**M1.**(a) 94−105.5°

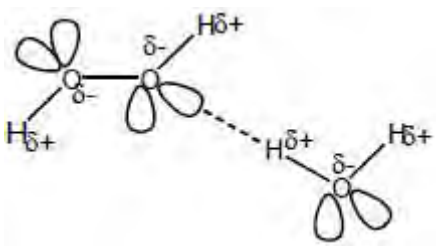
**1**

(b) (i) Hydrogen bond(ing) / H bonding / H bonds

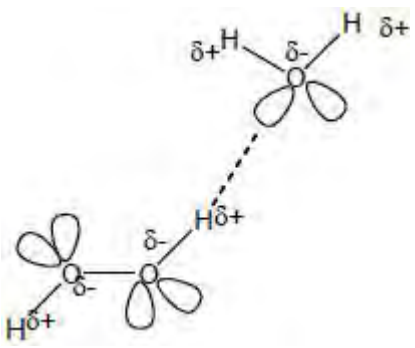
*Not just hydrogen*

**1**

(ii)




**OR**




*1 mark for all lone pairs*

*1 mark for partial charges on the O and the H that are involved in H bonding*

*1 mark for the H-bond, from Hδ+ on one molecule to lone pair on O of other molecule*

**3**

(c) Electronegativity of S lower than O or electronegativity difference between H and S is lower

*Mark independently*

**1**

No hydrogen bonding between $H_2S_2$ molecules

Or only van der Waals / only dipole-dipole forces between $H_2S_2$ molecules

*If breaking covalent bonds CE = 0*

1

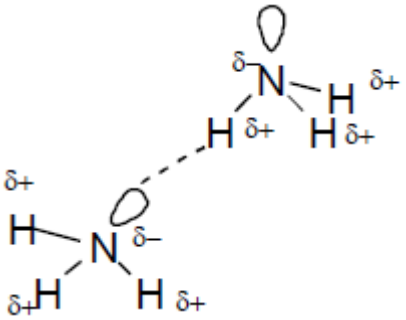
**[7]**

**M2.**(a) (i) Hydrogen bonds / H bonds

*Not just hydrogen.*

1

(ii)




*M1 – lone pair on each N.*

*M2 – correct partial charges must be shown on the N and H of a bond in each molecule.*

*M3 – for the H bond from lone pair on N to the Hδ⁺ on the other $NH_3$ molecule.*

*If not ammonia molecules, CE = 0 / 3.*

3

(b) Lone pair / both electrons / 2 electrons / electron pair on N($H_3$) is donated to B($Cl_3$)

*Allow both electrons in the bond come from N($H_3$).*

1

(c) (i) The power of an atom or nucleus to withdraw or attract electrons or electron density or a pair of electrons (towards itself)

1

in a covalent bond

1

(ii) LiF **OR** $Li_2O$ **OR** LiH

*Allow $Li_2O_2$, allow correct lithium carbide formula.*

**1**

(iii) $BH_3$ / $H_3B$

*Allow $B_2H_6$ / $H_6B_2$*

*Do not allow lower case letters.*

**1**

**[9]**

**M3.**C

**[1]**

**M4.**(a) A mixture of liquids is heated to boiling point for a prolonged time

**1**

Vapour is formed which escapes from the liquid mixture, is changed back into liquid and returned to the liquid mixture

**1**

Any ethanal and ethanol that initially evaporates can then be oxidised

**1**

(b) $CH_3CH_2OH + H_2O \longrightarrow CH_3COOH + 4H^+ + 4e^-$

**1**

(c) Mixture heated in a suitable flask / container

*A labelled sketch illustrating these points scores the marks*

**1**

With still head containing a thermometer

1

Water cooled condenser connected to the still head and suitable cooled collecting vessel

1

Collect sample at the boiling point of ethanal

1

Cooled collection vessel necessary to reduce evaporation of ethanal

1

(d) Hydrogen bonding in ethanol and ethanoic acid or no hydrogen bonding in ethanal

1

Intermolecular forces / dipole-dipole are weaker than hydrogen bonding

1

(e) Reagent to confirm the presence of ethanal:

Add Tollens' reagent / ammoniacal silver nitrate / aqueous silver nitrate followed by 1 drop of aqueous sodium hydroxide, then enough aqueous ammonia to dissolve the precipitate formed

**OR**

Add Fehling's solution

1

Warm

*M2 and M3 can only be awarded if M1 is given correctly*

1

Result with Tollen's reagent:

Silver mirror / black precipitate

**OR**

Result with Fehling's solution:

Red precipitate / orange-red precipitate

**1**

Reagent to confirm the absence of ethanoic acid

Add sodium hydrogencarbonate or sodium carbonate

**1**

Result; no effervescence observed; hence no acid present

**1**

*M5 can only be awarded if M4 is given correctly*

**OR**

Reagent; add ethanol and concentrated sulfuric acid and warm

Result; no sweet smell / no oily drops on the surface of the liquid,

hence no acid present

**[16]**

**M5.**A

**[1]**

**M6.**(a) $\Delta S = 238 + 189 - 214 - 3 \times 131 = -180$ J $K^{-1}$ $mol^{-1}$

**1**

$\Delta G = \Delta H - T\Delta S$

**1**

$= -49 - \frac{523 \times (-180)}{1000}$

**1**

= +45.1 kJ mol$^{-1}$

*Units essential*

**1**

(b) When $\Delta G = 0$, $\Delta H = T\Delta S$ therefore $T = \Delta H / \Delta S$

**1**

= –49 × 1000 / –180 = 272 (K)

*Mark consequentially to ΔS in part (a)*

**1**

(c) Diagram marks

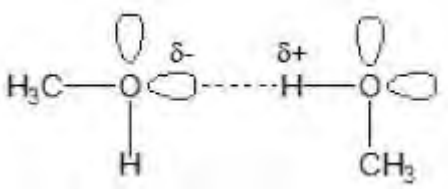



Diagram of a molecule showing O–H bond and two lone pairs on each oxygen

**1**

Labels on diagram showing δ+ and δ- charges

*Allow explanation of position of δ+ and δ- charges on H and O*

**1**

Diagram showing δ+ hydrogen on one molecule attracted to lone pair on a second molecule

**1**

Explanation mark

Hydrogen bonding (the name mentioned) is a strong enough force (to hold methanol molecules together in a liquid)

**1**

**[10]**

**M7.**D

**[1]**

**M8.**C

**[1]**