

Bonding (H)

1. Which equation shows the formation of a Group 2 metal ion?

M represents a Group 2 metal and e^- represents an electron.

- A $M + e^- \rightarrow M^+$
- B $M + 2e^- \rightarrow M^{2+}$
- C $M \rightarrow M^+ + e^-$
- D $M \rightarrow M^{2+} + 2e^-$

Your answer

[1]

2. Which of these substances has a **giant covalent structure**?

- A Carbon dioxide
- B Magnesium oxide
- C Sulfur dioxide
- D Silicon dioxide

Your answer

[1]

3. What is the electronic structure of sulfur?

- A 2
- B 2, 6
- C 2, 8, 6
- D 2, 8, 8, 6

Your answer

[1]

4. Mendeleev's arrangement of elements led to our modern Periodic Table.

How did Mendeleev arrange the elements in his Periodic Table?

- A In order of decreasing atomic mass and similar physical properties.
- B In order of increasing atomic number and similar physical properties.
- C In order of decreasing atomic number and similar chemical properties.
- D In order of increasing atomic mass and similar chemical properties.

Your answer

[1]

5. Sodium is an element that can be found in the Periodic Table.

A sodium atom contains 11 electrons.

Which statement about sodium is **true**?

- A Sodium is in Group 2 of the Periodic Table.
- B Sodium is in Period 2 of the Periodic Table.
- C Sodium is in Period 3 of the Periodic Table.
- D Sodium is in Group 3 of the Periodic Table.

Your answer

[1]

6. Which Period 3 element is in Group 2?

- A Aluminium
- B Boron
- C Calcium
- D Magnesium

Your answer

[1]

7. Sodium oxide, Na_2O , is a white solid.

Draw a dot and cross diagram to show the ions in sodium oxide.

[2]

8 (a). Mendeleev left gaps in his Periodic Table for undiscovered elements. He predicted properties of these elements.

Table 17.1 shows the predicted properties for one of these elements in one of the gaps.

Mendeleev called this element 'eka-silicon'.

Appearance	Grey metal
Melting point ($^{\circ}\text{C}$)	Over 800
Relative atomic mass	72
Density (g / cm^3)	5.5

Table 17.1

Table 17.2 shows some of the elements that were discovered after Mendeleev published his Periodic Table.

	Scandium (Sc)	Gallium (Ga)	Germanium (Ge)	Technetium (Tc)
Appearance	Silver-white metal	Silver-blue metal	Grey-white metal	Grey metal
Melting point ($^{\circ}\text{C}$)	1541	30	947	2157
Relative atomic mass	45.0	69.7	72.6	98.0
Density (g / cm^3)	3.0	5.9	5.35	11.0

Table 17.2

i. Which element matches Mendeleev's predictions for 'eka-silicon'?

Tick (✓) **one** box.

- Scandium
- Gallium
- Germanium
- Technetium

[1]

ii. Give **two** reasons for your answer to (i).

1

2

----- [2]

(b).

- i. Mendeleev did not predict the existence of argon, neon, krypton or xenon.

The electron arrangement of argon is 2,8,8.

What does this tell you about the reactivity of argon?

Explain your answer.

----- [2]

- ii. Neon is an element that has isotopes. Two of the isotopes are shown below.



Complete **Table 17.3** to show the number of protons, neutrons and electrons in each neon isotope.

	${}_{10}^{20}\text{Ne}$	${}_{10}^{22}\text{Ne}$
Proton		
Neutron		
Electron		

Table 17.3

[3]

9 (a). This question is about structure and bonding.

Look at the two structures, **A** and **B**, in Fig. 16.1.

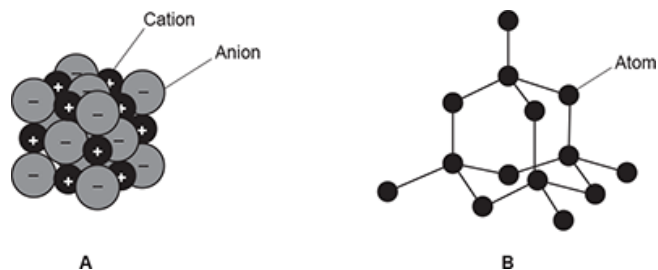


Fig. 16.1

- i. Identify the bonding in structure **A**.

Explain your answer.

Bonding

Explanation

- ii. Explain why structure **B** has a high melting point.

[2]

----- [2]

- iii. Explain why structure **B** does **not** conduct electricity.

----- [1]

(b). Look at the structure of a metal in **Fig. 16.2**. Metals are malleable, which means they can be hammered or pressed into shape without breaking or cracking.

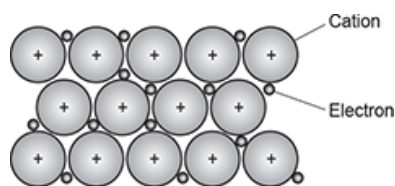


Fig. 16.2

Explain why metals are **malleable**.

----- **[2]**

10(a). Dmitri Mendeleev produced a Periodic Table of elements which is the basis for our modern Periodic Table. He left gaps for elements that had not been discovered yet as shown in **Fig. 17.1**.

I	II	III	IV	V	VI	VII
H						
Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca		Ti	V	Cr	Mn
Cu	Zn			As	Se	Br
Rb	Sr	Y	Zr	Nb	Mo	
Ag	Cd	In	Sn	Sb	Te	I
Ce	Ba	La		Ta	W	
Au	Hg	Tl	Pb	Bi		

Fig. 17.1

Describe **two** ways Mendeleev arranged the elements in his Periodic Table.

1

2

[2]

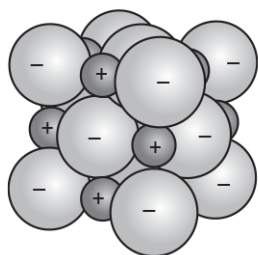
(b). Describe how the elements are arranged in the modern Periodic Table.

[1]

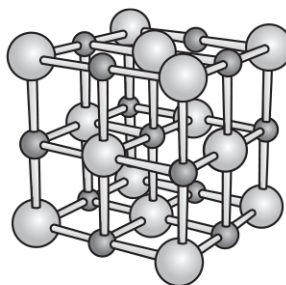
11. Sodium chloride, NaCl , is an ionic compound.

Sodium chloride forms a giant ionic lattice that can be represented using different models.

Look at the diagrams. They show two models of sodium chloride.



Space-filling model



Ball-and-stick model

- i. A scientist thinks the ball-and-stick model should be used to model ionic compounds.

Describe **two limitations** of using the ball-and-stick model for ionic compounds.

----- [2]

- ii. Ionic compounds can also be modelled using a dot-and-cross diagram.

Draw a dot and cross diagram to show the ions in sodium chloride.

[2]

12 (a). Metal elements and non-metal elements have different physical properties.

The table shows the physical properties of some elements.

Element	Melting point (°C)	Density (g / cm ³)	Electrical conductivity	Thermal conductivity	Cost
A	high	high	good	good	high
B	low	low	good	poor	high
C	high	low	good	good	low
D	high	high	poor	poor	low

- i. Which element, **A**, **B**, **C** or **D**, would be best to use for cables in overhead pylons to transfer electricity?

Tick (✓) **one** box.

A

B

C

D

Explain your answer.

[2]

- ii. What is meant by **physical** property?

[1]

(b). Element **C** burns in oxygen to make white clouds of its oxide.

Describe how you could test the oxide to find out if the element is a metal.

[3]

13. Lithium is a metal found in Group 1 of the Periodic Table.

- i. Describe the structure and bonding in a metal.

You may include a diagram in your answer.

----- [2]

- ii. Lithium is **malleable** even though metallic bonds are strong.

Explain why metals are malleable.

----- [1]

- iii. Lithium can conduct electricity in the solid and liquid state.

Explain why metals can conduct electricity.

----- [2]

14. The Group 7 elements are known as the halogens.

The halogens have similar chemical properties.

Their physical properties vary with increasing atomic number.

All halogens react with alkali metals to make a salt.

- i. All halogens have similar chemical reactions.

Explain why in terms of electronic structure.

----- [1]

- ii. Sodium reacts with bromine to make sodium bromide, NaBr.

Construct the **balanced symbol** equation for this reaction.

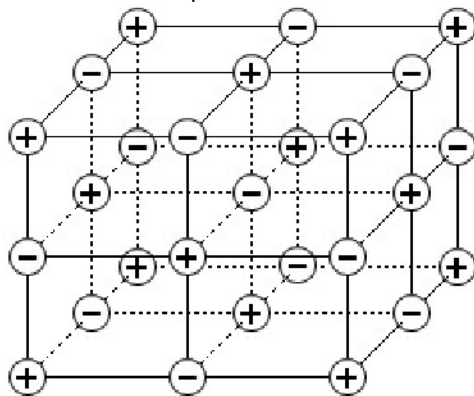
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- iii. What is the formula of the product of the reaction between astatine and potassium?

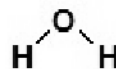
----- [1]

15. Look at the diagrams.

They show the structures of two compounds.



sodium chloride



water

Magnesium oxide has a similar structure to sodium chloride.

Draw 'dot and cross' diagrams to show the ionic bonding in magnesium oxide.

You should include the charges on the ions.

The electronic structure of magnesium is 2.8.2.

The electronic structure of oxygen is 2.6.

[3]

16(a). Look at the table. It shows information about some atoms and ions.

Particle	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electronic structure
A	11	23	11	.....	11	2.8.1
B	9	19	9	10	9	.....
C	.....	37	17	.....	17	2.8.7
D	13	27	.....	.....	10	2.8

Complete the table.

[4]

(b). Particle **A** is a metal **atom**, particle **D** is an **ion**.

Explain why.

[2]

(c). Particle **C** has the electronic structure 2.8.7.

What does this tell you about the position of particle **C** in the Periodic Table?

Explain your answer.

[4]

END OF QUESTION PAPER