

WEEK 3

1.1 The Periodic Table

Key Ideas

- Small molecules are formed from elements in a small section of the periodic table. Small molecules are those either of non-metallic elements or of compounds of non-metallic elements.
- Atoms in a molecule are bound strongly to each other by covalent bonds. Molecules interact weakly with each other.
- The strengths of secondary interactions between non-polar molecules depend on their molar mass.
- The shape of molecules can be explained and predicted by repulsion between pairs of bonding and non-bonding electrons.
- The polarity of a molecule results from the polar character of the bonds and their spatial arrangement.
- The strengths of secondary interactions between molecules of similar molar mass depend on the polarity of the molecules.
- Molecules containing N–H or O–H groups can form hydrogen bonds to N or O atoms in other molecules.

TOPIC CHECKLIST

- Compare the strengths of covalent bonds with the strengths of secondary interactions.
- Explain the higher melting points and boiling points of substances of large molar mass.
- Draw diagrams showing covalent bonds, non-bonding pairs, and shapes for three-element molecules and two-element ions containing no more than five atoms. Examples that involve valence shell octet expansion are limited to PO_4^{3-} tetrahedra, SO_2 , and SO_3 .
- Predict whether or not a molecule is polar, given its spatial arrangement.
- Explain the higher melting points and boiling points of polar substances compared with those of non-polar substances of similar molar mass.
- Describe, with the aid of diagrams, hydrogen bonding between molecules.

Periodic Table Assignment (Part B: Due Mon.wk4)

QUESTION 1

a) Predict whether each of the following is likely to be molecular:

i) a compound which does not conduct in the solid or molten states and melts at 1315 °C.

.....

ii) arsenic fluoride

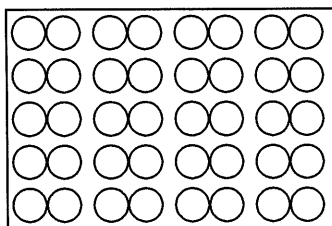
.....

iii) PbCl_2

.....

(3 marks)

b) The diagram shows the arrangement of the particles in a crystal of iodine.



i) State the formula of iodine.

.....
(1 mark)

ii) By considering the position of iodine in the periodic table make two statements about its electron configuration.

.....
.....
(2 marks)

iii) Within the crystal lattice there are two types of bonds.

1) Name the two types of bonds.

.....
.....
(2 marks)

2) Describe the two types of bonds.

.....
.....
(2 marks)

3) Compare the strengths of the two types of bonds.

.....

.....

(1 mark)

c) Bromine has a similar crystal lattice to that of iodine.

i) Explain why bromine has a lower boiling point than iodine.

.....

.....

(2 marks)

ii) Suggest, with explanation, whether hydrogen iodide has a higher or lower boiling point than that of iodine.

.....

.....

.....

(3 marks)

QUESTION 2

Ammonia and methane are both gases at 25 °C.

a) State the shape of molecules of ammonia and methane.

.....

.....

(2 marks)

b) Explain why an ammonia molecule has the shape it does.

.....

.....

.....

(3 marks)

c) The covalent bonds in both ammonia and methane are polar.

i) Explain why both N – H and C – H bonds are polar.

.....

.....

(2 marks)

ii) Explain which bond is more polar, a N – H bond or a C – H bond.

.....
.....
(2 marks)

d) The ammonia molecule is polar whereas the methane molecule is nonpolar.

i) Explain why this is so.

.....
.....
(2 marks)

ii) Explain which compound has the higher boiling point.

.....
.....
(2 marks)

QUESTION 3

Correct, with explanation, each of the following statements.

a) Potassium chloride is a high melting point solid. This is because not only are there strong forces within the molecules but the intermolecular forces are also strong.

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

b) Sodium fluoride does not conduct in the solid state. However, when it is melted, the electrons become delocalised so that the molten material will conduct electricity.

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

c) Water is polar. This is because the hydrogen bonds within the molecules are highly polar.

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