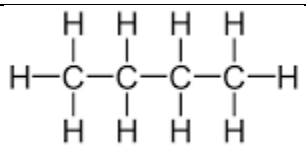
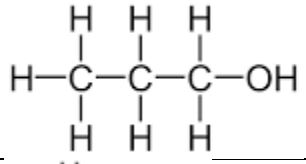
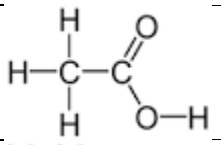
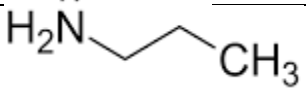
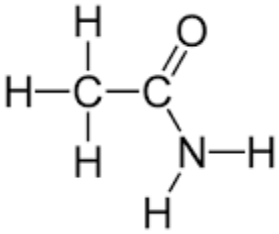
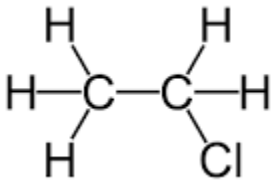
Revision 4 Trends and electrolysis

1)

Compound	Structural formula	Molar mass	Boiling temp °C	Intermolecular bonding
Butane		58	-1	*Dispersion forces only*
Propanol		60	97	*Dispersion forces and H-bonding*
Ethanoic acid		60	118	*Dispersion forces and H-bonding*
Propanamine		59	49	*Dispersion forces and H-bonding*
Ethanamide		59	210	*Dispersion forces and H-bonding*
Chloroethane		64	12	*Dispersion forces and dipole-dipole*

a) Describe the intermolecular bonding of each molecule.

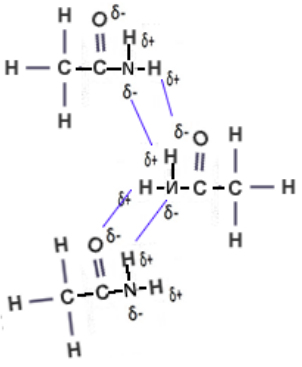
b) Name the functional group in each molecule.

Propanol = hydroxy(OH), ethanoic acid = carboxy(COOH), propanamine = amine(NH_2), ethanamide =amide(CONH), chloroethane=chloro(Cl)

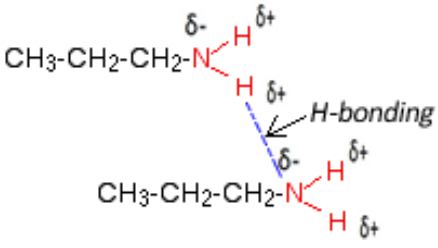
c) Consider the two molecules, ethanamide and propanamine.

i. Both exhibit H-bonding and yet ethanamide has a higher boiling temperature. Explain why. Draw a diagram.

Ethanamide



Propanamine



Ethanamide can form more hydrogen bonds between its molecules than propanamine. This allows for stronger intermolecular bonding between ethanamide molecules and hence a higher boiling temperature.

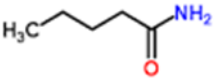
ii. Which one would be least soluble in water? Explain

Propanamine is less soluble in water as it has a longer, non-polar, hydrocarbon chain that does not interact well with water molecules.

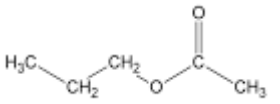
d) Consider the molecules pentanamide and propyl ethanoate.

i. Draw the structural formula of each molecule

pentanamide



propyl ethanoate

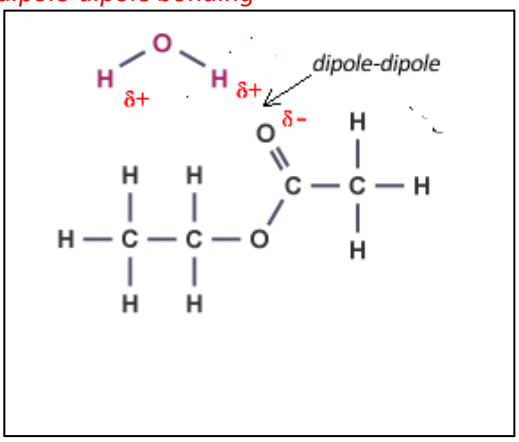


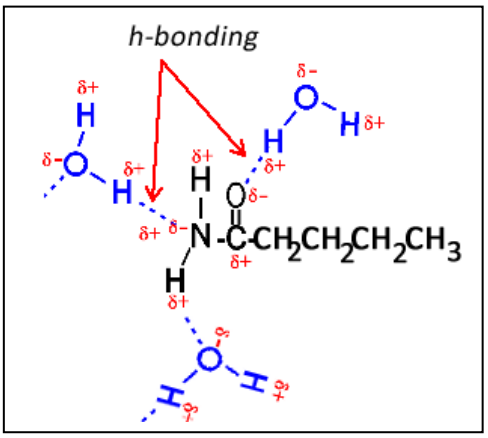
ii. Which molecule will have the highest boiling temperature? Explain

pentanamide because the nitrogen to hydrogen (N–H) and the carbon to oxygen double bonds (C=O) can engage in hydrogen bonding; propyl ethanoate cannot engage in hydrogen bonding.

iii. Draw a diagram to show how pentanamide and propyl ethanoate interact with water and discuss which one is most soluble in water? Indicate on your diagram charge and type of intermolecular bonding.

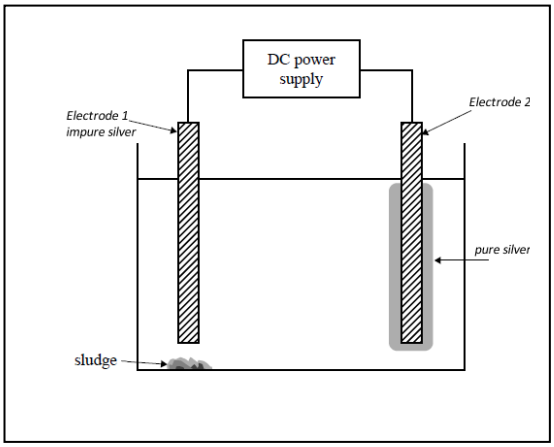
Pentanamide. It exhibits hydrogen bonding between its molecules and has more interaction with water molecules than propyl ethanoate which only exhibits dipole-dipole bonding





2) An electrolytic cell is set up to obtain pure silver from an impure piece of silver. The electrolyte solution contains silver nitrate. The impure silver, Electrode I, contains impurities such as zinc, cobalt, copper, gold, nickel and iron. The cell voltage is adjusted so that only silver is deposited on Electrode II. Sludge, which contains solid metal impurities present in the impure silver, forms beneath Electrode I. The other impurities remain in solution as ions.

The diagram on the right represents the cell.



a) What are the metals in the sludge?

Any metal that is a stronger reductant than Ag as shown on the electrochemical series will be oxidised into ions in solution. Any metal that is a weaker reductant than silver, such as gold, will fall and collect as a sludge on the bottom of the cell.

b) What metal ions from the impure silver remain in the electrolyte?

Gold is the only metal that is a weaker reductant than silver and will fall to the bottom as a solid all other metals are stronger reductants than silver and will oxidise and form ions in solution.

c) What is the polarity of each electrode?

Electrode 1 is where oxidation takes place and hence is the anode (positive), electrode 2 is negative.

d) The cell runs for 2.40 hours at a current of 1.89 A. What mass, in kg, of silver is deposited during this time. Answer is must be to the right number of significant figures.

Step 1 find the charge delivered.

=> Q = It = 1.89 X 2.40 X 60 X 60 = 16330 C

Step 2 find the mol of electrons delivered.

=> 16330 / 96500 = 0.169

Step 3 find the mol of Ag

=> $Ag^{+}(aq) + e \Rightarrow Ag(s)$

=> 0.169

Step 4 find the mass of silver

=> 0.169 X 108 = 0.0183 kg