells of electrons [1]
These two factors outweigh fact that nuclear charge is more positive going down Group 7 [1]

3. Caesium is near the bottom of Group 1 in the periodic table. What do you think will happen if it was dropped into water containing universal indicator solution? Explain what you would observe (5)

explodes [1] on contact as hydrogen is released very quickly [1] alkali metals more reactive going down group so Cs, near bottom, extremely reactive [1] U.I. turns purple [1] as strongly alkaline CsOH(aq) formed in reaction [1]

G. Periodic Table part 3 – Transition metals Chemistry only

1. Describe the chemical and physical differences of the transition metals compared with Group 1. (4)

Maximum three from:
Physical – the transition metals are
Stronger (1)
Harder (1)
Denser (1)
Have higher melting points (1)

Maximum two from:
Chemical – the transition metals are
Less reactive
Some e.g. platinum do not react (any 4 points)

2. Give two examples of why transition metals are useful as catalysts. (2)

Any two of:
Platinum/palladium/rhodium are used in catalytic convertors
Iron is used in the Haber process
Nickel is used to produce margarine