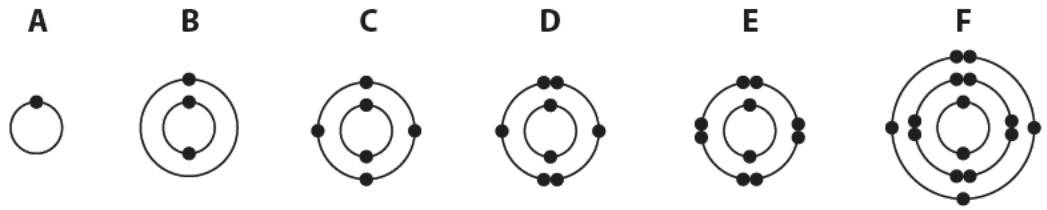
1 The diagram shows the electronic configurations of six different atoms.



(a) You may use the Periodic Table on page 2 to help you answer this question.
Answer each part by writing one of the letters A, B, C, D, E or F in the box provided.
You may use each letter once, more than once or not at all.

Give the letter that represents an atom

(6)

(i) of a noble gas ☐

(ii) that contains three protons ☐

(iii) of phosphorus ☐

(iv) of an element in Group 4 of the Periodic Table ☐

(v) of an element in Period 3 of the Periodic Table ☐

(vi) with a full outer shell of electrons ☐

(b) Atoms of A and D combine to form a compound containing covalent bonds.

(i) Complete the sentence to describe a covalent bond.

(2)

A covalent bond is the electrostatic attraction between a pair of .....

and the ..... of two atoms.

(ii) Suggest, with reference to electronic configurations, the most likely formula of the compound formed between atoms of A and D.

(1)

.....

(Total for Question 1 = 9 marks)

2 This question is about hydrogen (H_2) and water.

(a) Hydrogen is a gas at room temperature. It exists as simple molecules.

(i) Draw a dot and cross diagram to show the arrangement of the electrons in a hydrogen molecule.

(1)

(ii) Explain why hydrogen has a very low boiling point.

(2)

.....

.....

.....

.....

(b) The symbols for the three isotopes of hydrogen are

^{1}H ^{2}H ^{3}H

(i) State what is meant by the term **isotopes**.

(2)

.....

.....

.....

.....

(ii) Complete the table to show the number of protons, neutrons and electrons in each of the three isotopes of hydrogen.

(3)

	Isotope		
	^{1}H	**^{2}H**	**^{3}H**
number of protons			
number of neutrons			
number of electrons			

(c) When hydrogen burns in oxygen, heat energy is transferred to the surroundings.

(i) State the name given to a reaction in which heat energy is transferred to the surroundings.

(1)

.....

(ii) Write a chemical equation to represent the reaction that takes place when hydrogen burns in oxygen.

(2)

.....

(iii) Describe a chemical test to show that the product is water.

(2)

.....

.....

.....

.....

(iv) Describe a physical test to show that the product is pure water.

(2)

.....

.....

.....

.....

(Total for Question 2 = 15 marks)

3 This question is about bonding, structures and properties.

(a) The box gives four types of structure.

giant covalent	iant ionic	iant metallic	sim

The table shows some properties of four substances, A, B, C and D.

Complete the table by giving the correct type of structure for each substance.

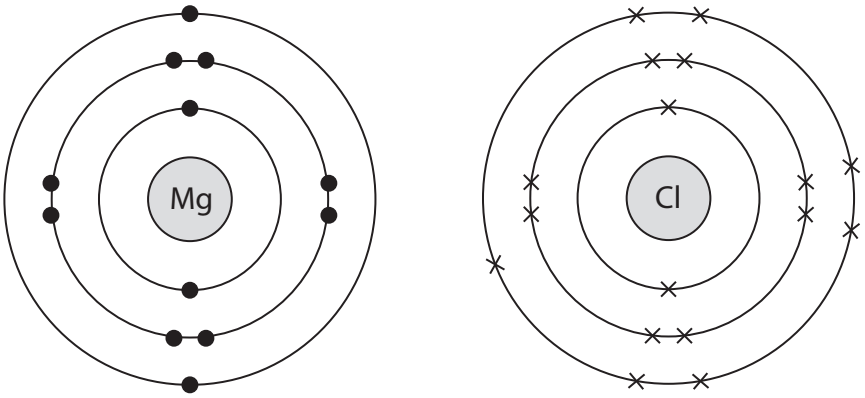
You may use each structure once, more than once or not at all.

(4)

Substance	Electrical conductivity		Melting point	Type of structure
	of the solid	of the liquid		
A	poor	poor	low	
B	poor	poor	high	
C	good	good	high	
D	poor	good	high	

(b) Magnesium chloride ($MgCl_2$) is an ionic compound.

The diagram shows the electronic configurations of atoms of magnesium and chlorine.



(i) Describe how magnesium atoms and chlorine atoms form magnesium ions and chloride ions.

(3)

.....

.....

.....

.....

.....

.....

(ii) Draw a diagram to represent the electronic configurations of each of the ions in magnesium chloride.

Show the charge on each ion.

(3)

(c) A molecule of carbon dioxide contains double covalent bonds.

Complete the diagram, using dots and crosses, to show the arrangement of the outer electrons in a molecule of carbon dioxide.

O C O

(2)

(d) Indium is a metal in Group 3 of the Periodic Table.

(i) Describe the structure and bonding in indium.

(3)

.....

.....

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.....

.....

.....

(ii) Explain why indium is malleable.

(2)

.....

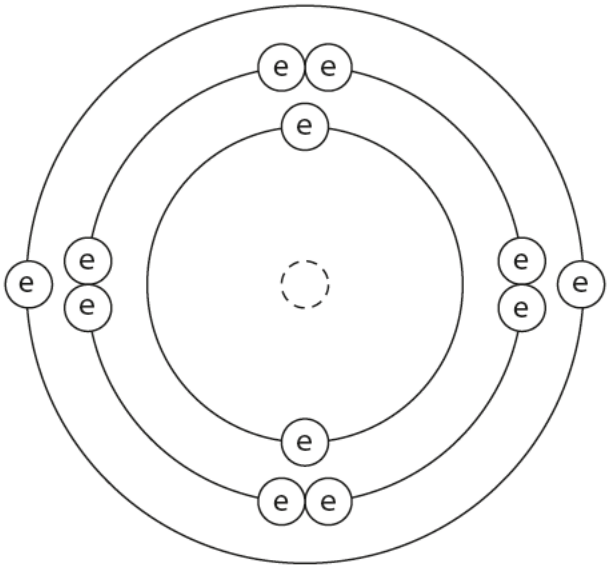
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(Total for Question 3 = 17 marks)

4 The diagram shows the electronic configuration of an atom of element X.



(a) (i) How many protons does the nucleus of the atom contain?

(1)

.....

(ii) Which group of the Periodic Table contains element X?

Give a reason for your choice.

(2)

.....

.....

.....

.....

(iii) Give the formula of the ion formed by element X in its compounds.

(1)

.....

(b) Element X has three isotopes.

The table gives the mass number of each isotope and its percentage abundance in a sample of element X.

Mass number	Percentage abundance (%)
24	79.0
25	10.0
26	11.0

Calculate the relative atomic mass (A_r) of element X.

Give your answer to one decimal place.

(3)

relative atomic mass of X = ...

(Total for Question 4 = 7 marks)

5 Boron is an element in Group 3 of the Periodic Table.

An atom of boron can be represented as $^{11}_{5}B$

(a) Use numbers from the box to complete the sentences about this atom of boron.

3	5	6	11	16

Each number may be used once, more than once or not at all.

(i) The atomic number of boron is .....

(1)

(ii) The mass number of boron is .....

(1)

(iii) This atom of boron contains ..... protons.

(1)

(iv) This atom of boron contains ..... neutrons.

(1)

(v) This atom of boron contains ..... electrons.

(1)

(b) Aluminium is another element in Group 3 of the Periodic Table.

Select a word or phrase from the box to complete each sentence about an atom of aluminium.

fewer	m e	the same number of

Each word or phrase may be used once, more than once or not at all.

(i) Compared to an atom of boron, an atom of aluminium has

..... protons.

(1)

(ii) Compared to an atom of boron, an atom of aluminium has

..... neutrons.

(1)

(iii) Compared to an atom of boron, an atom of aluminium has

..... electrons in its **outer** shell.

(1)

(c) The electronic configuration of aluminium is

(1)

- ☒ **A** 2.3
- ☒ **B** 2.2.3
- ☒ **C** 2.2.8
- ☒ **D** 2.8.3

(Total for Question 5 = 9 marks)