## **Stage 2 Chemistry**

## **Birdwood**

HIGH SCHOOL **Topic 3: using and Controlling Reactions**

**Measuring Energy Changes, Calculations, Fuels**

**Review Paper 14**

**DUE DATE:** Ref: ESSENTIALS pages 125 – 138

**Question 1**

The *enthalpy of solution* of aluminium chloride, AlCl3, is –321 kJ mol-1.

a) Write a thermochemical equation for the enthalpy of solution of aluminium chloride.

A laboratory technician prepared a solution of aluminium chloride by dissolving 3.05 g in a

250.0 mL volumetric flask filled appropriately with distilled water.

b) Calculate the number of moles of aluminium chloride dissolved in the 250.0 mL of water.

c) Calculate the concentration of the aluminium chloride solution.

d) When 3.05 g of aluminium chloride is dissolved in the 250.0 mL of water, show that the theoretical

energy change expected, (ΔH), is approximately 7.34 kJ (to 3 sig figures).

e) Hence calculate the final temperature of the solution that could be expected, if the initial

temperature of the water was 20.00C.

[1.00 g of water requires 4.18 J to raise its temperature by 10C.]

f) Explain why in practice, this temperature will not actually be reached. (11 marks)

**Question 2**

|  |  |  |
| --- | --- | --- |
| **Fuel** | **ΔHcomb (kJ mol-1)** | **ΔHcomb (kJ g-1)** |
| methanol | -890 |  |
| butane | -2875 |  |
| ethanol | -1368 |  |
| ethyne | -1298 |  |

The table below shows some enthalpy of

combustion values for various fuels.

a) Give *two* reasons for the continued

use of fossil fuels.

b) Give *two* arguments against the continued use of fossil fuels.

c) Explain the term *energy density*.

d) Convert the **kJ mol-1** to **kJ g-1** for each fuel and so decide, on this basis alone, which is the best fuel, when sold on a mass basis.

e) Methanol is a liquid with a density of 0.54 g mL-1. Calculate the enthalpy of combustion for

methanol in kJL-1**.**

f) Ethyne burns in air with a smoky flame. Write an equation for the incomplete combustion of ethyne

given that the products are carbon monoxide, water and carbon.

(13 marks)

**Question 3**

Octane (C8H18), is a major constituent of petrol and releases 5464 kJ mol-1 of heat when completely burnt.

a) Write a thermochemical equation for the complete combustion of octane.

b) Calculate the heat energy released when 10L of octane is completely burnt. [Assume 1L octane = 1 kg]

c) Under strict laboratory conditions, a laboratory assistant used octane to boil 1L of water, initially at 200C.

Calculate the mass of octane required to boil the water (to 1000C).

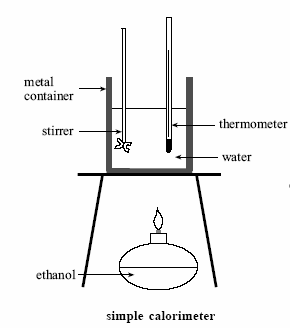
(Assume the specific heat of water to be 4.18 Jg-1C-1.)

d) In the internal combustion engines of cars, under certain conditions poisonous gases can be released

during the incomplete combustion of octane.

* 1. Name one of these poisonous gases.
  2. Under these conditions is *more* or *less* heat energy produced when compared to the complete combustion of octane?

(10 marks)



**Question 4**

The molar enthalpy of combustion of ethanol may be determined using calorimetry.

The energy released by combustion of a sample of ethanol was determined in an experiment using

a simple spirit burner calorimeter.

The results obtained are shown below:

Mass of ethanol burnt = 0.125 g

Mass of water in calorimeter = 250 g

Initial temperature of water = 17.0°C

Final temperature of water = 19.0°C

4.18 J of energy is needed to raise the temperature of

1.0 g of water by 1.0°C.

a) Calculate the energy, in kilojoules, absorbed by

the water.

b) Hence calculate the **molar enthalpy** of combustion of ethanol.

c) Describe **one main systematic error** in an experiment using a spirit burner that will lead to a value for

the molar enthalpy of ethanol that is much lower than the theoretical value.

d) Suggest **one improvement** that would increase the accuracy of the experiment.

(8 marks)

**TOTAL MARK = 42**