Worksheet 4.5

Electronegativity and intermolecular forces

1 Electronegativity values can be used to predict the polarity of bonds.

a What is the meaning of the term **electronegativity**? [2]

b The table below lists electronegativity values for a number of atoms.

Atom	Cl	F	H	I	O
Electronegativity	3.0	4.0	2.1	2.5	3.5

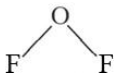
Use the data in the table to predict the polarity of the following bonds. Copy the bonded atoms shown and add the symbols + and above the appropriate atoms.

i Cl–O [1]

ii H–I [1]

iii O–F [1]

c The shape of the molecule F_2O is shown on the right.



i Describe the shape of this molecule. [1]

ii Explain why F_2O has this shape. [3]

iii Suggest a value for the F–O–F bond angle. [1]

iv Draw a diagram of the F_2O molecule to show the direction of the dipole. [1]

2 The boiling points of some Group V hydrides are shown below.

Hydride	NH_3	PH_3	AsH_3	SbH_3
Boiling point / °C	33	88	55	17

a Describe and explain the general trend in the boiling points of the hydrides from PH_3 to SbH_3. [3]

b Explain why the boiling point of ammonia, NH_3, is higher than that of phosphine, PH_3. [2]

3 Use ideas about structure, electronegativity and intermolecular forces to explain why phosphorus trichloride, PCl_3, is a liquid at room temperature but phosphine, PH_3, is a gas. Electronegativity values: Cl = 3.0; H = 2.1; P = 2.1 [10]

4 Ethanol, C_2H_5OH, is a hydrogen-bonded molecule at room temperature.

a What are the requirements for hydrogen bonding to occur between two molecules? [4]

b Draw **two** molecules of ethanol to show the hydrogen bonding between them. Include on your diagram any relevant lone pairs of electrons that play a part in the hydrogen bonding. [3]

c Explain why butane, $CH_3CH_2CH_2CH_3$, has a higher boiling point than 2-methylpropane, $CH_3CH(CH_3)CH_3$, even though they have the same number of electrons. [7]