**Quiz (Factors affecting the Strength of Van der Waals' Forces)**

1. Explain why iodine has a higher boiling point than bromine.

2. The information on some hydrocarbons is given below:

| Hydrocarbon | Boiling point (°C) |
|---|---|
| Propane ($C_3H_8$) | –42.0 |
| Butane ($C_4H_{10}$) | 4.6 |
| 2-methylpropane ($C_4H_{10}$) | –11.7 |
| Pentane ($C_5H_{12}$) | 36.0 |

   (a) State whether the above hydrocarbons consist of polar or non-polar molecules.

   (b) Name the type of intermolecular forces that exist between these hydrocarbon molecules.

   (c) Butane and 2-methylpropane have the same molecular formula but their boiling points are different. Explain briefly.

3. Methane ($CH_4$), ethane ($C_2H_6$) and propane ($C_3H_8$) have different boiling points.
   (a) State whether each of the above substances is polar or non-polar.

   (b) Arrange methane, ethane and propane in order of decreasing boiling points. Explain your answer.

**Suggested Answer**

1. The intermolecular forces between bromine molecules and between iodine molecules are van der Waals' forces. Iodine has a larger molecular size than bromine, so the van der Waals' forces between their molecules are stronger. Thus, iodine has a higher boiling point than bromine.

2. (a) Non-polar molecules

   (b) Van der Waals' forces

   (c) Butane is a straight-chain hydrocarbon and is rod shaped.

   2-methylpropane is a branched-chain hydrocarbon and has a spherical shape.

   As butane molecules have a greater area of contact with one another, the van der Waals' forces between their molecules are stronger. Thus, butane has a higher boiling point.

3. (a) Methane, ethane and propane are all non-polar.

   (b) As the molecular size decreases in the order: propane > ethane > methane, the van der Waals' forces between propane molecules are the strongest, while those between methane molecules are the weakest. Thus, the boiling points decrease in the order: propane > ethane > methane.