Answers to worksheet questions

Chapter 3

Worksheet 3.1

Mind maps relating to the Periodic Table could be discussed in groups.

Worksheet 3.2

1 Scientists look for patterns in data. Historically, when they arranged the known elements in order of relative ***atomic mass***, they found that there was a repeating pattern. These patterns were shown clearly when the elements were arranged in a ***table***. Each row in the table is called a period, with metals on the ***left*** and ***non-metals*** on the right. The vertical columns of elements in the table were made up of elements with ***similar*** properties.

Modern versions of the Periodic Table put the elements in order of ***proton*** number, also known as the atomic number.

The words *GROUP* and *PERIOD* complete the diagram.

2 soft; shiny; tarnish; density; hydrogen; alkaline; (metal) hydroxide

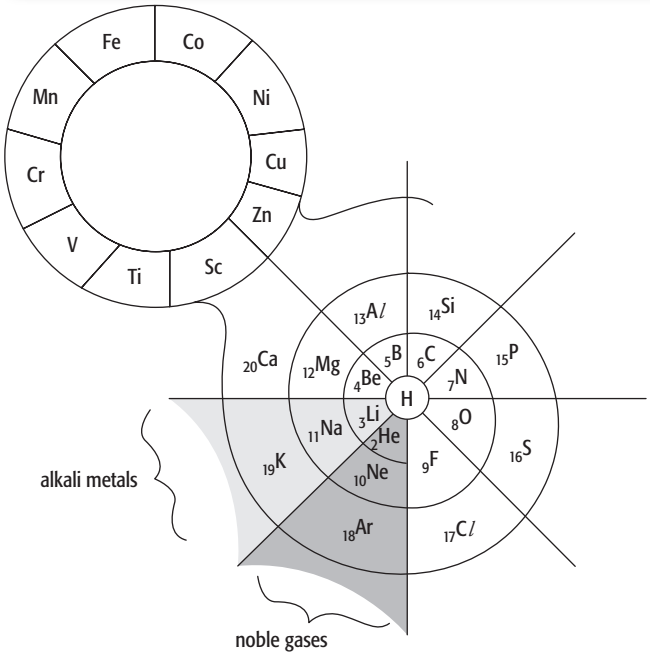
lithium + ***water*** → ***lithium hydroxide*** + ***hydrogen***

caesium + water → caesium hydroxide + ***hydrogen***

3

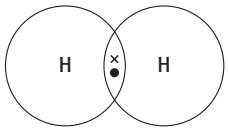
Halogen	Symbol	Physical state (at r.t.p.)	Formula of compound with potassium	Electron arrangement
fluorine	*F*	*gas*	KF	*2,7*
chlorine	*Cl*	gas	*KCl*	*2,8,7*
bromine	*Br*	*liquid*	*KBr*	2,8,18,7
iodine	I	*solid*	*KI*	2,8,18,18,7

4

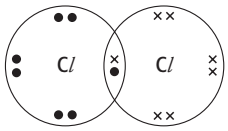


Worksheet 3.3

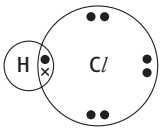
1 **a**



hydrogen molecule, H_2

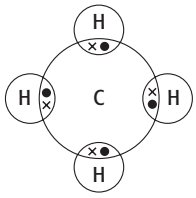


chlorine molecule
(each chlorine is now 2,8,8)

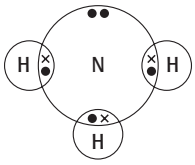


hydrogen chloride

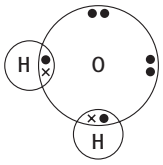
b



methane molecule

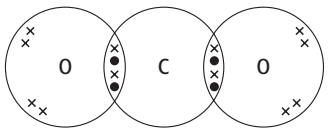


ammonia molecule

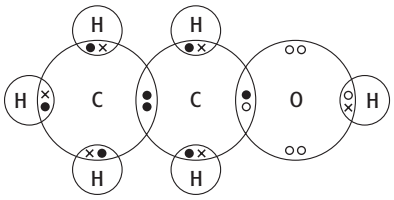


water molecule

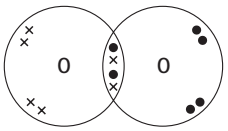
c



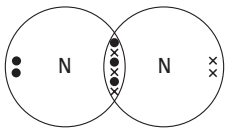
carbon dioxide molecule, CO_2



ethanol molecule, C_2H_5OH

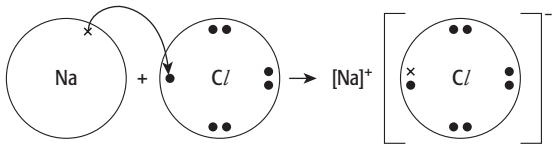


oxygen, O_2

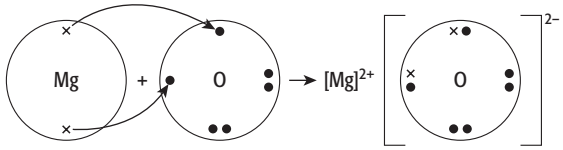


nitrogen, N_2

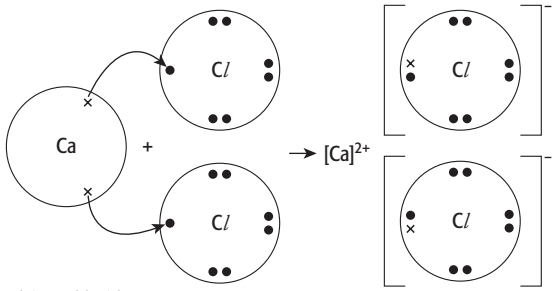
2



sodium chloride (NaCl)



magnesium oxide (MgO)



calcium chloride ($CaCl_2$)

Worksheet 3.4

1 **a**

Compound	Positive ion	Negative ion	Relative number of ions		Formula of ionic compound
sodium chloride	Na^+	Cl^-	$1 \times Na^+$	$1 \times Cl^-$	NaCl
magnesium bromide	Mg^{2+}	Br^-	$1 \times Mg^{2+}$	$2 \times Br^-$	$MgBr_2$
aluminium fluoride	Al^{3+}	F^-	$1 \times Al^{3+}$	$3 \times F^-$	AlF_3
potassium oxide	K^+	O^{2-}	$2 \times K^+$	$1 \times O^{2-}$	K_2O
iron(III) oxide	Fe^{3+}	O^{2-}	$2 \times Fe^{3+}$	$3 \times O^{2-}$	Fe_2O_3

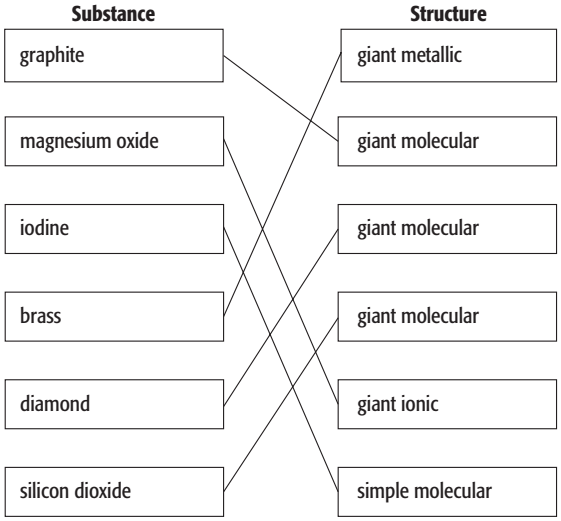
b

Compound	Positive ion	Negative ion	Relative number of ions		Formula of ionic compound
sodium hydroxide	Na^+	OH^-	$1 \times Na^+$	$1 \times OH^-$	NaOH
magnesium nitrate	Mg^{2+}	NO_3^-	$1 \times Mg^{2+}$	$2 \times NO_3^-$	$Mg(NO_3)_2$
aluminium hydroxide	Al^{3+}	OH^-	$1 \times Al^{3+}$	$3 \times OH^-$	$Al(OH)_3$
potassium carbonate	K^+	CO_3^{2-}	$2 \times K^+$	$1 \times CO_3^{2-}$	K_2CO_3
iron(II) sulfate	Fe^{2+}	SO_4^{2-}	$1 \times Fe^{2+}$	$1 \times SO_4^{2-}$	$FeSO_4$

2 **a** NH_3 **b** CH_4 **c** H_2O_2 **d** HNO_3 **e** H_2SO_4

Worksheet 3.5

1

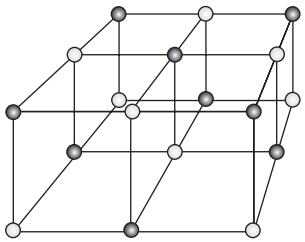


2 **a** **i** graphite

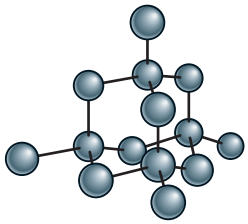
ii Graphite is a lubricant (the layers slide over each other); graphite conducts electricity.

b ○ for an oxide ion and

● for a magnesium ion



c



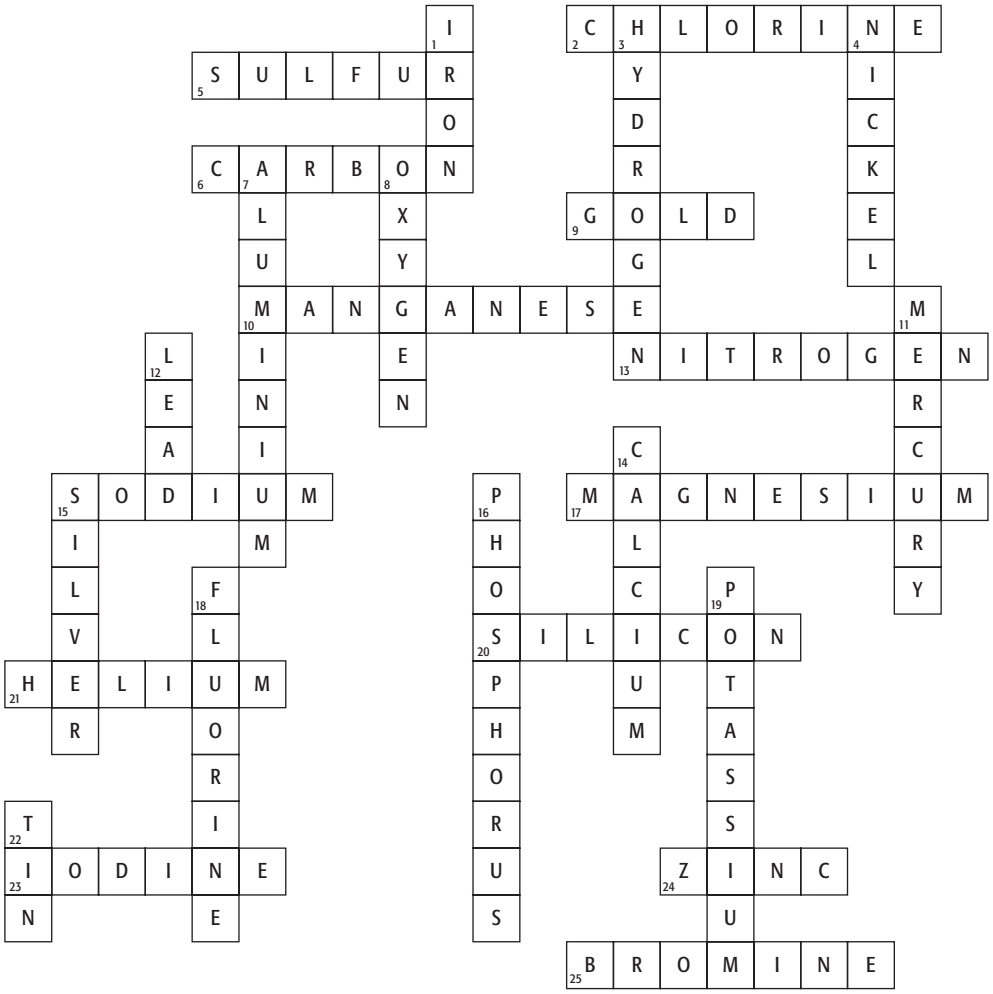
3

Compound	Type of elements	Type of bonding
sodium chloride ($NaCl$)	sodium metal chlorine non-metal	ionic
ammonia (NH_3)	***nitrogen non-metal*** ***hydrogen non-metal***	***covalent***
calcium oxide (CaO)	***calcium metal*** ***oxygen non-metal***	***ionic***
methane (CH_4)	***carbon non-metal*** ***hydrogen non-metal***	***covalent***
magnesium nitride (Mg_3N_2)	***magnesium metal*** ***nitrogen non-metal***	***ionic***

4 Although ***covalent*** bonds are very strong, the forces between simple covalent molecules are ***weak***. Because of this, substances with small ***molecules***, such as methane or ammonia, have very ***low*** melting and boiling points.

Some covalent materials, such as diamond or silicon dioxide, form ***giant*** structures. Because every bond in these materials is a ***strong*** covalent bond, they are hard solids with ***high*** melting and boiling points.

Worksheet 3.6



Worksheet 3.7

1 There is a trend from metallic to non-metallic properties across Period 3. Al is a metal, then Si is a non-metal.

2 Not exactly but, the trend is generally repeated. The change from metal to non-metal takes place further to the right, between germanium and arsenic.

3 There is a trend from non-metal (C, Si) to metal as you go down the group (Ge, Sn, Pb).

4 sodium, potassium, magnesium and calcium

5 aluminium

6 argon and krypton

7 bottom left of the table / bottom of Group I

8 top right of the table, not including the noble gases / top of Group VII

9 calcium

10 Arsenic oxide is amphoteric.

Worksheet 3.8

Part 1

1 Discuss in class the distribution of elements in the table in relation to the modern Periodic Table based on proton (atomic) number.

2 Reason for position of hydrogen at top of Group I: hydrogen forms an H^+ ion.
Reason against position at top of Group I: hydrogen is a non-metallic gas.

Part 2

1 **a** Li, Na, K, Mg, Ca, any of the transition metals (Sc to Zn), Be, Al, Ga, Ge
b N, O, F, Cl, He, Ne, Ar, Kr
c any of the transition metals (Sc to Zn)

2 **a** Group VII **b** 3 **c** 3 **d** 7

3 Atomic number (or proton number) is the number of protons in the nucleus of an atom; it is also the number of electrons present in a neutral atom and gives the position of the element in the Periodic Table.

4 **a** noble gases
b They are very unreactive and so no compounds present naturally / difficult to find / they are gases and only present in very small amounts.

Worksheet 3.9

1 **a** noble gases
b helium, argon, neon, krypton

2 **a** C
b The diagram shows that **C** has just individual atoms / monatomic gases / the noble gases exist as individual atoms. The other boxes show atoms combined together and Group O elements are very unreactive.

3 The lighted splint would go out.

4 **a** They are very unreactive but reactivity increases down the group – some compounds for the lower elements in the group have now been made.
b The density of the gases increases as you go down the group.
c The gases are all non-metals; this property does not change.

5 The only method which would be effective is **iv** (Measure the density of each).

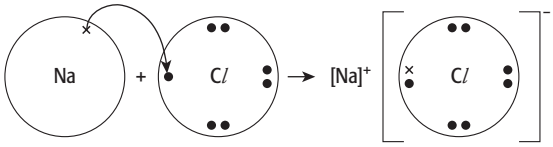
Worksheet 3.10

1 **a** ions
b a sodium ion
c a chloride ion
d electrostatic forces of attraction (electrovalent forces)

2

Element	Symbol	Number of electrons	Number of electron shells	Number of electrons in outer shell	Group number in Periodic Table
sodium	Na	*11*	*3*	*I*	*1*
chlorine	Cl	*17*	*3*	*VII*	*7*

3 **a** a sodium atom loses its outer electron to achieve a more stable electron arrangement / a chlorine atom gains an electron (from sodium) to achieve a more stable electron arrangement / an electron is transferred from sodium to chlorine



sodium chloride (NaC/)

b a sodium ion has a single positive charge / a chloride ion has a single negative charge / to balance the charges there is one sodium ion for each chloride ion / the formula is NaCl

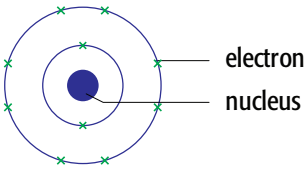
Worksheet 3.11

1 Group VIII / 0 / noble gases

2 **a** It would drop.

b the noble gases get denser going down the group / denser than the gases in the other balloons and those in the air

3 **a** Neon has electron arrangement 2,8



b there are 8 electrons in the outer shell of neon / this is a very stable arrangement of electrons / the atom does not gain or lose electrons / does not combine with other atoms to form molecules

4 The pitch of her voice would become higher. Helium is very light (low density) so vocal chords vibrate faster.

5 Helium has a low density and is not flammable.

6 When electricity is passed through these gases, they produce a coloured glow / light of different colours is emitted.

Worksheet 3.12

1 **a** 3

b second shell can only take 8 electrons / next electron must go into third shell, so start a new period in the table

2 **a** sodium, magnesium and aluminium / Na, Mg, Al

b The trend is from metal to non-metal moving across the period.

3 **a** Oxygen has 6 electrons in its outer shell.

b sodium oxide: Na_2O / magnesium oxide: MgO / aluminium oxide: Al_2O_3

c Sodium and magnesium oxides are basic; aluminium oxide is amphoteric.

Worksheet 3.13

1 **a** to kill bacteria/germs in water
b antiseptic / put on cuts to kill bacteria

2 **a** halogens
b non-metal
c non-metal
d seaweed

3 **a** that each chlorine atom has 17 protons in its nucleus / that each atom has 17 electrons / that chlorine is the 17th element in the Periodic Table
b **i** 2, 8, 7 **ii** 3 **iii** the third period
c 7

4 sodium iodide, NaI

Worksheet 3.14

1 **a** transition elements (metals)
b metals
c Fe: iron / Cu: copper / Zn: zinc / Mn: manganese / V: vanadium

2 **a** A
b Group I
c Elements like **A** would be more suitable because **A** has a high melting point. Elements like **B** would be unsuitable because they would melt and would be likely to react with water.
d ticks for 'hard' / 'can be pulled out to make a wire' / 'shiny surface that can be polished'

Worksheet

Name of compound	Formula of positive ion	Formula of negative ion	Number of positive ions	Number of negative ions	Formula of compound
potassium bromide	K^+	Br^-	1	1	KBr
magnesium oxide	Mg^{2+}	O^{2-}	1	1	MgO
sodium sulfate	Na^+	SO_4^{2-}	2	1	Na_2SO_4
calcium hydroxide	Ca^{2+}	OH^-	1	2	$Ca(OH)_2$
aluminium nitrate	Al^{3+}	NO_3^-	1	3	$Al(NO_3)_3$
chromium(III) hydroxide	Cr^{3+}	OH^-	1	3	$Cr(OH)_3$
iron(III) oxide	Fe^{3+}	O^{2-}	2	3	Fe_2O_3

Assess by class discussion.