

تلخيص المعادلات الكيميائية الحرارية



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ⇨ المناهج الإماراتية ⇨ الصف الحادي عشر المتقدم ⇨ كيمياء ⇨ الفصل الأول ⇨ ملفات متنوعة ⇨ الملف

تاريخ إضافة الملف على موقع المناهج: 2026-10-26 16:50:29

ملفات اكتب للمعلم اكتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل
منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي للمدرس

المزيد من مادة
كيمياء:

إعداد: Mouad

التواصل الاجتماعي بحسب الصف الحادي عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة كيمياء في الفصل الأول

تلخيص الدرس الأول الطاقة انسباير - Energy - 1 lesson 14 module inspire

1

أسئلة وزارية في الوحدة الأولى الطاقة والتغيرات الكيميائية

2

تلخيص الدرس الثاني الحرارة انسباير - 2 lesson 14 module heatinspire

3

تجميعية مراجعة صفحات الكتاب وفق الهيكل الوزاري نظام حديث ثلاثة مواد

4

حل مراجعة نهائية وفق الهيكل الوزاري الجديد منهج انسباير

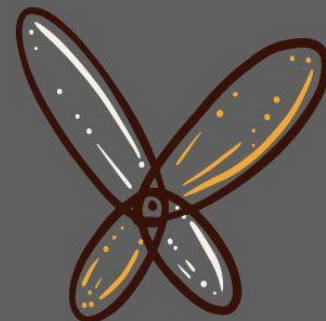
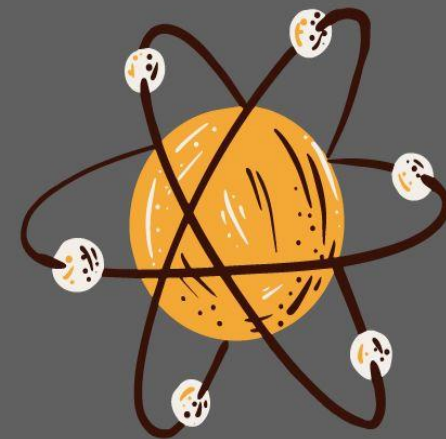
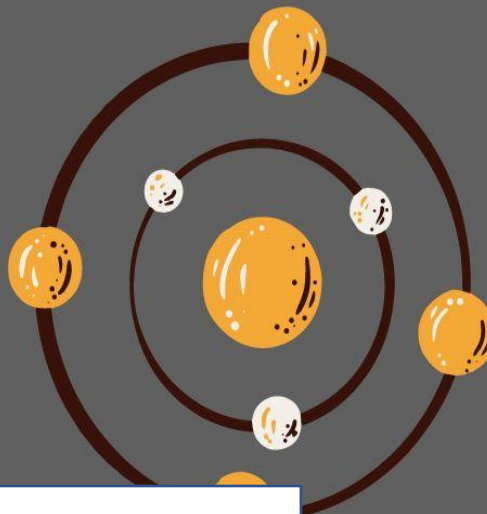
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CHEMISTRY



EasyChemistry4all by Mr. Mouad

مناهج دولة الإمارات

عام، متقدم ونخبة 9،10،11،12

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Inspire Chemistry

Module 14_Lesson 3: “Thermochemical Equations”

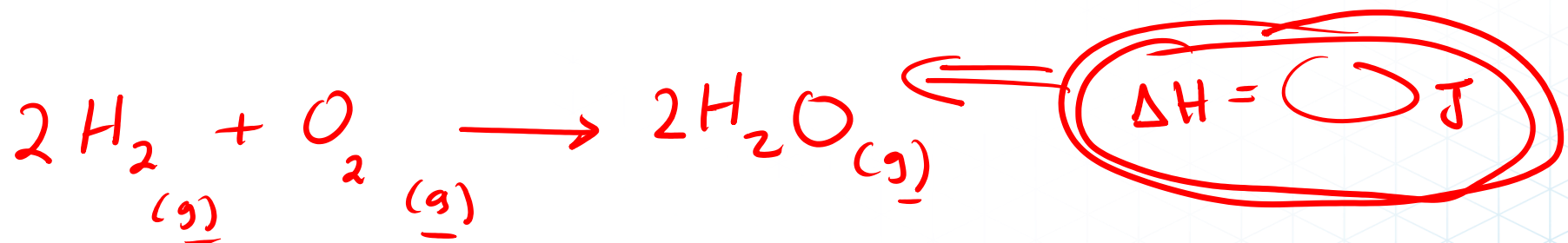
Learning Outcomes

After this lesson, I can:

- ▶ **Write** thermochemical equations for chemical reactions and other processes.
- ▶ **Describe** how energy is lost or gained during changes of state.
- ▶ **Calculate** the heat absorbed or released in a chemical reaction.

Focus Question

Why do you include energy changes in chemical equations?



$\Delta H +$ (endo)

$\Delta H -$ (exo)

New Vocabulary

- ✓ thermochemical equation
- ✓ enthalpy (heat) of combustion
- ✓ molar enthalpy (heat) of vaporization
- ✓ molar enthalpy (heat) of fusion

Review Vocabulary

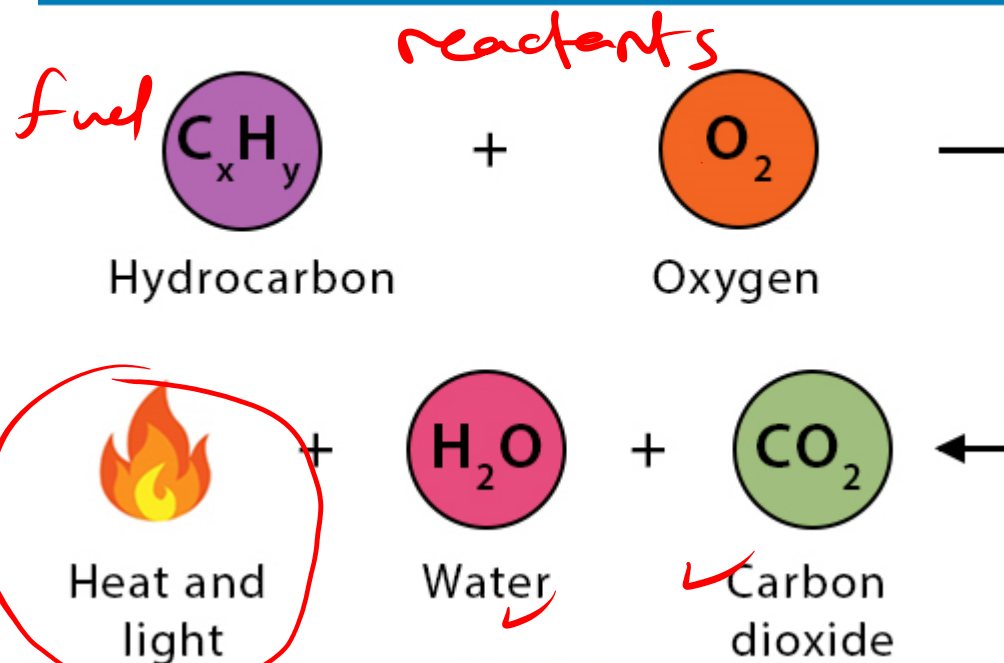
تفاعل الاحتراق

combustion reaction: a chemical reaction that occurs when a fuel substance reacts with oxygen, releasing energy in the form of heat and light

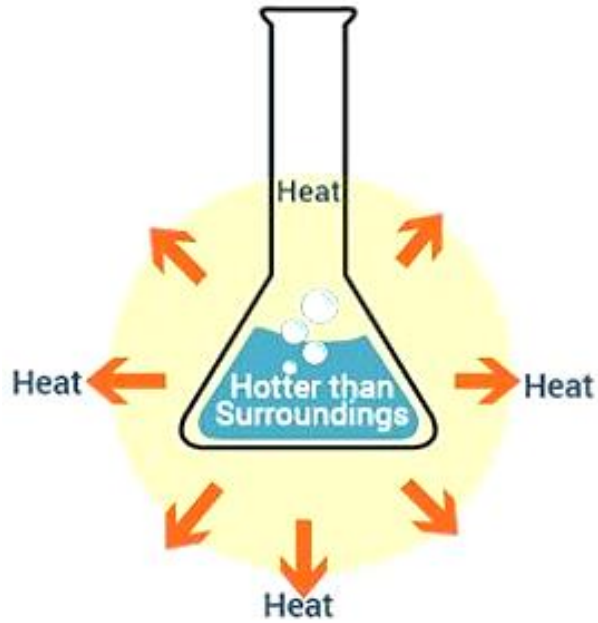
Combustion Reaction

Exothermic
 $\Delta H (-)$

Produce
heat
release
heat



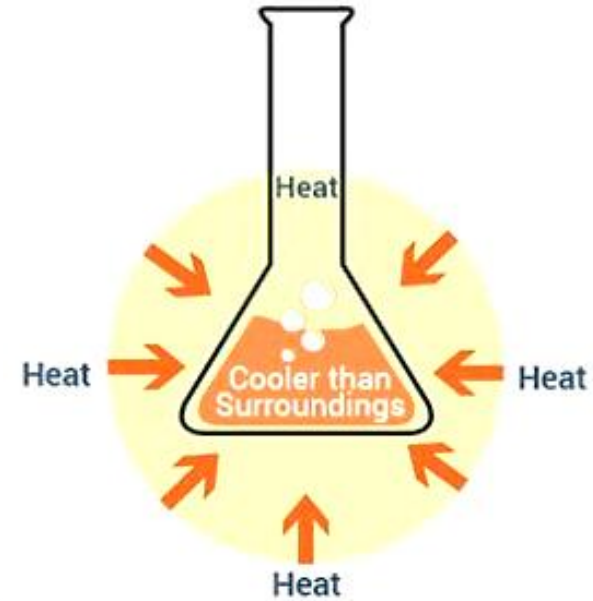
Remember Enthalpy change “ ΔH ”



Exothermic

-

ΔH



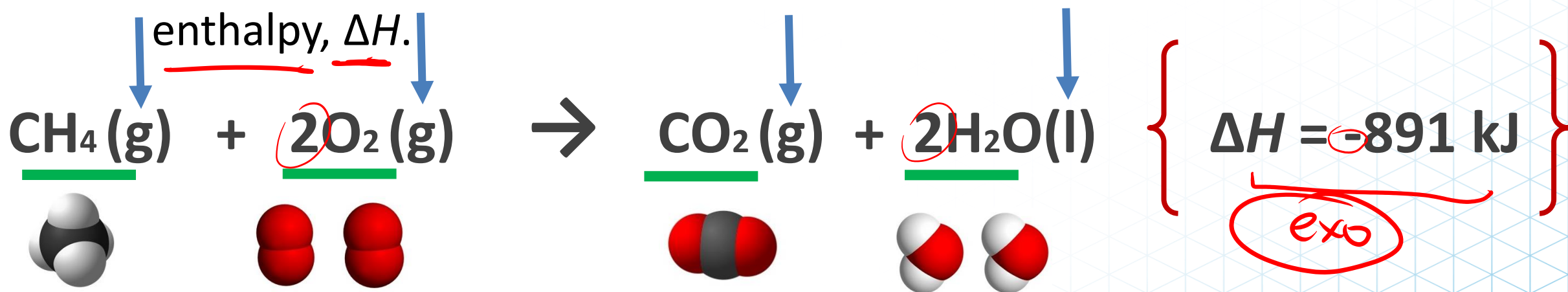
Endothermic

+

Writing Thermochemical Equations

- A **thermochemical equation** is a balanced chemical equation that includes the physical states of all reactants and products and the energy change.

- The energy change is usually expressed as the change in enthalpy, ΔH .



Lesson ②

$$\textcircled{1000 \text{ J}} = 1000 \text{ J}$$

Writing Thermochemical Equations



$$\underline{\Delta H = -1625 \text{ kJ}}$$



$$\Delta H = 27 \text{ kJ}$$

Quiz

1. Which of the following **is (are) included** in a *thermochemical equation*?

- A physical states of the reactants and products (s,l,g) ✓
- B a balanced chemical equation ✓
- C change in enthalpy (ΔH) ✓
- D All of the above.

Quiz

1. Which of the following **is (are) included** in a *thermochemical equation*?

- A physical states of the reactants and products (s,l,g)
- B a balanced chemical equation
- C change in enthalpy (ΔH)
- D All of the above.**

Writing Thermochemical Equations

- The **enthalpy (heat) of combustion** (ΔH_{comb}) of a substance is the enthalpy change for the complete burning of **one mole** of the substance.

ΔH_{comb} = ΔH for a combustion reaction
1 mol of a substance

1 mol

1 C₆H₁₂O₆ (s)

+

6O₂ (g)

→

6CO₂ (g) + 6H₂O(l)

$\Delta H_{\text{comb}} = -2808 \text{ kJ}$

combustion
reaction

-2808 kJ/mol

Writing Thermochemical Equations

- Standard enthalpies of combustion for several substances are given in Table 3 on the next slide.
- Standard enthalpy changes have the symbol ΔH° . The zero superscript indicates the changes were determined under standard conditions.

$T \neq 25^\circ\text{C}$

Writing Thermochemical Equations

ΔH

Exothermic

Substance	Formula	$\Delta H^\circ_{\text{comb}}$ (kJ/mol)
<u>Sucrose</u> (table sugar)	<u>$\text{C}_{12}\text{H}_{22}\text{O}_{11}(\text{s})$</u>	-5644
Octane (a component of gasoline)	$\text{C}_8\text{H}_{18}(\text{l})$	-5471
<u>Glucose</u> (a simple sugar found in fruit)	$\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$	-2808
Propane (a gaseous fuel)	$\text{C}_3\text{H}_8(\text{g})$	-2219
<u>Methane</u> (a gaseous fuel)	$\text{CH}_4(\text{g})$	-891

kJ/mol

2 mol

2 mol
 CH_4

$\Delta H = 2 \times -891$

The symbol "O" means: Standard state conditions : 298 K (25°C) ,
1 atm pressure

Quiz

2. Standard enthalpy changes have the symbol ΔH° . What component of the symbol indicates that the changes were determined with all the reactants and products at standard conditions (298 K (25°C) , 1 atm pressure)?

A the H

B the Δ

C the zero superscript " $^\circ$ "

D Nothing indicates this.

Quiz

2. Standard enthalpy changes have the symbol ΔH° . What component of the symbol indicates that the changes were determined with all the reactants and products at standard conditions (298 K (25°C) , 1 atm pressure)?

A the H

B the Δ

C the zero superscript " $^\circ$ "

D Nothing indicates this.

تغير الحالات الفيزيائية (Phase change) Changes of State

- Molar enthalpy (heat) of **fusion (الذوبان)** (ΔH_{fus}) is the heat required to melt **one mole** of a **solid**.

Fusion: Solid $\rightarrow$ Liquid

What is the $\Delta H_{\text{fus}}^{\circ}$ for ethanol?

4.94 kJ/mol

It means, you need 4.94 KJ (4940 J) of heat or energy to melt 1 mol of ethanol.

Table 4 Standard Enthalpies of Vaporization and Fusion

Substance	Formula	$\Delta H_{\text{vap}}^{\circ}$ (kJ/mol)	$\Delta H_{\text{fus}}^{\circ}$ (kJ/mol)
Water	H ₂ O	40.7	6.01
Ethanol	C ₂ H ₅ OH	38.6	4.94
Methanol	CH ₃ OH	35.2	3.22
Acetic acid	CH ₃ COOH	23.4	11.7
Ammonia	NH ₃	23.3	5.66

Changes of State (Phase change) تغير الحالات الفيزيائية

1 mol Solid

ΔT

liquid

- ↓ melting
- Molar enthalpy (heat) of fusion (الذوبان) (ΔH_{fus}) is the heat required to melt one mole of a solid.

Fusion: Solid $\rightarrow$ Liquid

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تغير الحالات الفيزيائية (Phase change) Changes of State

- **Molar enthalpy (heat) of vaporization (ΔH_{vap})** is the heat required to vaporize (evaporate تبخر) **one mole** of a **liquid**.

Vaporization: Liquid $\rightarrow$ Gas

Table 4 Standard Enthalpies of Vaporization and Fusion			
Substance	Formula	$\Delta H_{\text{vap}}^{\circ}$ (kJ/mol)	$\Delta H_{\text{fus}}^{\circ}$ (kJ/mol)
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Ammonia	NH ₃	23.3	5.66

What is the $\Delta H_{\text{vap}}^{\circ}$ for ethanol?

38.6 kJ/mol

It means, you need 38.6 KJ (38600 J) of heat or energy to evaporate 1 mol of ethanol.

تغير الحالات الفيزيائية (Phase change) Changes of State

liquid $\rightarrow$ gas

- Molar enthalpy (heat) of vaporization** (ΔH_{vap}) is the heat required to vaporize (evaporate تبخر) **one mole** of a **liquid**.

Vaporization: Liquid $\rightarrow$ Gas

$\Delta H^{\circ}_{\text{fus}}$
 $\Delta H^{\circ}_{\text{vap}}$

$\oplus$ **endothermic**

What is the $\Delta H^{\circ}_{\text{vap}}$ for ethanol?

Table 4 Standard Enthalpies of Vaporization and Fusion			
Substance	Formula	$\Delta H^{\circ}_{\text{vap}}$ (kJ/mol)	$\Delta H^{\circ}_{\text{fus}}$ (kJ/mol)
Water	H ₂ O	+ 40.7	+ 6.01
Ethanol $\rightarrow$	C ₂ H ₅ OH	+ 38.6	+ 4.94
Methanol	CH ₃ OH	35.2	3.22
Acetic acid	CH ₃ COOH	23.4	11.7
Ammonia	NH ₃	23.3	5.66

38.6 kJ/mol

It means, you need 38.6 KJ (38600 J) of heat or energy to evaporate 1 mol of ethanol.

2 mol ethanol $\Rightarrow 2 \times 38.6 \sim 77$

Changes of State

$$\Delta H_{\text{vap}} = -\Delta H_{\text{cond}}$$

Cond= condensation (التكثف)

Gas $\rightarrow$ Liquid

التكثف

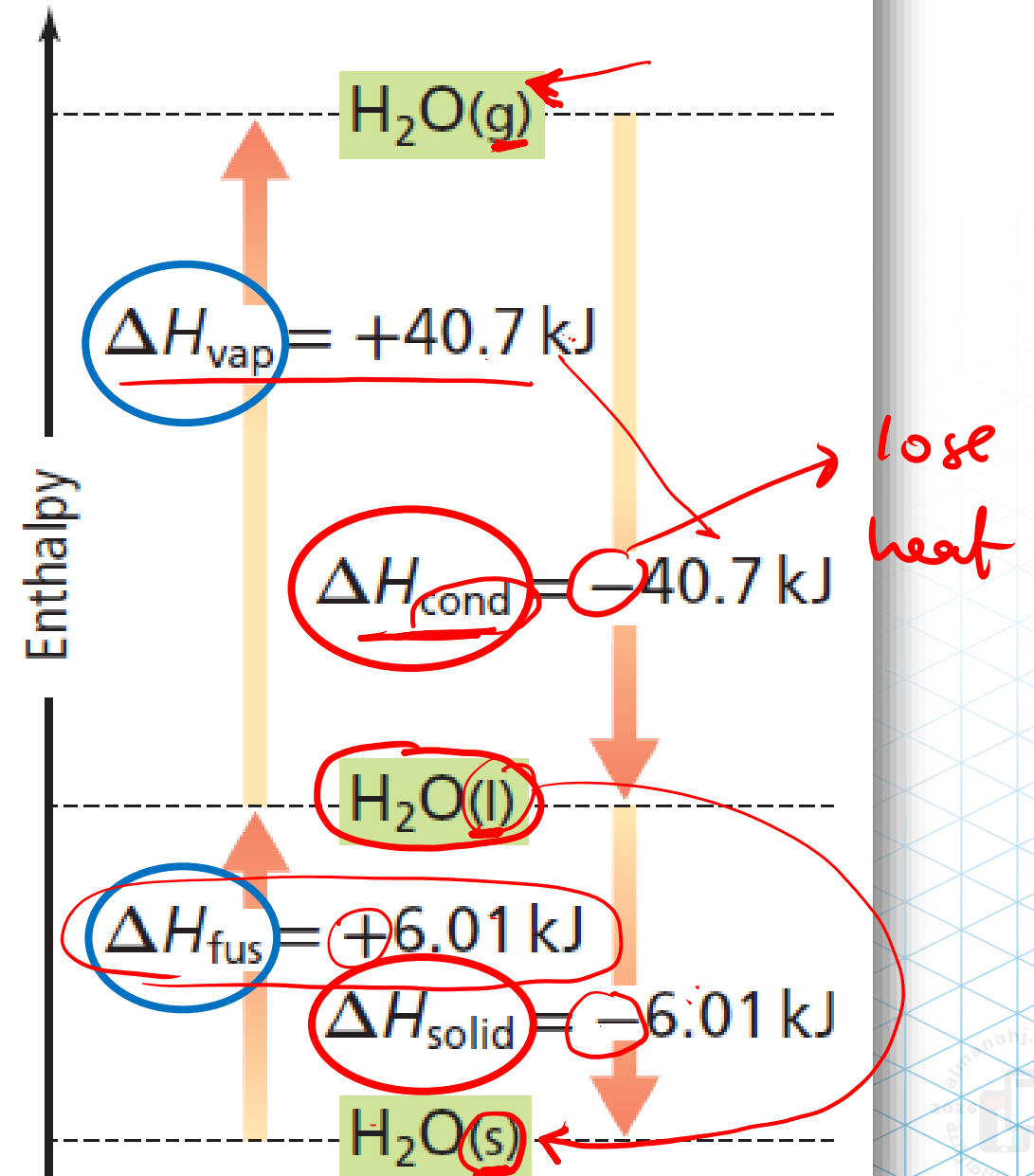
$$\Delta H_{\text{fus}} = -\Delta H_{\text{solid}}$$

Solid= freezing (التصلب أو التجمد)

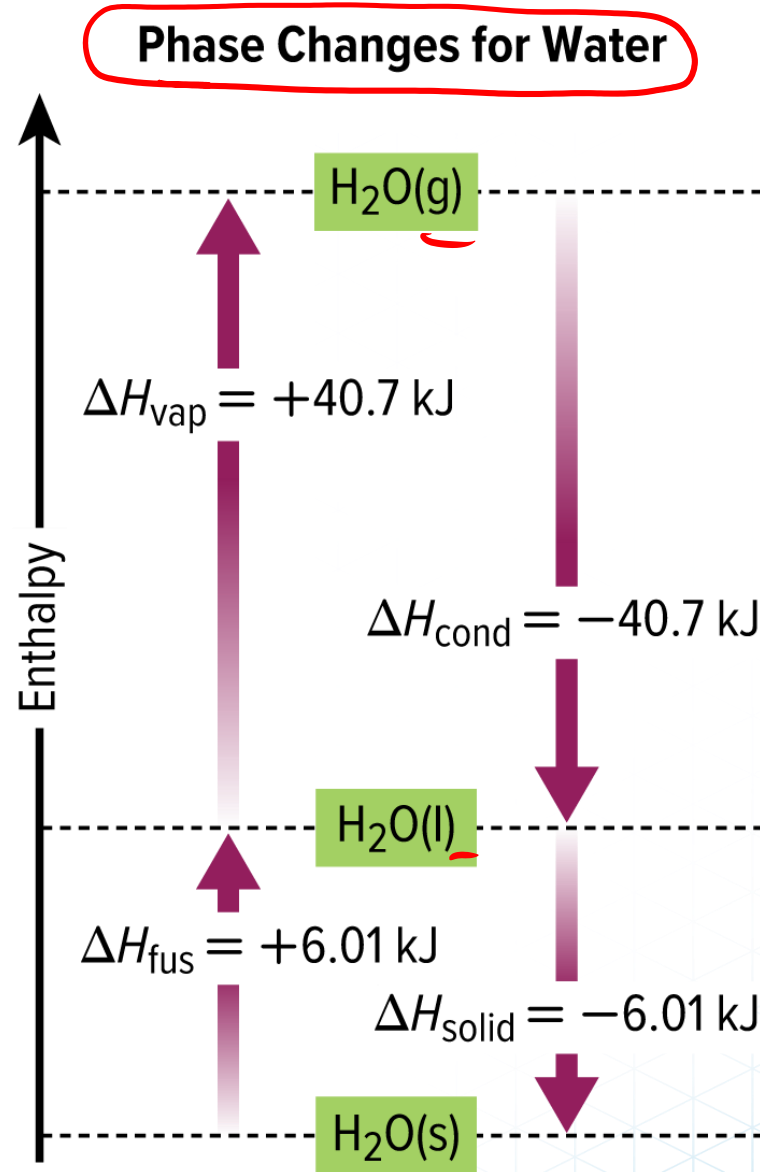
Liquid $\rightarrow$ Solid

التجمد

Phase Changes for Water



Changes of State



THE ENERGY RELEASED IN A REACTION

IN-CLASS EXAMPLE

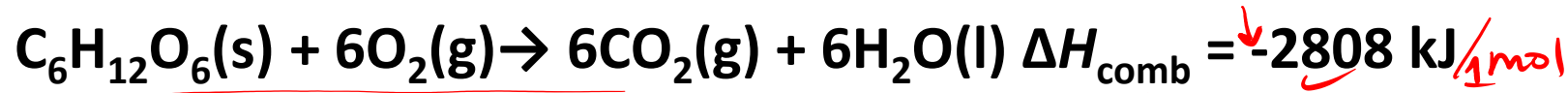
Use with Example Problem 4.

Problem

lesson 2

grams → Moles

A bomb calorimeter is useful for measuring the energy released in combustion reactions. The reaction is carried out in a constant-volume bomb with a high pressure of oxygen. How much heat is evolved when 54.0 g glucose ($C_6H_{12}O_6$) is burned according to this equation? ^{تكون}



KNOWN

✓ mass of glucose = 54.0 g $C_6H_{12}O_6$

ΔH_{comb} = -2808 kJ
1 mol

UNKNOWN

q = ? kJ

1 mol → 2808 kJ
54g → ? kJ

KNOWN

mass of glucose = 54.0 g $C_6H_{12}O_6$

$$\Delta H_{\text{comb}} = -2808 \text{ kJ}$$

UNKNOWN

$$q = ? \text{ kJ}$$

$$\text{Molar Mass} = 180 \text{ g/mol}$$
$$C_6H_{12}O_6$$

First, we need to change 54g into moles

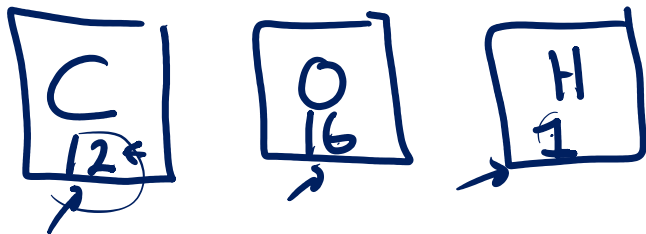
$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{54 \text{ g}}{180 \text{ g/mol}} = 0.3 \text{ mol } C_6H_{12}O_6$$

$$\begin{array}{ccc} 1 \text{ mol} & \xrightarrow{2808 \text{ kJ}} & \\ 0.3 \text{ mol} & \xrightarrow{??} & \end{array}$$

$$\frac{0.3 \times 2808}{1}$$

$$= -842.4 \text{ kJ}$$

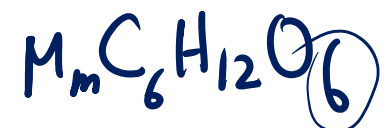
If you burn 54g $C_6H_{12}O_6$



$$M_m \text{C} = 12 \text{ g/mol}$$

$$M_m \text{O} = 16 \text{ g/mol}$$

$$M_m \text{H} = 1 \text{ g/mol}$$



$$= (6 \times 12) + (12 \times 1) + (6 \times 16)$$

$$= 180 \text{ g/mol}$$

known (given)

Unknown??

$$m_{\text{C}_6\text{H}_{12}\text{O}_6} = 54 \text{ g}$$

$$\Delta H_{\text{comb}} = -2808 \text{ kJ} \rightarrow 1 \text{ mol}$$

$$\begin{array}{r} 842 \\ 1000 \\ 300 \end{array}$$

$$1 \text{ mol} \rightarrow -2808 \text{ kJ}$$

$$\text{mass } 54 \text{ g} \rightarrow ?? \text{ kJ}$$

change it to moles

$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{54 \text{ g}}{180 \text{ g/mol}}$$

$$\text{Moles} = 0.3 \text{ mol}$$

$$1 \text{ mol} \rightarrow -2808 \text{ kJ}$$

$$0.3 \text{ mol} \rightarrow ??$$

$$\Delta H = 0.3 \times -2808 = -842 \text{ kJ}$$

$$\begin{array}{r} -842 \\ + 842 \end{array}$$

PRACTICE Problems

Ex

23. Calculate the heat required to melt 25.7 g of solid methanol at its melting point.

Use Table 4.

Molar Masses

C= 12g/mol

H= 1g/mol

O= 16 g/mol

Table 4 Standard Enthalpies of Vaporization and Fusion

Substance	Formula	$\Delta H_{\text{vap}}^{\circ}$ (kJ/mol)	$\Delta H_{\text{fus}}^{\circ}$ (kJ/mol)
Water	H ₂ O	40.7	6.01
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Methanol	CH ₃ OH	35.2	3.22
Acetic acid	CH ₃ COOH	23.4	11.7
Ammonia	NH ₃	23.3	5.66

PRACTICE Problems

Ex

23. Calculate the heat required to melt 25.7 g of solid methanol at its melting point.

Use Table 4.



$$(\Delta H_{\text{fus}}^\circ = 3.22 \text{ kJ/mol})$$

Molar Masses

C = 12g/mol
H = 1g/mol
O = 16 g/mol

known:-

$$m_{\text{CH}_3\text{OH}} = 25.7 \text{ g}$$

$$\Delta H_{\text{fus}}^\circ = 3.22 \text{ kJ/mol}$$

unknown
 $q = ??$

$$1 \text{ mol} \rightarrow 3.22 \text{ kJ}$$

$$25.7 \text{ g} \rightarrow ??$$

$\textcircled{1}$ change g $\rightarrow$ mol

$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{25.7}{32} = 0.803 \text{ mol}$$

$$q = 0.803 \times 3.22 \text{ kJ} = 2.586 \text{ kJ}$$

Table 4 Standard Enthalpies of Vaporization and Fusion

Substance	Formula	$\Delta H_{\text{vap}}^\circ$ (kJ/mol)	$\Delta H_{\text{fus}}^\circ$ (kJ/mol)
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Methanol	CH ₃ OH	35.2	3.22
Acetic acid	CH ₃ COOH	23.4	11.7
Ammonia	NH ₃	23.3	5.66

Handwritten calculations for Methanol: $(1 \times 12) + (4 \times 1) + (1 \times 16) = 12 + 4 + 16 = 32 \text{ g/mol}$

24. How much heat evolves when ^{mass} 275 g of ^{NH₃} ammonia gas condenses to a liquid at its boiling point? | Use Table 4 page 20 to find : $\Delta H_{\text{cond.}} = -\Delta H_{\text{vap}}$

$$MM_{\text{NH}_3} = 17 \text{ g/mol}$$

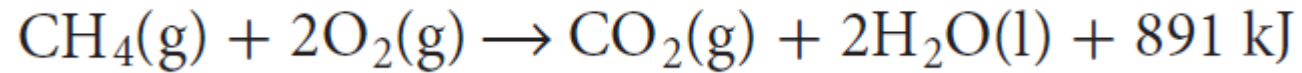
$$\uparrow -23.3 \text{ kJ/mol}$$

Table 4 Standard Enthalpies of Vaporization and Fusion

Substance	Formula	$\Delta H_{\text{vap}}^\circ$ (kJ/mol)	$\Delta H_{\text{fus}}^\circ$ (kJ/mol)
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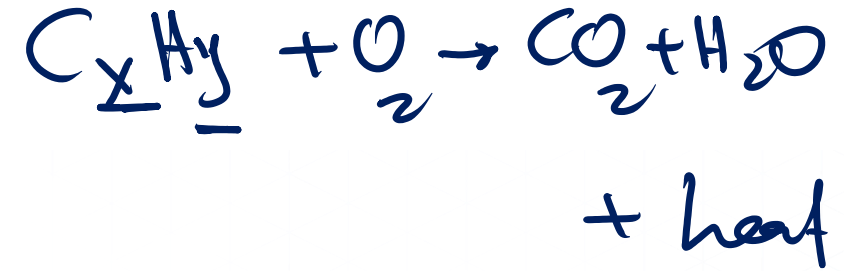
Combustion Reactions

- Combustion is the reaction of a fuel with oxygen.
- Food is the fuel in combustion reactions in biological systems.

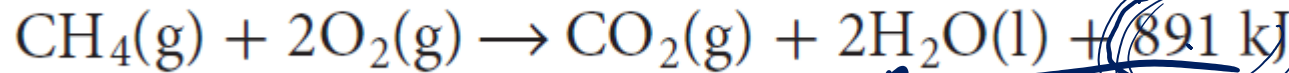
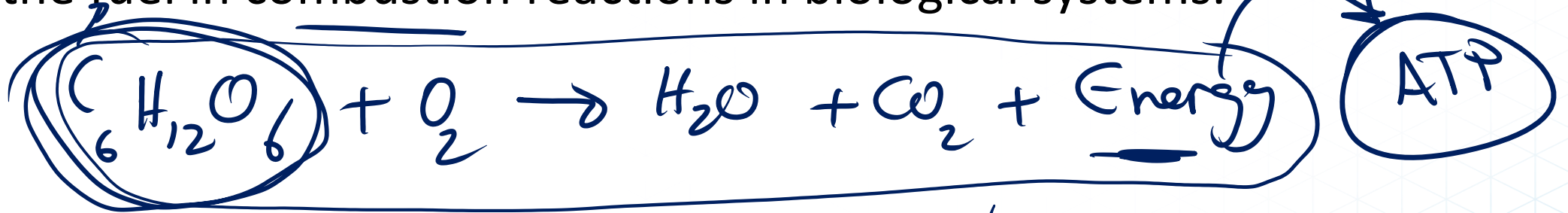


Combustion Reactions

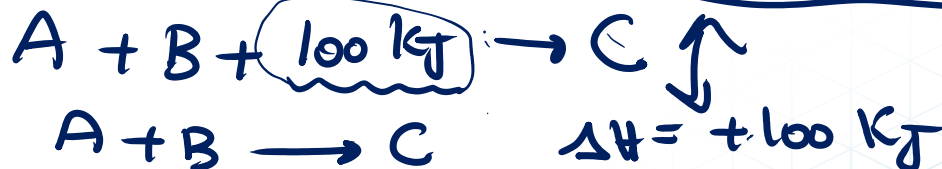
- Combustion is the reaction of a fuel with oxygen.



- Food is the fuel in combustion reactions in biological systems.



exothermic



Quiz

2. Standard enthalpy changes have the symbol ΔH° . What component of the symbol indicates that the changes were determined with all the reactants and products at standard conditions?

 the H

☒ the zero superscript

CORRECT

 the Δ

 Nothing indicates this.

Quiz

3. Which of the following has a positive change in enthalpy?

ΔH positive

 the combustion of glucose $\Delta H -$

✓  vaporizing water $\Delta H +$ (Table 4)
CORRECT

 condensing water $\Delta H (-)$

 freezing water $(\Delta H (-))$

Quiz

4. Which of the following is true for enthalpy of combustion?

 It is positive for glucose. 

 It is ^{$\Delta H(-)$} negative for propane.  **CORRECT**

 It measures the change in temperature that occurs. 

 None of the above. 

Learning Outcomes

After this lesson, I can:

- ▶ **Write** thermochemical equations for chemical reactions and other processes.
- ▶ **Describe** how energy is lost or gained during changes of state.
- ▶ **Calculate** ^② the heat absorbed or released in a chemical reaction.