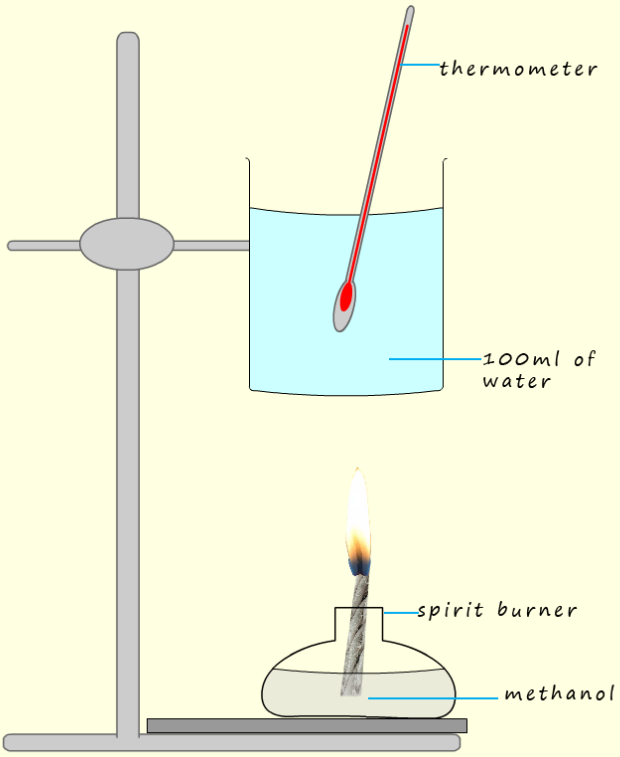
Answer all the questions below then check your answers.

1. A student set-up a simple calorimeter as shown opposite. She was burned 1.5g of methanol and recorded a temperature rise of 42°C.



a. What is the phrase specific heat capacity of a material mean?

b. What is the specific heat capacity of water?

c. The equation below is often used in calorimetry, what do each of the terms in this equation mean?

$$q = c \times m \times \Delta T$$

d. Methanol is a simple alcohol with the formula CH_3OH. Calculate its M_r.

e. When the student burned 1.5g of methanol the temperature of the water in the calorimeter shown rose by 42°C. Calculate the enthalpy change for this combustion reaction. Then calculate the enthalpy change for the combustion of 1 mole of methanol.

f. Suggest why the calculated enthalpy change is much less than the actual enthalpy change of methanol.

g. How could the student improve this experiment in order to obtain a more accurate result for the calculate enthalpy change?

2. During a combustion experiment 1.5g of ethanol (C_2H_5OH) raised the temperature of 250ml of water by 38 ^oC.

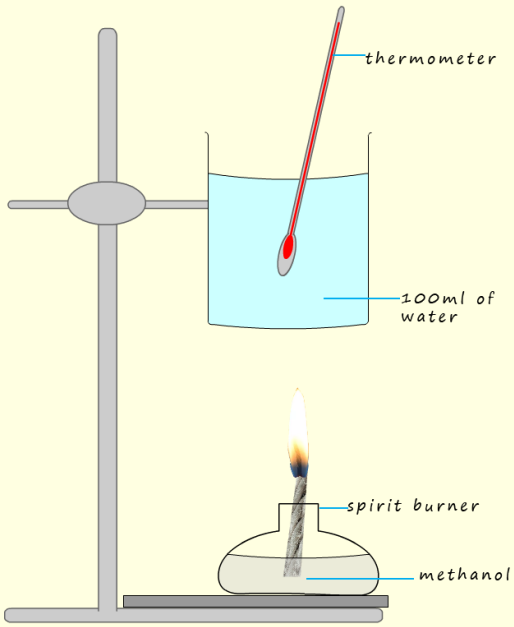
a. Calculate the enthalpy change for this reaction.

b. Calculate the molar enthalpy change for the combustion of ethanol.

Answers

Answer all the questions below then check your answers.

1. A student set-up a simple calorimeter as shown opposite. She was burned 1.5g of methanol in a spirit burner. This heated 100ml of water and recorded a temperature rise of 42°C.



a. What is the phrase specific heat capacity of a material mean?

The specific heat capacity of a material is the amount of energy needed to raise the temperature of 1Kg of the material by 1 degree Kelvin.

b. What is the specific heat capacity of water?

4.18 $kJkg^{-1}$ K^{-1}, 4.18 kilojoules per kilogram per degree Kelvin, using these units requires that the temperature be in Kelvin and the mass in kilograms.

c. The equation below is often used in calorimetry, what do each of the terms in this equation mean?

$$q=c \times m \times \Delta T$$

q= heat energy taken in by the water c= heat capacity

c= heat capacity m= mass of water being heated

ΔT = change in temperature

d. Methanol is a simple alcohol with the formula CH_3OH. Calculate its M_r.

(12 x1) + (1 x4) + 16 = 32

e. A student set-up a simple calorimeter as shown opposite. She was burned 1.5g of methanol in a spirit burner. This heated 100ml of water and recorded a temperature rise of 42°C.

$q=c \times m \times \Delta T$

= 4.18 x 0.1 x 42

= 17.56 kJ of heat energy per 1.5g of methanol.

Number of moles of methanol used:

$n= mass/M_r$

= 1.5/32

= 0.04(6875) mol of methanol. Best not to round down here to reduce errors for next calculation!

To get the molar enthalpy change use the formula:

ΔH = heat energy lost by 1.5g of methanol/ number of moles of methanol burned

= 17.56/0.04(6875)

= -374.61 kJ. The negative sign indicated the reaction is exothermic

f. Suggest why the calculated enthalpy change is much less than the actual enthalpy change of methanol. See below

g. How could the student improve this experiment in order to obtain a more accurate result for the calculate enthalpy change?

Main area of heat loss will be to the surrounding, the student should alter the set-up to reduce this by using:

- A heat shield around the burning methanol and beaker
- Use a fire resistant insulation around the beaker to reduce heat loss.
- Use a copper beaker rather than a glass one. Copper will transfer more heat to the water.
- Use a more efficient burner, spirit burners are not efficient, will cause lots of incomplete combustion. This is obvious due to the large amounts of soot that collect on the beaker.
- Make sure the beaker has lid to reduce heat loss by evaporation of water.
- Adjust the size of the wick to reduce evaporation of the methanol prior to combustion.

2. During a combustion experiment 1.5g of ethanol (C_2H_5OH) raised the temperature of 250ml of water by 38 ^oC.

a. Calculate the enthalpy change for this reaction.

$q=c \times m \times \Delta T$

$= 4.18 \times 0.25 \times 38$

$= 39.71$ kJ of heat energy per 1.5g of methanol.

b. Calculate the molar enthalpy change for the combustion of ethanol.

1 mole of ethanol = 46g

Number of moles of ethanol used

Number of moles of methanol used:

$n = mass/M_r$

= 1.5/46

= 0.0326 mol of methanol. Best not to round down here to reduce errors for next calculation!

ΔH = heat energy lost by 1.5g of ethanol/ number of moles of methanol burned

= 39.71/0.0326(6875)

= -1218 kJ. The negative sign indicated the reaction is exothermic