

5.1 Energetics

Question Paper

Course	DPIB Chemistry
Section	5. Energetics / Thermochemistry
Topic	5.1 Energetics
Difficulty	Easy

Time allowed: 50
Score: /35
Percentage: /100

Question 1a

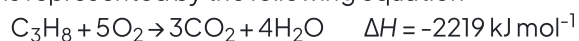
a)
Chemical reactions can be exothermic or endothermic. State which type of reaction is indicated by a decrease in temperature.

[1 mark]**Question 1b**

b)
State the type of reaction in which the energy of the system decreases.

[1 mark]**Question 1c**

c)
The reaction of propane with oxygen is represented by the following equation



State the classification of the enthalpy change is occurring in this reaction.

[1 mark]**Question 1d**

d)
Define the term enthalpy of formation, ΔH_f , and state the standard conditions.

[6 marks]

Question 2a

a)

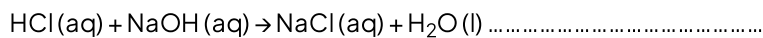
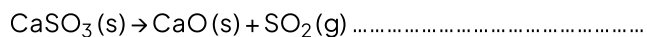
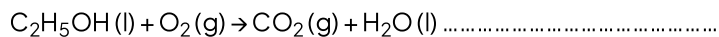
Define the term enthalpy change of reaction, ΔH_r .**[2 marks]**

Question 2b

b)

The equations below can be identified as any of the following enthalpy changes. Identify the enthalpy change for each reaction.

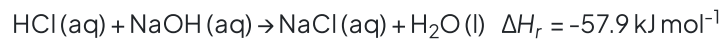
- Enthalpy of reaction, ΔH_r
- Enthalpy of formation, ΔH_f
- Enthalpy of combustion, ΔH_c
- Enthalpy of neutralisation, ΔH_{neut}

**[3 marks]**

Question 2c

c)

Hydrochloric acid, $\text{HCl}(\text{aq})$, and sodium hydroxide, $\text{NaOH}(\text{aq})$, react as follows



Determine the enthalpy change, in kJ, when 25 cm^3 of 0.5 mol dm^{-3} hydrochloric acid reacts with 25 cm^3 of 0.5 mol dm^{-3} sodium hydroxide. Give your answer to 2 decimal places.

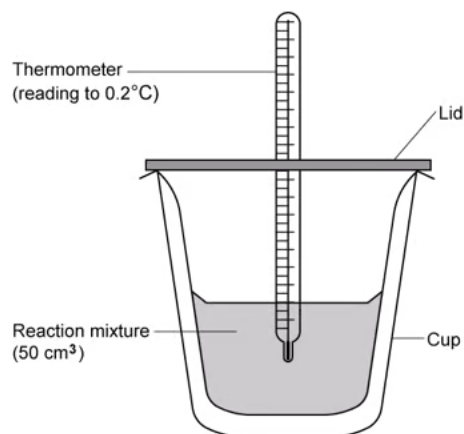
[2 marks]

Question 3a

a)

A student set up apparatus for a calorimetry experiment as shown below.

Suggest suitable materials for the lid and cup. Justify your answer.

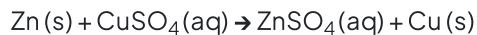


[3 marks]

Question 3b

b)

The student added excess zinc powder to the cup with 50.0 cm^3 of 1.0 mol dm^{-3} copper(II) sulfate solution in a calorimeter. The reaction equation was as follows:



The maximum temperature rise was $22.6 \text{ }^\circ\text{C}$. Using section 1 of the data booklet, determine the enthalpy of reaction, in kJ. Give your answer to 2 significant figures.

Calculate the energy change, q

Calculate the number of moles of copper(II) sulfate solution

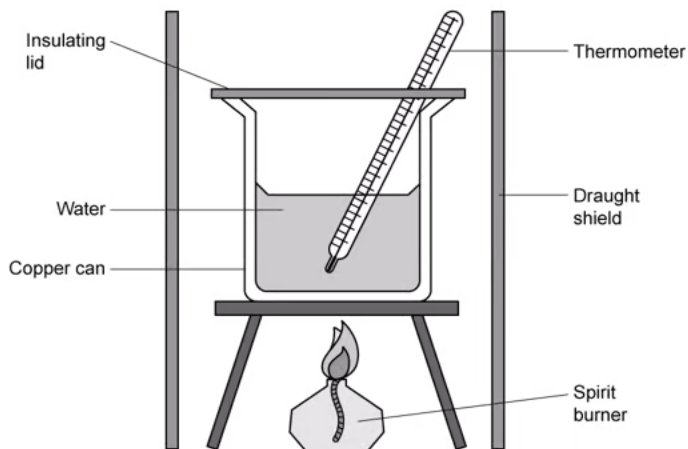
Calculate the enthalpy change of the reaction

[3 marks]

Question 3c

c)

Another calorimetry experiment was set up to determine the enthalpy of combustion for ethanol.



Define standard enthalpy of combustion, ΔH_c .

[2 marks]

Question 3d

d)
0.61 g of ethanol, C_2H_5OH , was burned in a spirit burner and used to heat 100 cm^3 of water in a copper calorimeter. The temperature of the water rose by $40\text{ }^\circ\text{C}$.

i)
Using section 1 and 2 in the data booklet determine the energy, in joules, for this reaction.

ii)
Convert your answer to part (i) into kilojoules.

[2 marks]

Question 3e

e)
Calculate the enthalpy change for the combustion of ethanol.

Determine the moles of ethanol

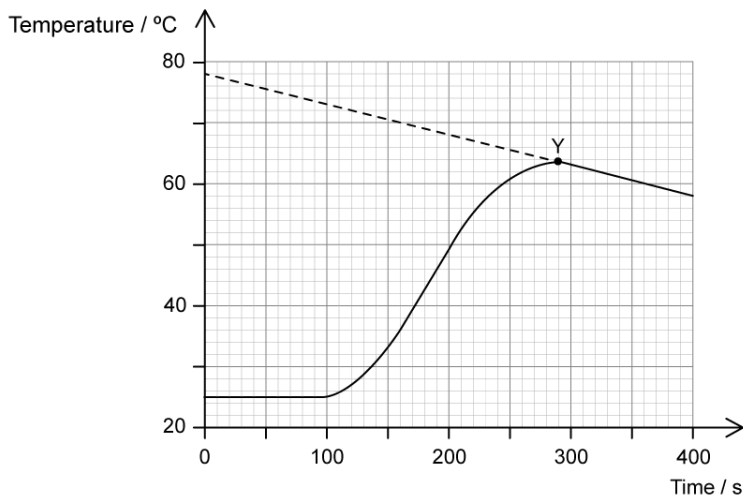
Determine the overall enthalpy change

[3 marks]

Question 4a

a)

4.00 g of powdered iron was reacted with 25.0 cm³ of 2.00 mol dm⁻³ copper(II) sulfate solution in an insulated beaker. Temperature was plotted against time.



Estimate the time at which the powdered iron was added to the beaker.

[1 mark]

Question 4b

b)

A student added point Y to the graph.

i)

State what point Y indicates on the graph.

ii)

Assuming there is no heat loss in the experiment and the heat change is instantaneous, using the graph, determine the total temperature change.

[3 marks]

Question 4c

c)

Explain why the student has recorded the temperature of the copper sulfate solution for a period of time before adding the iron powder.

[1 mark]**Question 4d**

The student used the equation $q = mc\Delta T$ to calculate the enthalpy change for the reaction that took place in the beaker. State the value that the student should use for m .

[1 mark]