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VCE Chemistry ½
Intermolecular Bonding [1.8]
Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing

Results:

Quiz Questions	_____ / 15
Extension	_____ / 5

Section A: Quiz Questions (15 Marks)

Question 1 (4 marks)

Tick whether the following statements are **true** or **false**.

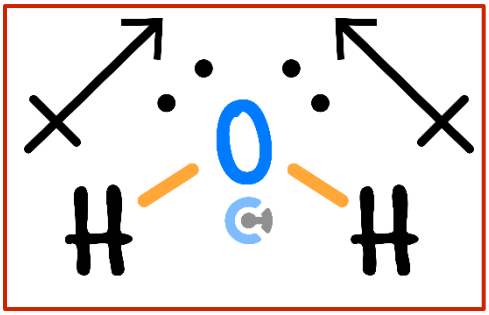
	True	False
a. Dispersion forces are found only in non-polar molecules.		✓
b. The dipoles formed that allow for dispersion forces are temporary and instantaneous and only occur for a split second in molecules.	✓	
c. Fluorine has stronger dispersion forces than neon.	✓	
d. Dipole-dipole interactions can form between a polar molecule and a non-polar molecule.		✓
e. Hydrogen bonding is a type of intermolecular force which occurs when hydrogen is bonded to any other atom in a molecule.		✓
f. Hydrogen bonding is stronger than dipole-dipole forces between molecules.	✓	
g. Both ammonia (NH_3) and phosphine (PH_3) are able to form Hydrogen bonds.		✓
h. When water goes from a liquid state to a solid state, the intermolecular bonds are strengthened due to less kinetic energy being present to disrupt them.	✓	

Space for Personal Notes

Question 2 (5 marks)

Araav is exploring the properties of water and is especially curious as to why it is found in so many different states.

a. Draw the Lewis structure of water indicating the dipoles with polarity arrows. (1 mark)



b. Hence, explain how dipole-dipole interactions are able to form in the molecule you have drawn. (2 marks)

Since the hydrogen is bonded to an oxygen we can have hydrogen bonding. This is just a type of dipole dipole bond where the partially negative oxygens become attracted to the partially positive hydrogens. It can occur because the oxygen is very electronegative and hence pulls the electrons closer towards it in the covalent bond.

c. Jeff and Ryan are arguing about whether these dipole-dipole interactions are the same as hydrogen bonds, and whether water can form hydrogen bonds. Explain what a hydrogen bond is and how it can/cannot form between water molecules. (2 marks)

Hydrogen bonds are just a type of dipole-dipole interaction – but they are stronger than normal dipole dipole bonds. In water, the hydrogen is bonded to an oxygen, allowing it to form hydrogen bonds between the molecules.

Space for Personal Notes

Question 3 (3 marks)

Consider a molecule of methane - CH_4. Methane is known to have a symmetrical, tetrahedral shape. At room temperature, it is found in a gaseous state.

a. With reference to intermolecular bonds, explain why methane is a gas at room temperature, rather than a solid or liquid. (2 marks)

Methane is a completely non-polar molecule. This means that it only has dispersion forces from instantenous electron movement. Since dispersion forces are weak, only small amounts of energy are required to break them, and as such methane is a gas.

b. Jeff remembers learning that dispersion forces are only temporary but wonders how molecules can stay together then for a long period of time. Explain why this is the case. (1 mark)

Dispersion forces constantly form, and also constantly break.

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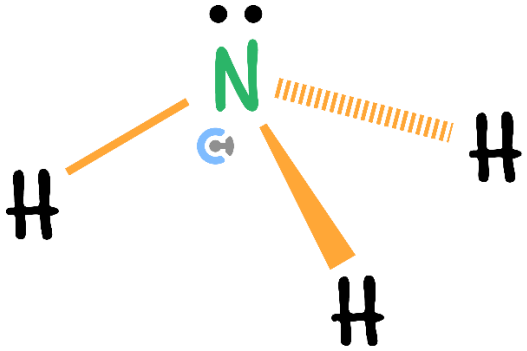
Question 4 (3 marks)

Consider the molecule drawn below:



a. Is this molecule capable of forming hydrogen bonds? Explain why with reference to the two factors required to form a hydrogen bond. (2 marks)

Yes. It has N bonded to H setting up a strong negative and positive dipole. Further the nitrogen has a lone pair.

b. What other types of intermolecular forces are present in this molecule? (1 mark)

Dispersion, dipole-dipole

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Section B: Extension (5 Marks)

Question 5 (5 marks)

In the lab, Ryan is experimenting with a number of different compounds. Of these, two catch his attention. The first is butane, C_4H_{10}, and the second is nonane, C_9H_{18}.

a. What intermolecular forces are present in these molecules? (1 mark)

Dispersion only

b. Ryan notices that despite both molecules being part of the same homologous series, nonane is much thicker. Why is this the case? (2 marks)

Nonane is bigger, hence has more atoms and more electrons. This allows for more instantaneous electron movement and thus more dispersion forces.

c. Why is the strength of intermolecular forces directly correlated to boiling point? (1 mark)

When boiling, the intermolecular forces of a molecule need to be broken - thus when intermolecular forces are stronger greater thermal energy is required.

d. Explain whether or not butane could form hydrogen bonds with water. (1 mark)

No – Butane does not have any dipoles.

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VCE Chemistry ½

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