Answers

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Atomic structure and the periodic table

Review it!

1 **a** $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$

b **i** Both have only 1 chemical symbol and therefore only 1 type of atom.

ii Na is a shiny silver white solid; Cl is a pale green gas.

iii Ions

c The sodium chloride is not chemically combined with the water and they can be easily separated by physical means.

2 The group is a vertical column of elements and a period is a horizontal row.

3 Each element can only have one atomic number and that number is unique to that element. If it had an atomic number of 12 it would not be sodium.

4 Group 6, period 3

5 **a** X is found in the middle of the periodic table in the transition elements.

b Shiny; good electrical conductor; good thermal conductor; malleable; ductile; denser than the group 1 elements.

6 **a** −1

b When they react the Group 7 elements gain one electron to form a stable outer shell, their reactivity depends on their ability to gain this extra electron. As the group descends, the outer shell is further from the positively charged nucleus and is shielded from the nucleus by an increasing number of electrons. This means that as you go down the group the attractive force on an electron being gained gets less and it gets harder to capture the extra electron.

7 **a** It has 12 protons and 12 electrons.

b These are isotopes. Each isotope has the same number of protons but a different number of neutrons.

c Let there be 100 atoms of gallium. 60 atoms have a mass number 69 with a total mass of 4140 atomic mass units. 40 atoms have a mass number of 71 the total mass of 2840 atomic mass units.

Therefore 100 atoms have a total mass of 4140 + 2840 atomic mass units = 6980 atomic mass units. The relative atomic mass is the average mass of each atom $= \frac{6980}{100} = 69.8$ atomic mass units

8 Elements with similar properties were placed in vertical columns and ordered by their relative atomic masses. Where the known elements did not fit the pattern he left spaces for elements which had not yet been discovered.

9 Group 1 elements lose their outer electron when they react. As the group is descended, this outer electron is further from the attractive force of the nucleus and there are more shielding electrons between the nucleus and the outer electron. This means that the outer electron feels less of an attractive force and is more easily lost therefore making the lower elements more reactive.

10 The noble gases have stable full outer electron shells. This means they do not have to gain or lose electrons to become stable.

11 **a** Mendeleev's periodic table was organised in groups of elements with similar properties. If argon had very distinct properties then it had to fit into its own group and therefore they had to be a group of elements with similar properties.

b It did not react with any other elements.

12 **a** As the group is descended the elements get darker in appearance. Iodine is a dark grey solid; astatine is below iodine and would be darker in colour which suggests that it is black.

b At_2

c NaAt

d -1. The ion is At^-.

Bonding, structure and the properties of matter

Review it!

1 The lithium atom loses its outer electron to form the Li^+ ion. The ion has a stable full outer electron shell.

2 **a** 1 nm to 100 nm (1 nm = 1×10^{-9} m)

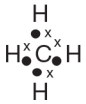
b (Titanium dioxide nanoparticles in) sunscreens; (Silver nanoparticles are used in) antibacterial preparations; (Fullerenes are used to) deliver drugs and as lubricants.

3 **a** 

b $MgCl_2$

c The ionic bonds between the magnesium and chloride ions are very strong and because it is a giant structure all the bonds have to be broken. This requires lots of energy and a high melting point.

d In solids the ions are not free to move, therefore they cannot carry the current and do not conduct electricity.

4 **a** 

b Methane is a neutral molecule and the intermolecular forces between methane molecules are weak and require a small amount of energy to break them. Therefore methane has low melting and boiling points making it a gas at room temperature.

5 **a** Giant covalent structure

b The bonds between the carbon atoms in both diamond and graphite are strong covalent bonds, all these bonds have to be broken. This requires lots of energy, so the melting point is high.

c The bonds in the layers of graphite are strong covalent bonds but between the layers the intermolecular forces are weak and easily broken allowing the layers to slide over each other easily.

d In graphite each carbon is bonded to 3 other carbons leaving a spare electron. These spare electrons are delocalised in the layer and can carry an electric current making graphite a good electrical conductor. In diamond there are no spare electrons or charged particles making it a poor conductor.

6 A – Simple molecular B – Giant ionic
C – Giant metallic D – Giant covalent

7 **a** Methane has a simple molecular structure with weak intermolecular forces so it has low melting and boiling points. Potassium chloride has a giant ionic structure with strong ionic bonds between the ions. All these bonds need lots of energy to break them and therefore it has high melting and boiling points.

b The ions in magnesium oxide are Mg^{2+} and O^{2-}. In potassium chloride they are K^+ and Cl^-. The larger charges on the Mg^{2+} and O^{2-} means that their ionic bonds are stronger than those between the K^+ and Cl^- ions, these need more energy to break and therefore magnesium oxide has a higher melting point.

c Zinc ions are larger than copper ions in the giant metallic lattice, this means that the layers of ions cannot slide over each other as easily, making the alloy a harder material.

d Sodium has a giant metallic structure in which there are delocalised electrons in both the solid and liquid states and these delocalised electrons can carry an electric current. This means that sodium is a good electrical conductor in both the solid and liquid states. Sodium chloride has a giant ionic structure. In the solid state the ions are not free to move and cannot carry an electric current so as a solid sodium chloride is a poor conductor. In the liquid state they can move and carry the current making sodium chloride a good electrical conductor.

Quantitative chemistry

Review it!

1 **a** **i** 8.33×10^{-2}; **ii** 2.23×10^5
iii 8.561×10^2 **iv** 4.53×10^{-5}

b **i** 4.00 **ii** 6.57×10^{-2}
iii 4.55×10^{-2}
iv 4.39×10^{-4} **v** 5.68×10^5

2 **a** **i** $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

ii $2Na(s) + Br_2(l) \rightarrow 2NaBr(s)$

iii $6K(s) + N_2(g) \rightarrow 2K_3N(s)$

iv $Mg(s) + 2AgNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + 2Ag(s)$

v $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$

b The law of conservation of mass states that the mass of the reactants = mass