

1. Underline the changes that are physical changes.

Burning magnesium in air

Separating iron from sulfur using a magnet

Rusting of iron

Melting zinc

Distilling plant oils from a mixture of plant oils and water

[3]

2. Complete the table to show the difference between a compound and a mixture using words from the list. Some words may be used more than once.

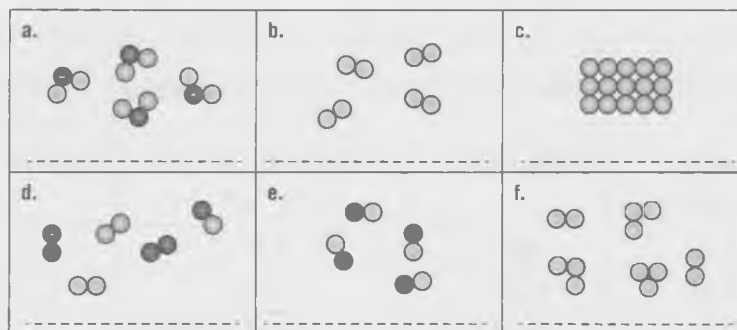
any average combined definite different elements physical present separated

Compound	Mixture
The ..... cannot be ..... by ..... means.	The substances in it can be ..... by ..... means.
The properties are ..... from those of the ..... which went to make it.	The properties are the ..... of the substances in it.
The elements are ..... in a ..... proportion by mass.	The substances can be ..... in ..... proportion by mass.

[6]

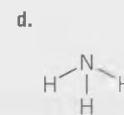
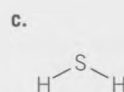
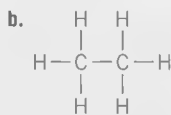
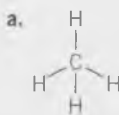
3. The diagram shows six different substances. Each circle represents an atom.

Classify these as pure elements, pure compounds, or mixtures.



[6]

4. Write chemical formulae for the following compounds.



[4]

Extension

5. a. Use books or the internet to find out about the physical and chemical properties of zinc and sulfur. [12]

- b. Suggest two methods by which you could separate sulfur from a mixture of powdered zinc and powdered sulfur. [6]

1. Read the following passage then answer the question that follows.

Chlorine is a green gas that dissolves slightly in water to form a weakly acidic solution. Sodium is a silvery metal that reacts violently with water. When sodium reacts with chlorine, heat is given out and a white powder (sodium chloride) is formed. Sodium chloride dissolves in water and forms a solution that is not acidic.

What information in the passage tells you that sodium chloride is a compound and not a mixture?

.....  
 .....  
 ..... [3]

2. Complete these sentences about ionic compounds:

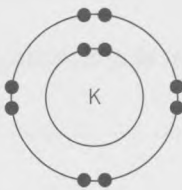
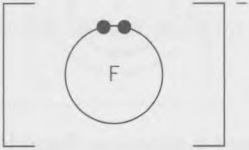
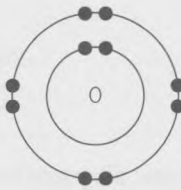
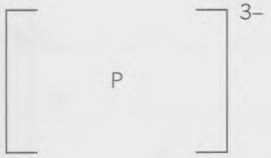

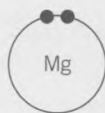
a. An ion is a ..... particle. [1]

b. Ions have unequal numbers of ..... and ..... [2]

3. Put a ring around the electron arrangements that are stable ions or atoms.

2,8    2,5    2,8,8    2,8,8,2    2    2,8,3    2,8,18,8 [4]

4. Complete the diagrams below to show the electron arrangement of the stable ions. Include brackets and charges.

<p>a.</p> 	<p>b.</p> 	<p>c.</p> 
<p>d.</p> 	<p>e.</p> 	<p>f.</p> 

[6]

5. a. Use books or formulae to find the charges on the stable ions of the following transition elements: vanadium, iron, cobalt, and copper. [2]
- b. What do you notice about the charges on these ions? [2]

1. Complete the passage about ionic structures using words from the list.

alternate    atoms    bonds    giant    ions    irregular    lattice  
molecular    negative    positive    regular    strong    weak

A sodium chloride ..... is a ..... arrangement of ..... sodium ions and ..... chloride ions, which ..... with each other. The ions are held together by ..... ionic .....  
This structure is called a ..... ionic structure.

[8]

2. Link the phrases on the left with the phrases on the right to make four correct sentences.

Ionic compounds are formed .....

..... it loses one or more electrons.

Ionic compounds have no .....

..... it gains one or more electrons.

When a metal atom forms an ion .....

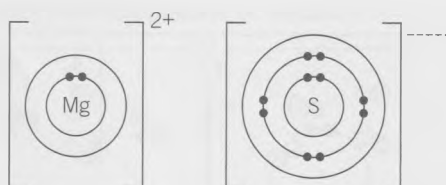
..... overall charge.

When a non-metal atom forms an ion .....

..... by the reaction of metals with non-metals.

[2]

3. a. Complete the ionic structure of magnesium sulfide. Show all the electrons as dots.



[3]

- b. Draw ionic diagrams for lithium chloride and magnesium fluoride in a similar way.

lithium chloride	magnesium fluoride
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">Li</div> <div style="text-align: center;">Cl</div> </div>	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">F</div> <div style="text-align: center;">Mg</div> <div style="text-align: center;">F</div> </div>
[3]	[4]

Extension

- c. The nitride ion is  $\text{N}^{3-}$ . Draw the electron arrangement of the ions in calcium nitride.

[4]

1. a. Work out the formulae of compounds A to H using the list of ions below.

$\text{Al}^{3+}$     $\text{Br}^-$     $\text{Ca}^{2+}$     $\text{Cl}^-$     $\text{Fe}^{3+}$     $\text{H}^+$     $\text{K}^+$     $\text{Mg}^{2+}$     $\text{N}^{3-}$     $\text{Na}^+$     $\text{O}^{2-}$     $\text{S}^{2-}$

- A magnesium bromide ..... B sodium oxide .....  
 C hydrochloric acid ..... D aluminium chloride .....  
 E potassium nitride ..... F calcium sulfide.....  
 G aluminium sulfide ..... H iron(III) oxide ..... [8]

- b. Work out the formulae of compounds J to Q. Use the list of compound ions below to help you.

$\text{CO}_3^{2-}$     $\text{HCO}_3^-$     $\text{NH}_4^+$     $\text{NO}_3^-$     $\text{OH}^-$     $\text{SO}_4^{2-}$

- J magnesium nitrate ..... [1]  
 K potassium sulfate ..... [1]  
 L ammonium nitrate ..... [1]  
 M ammonium sulfate ..... [1]  
 N calcium hydroxide ..... [1]  
 O sodium hydrogencarbonate ..... [1]  
 P aluminium nitrate ..... [1]  
 Q lithium carbonate ..... [1]

2. Name compounds R to W. You may want to use the periodic table on page 177 to help you.

- R  $\text{MgI}_2$  ..... [1]  
 S  $\text{Sr(OH)}_2$  ..... [1]  
 T  $\text{FeSO}_4$  ..... [1]  
 U  $\text{Zn(NO}_3)_2$  ..... [1]  
 V  $(\text{NH}_4)_2\text{CO}_3$  ..... [1]  
 W  $\text{Ca(HCO}_3)_2$  ..... [1]

3. Use the list of ions below to work out the formulae for compounds a. to e.

manganate(VII),  $\text{MnO}_4^-$    peroxide,  $\text{O}_2^{2-}$    phosphate,  $\text{PO}_4^{3-}$    sulfite,  $\text{SO}_3^{2-}$

- a. potassium manganate(VII)   b. sodium peroxide   c. calcium phosphate  
 d. calcium sulfite   e. sodium phosphate [5]

1. Complete the passage about covalent bonding using words from the list.

attraction      covalent      electrons      giving      ionic      metal      non-metal  
nucleus      pair      repulsive      sharing      single      strong      weak

A covalent bond is formed when ..... atoms combine. It forms because of the ..... force of ..... between the ..... of one atom and the outer ..... of the atom next to it.  
A single ..... bond is formed by ..... one ..... of electrons between two atoms.

[8]

2. a. What is meant by the term *molecule*?

..... [1]

- b. Put a ring around the molecules that are diatomic.

CO      Cl<sub>2</sub>      N<sub>2</sub>      N<sub>2</sub>O<sub>4</sub>      O<sub>2</sub>      O<sub>3</sub>      P<sub>4</sub>      S<sub>8</sub> [2]

3. a Draw diagrams to show the electron distribution (electron arrangement) in each of these diatomic molecules. Show only the outer shell electrons.

i. hydrogen	ii. bromine
iii. oxygen	iv. nitrogen

[4]

- b. i. How many outer shell electrons are there around each atom in the molecules?

..... [1]

- ii. What is the significance of this number of electrons for the hydrogen, oxygen, or nitrogen molecules?

.....  
..... [2]

Extension

4. Some metals can form compounds with chlorine or hydrogen that are simple covalent molecules. Use books or the internet to find simple covalent compounds of three different metals.

[3]

1. a. Draw dot-and-cross diagrams to show the electron distribution (electron arrangement) of each of these covalent molecules. Show only the outer shell electrons.

hydrogen bromide, HBr	water, H <sub>2</sub> O
ammonia, NH <sub>3</sub>	hydrogen sulfide, H <sub>2</sub> S
methane, CH <sub>4</sub>	phosphorus trichloride, PCl <sub>3</sub>
carbon dioxide, CO <sub>2</sub>	ethene, C <sub>2</sub> H <sub>4</sub>

[8]

- b. Which of these molecules have unbonded pairs of electrons (lone pairs of electrons)?

..... [2]

Extension

2. Draw dot-and-cross diagrams to show the electron distribution (electron arrangement) of each of these covalent molecules. Show only the outer shell electrons.

a. methanol, CH<sub>3</sub>OH    b. ethyne, C<sub>2</sub>H<sub>2</sub>    c. hydrazine, N<sub>2</sub>H<sub>4</sub>    d. ethanol, C<sub>2</sub>H<sub>5</sub>OH

[4]

1. The table gives some properties of some simple molecular covalent compounds and ionic compounds. Complete the table by writing either 'covalent' or 'ionic' in the last column.

Compound	Melting point / °C	Solubility in water	Electrical conductivity when molten	Covalent or ionic?
barium oxide	2852	soluble	conducts	
carbon tetrachloride	-23	insoluble	does not conduct	
potassium bromide	734	soluble	conducts	
carbon disulfide	-111	insoluble	does not conduct	
octane	-57	insoluble	does not conduct	

[2]

2. Link the properties A to G on the left with the correct reasons 1 to 7 on the right.

A Simple molecular compounds have low melting points .....	1 ..... because there are no mobile ions or electrons present to conduct.
B Ionic compounds have high melting points .....	2 ..... because the molecules cannot form strong enough intermolecular forces with water molecules.
C Simple molecular compounds do not conduct electricity .....	3 ..... because they can form relatively strong bonds with the water molecules.
D Some simple molecular compounds do not dissolve in water .....	4 ..... because the forces of attraction between the molecules are low.
E Ionic compounds conduct electricity when molten .....	5 ..... because they can form relatively strong intermolecular forces with solvent molecules.
F Many ionic compounds dissolve in water .....	6 ..... because the ions are free to move.
G Some molecular compounds dissolve in organic solvents .....	7 ..... because there are strong forces of attraction between all the ions.

[3]

3. Put a ring around the formulae of the substances below that will dissolve in organic hydrocarbon solvents.



[1]

4. Explain why ionic compounds do not conduct electricity when solid.

..... [1]

Extension

5. a. The simple covalent molecules  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ , and  $\text{C}_6\text{H}_{12}\text{O}_6$  dissolve in water.

The simple covalent molecules  $\text{CH}_4$ ,  $\text{C}_6\text{H}_{14}$ , and  $\text{CH}_3\text{Cl}$  do not dissolve in water.

What feature of the molecules seems to make them soluble in water?

[1]

- b. Use books or the internet to find three other examples of simple covalent molecules that are soluble in water. [3]

1. Some physical properties, A to F, are shown below.

A conducts electricity

B does not conduct electricity

C hard

D high melting point

E low melting point

F soft

Write the letters of the properties that belong to:

Diamond ..... [1]

Graphite ..... [1]

Silicon dioxide ..... [1]

2. Link the observations A to E on the left with the explanations 1 to 5 on the right.

A Giant covalent structures have a high melting point .....

1 ..... because the delocalised electrons are free to move along the layers.

B Graphite conducts electricity .....

2 ..... because the weak forces between the layers can easily be overcome.

C Diamond does not conduct electricity .....

3 ..... because the carbon atoms are packed closer to each other on average.

D Graphite is soft .....

4 ..... because it takes a lot of energy to break the large number of strong bonds.

E Diamond is denser than graphite .....

5 ..... because all its electrons are involved in covalent bonding.

[2]

3. Complete these sentences by adding the correct number.

a. Each atom in diamond forms ..... covalent bonds with other atoms. [1]

b. Each atom in graphite forms ..... covalent bonds with other atoms. [1]

c. Each silicon atom in silicon dioxide forms ..... covalent bonds with oxygen atoms,  
but each oxygen atom forms ..... covalent bonds with silicon atoms. [2]

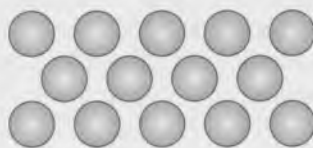
4. There are two forms of the compound boron nitride, BN. One of these forms is similar to graphite.

a. In this form of boron nitride, the atoms alternate. Draw the structure of this form of boron nitride. [3]

b. Explain why this form of boron nitride can be used as a lubricant. [2]



1. a. Complete the diagram below to show the structure of a metal. Label your diagram.



[4]

- b. Use the information in your diagram to explain:

i. why metals conduct electricity.

..... [2]

ii. why metals are ductile.

.....  
 .....  
 ..... [3]

iii. why metals such as nickel have high melting points.

.....  
 ..... [2]

2. The bar chart shows the melting point of six successive elements A to F in the Periodic Table.

- a. One of these elements is a giant covalent structure.

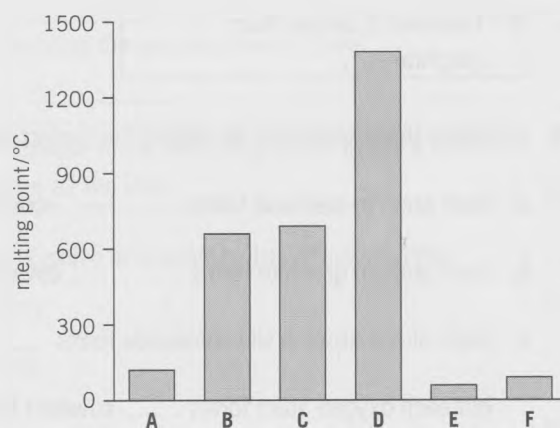
Which one? ..... [1]

- b. Which elements are metals? Give a reason for your

answer. ....  
 .....  
 ..... [2]

- c. Which elements are non-metals? Give a reason for your

answer. ....  
 ..... [2]



Extension

3. Bronze is a mixture of copper and tin. Tin atoms are larger than copper atoms. Use your knowledge of the structure of metals to explain why bronze is less malleable than either copper or tin alone.

[2]



3. Any 6 points, one of which must refer to the Periodic Table, e.g.  
 Position in Periodic Table: idea of the 'step line' between metals and non-metals [1]  
 They have high melting points so are like many metals [1]  
 They are poor electrical conductors so unlike metals [1]  
 Electrical conduction increases with temperature / they are semiconductors so unlike metals [1]  
 Generally shiny so like metals [1]  
 Some exist in metallic and non-metallic forms [1]  
 Some forms have a some degree of covalent bonding [1]

## Unit 4.1

1. Separating iron from sulfur using a magnet [1]  
 Melting zinc [1]  
 Distilling plant oils from a mixture of plant oils and water [1]
2. 12 correct = 6, 10 or 11 correct = 5, 8 or 9 correct = 4, 6 or 7 correct = 3, 4 or 5 correct = 2, 2 or 3 correct = 1.

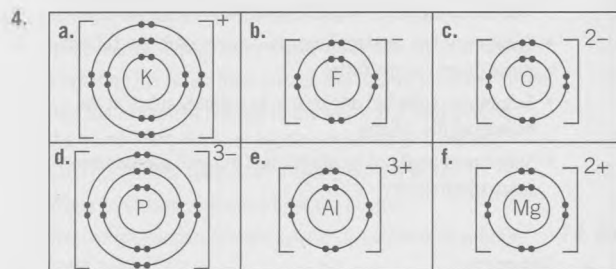
Compound	Mixture
The <b>elements</b> cannot be <b>separated</b> by <b>physical</b> means.	The substances in it can be <b>separated</b> by <b>physical</b> means.
The properties are <b>different</b> from those of the <b>elements</b> which went to make it.	The properties are the <b>average</b> of the substances in it.
The elements are <b>combined</b> in a <b>definite</b> proportion by mass.	The substances can be <b>present</b> in <b>any</b> proportion by mass.

3. A compound [1] B element [1] C element [1]  
 D mixture [1] E compound [1] F mixture [1]
4. a. CH<sub>4</sub> [1]  
 b. C<sub>2</sub>H<sub>6</sub> [1]  
 c. H<sub>2</sub>S [1]  
 d. NH<sub>3</sub> [1]
5. a. Any three physical properties of zinc (1 mark each), e.g. high melting point / conducts electricity / malleable  
 Any three physical properties of sulfur (1 mark each), e.g. low melting point / dissolves in (some) organic solvents / insoluble in water / brittle  
 Any three chemical properties of zinc (1 mark each), e.g. reacts with hydrochloric acid / oxidises slowly in oxygen / reacts with chlorine  
 Any three chemical properties of sulfur (1 mark each), e.g. reacts with oxygen / reacts with chlorine / does not react with acids  
 b. Any two workable methods (3 marks each), e.g.  
 Dissolve sulfur in suitable organic solvent, e.g. methylbenzene [1]  
 Sulfur dissolves and zinc does not so filter off the zinc [1]  
 Take the filtrate and evaporate the organic solvent in fume cupboard to get solid sulfur [1]  
 AND  
 Dissolve zinc in dilute hydrochloric acid [1]  
 Sulfur does not dissolve so filter off the sulfur [1]  
 Wash the sulfur residue with distilled water and dry in drying oven [1]

## Unit 4.2

1. Any three (1 mark each) of:  
 Colour of sodium chloride is different from the colours of chlorine and sodium [1]  
 Sodium chloride is not acidic whereas chlorine is slightly acidic [1]  
 Sodium chloride dissolves in water but sodium reacts with water [1]  
 Heat is given out when the sodium chloride forms [1]
2. a. An ion is a **charged** particle [1]  
 b. Ions have unequal numbers of **protons** and **electrons** / Ions have unequal numbers of **electrons** and **protons** (1 mark for each gap correctly filled)

3. 2,8 [1] 2,8,8 [1] 2 [1] 2,8,18,8 [1]



(1 mark for each correct structure)

5. a. V<sup>2+</sup> and V<sup>3+</sup>, Fe<sup>2+</sup> and Fe<sup>3+</sup>, Co<sup>2+</sup> and Co<sup>3+</sup>, Cu<sup>+</sup> and Cu<sup>2+</sup>  
 (2 marks for all correct, 1 mark for 6 correct or with 1 ion which is incorrect e.g. Fe<sup>+</sup>)  
 b. Most form ions with charges of 2+ and 3+ [1] apart from Cu<sup>+</sup> [1]  
 (if no marks scored allow 1 mark for all form ions with different charges)

## Unit 4.3

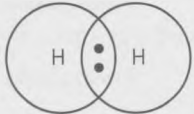
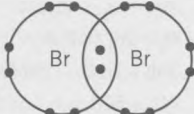
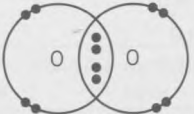
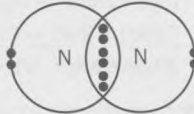
1. A sodium chloride **lattice** is a **regular** arrangement of **positive** sodium ions and **negative** chloride ions, which **alternate** with each other. The ions are held together by **strong** ionic **bonds**. This structure is called a **giant** ionic structure.  
 (1 mark for each correct word)
2. Ionic compounds are formed ..... by the reaction of metals with non metals.  
 Ionic compounds have no ..... overall charge.  
 When a metal atom forms an ion ..... it loses one or more electrons.  
 When a non-metal atom forms an ion ..... it gains one or more electrons  
 (4 correct = 2 marks, 2 correct = 1 mark)
3. a. 8 electrons in outer shell of Mg [1]  
 8 electrons in outer shell of S [1]  
 2- charge on S [1]  
 b. Lithium chloride:  
 2 electrons in one shell around Li [1]  
 2,8,8 electrons for chlorine [1]  
 + charge for Li and - charge for Cl at top right of square brackets around each [1]  
 Magnesium fluoride:  
 2,8 electronic structure for Mg [1]  
 2,8 electronic structure for each F [1]  
 Each F has single negative (-) charge at top right of [] [1]  
 Mg has 2+ charge at top right of [] [1]  
 c. Calcium nitride:  
 Three Ca ions and two nitride ions shown [1]  
 Electronic structure is 2,8,8 for calcium [1]  
 Electronic structure is 2,8 for nitride [1]  
 2+ charge for Ca and 3- charge for nitride at top right of each [1]

## Unit 4.4

1. a. A MgBr<sub>2</sub> [1] B Na<sub>2</sub>O [1] C HCl [1] D AlCl<sub>3</sub> [1]  
 E K<sub>3</sub>N [1] F CaS [1] G Al<sub>2</sub>S<sub>3</sub> [1] H Fe<sub>2</sub>O<sub>3</sub> [1]  
 b. J Mg(NO<sub>3</sub>)<sub>2</sub> [1] K K<sub>2</sub>SO<sub>4</sub> [1] L NH<sub>4</sub>NO<sub>3</sub> [1] M (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> [1]  
 N Ca(OH)<sub>2</sub> [1] O NaHCO<sub>3</sub> [1] P Al(NO<sub>3</sub>)<sub>3</sub> [1] Q Li<sub>2</sub>CO<sub>3</sub> [1]
2. R magnesium iodide [1]  
 S strontium hydroxide [1]  
 T iron(II) sulfate [1]  
 U zinc nitrate [1]  
 V ammonium carbonate [1]  
 W calcium hydrogencarbonate [1]
3. a. KMnO<sub>4</sub> [1]  
 b. Na<sub>2</sub>O<sub>2</sub> [1]

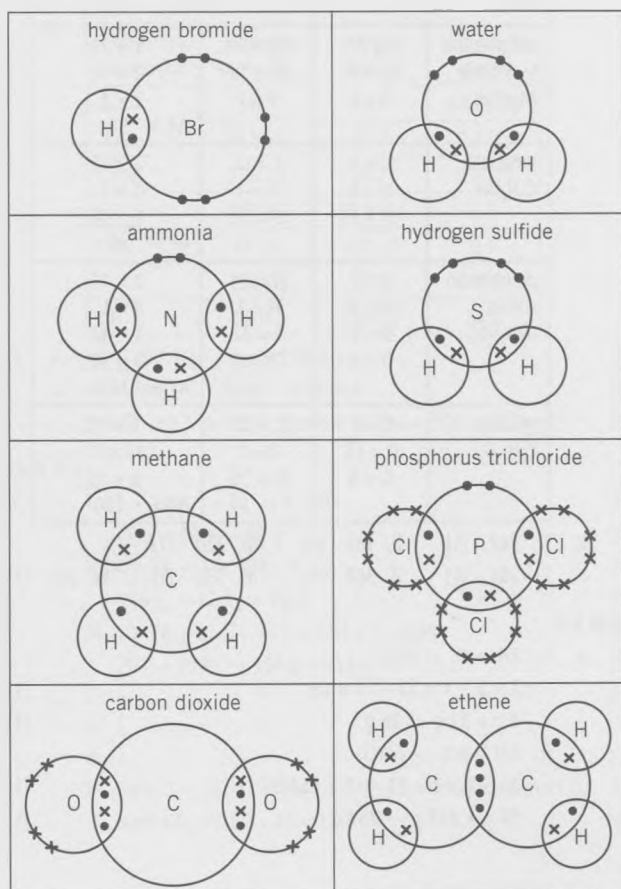
- c.  $\text{Ca}_3(\text{PO}_4)_2$  [1]  
 d.  $\text{CaSO}_3$  [1]  
 e.  $\text{Na}_3\text{PO}_4$  [1]

## Unit 4.5

1. A covalent bond is formed when **non-metal** atoms combine. It forms because of the **strong** force of **attraction** between the **nucleus** of one atom and the outer **electrons** of the atom next to it. A single **covalent** bond is formed by **sharing** one **pair** of electrons between two atoms. (1 mark each word)
2. a. A group of atoms held together by covalent bonds [1]  
 b.  $\text{CO}$   $\text{Cl}_2$   $\text{N}_2$   $\text{O}_2$  [2]  
 (1 mark if 3 correct)
3. a. i.  [1]  
 ii.  [1]  
 iii.  [1]  
 iv.  [1]
- b. 2 around the hydrogen and eight around the bromine, oxygen, and nitrogen [1]  
 (You will not get this mark if you just write eight)
- c. The electron shells are complete / full [1]  
 This is a stable structure / electrons cannot easily be lost or gained [1]
4. (1 mark for each up to a maximum of three) aluminium chloride (vapour) / beryllium chloride / tin tetrachloride / stannane,  $\text{SnH}_4$  / plumbane,  $\text{PbH}_4$

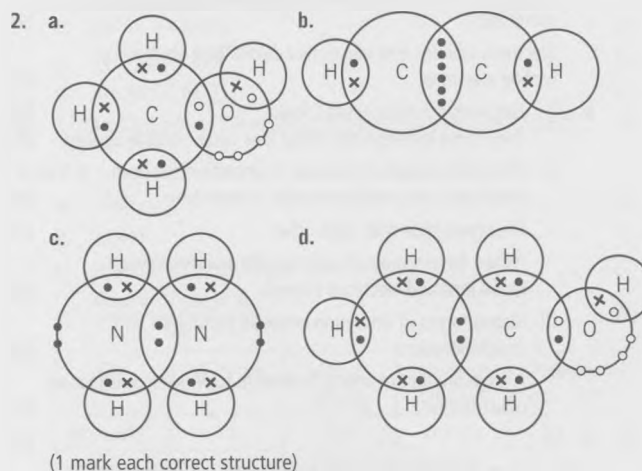
## Unit 4.6

1. a. (1 mark for each correct structure)



- b. hydrogen bromide, water, ammonia, hydrogen sulfide, phosphorus trichloride, carbon dioxide

(All correct 2 marks, 3 or 4 correct 1 mark)



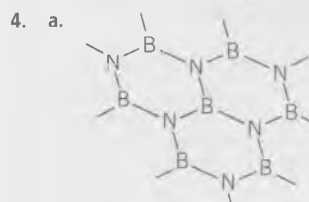
## Unit 4.7

1. Magnesium oxide: ionic  
 Carbon tetrachloride: covalent  
 Potassium bromide: ionic  
 Carbon disulfide: covalent  
 Octane: covalent  
 (2 marks if all correct and 1 mark if one error)
2. A with 4; B with 7; C with 1; D with 2; E with 6; F with 3; G with 5  
 (All 7 correct = 3 marks, 5 or 6 correct = 2 marks, 3 or 4 correct = 1 mark)
3.  $\text{CS}_2$ ,  $\text{I}_2$ ,  $\text{S}_8$  [1]
4. The ions are not free to move [1]
5. a. The molecules dissolving in water all have oxygen atoms / OH [1]  
 b. 1 mark for each soluble substance, e.g. ammonia / methylamine / sucrose / other alcohols / ethanoic acid / many amino acids

## Unit 4.8

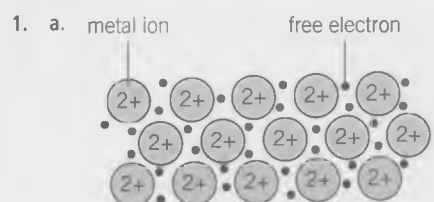
1. Diamond: B, C, D [1]  
 Graphite: A, D, F [1]  
 Silicon dioxide: B, C, D [1]
2. A with 4; B with 1; C with 5; D with 2; E with 3  
 (All correct = 2 marks but 3 or 4 correct = 1 mark)

3. a. 4 [1]  
 b. 3 [1]  
 c. 4 [1] 2 [1]



- Two or more layers drawn (two layers not shown in diagram above) [1]  
 (Layers of) hexagons drawn similar to graphite structure [1]  
 B atoms alternate with N atoms [1]  
 b. Weak force between the layers [1]  
 So the layers can slide when a force is applied [1]

## Unit 4.9



Metal ions shown as + or 2+

Metal ions labelled

Electrons shown as dots randomly dispersed between the metal ions

Electrons labelled free electrons / delocalised electrons / mobile electrons

- b. i. Electrons are delocalised / free  
They move between the metal ions when voltage applied
- ii. When force applied the force of attraction between metal ions and mobile electrons is overcome  
The layers slide over each other  
(When force removed) new metallic bonds between metal ions and electrons formed
- iii. Strong forces of attraction between metal ions and mobile electrons  
A large amount of energy is needed to weaken these forces of attraction
2. a. D
- b. A, B, and C [1] Idea that metals are to the left of Group IV / to the left of covalent giant structures (in the Periodic Table)
- c. E and F [1] They have low melting points / they are to the right of Group IV
3. The large ions disrupt the regular arrangement of the metal ions  
The layers cannot slide as easily (compared with the pure metals)

## Unit 5.1

1. The formula for giant covalent and ionic compounds is the **ratio of atoms** or ions in the compound. The formula of a simple molecule shows exactly how many atoms are **bonded** together in each molecule. For example, ammonia has one **nitrogen** and three **hydrogen** atoms so its **molecular** formula is  $\text{NH}_3$ .  
(1 mark for each correct word)

2. a.

										H			
										1			
Li								B	C	N	O	F	Ne
1								3	4	3	2	1	0
Na	Mg							Al			S	Cl	
1	2							3			2	1	
K	Ca		transition elements variable				Zn					Br	
1	2						2					1	

(1 mark for each column correct (= 8), 1 mark for H, 1 mark for transition elements)

- b. Li, Na, K, Mg, Ca, Zn, Al Allow: H
- c. N, O, F, S, Cl, Br Allow: H
- d. Any suitable, e.g. C and N / O / S / F / Cl / Br  
H and O / N / O / S / F / Cl / Br  
N and O / S and O
- e. i.  $\text{H}_2\text{S}$   
ii.  $\text{B}_2\text{O}_3$   
iii.  $\text{CS}_2$   
iv.  $\text{CBr}_4$   
v.  $\text{Ca}_3\text{N}_2$   
vi.  $\text{Al}_2\text{O}_3$   
vii.  $\text{CH}_4$
3. a. (-)1  
b. 3  
c. 2  
d. 1  
e. 4  
f. (-)1

## Unit 5.2

1. a.  $\text{O}_2 + 2\text{H}_2 \rightarrow 2\text{H}_2\text{O}$   
Correct balance [1] correct use of + and  $\rightarrow$  [1]
- b.  $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$   
Correct balance [1] correct use of + and  $\rightarrow$  [1]
2. a. atoms  $2 \times \text{H} + 2 \times \text{Cl}$   $1 \times \text{H}$   $1 \times \text{Cl}$   
balance  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$
- b. atoms  $1 \times \text{Mg} + 2 \times \text{O}$   $1 \times \text{Mg}$   $1 \times \text{O}$   
balance  $\text{O}$   $1 \times \text{Mg} + 2 \times \text{O} \rightarrow 2\text{MgO}$   
balance  $\text{Mg}$   $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
3. a.  $2\text{K} + \text{Br}_2 \rightarrow 2\text{KBr}$   
b.  $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$   
c.  $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$   
d.  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$   
e.  $2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$   
f.  $\text{I}_2\text{O}_5 + 5\text{CO} \rightarrow \text{I}_2 + 5\text{CO}_2$   
g.  $\text{MgO} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$   
h.  $\text{Ca}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$   
i.  $3\text{PbO} + 2\text{NH}_3 \rightarrow 3\text{Pb} + \text{N}_2 + 3\text{H}_2\text{O}$

## Unit 5.3

1. Relative atomic mass (symbol  $A_r$ ) is the **average** mass of naturally occurring **atoms** of an element on a scale where the **carbon-12** atom has a mass of exactly **twelve** units. The relative **molecular** mass (symbol  $M_r$ ) is the **sum** of the relative atomic masses of the atoms in a molecule. For ionic substances we use the term relative **formula** mass. [9]
2. a. 2 marks for each correct  $M_r$  (If 2 not scored, 1 mark for correct number of atoms)

Compound	Number of each atom	$A_r$ of atom	$M_r$ calculation
phosphorus trichloride $\text{PCl}_3$	P = 1 Cl = 3	P = 31 Cl = 35.5	$1 \times 31$ $3 \times 35.5$ $M_r = 137.5$
magnesium hydroxide $\text{Mg}(\text{OH})_2$	Mg = 1 O = 2 H = 2	Mg = 24 O = 16 H = 1	$1 \times 24$ $2 \times 16$ $2 \times 1$ $M_r = 58$
ethanol $\text{C}_2\text{H}_5\text{OH}$	C = 2 H = 6 O = 1	C = 12 H = 1 O = 16	$2 \times 12$ $6 \times 1$ $1 \times 16$ $M_r = 46$
ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$	N = 2 H = 8 S = 1 O = 4	N = 14 H = 1 S = 32 O = 16	$2 \times 14$ $8 \times 1$ $1 \times 32$ $4 \times 16$ $M_r = 132$
glucose $\text{C}_6\text{H}_{12}\text{O}_6$	C = 6 H = 12 O = 6	C = 12 H = 1 O = 16	$6 \times 12$ $12 \times 1$ $6 \times 16$ $M_r = 180$

- b. i. 342 [1] ii. 183 [1] iii. 220 [1]  
c. i. 284 [1] ii. 363 [1] iii. 393 [1] iv. 287 [1]

## Unit 5.4

1. a. i.  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$   
 $2 \times 2 + 1 \times 32 \rightarrow 2 \times 18$   
 $4\text{g} + 32\text{g} \rightarrow 36\text{g}$
- ii.  $2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$   
 $2 \times 27 + 3 \times 71 \rightarrow 2 \times 133.5$   
 $54\text{g} + 213\text{g} \rightarrow 267\text{g}$