Revision for SAC 1 Experimental comparisons and fuels.

Show all working out in the space provided

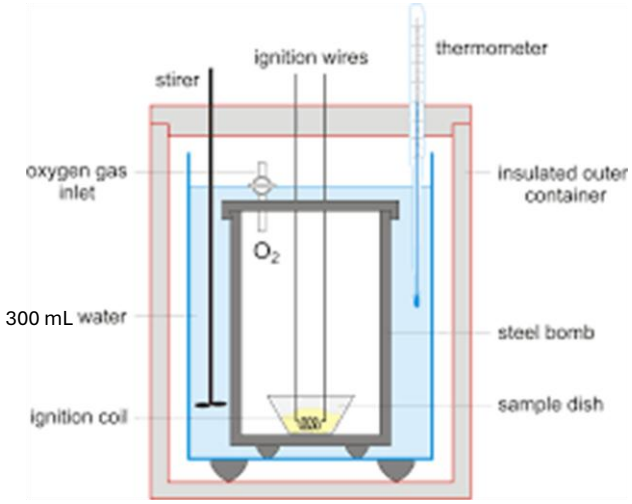

Figure 1 – bomb calorimeter

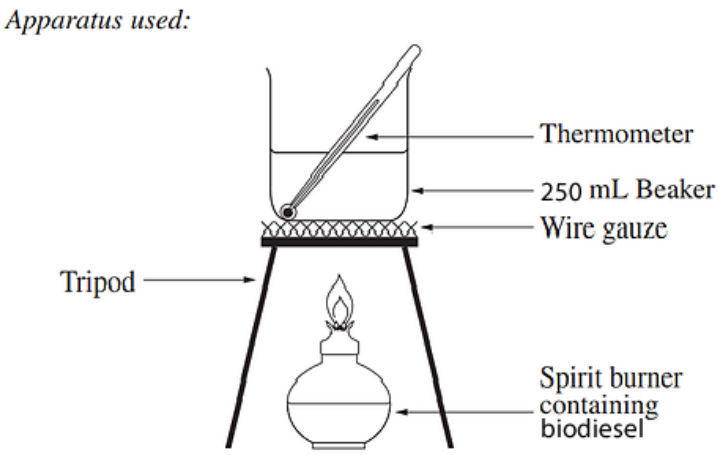

Figure 2 – experimental setup for the energy content of biodiesel

1. The energy content of a **pure** sample of biodiesel was investigated using two different methods as shown in fig. 1 and fig. 2, above.

a. The bomb calorimeter was calibrated via chemical means using the combustion of 1.600 grams of methanol as measured by an electronic balance. The temperature of the water increased from 19.0 °C to 46.0 °C.

i. Write a balanced thermochemical equation for the complete combustion of methanol at SLC.

_____ *3 marks*

ii. Calculate the amount of energy delivered by the combustion of 1.600 grams of methanol. *2 marks*

iii. Calculate the calibration factor (CF) of the bomb calorimeter in kJ/°C.

2 marks

b. Accurately calculate the energy content, in kJ/g, if the 2.534 grams of biodiesel, combusted in the bomb calorimeter, if the temperature of the water increased by 65 .0 °C *2 marks*

c. Compare the energy content of the biodiesel, calculated in question b. above with the literature value in your 2026 Data Book. Give a clear explanation of a possible error by the operators of the bomb calorimeter that would account for the discrepancy.

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_____*2 marks*

d. Figure 2. Shows the setup used to calculate the energy content of the biodiesel in the classroom. Heating took place for 2 minutes after which the temperature was immediately recorded. This time 1.534 grams of the biodiesel was combusted using a spirit burner to increase the temperature of 200 grams of water by 75.0 °C.

i. Calculate the energy content of the biodiesel in kJ/g *2 marks*

ii. Comment on the accuracy of your answer to question i, above and give a detailed explanation as to what may have caused the discrepancy.

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_____*2 marks*

iii. What is assumed when calculating the energy content of biodiesel using the apparatus in fig 2?

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_____*1 mark*

iv. Which method fig 1 or fig 2 provides results with the greatest validity? Give a clear and detailed explanation.

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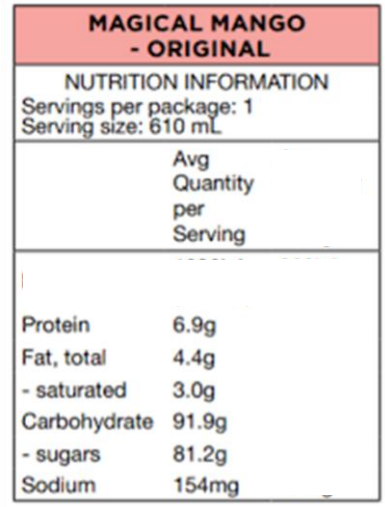
_____*3 marks*

2. Consider the food label in fig. 3 below.



MAGICAL MANGO - ORIGINAL	
NUTRITION INFORMATION Servings per package: 1 Serving size: 610 mL	
	Avg Quantity per Serving
Protein	6.9g
Fat, total	4.4g
- saturated	3.0g
Carbohydrate	91.9g
- sugars	81.2g
Sodium	154mg

Figure 3 Food label for a fruit drink

Given that the density of a fruit juice is 1.035 g/mL answer the following questions.

a. What is the mass in grams of an average serve? *2 marks*

b. What is the energy content, available to the consumer, of an average serve (610 ml) of fruit juice if an average serve contains 8 grams of fibre? *3 marks*

3. The same bomb calorimeter, as shown in fig. 1 above, was used to find the ΔH for the complete combustion of ethene (C_2H_4) in atmospheric oxygen (O_2)

A pure sample of 0.560 grams of ethene was placed in the bomb calorimeter and bunt at SLC. The temperature of the water increased by 21.1 °C.

a. Calculate the energy released in this combustion reaction in kJ

2 marks

b. Calculate the molar heat of combustion of ethene. *2 marks*

c. Write a balanced thermochemical equation for the combustion of ethene in pure oxygen gas at SLC.

_____ *3 marks*

d. A camping stove burns 56.00 grams of ethene to boil 3.00 L of water originally at 5.00 °C. Calculate the energy efficiency of the stove.

4 marks

4. Gaseous butane reacts with atmospheric oxygen in a complete combustion reaction at SLC according to the reaction below.

$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$ $\Delta H = -5760$ kJ/mol or kJ

4.80 litres of butane is mixed with 40.00 litres of oxygen gas and ignited.

a. After the reaction is complete, which reactant is in excess and by how much, in mol. *4 marks*

b. What is the total volume of gas remaining after the reaction is complete? *3 marks*

c. Calculate the amount of energy, in kJ, given out by the reaction as heat. *2 marks*

d. What is the mass of CO_2 gas, in kg, produced if 11.4 MJ of energy is released 2 marks