CH34 [1.2] - Energy Calculations _ Delta H - Test

Monday 2 December 2024 6:17 PM

CH34 [1.2] - Energy...

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VCE Chemistry ¾
Energy Calculations & Delta H [1.2]
Test

Results:

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Extension	________ / 5

Section A: Test (15 Marks)

INSTRUCTION: 15 Marks. 1 Minutes Reading. 12 Minutes Writing.

Question 1 (4 marks)

Tick whether the following statements are **true** or **false.**

	True	False
a. Ethanol releases more energy per gram than hydrogen.		
b. As the carbon chain length increases, the molar enthalpy of combustion also typically increases.		
c. Blended fuels' ΔH values may be determined in kJ/mol directly using the information provided in Item 14 of the databook.		
d. Petrol's density is 0.756 g/mL, based on the information in Item 14 of the databook.		
e. The heat of combustion of ethanol from Item 13 of the databook compared with that of bioethanol from Item 15 is significantly different.		
f. Using a spirit burner to determine the heat of combustion of a fuel is typically accurate.		
g. If a question provides a fuel's ΔH, and this fuel's enthalpy can also be found in the databook, the databook's one must be used as it is more accurate.		
h. The reaction, $2H_2O \rightarrow 2H_2 + O_2$ has a $\Delta H = +572\ kJ$.		

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Question 2 (5 marks)

A sample of propane is combusted in excess oxygen at standard conditions.

a. Write a balanced thermochemical equation for this reaction. (1 mark)

$C_3H_8 (g) + O_2 (g) \rightarrow CO_2 (g) + H_2O$ $\Delta H = -2220 kJ/mol$

b. If 5.70 MJ of energy is released by this reaction, find the mass of propane used, in g. (2 marks)

$n(C_3H_8) = \frac{q}{\Delta H} = \frac{5700 kJ}{2220 kJ/mol} =$ ____

$m(C_3H_8) = n \times M_r = 2.57 \times 44 =$ ____

c. Suppose the propane was instead burnt at 100° C, at which its heat of combustion is approximately $-2352\ kJ/mol$. How much less propane would be needed (in g) at this new temperature compared to in **part b.** to release the same amount of energy, 5.70 MJ? (2 marks)

$n = \frac{q}{\Delta H} = \frac{5700 kJ}{2352 kJ/mol} =$ ____

$m(C_3H_8) = n \times M_r =$ ____

$\Delta m = 113 - 106.6 =$ ____

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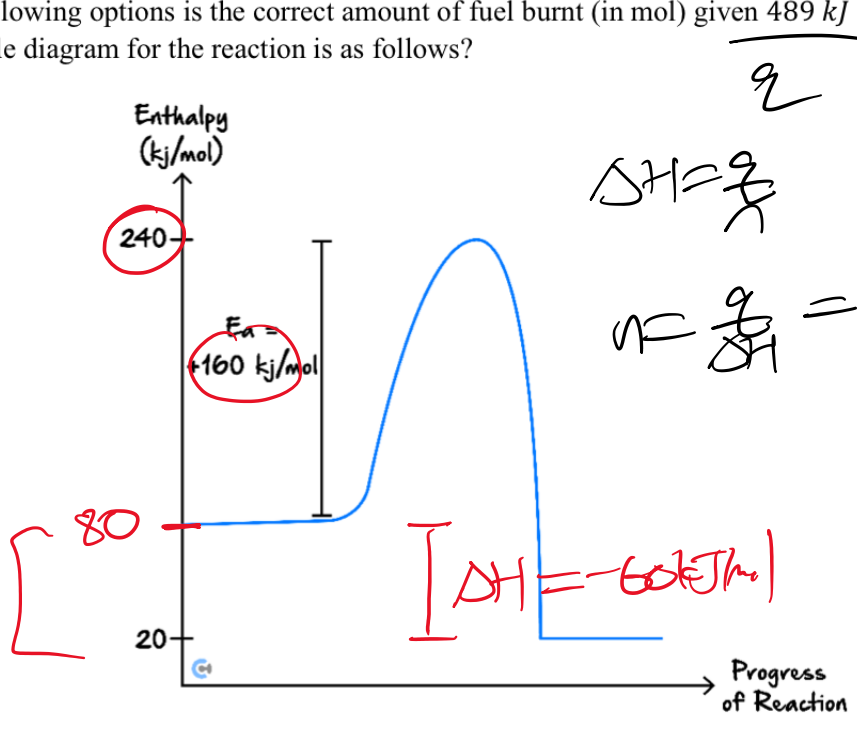
Question 3 (1 mark)

Which of the following options is the correct amount of fuel burnt (in mol) given 489 kJ of heat was released, and the energy profile diagram for the reaction is as follows?



$\Delta H = \frac{q}{n}$

$n = \frac{q}{\Delta H} = \frac{487}{60} = 8.15$

A. 3.03.

B. 8.15.

C. 24.5.

D. 2.22.

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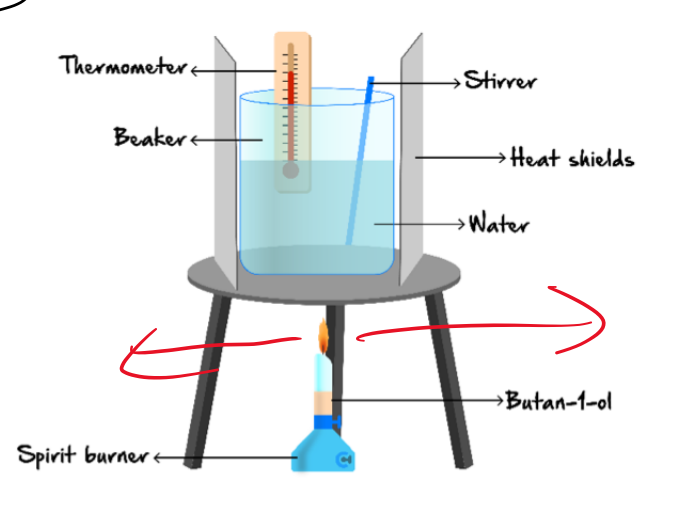
Question 4 (5 marks) $M_r = 74 g/mol$

The following set-up was observed in a high-school laboratory in which students aimed to determine the molar heat of combustion of butan-1-ol:



The students used the data they obtained (depicted in the table below) to perform their calculations.

You may use the information in this table in any part of the question.

Initial mass of spirit burner (g)	Final mass of spirit burner (g)	Initial temperature of the beaker (℃)	Final temperature of the beaker (℃)	Volume of water in the beaker
50.4	47.9	25.0	38.5	300 mL

a. Calculate the amount of fuel used, in mol. (1 mark)

$m(\text{butan-1-ol}) = 50.4g - 47.9g = 2.5g$ 2sf

$n(\text{butan-1-ol}) = \frac{m}{M_r} = \frac{2.5g}{74} = 0.034 mol$ (1)

b. Hence, calculate the experimental molar heat of combustion of butan-1-ol. (3 marks)

$q = mc\Delta T = 300 \times 4.18 \times (38.5 - 25) = 16929 J$ (1)

$\Delta H = \frac{q}{n} = \frac{16.929 kJ}{0.034 mol} = -501 kJ/mol$ (1)

(1) sign

$-5.0 \times 10^3 kJ/mol$

c. State one assumption that was made during the calculations performed in **part b.** (1 mark)

All energy was transferred from fuel to water

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Section B: Extension (5 Marks)

INSTRUCTION: 5 Marks. Y Minutes Reading. Z Minutes Writing.

Question 5 (5 marks)

You have been tasked with burning ethanol in a spirit burner to heat up water to determine how efficient the process is.

Given the density of ethanol is 0.789 g/mL, and 8.00 mL of ethanol raised the temperature of 250 g of water by 22.7℃, calculate the percentage of heat lost to the environment.

$m(C_2H_5OH) = dV = 0.789 g/mL \times 8 mL = 6.312g$

$n(C_2H_5OH) = \frac{m}{M_r} = \frac{6.312g}{46 g/mol} = 0.137 mol$

$q(\text{released}) = \Delta H \times n = 1370 \times 0.137 mol = 187.99 kJ$

$q(\text{absorbed}) = mc\Delta T = 250 \times 4.18 \times 22.7 = 23.72 kJ$

$q(\text{lost}) = 187.99 - 23.72 = 164.27 kJ$

$\% \text{energy loss} = \frac{164.27 kJ}{187.99 kJ} \times 100\% = 87.4\%$

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