

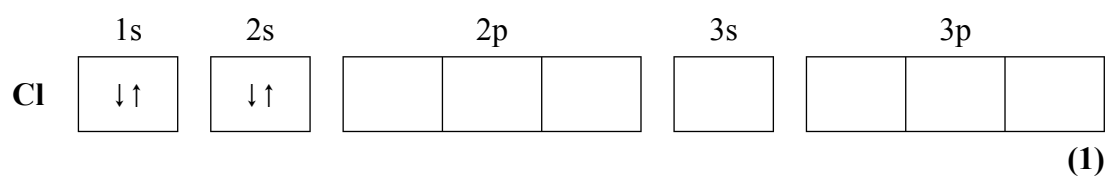
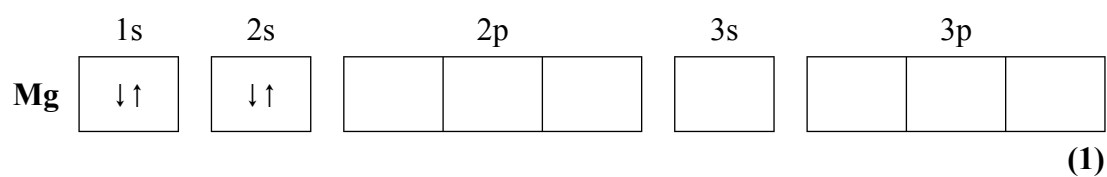
Answer ALL the questions. Write your answers in the spaces provided.

1. (a) Complete the table below which is about isotopes and an ion of magnesium.

	Numbers of		
	Protons	Neutrons	Electrons
$^{24}_{12}\text{Mg}$	12	12	
$^{26}_{12}\text{Mg}$	12		12
$^{24}_{12}\text{Mg}^{2+}$	12	12	

(3)

- (b) Complete the electronic configurations of magnesium and chlorine atoms.



- (c) Write the equation, including state symbols, for the reaction of magnesium with chlorine.

.....
(2)

- (d) The mass spectrum of a sample of chlorine molecules shows three molecular peaks. These are formed from the molecules shown below.

Molecule	Percentage abundance
$^{35}\text{Cl}-^{35}\text{Cl}$	56.25
$^{35}\text{Cl}-^{37}\text{Cl}$	37.50
$^{37}\text{Cl}-^{37}\text{Cl}$	6.25

Calculate the relative molecular mass of chlorine in this sample.

(2)

- (e) Calculate the volume of 4.73 g of chlorine gas at 100 °C.
[The molar volume of a gas at 100 °C = 30.6 dm³ mol⁻¹]

(2)



Leave
blank

(f) State and explain the type of bond that exists in solid magnesium.

Type

Explanation

.....

.....

(3)

(g) State the type of bond that exists in magnesium chloride. Draw a dot and cross diagram showing the **outer** shell electrons.

Type

Dot and cross diagram

(3)

Q1

(Total 17 marks)



Leave
blank

2. (a) Define the term

(i) **atomic number**

.....
.....
.....
.....

(1)

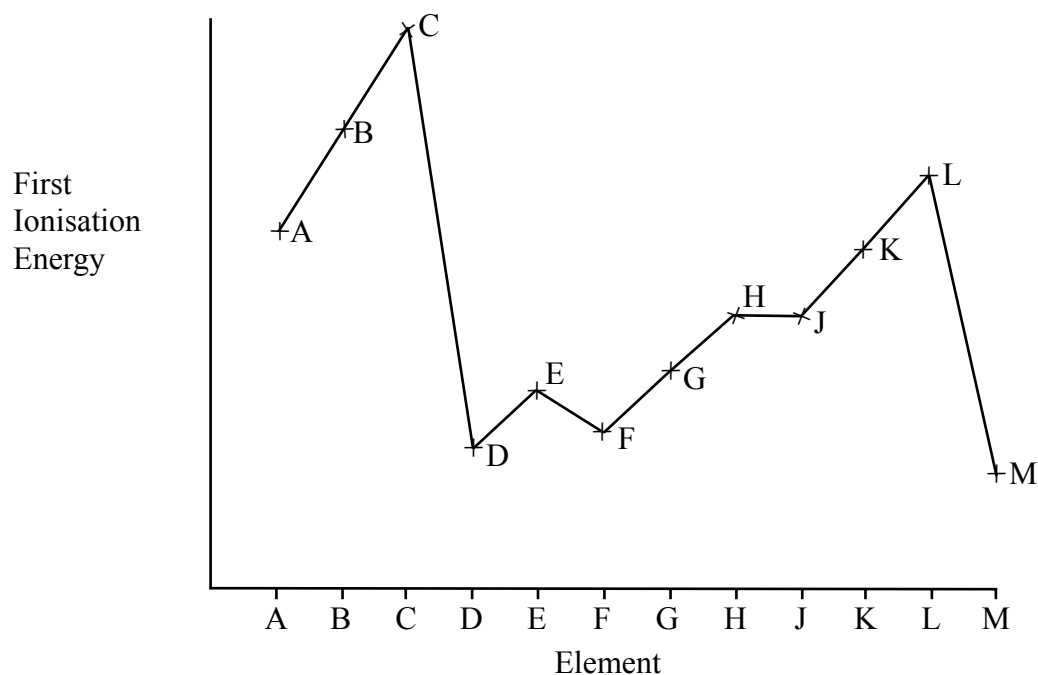
(ii) **mass number**

.....
.....
.....
.....

(1)



- (b) First ionisation energies of the elements show periodicity. The graph below shows the first ionisation energy of twelve successive elements in the Periodic Table in order of increasing **atomic number**.
The letters are **not** the symbols for the elements.



- (i) Give the letters of the **two** elements in **Group 0** (the noble gases).

Explain your answer in terms of ionisation energy.

Letters and

Explanation

.....

.....

.....

(2)

- (ii) Give the letter of the **Group 3** element.

Explain your answer in terms of ionisation energy.

Letter

Explanation

.....

.....

.....

(2)



Leave
blank

(iii) Explain why there is an increase in the first ionisation energy of the elements **from F to H** shown on the graph on the previous page.

.....

.....

.....

.....

.....

.....

.....

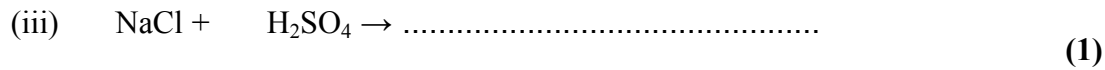
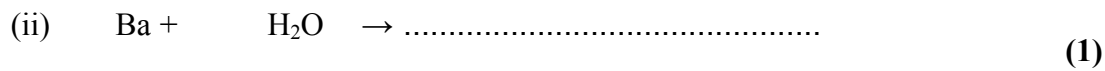
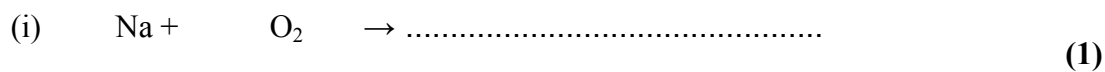
(2)

Q2

(Total 8 marks)



3. (a) Complete and balance an equation for each of the following reactions. Do **not** include state symbols.



(b) State the flame colours produced by compounds of:

(i) barium $\dots\dots\dots$ **(1)**

(ii) lithium $\dots\dots\dots$ **(1)**

(c) Explain how compounds of elements in Groups 1 and 2 produce colours in the flame test.

$\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$ **(3)**

(d) When potassium is burnt in excess oxygen, a compound is produced that contains 54.9% potassium.

Calculate the percentage of oxygen present and hence calculate the empirical formula of this compound.

(3)



Leave
blank

(e) The double bonds in carbon dioxide consist of σ (sigma) and π (pi) bonds.

Explain, in terms of orbital overlap, how these two types of bond are formed. You may use diagrams to help your explanation.

σ bond

.....
.....

π bond

.....
.....

(2)

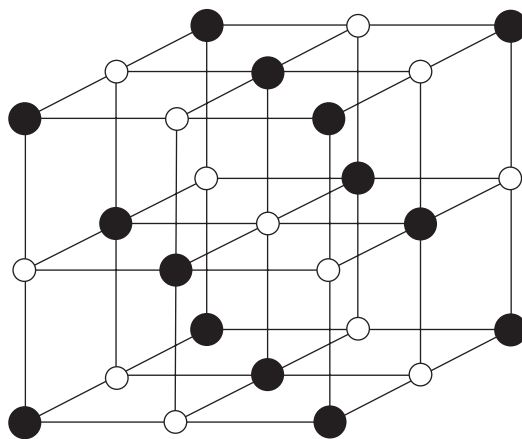
Q3

(Total 13 marks)



4. (a) (i) A diagram of the structure of solid sodium chloride is shown below.

Label the diagram to identify the particles present in solid sodium chloride.



(1)

(ii) Explain why sodium chloride has a high melting temperature.

.....

.....

.....

.....

.....

.....

.....

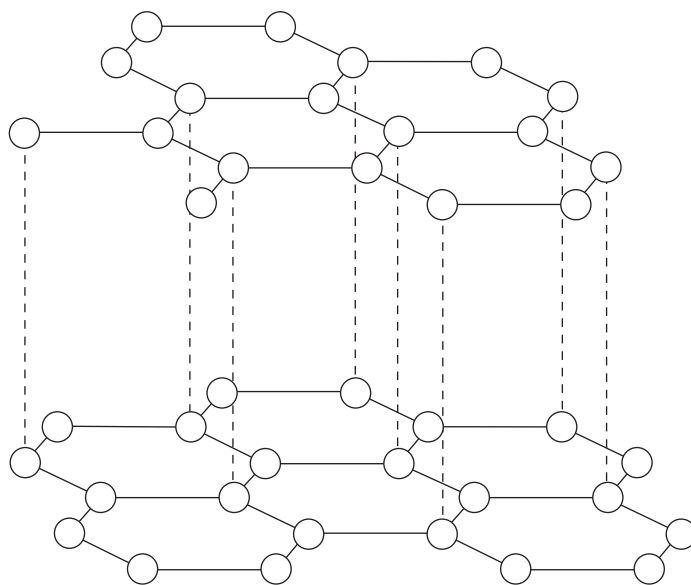
.....

(2)



(b) A diagram of the structure of solid graphite is shown below.

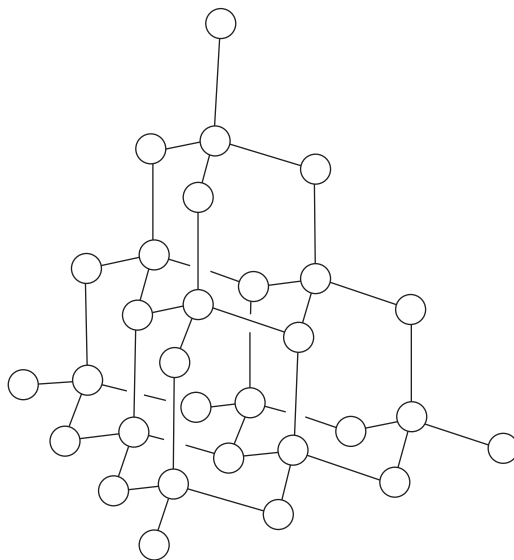
On the diagram name and label the types of bonding that exist in solid graphite.



(2)

(c) A diagram of the structure of solid diamond is shown below.

On the diagram name and label the type of bond that exists in solid diamond.



(1)



Leave blank

(d) The densities of diamond and graphite are

	Density / g cm ⁻³
Diamond	3.53
Graphite	2.25

Suggest, using information from (b) and (c), why diamond is more dense than graphite.

.....

.....

.....

.....

.....

.....

.....

.....

.....

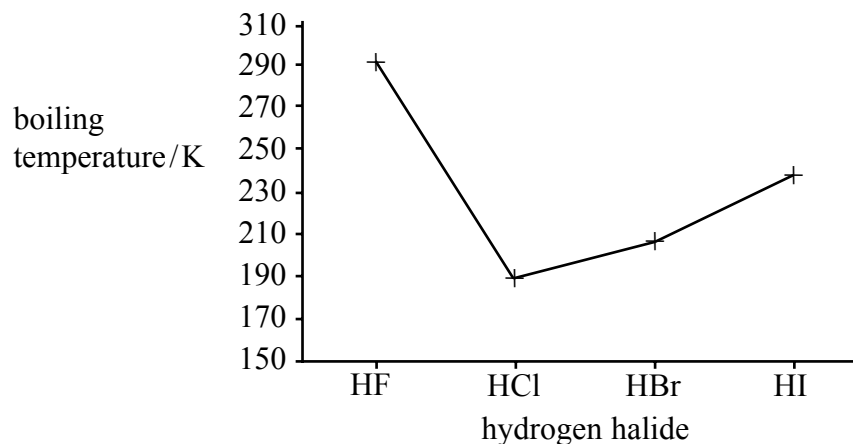
(2)

Q4

(Total 8 marks)



5. The graph shows the boiling temperatures of the hydrogen halides, hydrogen fluoride, HF, to hydrogen iodide, HI.



(a) Complete the table to identify the **strongest** intermolecular forces present in the **liquid** form of each hydrogen halide.

Hydrogen halide	Strongest intermolecular force
HF	
HCl	
HBr	
HI	

(2)

(b) Explain why HF has a higher boiling temperature than the other hydrogen halides and why there is an increase from HCl to HI.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(Total 5 marks)

Q5



6. (a) Write **ionic half-equations** for the following changes.
Do **not** include state symbols.

(i) Chlorate(I) ions, ClO^- , in a solution containing hydrogen ions, H^+ , reduced to chlorine molecules and water.

.....
(1)

(ii) Chloride ions, Cl^- , oxidised to chlorine molecules.

.....
(1)

(b) Combine (a)(i) and (ii) to show the reaction between chlorate(I) and chloride ions in acidic solution to produce chlorine.

.....
(1)

(c) (i) Write an **ionic** equation to show how chlorine liberates bromine from sea water.

.....
(1)

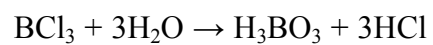
(ii) What is the role of chlorine in reaction (c)(i)?

.....
(1)



Leave
blank

(d) Boron trichloride, BCl_3 , reacts with water as follows



Calculate the mass of water that would be needed to react with 12.3 g of BCl_3 .

(3)

(e) Explain why the solution produced in (d) is acidic.

.....
.....
.....

(1)

Q6

(Total 9 marks)

TOTAL FOR PAPER: 60 MARKS

END



THE PERIODIC TABLE

Group **1** **2** **3** **4** **5** **6** **7** **0**

Period

1	H Hydrogen
---	---------------

Key	
Molar mass g mol ⁻¹	
Symbol	
Name	
Atomic number	

4	He Helium
---	--------------

7	Li Lithium	9	Be Beryllium
3		4	
23	Na Sodium	12	Mg Magnesium

45	Sc Scandium	89	Y Yttrium
----	----------------	----	--------------

48	Ti Titanium	91	Zr Zirconium
----	----------------	----	-----------------

51	V Vanadium	93	Nb Niobium
----	---------------	----	---------------

52	Cr Chromium	96	Mo Molybdenum
----	----------------	----	------------------

55	Mn Manganese	99	Tc Technetium
----	-----------------	----	------------------

56	Fe Iron	101	Ru Ruthenium
----	------------	-----	-----------------

59	Co Cobalt	103	Rh Rhodium
----	--------------	-----	---------------

59	Ni Nickel	106	Pd Palladium
----	--------------	-----	-----------------

63.5	Cu Copper	108	Ag Silver
------	--------------	-----	--------------

65.4	Zn Zinc	112	Cd Cadmium
------	------------	-----	---------------

70	Ga Gallium	115	In Indium
----	---------------	-----	--------------

73	Ge Germanium	119	Sn Tin
----	-----------------	-----	-----------

75	As Arsenic	122	Sb Antimony
----	---------------	-----	----------------

79	Se Selenium	127	I Iodine
----	----------------	-----	-------------

80	Br Bromine	127	Xe Xenon
----	---------------	-----	-------------

84	Kr Krypton	131	Rn Radon
----	---------------	-----	-------------

39	K Potassium	40	Ca Calcium
----	----------------	----	---------------

85	Rb Rubidium	88	Sr Strontium
----	----------------	----	-----------------

133	Cs Caesium	137	Ba Barium
-----	---------------	-----	--------------

178	Hf Hafnium	181	Ta Tantalum
-----	---------------	-----	----------------

186	Re Rhenium	188	Os Osmium
-----	---------------	-----	--------------

190	Ru Ruthenium	190	Os Osmium
-----	-----------------	-----	--------------

192	Rh Rhodium	192	Ir Iridium
-----	---------------	-----	---------------

195	Pd Palladium	195	Pt Platinum
-----	-----------------	-----	----------------

197	Ag Silver	197	Au Gold
-----	--------------	-----	------------

201	Cd Cadmium	201	Hg Mercury
-----	---------------	-----	---------------

204	In Indium	204	Pb Lead
-----	--------------	-----	------------

207	Sn Tin	207	Pb Lead
-----	-----------	-----	------------

209	Sb Antimony	209	Bi Bismuth
-----	----------------	-----	---------------

210	Te Tellurium	210	Po Polonium
-----	-----------------	-----	----------------

210	I Iodine	210	At Astatine
-----	-------------	-----	----------------

222	Xe Xenon	222	Rn Radon
-----	-------------	-----	-------------

227	Fr Francium	227	Ac Actinium
-----	----------------	-----	----------------

139	La Lanthanum	139	Y Yttrium
-----	-----------------	-----	--------------

172	Hf Hafnium	172	Ta Tantalum
-----	---------------	-----	----------------

186	Re Rhenium	186	Os Osmium
-----	---------------	-----	--------------

190	Ru Ruthenium	190	Os Osmium
-----	-----------------	-----	--------------

192	Rh Rhodium	192	Ir Iridium
-----	---------------	-----	---------------

195	Pd Palladium	195	Pt Platinum
-----	-----------------	-----	----------------

197	Ag Silver	197	Au Gold
-----	--------------	-----	------------

201	Cd Cadmium	201	Hg Mercury
-----	---------------	-----	---------------

204	In Indium	204	Pb Lead
-----	--------------	-----	------------

207	Sn Tin	207	Pb Lead
-----	-----------	-----	------------

209	Sb Antimony	209	Bi Bismuth
-----	----------------	-----	---------------

210	Te Tellurium	210	Po Polonium
-----	-----------------	-----	----------------

210	I Iodine	210	At Astatine
-----	-------------	-----	----------------

222	Xe Xenon	222	Rn Radon
-----	-------------	-----	-------------

227	Fr Francium	227	Ac Actinium
-----	----------------	-----	----------------

238	Th Thorium	238	U Uranium
-----	---------------	-----	--------------

231	Pa Protactinium	231	U Uranium
-----	--------------------	-----	--------------

237	Np Neptunium	237	U Uranium
-----	-----------------	-----	--------------

242	Pu Plutonium	242	U Uranium
-----	-----------------	-----	--------------

243	Am Americium	243	U Uranium
-----	-----------------	-----	--------------

245	Bk Berkelium	245	U Uranium
-----	-----------------	-----	--------------

251	Cf Californium	251	U Uranium
-----	-------------------	-----	--------------

254	Es Einsteinium	254	U Uranium
-----	-------------------	-----	--------------

147	Pm Promethium	150	Sm Samarium
-----	------------------	-----	----------------

150	Sm Samarium	150	Sm Samarium
-----	----------------	-----	----------------

152	Eu Europium	152	Eu Europium
-----	----------------	-----	----------------

157	Gd Gadolinium	157	Gd Gadolinium
-----	------------------	-----	------------------

163	Dy Dysprosium	163	Dy Dysprosium
-----	------------------	-----	------------------

165	Ho Holmium	165	Ho Holmium
-----	---------------	-----	---------------

167	Er Erbium	167	Er Erbium
-----	--------------	-----	--------------

169	Tm Thulium	169	Tm Thulium
-----	---------------	-----	---------------

173	Yb Ytterbium	173	Yb Ytterbium
-----	-----------------	-----	-----------------

175	Lu Lutetium	175	Lu Lutetium
-----	----------------	-----	----------------

254	No Nobelium	254	No Nobelium
-----	----------------	-----	----------------

255	Fm Fermium	255	Fm Fermium
-----	---------------	-----	---------------

256	Md Mendelevium	256	Md Mendelevium
-----	-------------------	-----	-------------------

257	Lr Lawrencium	257	Lr Lawrencium
-----	------------------	-----	------------------

