

# Revision for SAC 1 Experimental comparisons and fuels.

## Part B

Show all working out in the space provided

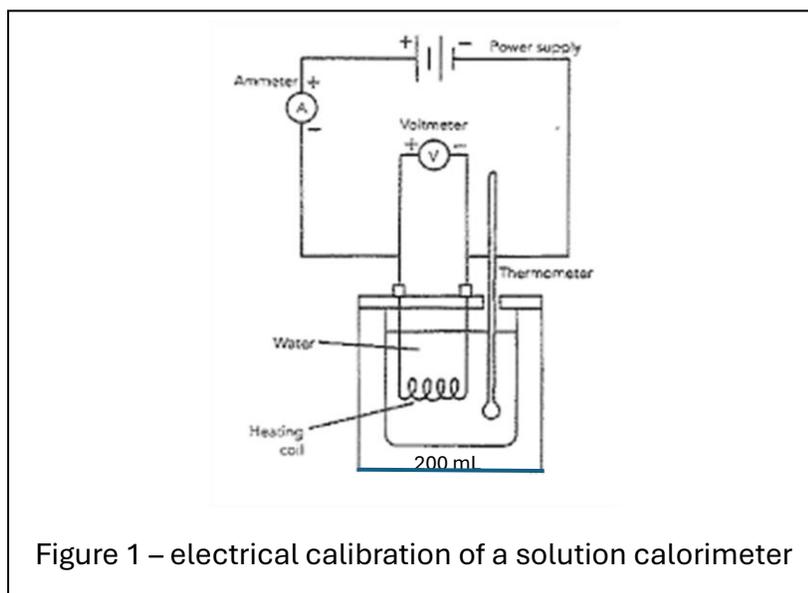


Figure 1 – electrical calibration of a solution calorimeter

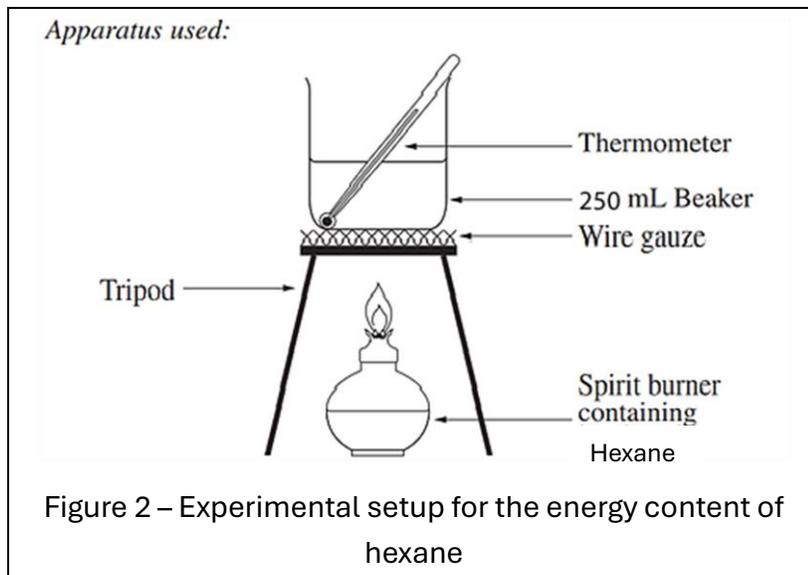
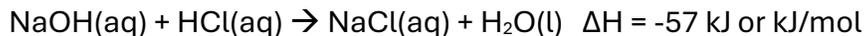


Figure 2 – Experimental setup for the energy content of hexane

The enthalpy of two different chemical reactions was determined using two methods listed below

- Experiment 1: A solution calorimeter (fig 1) was filled with 200 mL of water and calibrated and used to find the heat released during the neutralization reaction



- Experiment 2: A spirit burner heating water in an open beaker (fig 2) was used to calculate the molar heat of combustion of liquid hexane.

1. The solution calorimeter in fig. 1 was calibrated using a current of 5.00 amps at 6.00 V for 240 seconds. The temperature of the 200 mL of water increased by 7.5 °C.

- a. Calculate the calibration factor (CF), in kJ/°C, of the solution calorimeter. *2 marks*

b. Using the equipment shown in fig. 1, a student performed 5 trials and recorded the results in the table shown below.

Each trial consisted of mixing 100 mL of 0.1 M NaOH and 100 mL of 0.1 M HCl.

Trial	1	2	3	4	5
$\Delta H$ (kJ/mol)	-50	-51	-20	-51	-50

Circle the appropriate response that describes the results.

The results are: Accurate,                      repeatable,                      *1 mark*

c. Trial three shows a distinct deviation from the rest of results and is a major outlier. Three possible experimental errors were suggested by the students conducting the experiment. State how each one would impact on the final calculation of the  $\Delta H$  and identify the error that most likely caused the outlier.

i. The amount of water used in trial three was greater than 250 mL

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*2 marks*

ii. The amount of water used in trial three was less than 250 mL

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*2 marks*

iii. Instead of using 0.1 M solutions the student knowingly performed the experiment using 0.2 M NaOH and 0.2 M HCl and performed the necessary calculations accurately.

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*2 marks*



- ii. Write the balanced thermochemical equation for the complete combustion of hexane at SLC.

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- iii. Suggest one random error that could occur in the beaker experiment shown in fig 2 and indicate how this error would impact on the final calculations of the molar heat of combustion of hexane.

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\_\_\_\_\_ *2 marks*

- iv. Suggest one systematic error that could occur in the beaker experiment shown in fig 2 and indicate how this error would impact on the final calculations of the molar heat of combustion of hexane.

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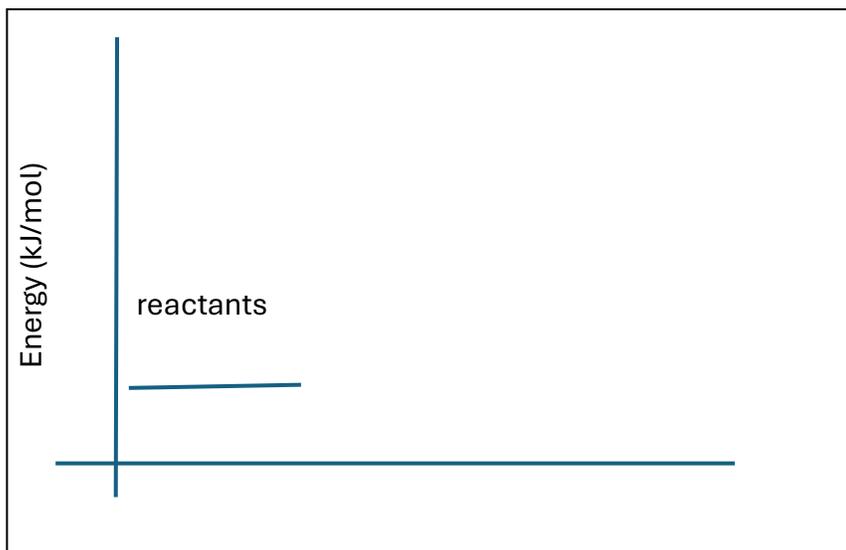
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\_\_\_\_\_ *2 marks*

- f. A group, using the same setup as shown in fig. 2 obtained a molar heat of combustion for hexane of  $\Delta H = -3980 \text{ kJ mol}^{-1}$
- On the set of axes shown below complete the energy profile for the complete combustion of hexane. For the purpose of this question the activation energy is given as  $1200 \text{ kJ mol}^{-1}$  and the energy of the reactants as  $1000 \text{ kJ/mol}$ .  
Label the following:
    - Energy released during bond formation
    - Energy level of products
    - Activation energy ( $E_a$ )
    - Enthalpy change ( $\Delta H$ )
    - Energy of the activated complex

5 marks



- Consider the reaction given below.  

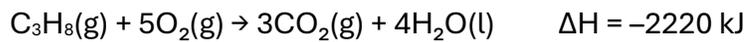
$$6\text{CO}_2(\text{g}) + 7\text{H}_2\text{O}(\text{l}) \rightarrow \text{C}_6\text{H}_{14}(\text{l}) + 9\frac{1}{2}\text{O}_2(\text{g})$$
 Using the energy profile determine the:
  - activation energy for the reaction

1 mark

- $\Delta H =$

2 marks

2. The thermochemical equation for the complete combustion of propane is given below



a. Determine the mass of  $\text{CO}_2$  produced if 456 kJ of energy is released during the combustion of propane *3 marks*

b. In another combustion reaction, 35.0 litres of propane was mixed with 190.0 litres of oxygen gas. The mixture was ignited and allowed to burn at SLC.

i. Which reactant is the limiting reactant? *2 marks*

ii. What is the volume of excess reactant remaining? *2.0 marks*

3. Biogas is a mixture of methane and carbon dioxide. It is produced via decomposition of organic matter buried in rubbish tips, as shown in fig 3.

a. Using Item 24 on page 24 of the 2026 Data Booklet, identify one United Nations Sustainable Development Goal (SDG) that is addressed by the capture of biogas from landfill sites.



Figure 3 – biogas capture from rubbish tip.

Your response must:

- State the SDG number and title.
- Explain how methane contributes to climate change if released to the atmosphere.
- Clearly link the capture and combustion of methane in biogas to the specific aim of the SDG you selected.

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*2 marks*

b. Does the use of biogas represent a circular economy? Explain.

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*2 marks*

4. Consider the two triglycerides shown in figures 4 and 5 below.

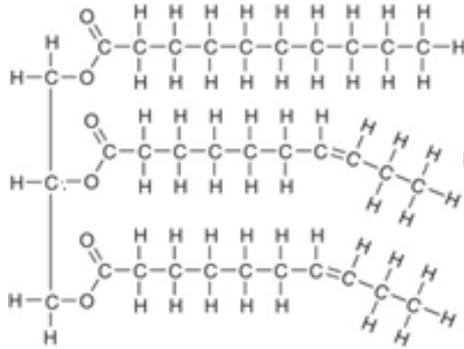


Figure 4- Triglyceride A

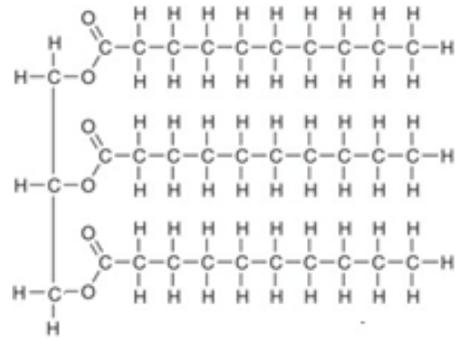


Figure 5- Triglyceride B

a. Name the functional groups visible in triglyceride A

\_\_\_\_\_  
\_\_\_\_\_ 2 marks

b. Which triglyceride will produce biodiesel with the lowest viscosity and lowest melting temperature? Justify your choice .

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\_\_\_\_\_ 4 marks