

Chem!stry

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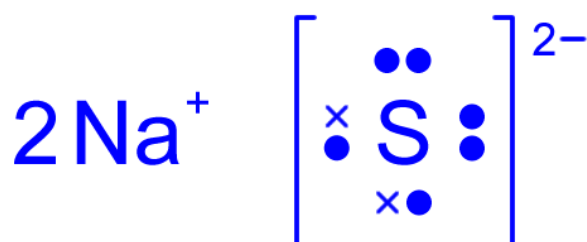
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Assignment Two on Chemical Bonding – Answers

Question 1:

Draw a dot-and-cross diagram to clearly show the arrangement of the electrons, and hence the bonding, in the compound that is formed when sodium reacts with sulfur.



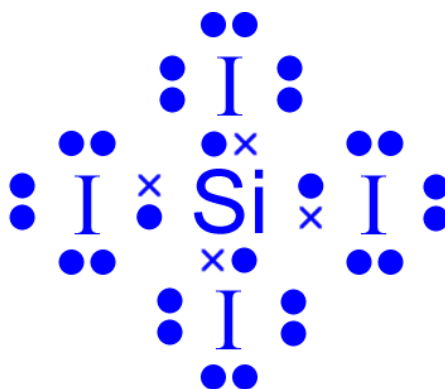
× = Electron of sodium

• = Electron of sulfur

[2]

Question 2:

Draw a dot-and-cross diagram to clearly show the arrangement of the electrons, and hence the bonding, in the compound that is formed when silicon reacts with iodine.



• = Electron of iodine

× = Electron of silicon

[2]

Question 3:

- a) Predict formula of the compound that is formed when aluminium reacts with sulfur.

The valency of Al = 3. The valency of S = 2. Swapping the valencies give Al_2S_3 .

- b) Predict the formula of the compound that is formed when selenium reacts with fluorine.

The valency of Se = 2. The valency of F = 1. Swapping the valencies gives SeF_2 .

[2]

Question 4:

Study the properties of the chemicals that are given in the table below:

Chemical	Melting Point / °C	Electrical Conductivity (Solid)	Electrical Conductivity (Liquid)	Solubility in Water
W	1084	Conductor	Conductor	Insoluble
X	-182	Insulator	Insulator	Insoluble
Y	772	Insulator	Conductor	Soluble
Z	1650	Insulator	Insulator	Insoluble

- a) Which chemical could be silica (sand)? **Z** (very high melting point, electrical insulator).
- b) Which chemical could be calcium chloride? **Y** (insulator when solid, conductor when molten).
- c) Which chemical could be methane? **X** (low melting point, electrical insulator).
- d) Which chemical could be copper? **W** (conducts electricity as both solid and liquid).

[4]

Question 5:

Tritium is an *isotope* of hydrogen.

- a) Define the term *isotope*.

Isotopes are atoms of the same chemical element which contain the same number of protons, but a different number of neutrons.

[2]

- b) Would you expect the compound formed between sodium and tritium to be ionic or covalent? Explain your answer.

Ionic. Sodium is a metal and tritium – an isotope of hydrogen – is a non-metal. Metals react with non-metals, through electron transfer, to form ionic compounds.

[2]

- c) Would you expect the compound formed between tritium and oxygen to be a solid, liquid or gas at room temperature and pressure? Explain your answer.

The compound would be liquid. The compound formed between hydrogen and oxygen, H_2O , is a liquid, therefore the compound formed between tritium – an isotope of hydrogen – and oxygen would also be a liquid.

[2]

Question 6:

Figure 1 shows an insulated copper wire used to construct an electric circuit.

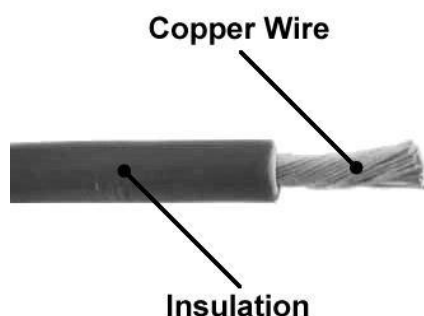


Figure 1. An insulated copper wire.

Briefly explain why, instead of using plastic for their insulation, the wires used to construct fire alarm circuits are insulated using magnesium oxide.

Plastic is a covalent compound with a relatively low melting point due to weak intermolecular forces of attraction (van der Waals forces of attraction). The plastic would melt during a fire, exposing the wires inside it, possibly causing a short-circuit.

Magnesium oxide is an ionic compound. It does not contain any mobile ions in its solid state and is therefore an electrical insulator. Magnesium oxide has a very high melting point due to the strong electrostatic force of attraction that exists between the anions (negative ions) and cations (positive ions). Magnesium oxide would not melt at the high temperatures encountered during a fire and would therefore continue to insulate the wires inside it.

[3]

Question 7:

Figure 2 shows the structure of brass, which is an alloy of copper and zinc.

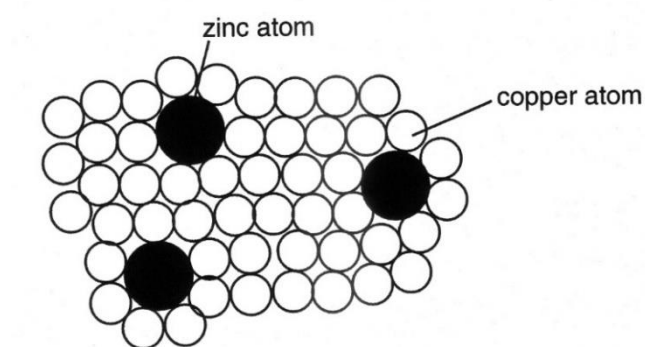


Figure 2. The structure of brass.

With reference to **Figure 2**, briefly explain why brass is *stronger* than pure copper.

The large zinc atoms distort the regular crystal structure of the copper, making it difficult for the layers of copper atoms to slide over each other. In brass, more force is required to make the layers of copper atoms slide over each other, therefore brass is stronger than pure copper.

[2]

Question 8:

Figure 3 shows the structure of a single walled carbon nanotube. Single walled carbon nanotubes are formed when a single layer of graphite rolls-up into a tube.

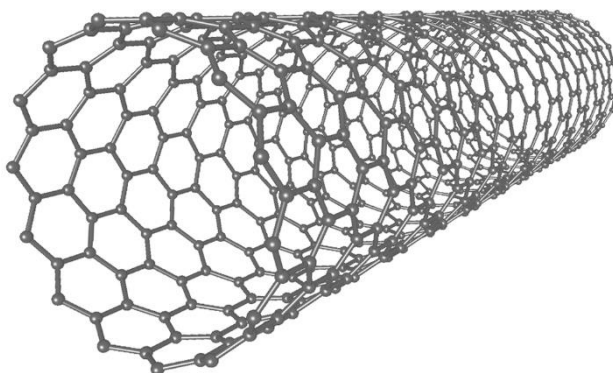


Figure 3. The structure of a single walled carbon nanotube.

- a) Identify one way in which the structure of the single walled carbon nanotube is similar to the structure of graphite.

In both structures, the carbon atoms are bonded together in a hexagonal arrangement.

In both structures, a single carbon atom makes three covalent bonds.

[1]

- b) Identify one way in which the structure of the single walled carbon nanotube is different to the structure of graphite.

Graphite is composed of many layers of carbon atoms. The single walled carbon nanotube is composed of only a single layer of carbon atoms.

In graphite, the layers of carbon atoms are flat (two-dimensional). In the single walled carbon nanotube, the layer of carbon atoms is curved into a cylinder (three-dimensional).

[1]

- c) Do you expect the single walled carbon nanotube to be a good conductor of electricity? Explain your answer.

The single walled carbon nanotube is able to conduct electricity. Carbon is in Group 14 of the Periodic Table and therefore has four valence electrons. Three of these valence electrons are used in the formation of the three covalent bonds. The fourth valence electron is delocalised and therefore the single walled carbon nanotube is able to conduct electricity.

[2]