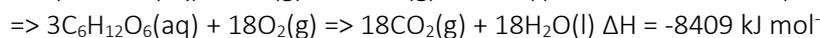
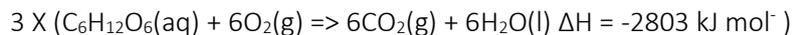
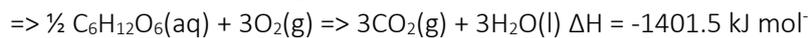
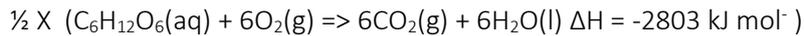
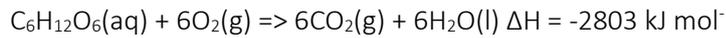


The ΔH

Lesson 1a.- What to do with the ΔH of thermochemical equations.

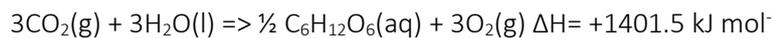
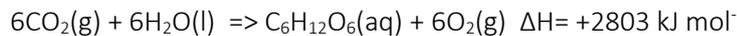
When multiplying the equation by X then multiply the ΔH by X as well (sign stays the same).

For example take the equation below of the combustion of glucose.



When flipping the equation, change the sign of the ΔH .

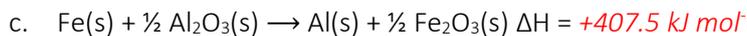
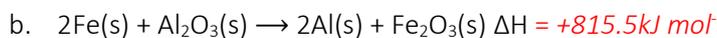
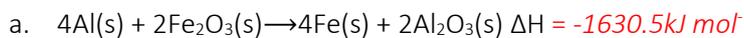
For example.



1. Consider the equation shown below of aluminium reacting with iron(III) oxide.



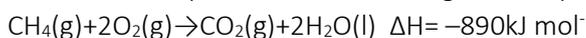
Give the ΔH for the following thermochemical equations.



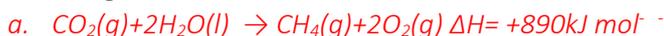
2. Fill in the boxes to complete the thermochemical equation below.



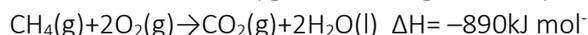
3. Consider the equation below showing the complete combustion of methane in oxygen gas.



Transform this equation to obtain balanced thermochemical equations that produce the following ΔH values.



4. Methane burns in oxygen according to the equation below.



a. What amount, in mol, of carbon dioxide gas is produced when 1780 kJ of energy is released during the complete combustion of methane .

Use the ratio shown on the right.

We are dealing with CO₂. So:

- Energy from the equation = 890

- Mol of CO₂ from the question = 1

- Energy given in the question = 1780 kJ

- Mol of CO₂ = ?

Putting the information in the ratio gives us the expression on the right.

Transpose to make mol of CO₂ the subject.

Mol of CO₂ = 2.00

$\frac{\text{Energy}(\text{from the equation})}{\text{Mol (from the equation)}}$	=	$\frac{\text{Energy}(\text{ Asked for or given in the question })}{\text{Mol (Asked for or given in the question)}}$
--	---	--

$\frac{890 \text{ kJ}}{1}$	=	$\frac{1780}{\text{Mol}_{\text{CO}_2}}$
----------------------------	---	---

Mol_{CO_2}	=	$\frac{1780 \times 1}{890 \text{ kJ}}$
----------------------------	---	--

b. What amount, in mol, of oxygen gas is used to produce 455 kJ of energy when methane is burnt in oxygen

Use the ratio shown on the right.

We are dealing with O₂. So:

- Energy from the equation = 890

- Mol of O₂ from the question = 2

- Energy given in the question = 455 kJ

- Mol of O₂ = ?

Putting the information in the ratio gives us the expression on the right.

Transpose to make mol of O₂ the subject.

Mol of O₂ = 1.02

$\frac{\text{Energy}(\text{from the equation})}{\text{Mol (from the equation)}}$	=	$\frac{\text{Energy}(\text{ Asked for or given in the question })}{\text{Mol (Asked for or given in the question)}}$
--	---	--

$\frac{890 \text{ kJ}}{2}$	=	$\frac{455}{\text{mol of O}_2}$
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Mol_{O_2}	=	$\frac{455 \times 2}{890 \text{ kJ}}$
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- c. What mass, in grams, of methane is needed to produce 1780 kJ of energy?

Use the ratio shown on the right.

We are dealing with CH₄. So:

- Energy from the equation = 890
- Mol of CH₄ from the question = 2
- Energy given in the question = 1780 kJ
- Mol of CH₄ = ?

Putting the information in the ratio gives us the expression on the right.

Transpose to make mol of CH₄ the subject.

Mol of CH₄ = 2.00

Mass of CH₄ = 2.00 X 16.0 = 32.0 grams.

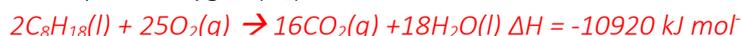
$\frac{\text{Energy (from the equation)}}{\text{Mol (from the equation)}} = \frac{\text{Energy (Asked for or given in the question)}}{\text{Mol (Asked for or given in the question)}}$

$\frac{890 \text{ kJ}}{1} = \frac{1780}{\text{mol of CH}_4}$
--

$\text{Mol CH}_4 = \frac{1780 \times 1}{890 \text{ kJ}}$
--

5. Consider the combustion of octane in atmospheric oxygen at SLC.

- a. Write the thermochemical equations for the complete combustion, at SLC, of octane in atmospheric oxygen (O₂). Include states.



The molar heat of combustion for octane is obtained from the data booklet.

It is given as 5460 kJ mol⁻¹. Since there are two moles of octane shown in the equation the ΔH is given as -10920 kJ mol⁻¹

- b. What volume, in litres, of CO₂ gas is produced if 80.0 megajoules of heat energy is delivered by the combustion octane in atmospheric oxygen? Express your answer to the right number of significant figures.

Use the ratio shown on the right to find the mol of CO₂ produced..

We are dealing with CO₂. So:

- Energy from the equation = 10920 kJ mol⁻¹
- Mol of CO₂ from the question = 16
- Energy given in the question = 80000 kJ
- Mol of CO₂ = ?

Putting the information in the ratio gives us the expression on the right.

Transpose to make mol of CO₂ the subject.

Mol of CO₂ = 117.2

Since the gas is at SLC (25°C and 100.0 kPa)

we can go straight to the data book and obtain the molar volume of an ideal gas as 24.8 L mol⁻¹

=> total volume of gas is 24.8 X 117.2 = 2.91 X 10³L

If you used the ideal gas equation you can also successfully obtain the answer albeit the longer way.

PV=nRT

=> V = 117.2 X 8.31 X 298 °K / 100.0 kPa = 2.90 X 10³L

The two values should be the same, however, since the molar volume of a gas at SLC is rounded up to 24.8 there may be a small discrepancy.

$\frac{\text{Energy (from the equation)}}{\text{Mol (from the equation)}} = \frac{\text{Energy (Asked for or given in the question)}}{\text{Mol (Asked for or given in the question)}}$

$\frac{10920 \text{ kJ}}{16} = \frac{80000 \text{ kJ}}{\text{mol of CO}_2}$

$\text{Mol}_{\text{CO}_2} = \frac{80000 \text{ kJ} \times 16}{10920 \text{ kJ}}$
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