GCSE Chemistry A (Gateway Science)

J248/03 C1-C3 and C7 Higher (Higher Tier)

Question Set 6

1 Simple distillation can be used to separate mixtures of liquids.

A scientist is using simple distillation to separate a mixture alcohols.

Look at the table. It shows the boiling points of three alcohols.

Alcohol	Boiling point (°C)
Methanol	65
Ethanol	78
Propanol	97

(a) **(i)** Which alcohol will be distilled first?

Tick (✓) **one** box.

Methanol ☑

Ethanol ☐

Propanol ☐

Explain your answer. Because it has the lowest boiling point **[2]**

(ii) Simple distillation uses evaporation and condensation to separate mixtures.

$$\text{ethanol (l)} \underset{\text{condensation}}{\overset{\text{evaporation}}{\rightleftharpoons}} \text{ethanol (g)}$$

Describe the change in the **arrangement** of particles as substances evaporate. **[1]**

Particles become more further away from each other and distributed randomly

(iii) Describe the change in the **movement** of particles as substances evaporate. **[1]**

The particles move randomly faster

(iv) The scientist wants to improve the separation of the mixture of alcohols.

Suggest a piece of equipment he could use. Fractional distillation – it has glass beads which alcohol vapours can condense and evaporate repeatedly thus distilling many times.

Explain how this will improve the separation of the mixture of alcohols. **[2]**

(b) Ethanol can be used as a biofuel. The combustion of ethanol is an **exothermic** reaction.

Explain why combustion is an exothermic reaction.

Use ideas about bond breaking and bond making in your answer. **[1]**

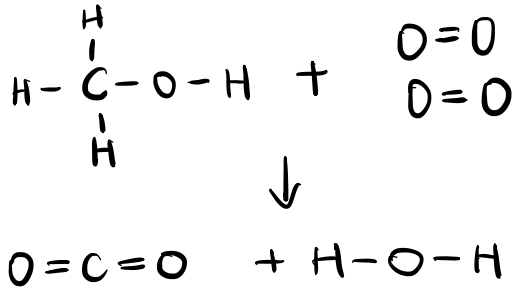
Because energy released by forming new bonds is greater than the energy needed to break the original bonds.

(c) **(i)** Methanol is another biofuel that can be used in combustion reactions.

$CH_3OH + 2O_2 \rightarrow CO_2 + 2H_2O$

Look at the table. It shows some bond energies.

Bond	Bond energy (kJ/mol)
C−H	413
O=O	498
C−O	358
C=O	805
O−H	464



Calculate the energy transferred to break all the bonds in the reactants.

413 x 3 + 358 + 464 + 498 x 2 = 3057

Energy transferred = ... 3057 ..... kJ/mol **[2]**

(ii) Calculate the energy transferred when all the bonds form in the products.

805 x 2 + 464 x 2 = 2538

Energy transferred = ... 2538 ..... kJ/mol **[2]**

(iii) Use your answers to parts **(i)** and **(ii)** to calculate the energy change for this reaction.

−3057 + 2538 = −519

Energy change = ... −519 ..... kJ/mol **[1]**

Total Marks for Question Set 6: 12

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 **H** hydrogen 1.0	2											13	14	15	16	17	2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

Key
atomic number
Symbol
name
relative atomic mass