

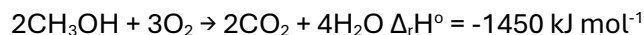
AS 91164 Demonstrate understanding of bonding, structure, properties and energy changes

Help Sheet for the Energy Calculations 2

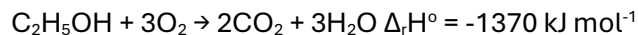
Questions involving calculations from equations e.g. questions that look like.....

2014: Methanol and ethanol can both be used as fuels. Their combustion reactions can be represented by the following equations:

Methanol combustion:



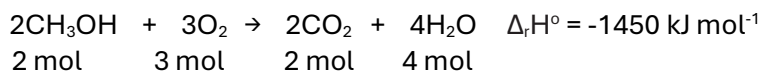
Ethanol combustion:



Justify which fuel, methanol or ethanol, will produce more heat energy when 345 g of each fuel is combusted in excess oxygen.

$$M(\text{CH}_3\text{OH}) = 32.0 \text{ g mol}^{-1} \quad M(\text{C}_2\text{H}_5\text{OH}) = 46.0 \text{ g mol}^{-1}$$

Method 1 – by using ratios.



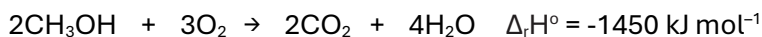
2 mol CH_3OH would have a mass of $32.0 \times 2 = 64.0 \text{ g}$

When 64.0 g (2 mol of methanol) burns, the energy released is 1450 kJ

When 345 g burns the energy released will be $345 / 64.0 \times 1450 = 7816 \text{ kJ}$ or 7820 kJ (3.s.f.)

Method 2 – by calculating moles.

$$n(\text{CH}_3\text{OH}) = m/M \quad n(\text{CH}_3\text{OH}) = 345 / 32.0 = 10.78 \text{ mol}$$



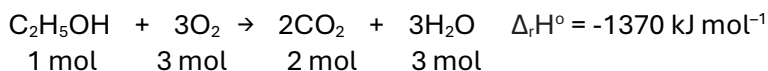
When 2 mol of methanol burns 1450 kJ of energy is released.

When 10.78 mol of methanol burns the energy released will be $10.78 / 2 \times 1450 = 7816 \text{ kJ}$ or 7820 kJ (3 s.f.)

Obviously to answer this question you also have to calculate the energy released by ethanol and compare the two alcohols.

Using Method 2 to calculate the energy released from 345 g of ethanol.

$$n(\text{C}_2\text{H}_5\text{OH}) = m / M \quad n(\text{C}_2\text{H}_5\text{OH}) = 345/46.0 = 7.50 \text{ mol}$$



When 1 mol of ethanol burns 1370 kJ of energy is released.

When 7.50 mol of ethanol burns the energy released will be $7.50 \times 1370 = 10275 \text{ kJ}$ or 10300 kJ (3 s.f.)

Therefore ethanol ($\text{C}_2\text{H}_5\text{OH}$) releases more energy when 345 g of the fuel is combusted.

$M(\text{CH}_3\text{OH}) = 32.0 \text{ g mol}^{-1}$ means that 1 mol of CH_3OH has a mass of 32.0g.

What happens if you are not given the $M(\text{CH}_3\text{OH})$?

If you had to calculate from the values on the periodic table you would use the molar masses...

1 H 1.0	6 C 12.0	8 O 16.0
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$$\text{C} \quad 3 \times \text{H} \quad \text{O} \quad \text{H}$$

$$12.0 + (3 \times 1.0) + 16.0 + 1.0 = 32.0$$

UNITS

$\Delta_r H^\circ = -1370 \text{ kJ mol}^{-1}$ has the units kJ mol^{-1} because it represents the enthalpy change per mol of reaction $\Delta_r H^\circ$. But if you are asked for the energy released or absorbed it's safer just to answer with x kJ absorbed or x kJ released.

Formula you MUST use to calculate moles (given on resource sheet)

$$n = m / M \quad n = m \div M$$

- n is the amount, in mol
 - m is the mass, in g
 - M is the molar mass, in g mol^{-1}
- BIG M is on the bottom!

When to use a sign and when not!

If the question asks for an enthalpy change, $\Delta H^\circ = \dots$ then you need a - sign if the reaction is exothermic. You can use a + for an endothermic reaction BUT absence of a sign implies a positive number.

If you are asked for energy released or energy absorbed then just answer with a number with units and description e.g.

1234 kJ of energy is released or 5678 kJ of energy is absorbed.

“-1234 kJ of energy is released” makes absolutely no sense at all!