Oxford Cambridge and RSA

AS Level Chemistry B

H033/01 Foundations of chemistry

Question Set 3

1 When ammonium nitrate, NH_4NO_3, dissolves in water, the process is endothermic. This process is used in 'ice packs' that are used for sports injuries.

(a) A group of students dissolve 8.0 g of ammonium nitrate in 200 cm^3 of water. The temperature falls by 3.0 °C.

(i) Calculate the enthalpy change on dissolving 1 mol of ammonium nitrate in water.

Give your answer in kJ mol^{-1} and to an **appropriate** number of significant figures.

ΔH =……kJ mol^{-1}

[3]

(ii) The students want to get a larger temperature change. Some suggest using a greater mass of ammonium nitrate, others suggest using more water.

Evaluate the students' suggestions.

[2]

(b) Another group of students investigates the exothermic reaction between zinc and copper sulfate solution.

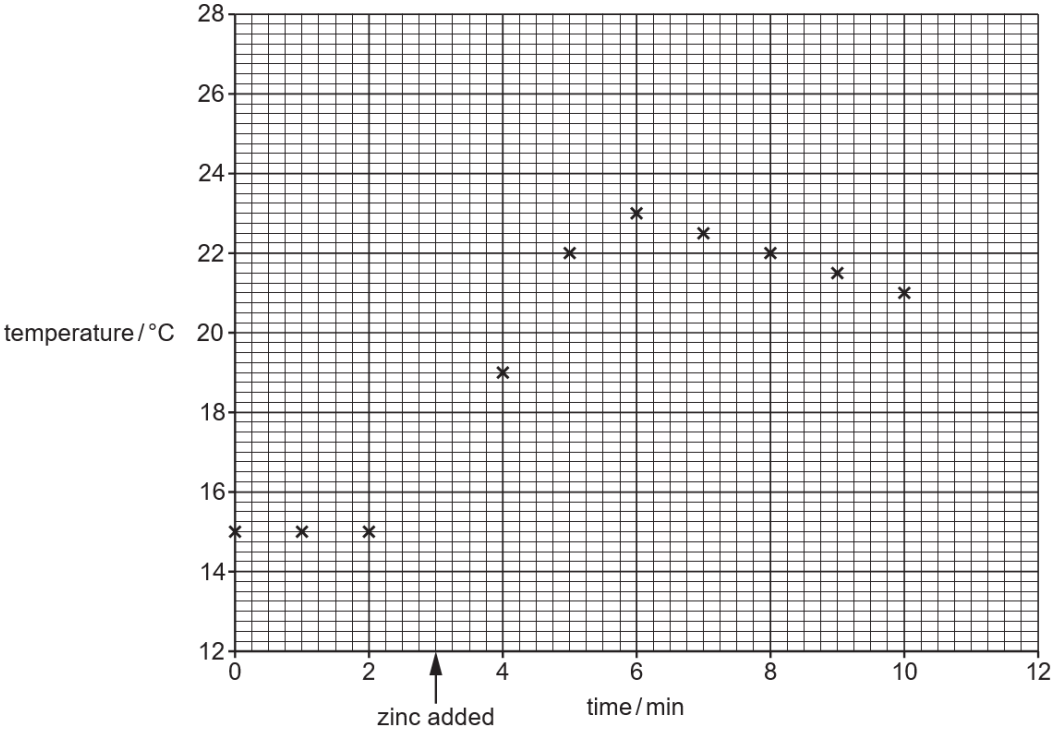
$Zn(s) + CuSO_4(aq, 0.2\,mol\,dm^{-3}) \rightarrow Cu(s) + ZnSO_4(aq)$

(i) The students are provided with powdered zinc metal and solid $CuSO_4 \cdot 5H_2O$ (M_r = 250).

They measure the temperature rise when 100 cm^3 (an excess) of 0.2 mol dm^{-3} copper sulfate is used.

Design a suitable method to investigate this exothermic reaction. **[5]**

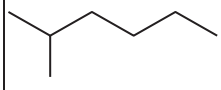
(b) (ii) The students repeat the experiment, measuring the temperature at different times. They plot the graph shown.



Use the graph to make an accurate measure of the temperature rise.
Show your working on the graph.

temperature rise =……....°C **[2]**

2 Some students are given samples of two liquid hydrocarbons, **B** and **C**, to test as fuels.

Fuel	Name	Skeletal formula	Molecular formula	Aliphatic or aromatic?	Saturated or unsaturated?
B	Cyclohexane				
C			C_7H_{16}		

(a) Complete the table above, filling the empty boxes. **[3]**

(b) **(i)** Calculate a value for the $\Delta_f H$ of fuel **C** using the data below.

$C_7H_{16}(l) + 11O_2(g) \rightarrow 7CO_2(g) + 8H_2O(l)$ $\Delta_c H = -4811\,kJ\,mol^{-1}$ fuel **C**

Compound	$\Delta_f H$ / kJ mol^{-1}
$CO_2(g)$	–394
$H_2O(l)$	–286

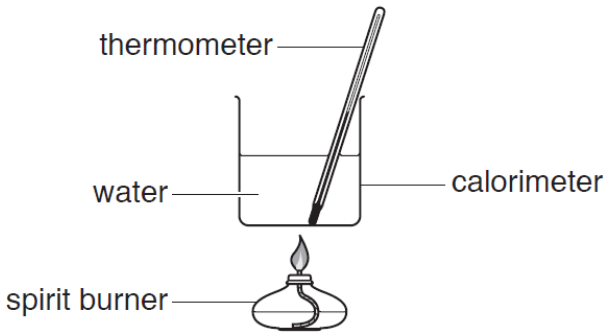
$\Delta_f H$ =.....kJ mol^{-1} **[2]**

(ii) A sample of a fuel produces 46 g of carbon dioxide when burned.

Calculate the volume (in cm^3) that this would occupy at 273 K and 150 kPa.Give your answer to an **appropriate** number of significant figures.

volume =.....cm^3 **[3]**

(c) The students burn the fuels **B** and **C** separately in the apparatus shown below. Their aim is to compare the energies produced on combustion.



(i) State the measurements that the students would make to calculate a value for the energy produced. Show how these measurements would be used to calculate this energy. **[2]**

(ii) State and explain **two** improvements that could be made to increase the accuracy of thecalculated value of the energy produced.

1 .....

2 .....

[4]

(d) Both the fuels would produce NO if used in a car engine.

Explain how NO is produced in a car engine. **[1]**

3 Ethene, C_2H_4, is the simplest alkene and has a wide variety of uses in industry, especially in making polymers.

Ethene is made by the catalytic cracking of longer hydrocarbons, such as those in light naphtha.

(a) Some students are given a supply of liquid light naphtha and they need to obtain some ethene from it. They use aluminium oxide as the catalyst.

(i) Draw a labelled diagram of a suitable apparatus that they could use. **[3]**

(ii) They test the gas by shaking it with some aqueous bromine.

Describe the colour **change** that they would see. **[1]**

(iii) Draw the mechanism for the reaction of ethene with Br_2.
Show curly arrows, full charges and the product. **[3]**

(b) Catalytic cracking uses a heterogeneous catalyst.

(i) State how catalysts work in terms of the activation enthalpy. **[1]**

(ii) The students research a simple model of the function of a heterogeneous catalyst.

Name the way the hydrocarbon molecules in light naphtha first attach to the catalyst surface. **[1]**

(c) Ethene can be converted to chloroethene, C_2H_3Cl.

(i) Draw the **skeletal** formula for chloroethene. **[1]**

(ii) A student says that chloroethene shows *cis-trans* isomerism.

Is the student correct? Explain your answer. **[1]**

Total Marks for Question Set 3: 38