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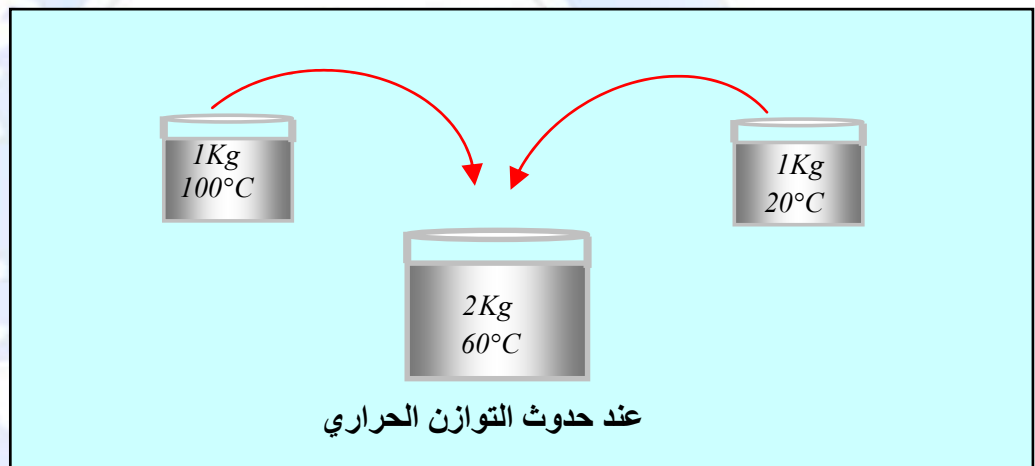
- يوظف حصيلة طاقوية كمية.
- يعرف بأن طاقة رابطة كيميائية بين الجزيئات أصغر بكثير أمام طاقة التماسك داخل الجزيئات



$$- \underline{1} \quad \underline{E_{th}} \quad - \underline{1}$$

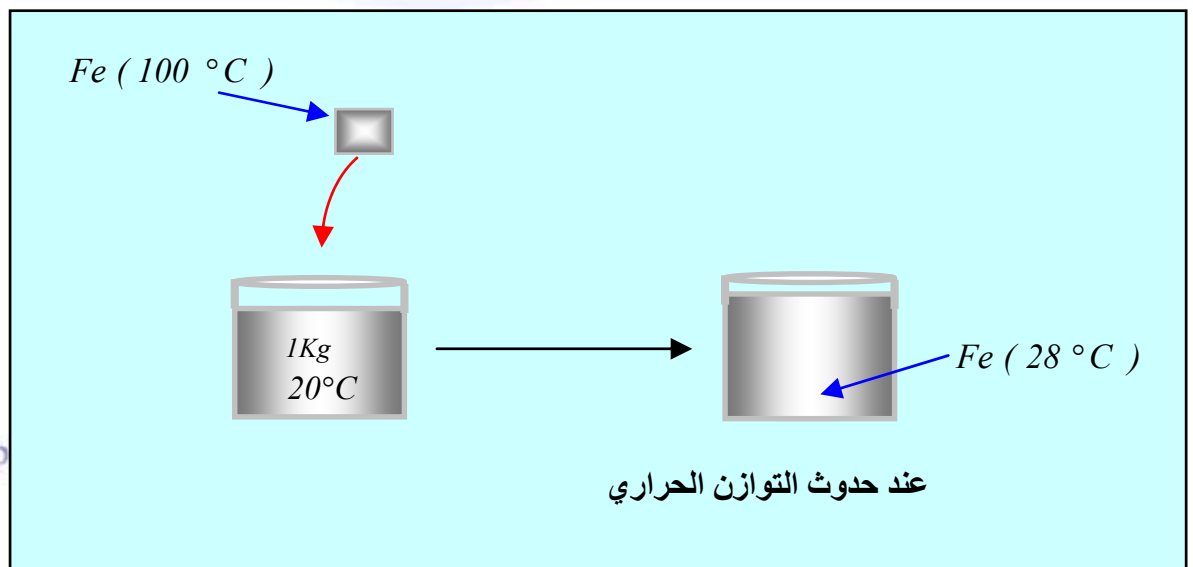
$$: \underline{1}$$

$20^{\circ}\text{C}$       1 Kg     $100^{\circ}\text{C}$       1Kg  
 $60^{\circ}\text{C}$       2 Kg



:2

$100^{\circ}\text{C}$     1 Kg    1 Kg     $20^{\circ}\text{C}$   
 $28^{\circ}\text{C}$



http

1: \_\_\_\_\_

100

60°C 20 60°C 20  
100°C 60 60°C 20

2: \_\_\_\_\_

1 Kg 28 °C 20 28 °C 100  
1 Kg 8 °C 1 Kg 72 °C  
9 :

كمية الحرارة اللازمة لرفع درجة حرارة مادة معينة بمقدار معين:  
- تتناسب مع كتلة الجسم  
- تتعلق بطبيعته الكيميائية.

2- \_\_\_\_\_ : ( )

الحرارة الكتلية لجسم صلب أو لسائل، هي كمية الحرارة اللازم تقديمها له لرفع درجة حرارة 1Kg منه بـ 1 °C. يرمز لها بـ ( c ) و وحدتها في جملة الوحدات الدولية هي Joule/ Kg. ° C

( c )

	c ( Joule/ Kg.°C)
	2100
	902
	506
	452
	385
	236
	129,5
	4185
	2424
	2058
	2100
	14420
	1867
	1039
	1000
	920

\_\_\_\_\_ - 3

( Q )  
 (                      )      ΔT      ( m )  
 :      ΔE<sub>th</sub>

$$\Delta E_{th} = Q = m.c.(T_f - T_i) = m.c.\Delta T$$

http:

جميع

\_\_\_\_\_ :

$$\mu = m . c :$$

Joule / Kg :

:

$$\Delta E_{th} = Q = \mu . (T_f - T_i) = \mu . \Delta T$$

**Pb** : **1** \_\_\_\_\_

\_\_\_\_\_ :

( c )

\_\_\_\_\_ :

$$\mu = 246,5 \text{ J/ kg}$$

( Pb ) \_\_\_\_\_

\_\_\_\_\_ :

$\mu$

M

Ti

m

T<sub>1</sub>

T<sub>f</sub>

\_\_\_\_\_ :

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T<sub>1</sub> = 86°C <http://www.onefd.edu.dz>

m = 255 g  جميع الحقوق محفوظة

m<sub>1</sub> = 1860°C

$$. m_2 = 2060 \text{ g}$$

$$. M = m_2 - m_1 = 200 \text{ g}$$

$$. T_i = 19,7 \text{ }^\circ\text{C}$$

$$. T_f = 21,1 \text{ }^\circ\text{C}$$

:

$$\underbrace{\mu (\theta_f - \theta_i) + M . C_e (\theta_f - \theta_i) + m . C_{Pb} (\theta_f - \theta_i)}_{\text{التحويل الطاقي الذي يحدث للماء و المسعر}} = 0$$

$$5(21,1 - 19,7) + 200.10^{-3} \cdot 4185(21,1 - 19,7) + 255.10^{-3} . C_{Pb} (21,1 - 86) = 0$$

c (joule/ Kg.°C)	902	452	129,5
------------------	-----	-----	-------

$$C_{Pb} = 127 \text{ J / kg.K}$$

129,5 J/ :

. Kg.K

:2

:

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(... )

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- 3

\_\_\_\_\_ :

22,5 °C : - 1

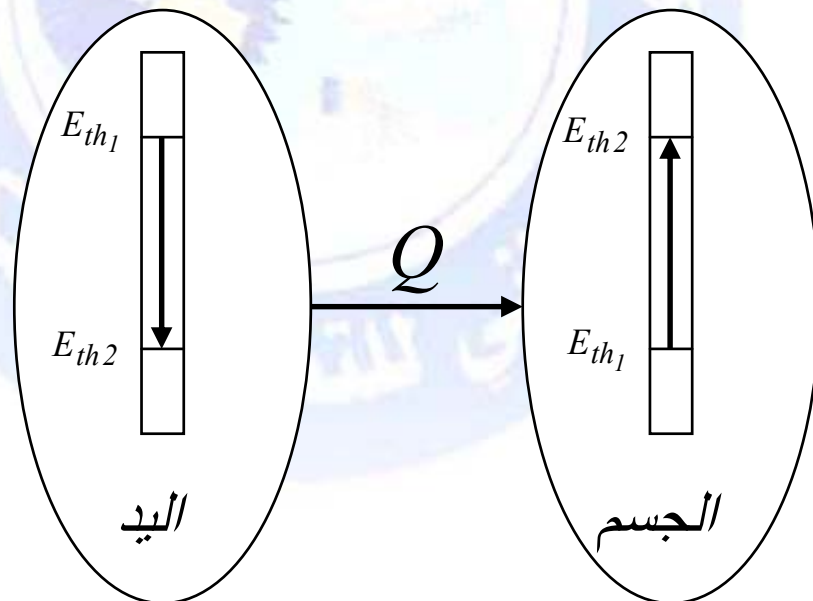
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: - 3

\_\_\_\_\_ :

37 °C

22,5 °C



: ( )

$$\Delta E = E_2 - E_1 = \sum \Delta E_c + \sum \Delta E_p + \sum \Delta E_i = \sum Q + \sum W_m + \sum W_e + \sum E_r$$

$$\Delta E = E_2 - E_1 = 0 + 0 + \sum \Delta E_i = \sum Q + 0 + 0 + 0$$

$$\sum \Delta E_i = \sum Q \Rightarrow [E_{th_2} - E_{th_1}]_{يَد} = Q$$

: ( )

$$E = E_2 - E_1 = \sum \Delta E_c + \sum \Delta E_p + \sum \Delta E_i = \sum Q + \sum W_m + \sum W_e + \sum E_r$$

$$\Delta E = E_2 - E_1 = 0 + 0 + \sum \Delta E_i = \sum Q + 0 + 0 + 0$$

$$\sum \Delta E_i = \sum Q \Rightarrow [E_{th_2} - E_{th_1}]_{جسم} = Q$$

( Q )

$$Q_{يَد} = Q_{جسم} \Rightarrow Q_{يَد} = m_{جسم} \times c_{جسم} \times \Delta T$$

:  $\Delta T = 1^\circ C$   $m = 1 \text{ kg}$

$$Q_{يَد} = m_{Al} \times c_{Al} \times \Delta T = 902 \text{ Joule}$$

\_\_\_\_\_

$$Q_{يَد} = m_{Fe} \times c_{Fe} \times \Delta T = 452 \text{ Joule}$$

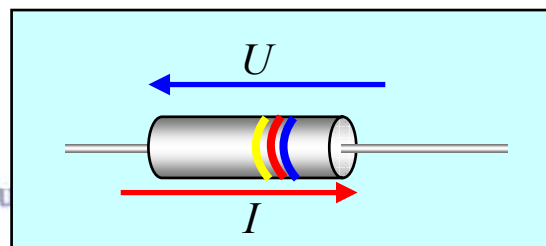
: \_\_\_\_\_

$$Q_{يَد} = m_{Pb} \times c_{Pb} \times \Delta T = 129,5 \text{ Joule}$$

: \_\_\_\_\_

( c )

أثناء لمس المواد، تتحسس اليد للحرارة التي تفقدها و ليس لدرجة حرارة المواد الملموسة





( We )

$$We = U . I . t = R . I^2 . t$$

.Ω

R

. Ampère

I

.seconde

T

U

:\_\_\_\_\_

10

I = 1,5 A

R = 1 KΩ

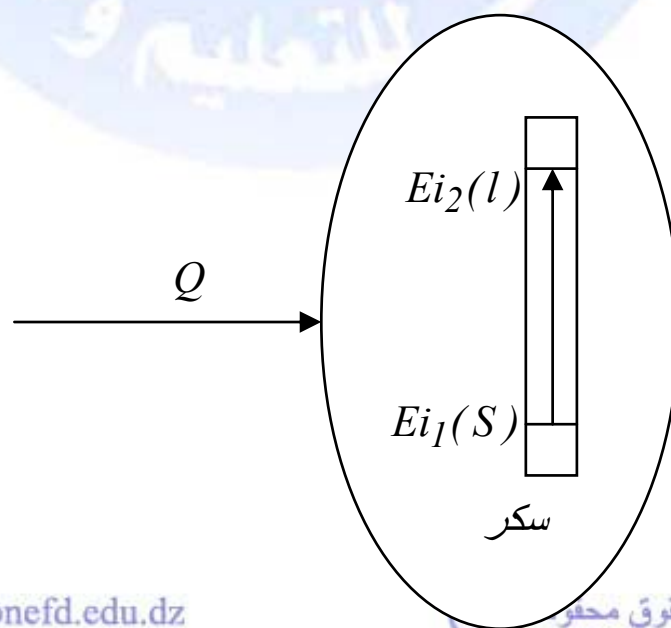
:\_\_\_\_\_

$$We = R . I^2 . t$$

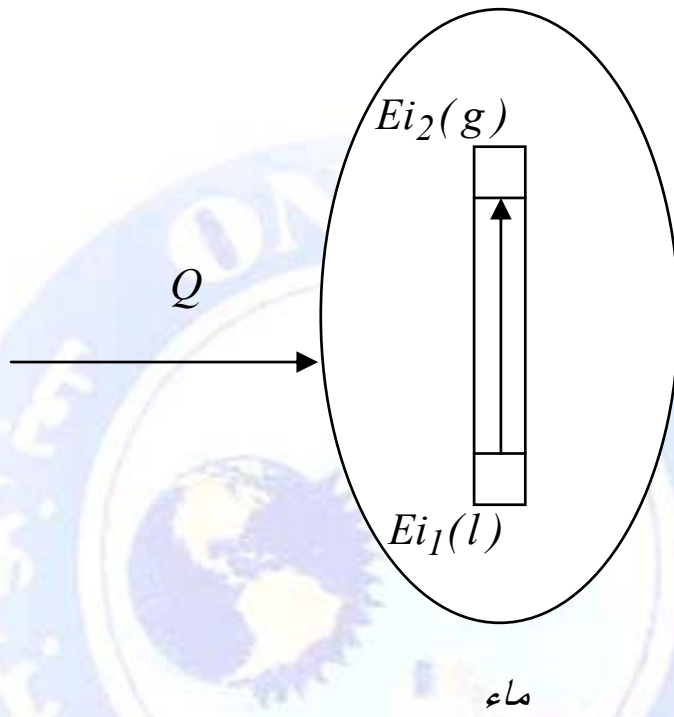
$$We = 1000 \times 1,5^2 \times ( 10 \times 60 ) = 1350 \text{ KJ}$$

- III

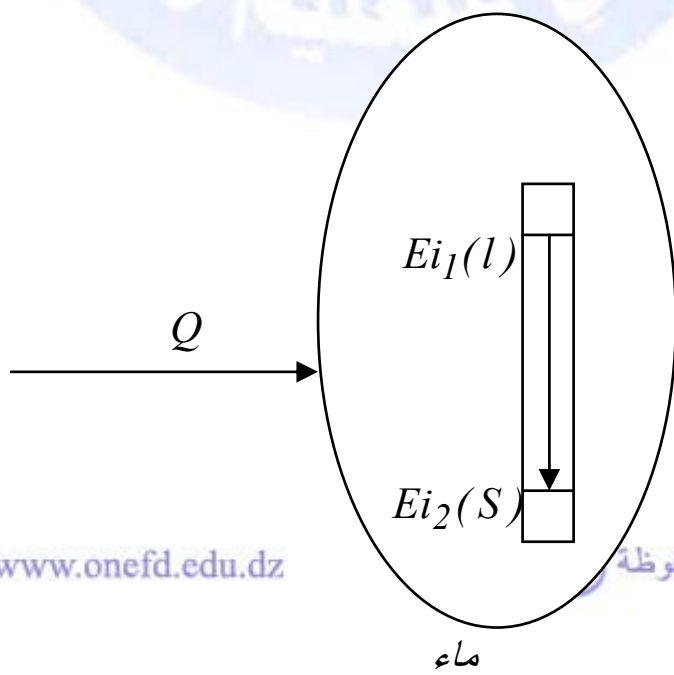
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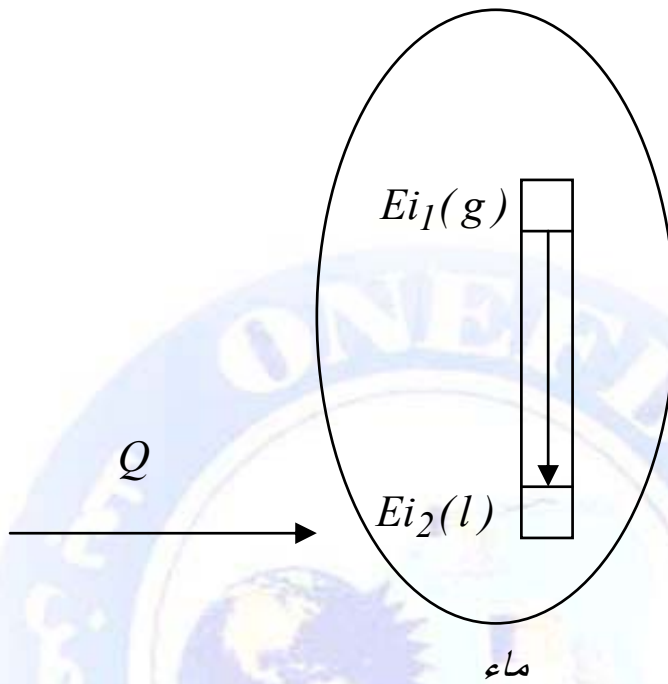


:2 \_\_\_\_\_



:3 \_\_\_\_\_





عندما يتلقى ( أو يفقد ) جسم معين طاقة عن طريق تحويل حراري، فإن هذا بإمكانه أن يحدث تغيراً في الحالة الفيزيائية للجسم، و هذا يؤدي إلى تغير في طاقته الداخلية

.( Q )

$$Q = m \cdot L$$

KJ / mole

$$Q = \frac{m}{M} \cdot L$$

g / mol :

M

. KJ / Kg

L

	L ( KJ / kg )
Hg ( - 39 °C )	11,7
O <sub>2</sub> ( - 219 °C )	13,8
Cu ( 1083 °C )	176
H <sub>2</sub> O ( 0 °C )	333
NH <sub>3</sub> ( -75 °C =	452
Al ( 660 °C )	393
N <sub>2</sub> ( -196 °C )	200
O <sub>2</sub> ( -183 °C )	213
Hg ( 357 °C )	272
NH <sub>3</sub> ( -33 °C )	1368
H <sub>2</sub> O ( 100 °C )	2258

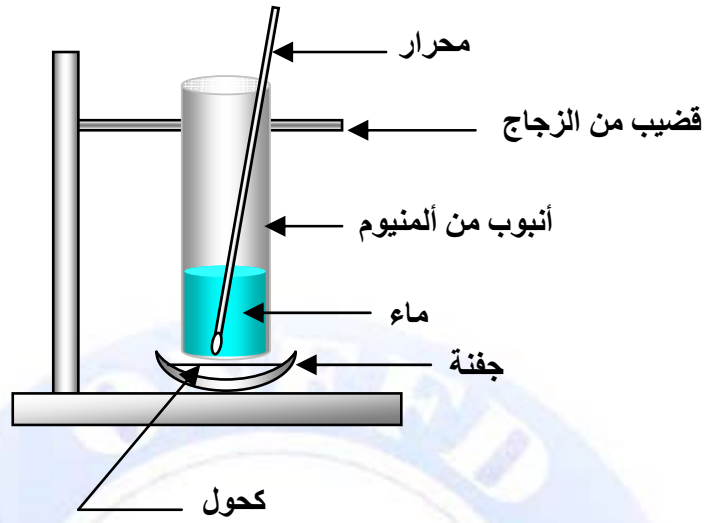
:

:

:

0,1

-10 °c- 110°c



:1

$$m_1 = 100 \text{ g}$$

$$m_2 = 2,0 \text{ g}$$

$$T_f \quad T_i$$

$$4,185 \text{ joule}$$

$$1^\circ \text{C}$$

$$1,00 \text{ g}$$

:2

$$2,0 \text{ g}$$

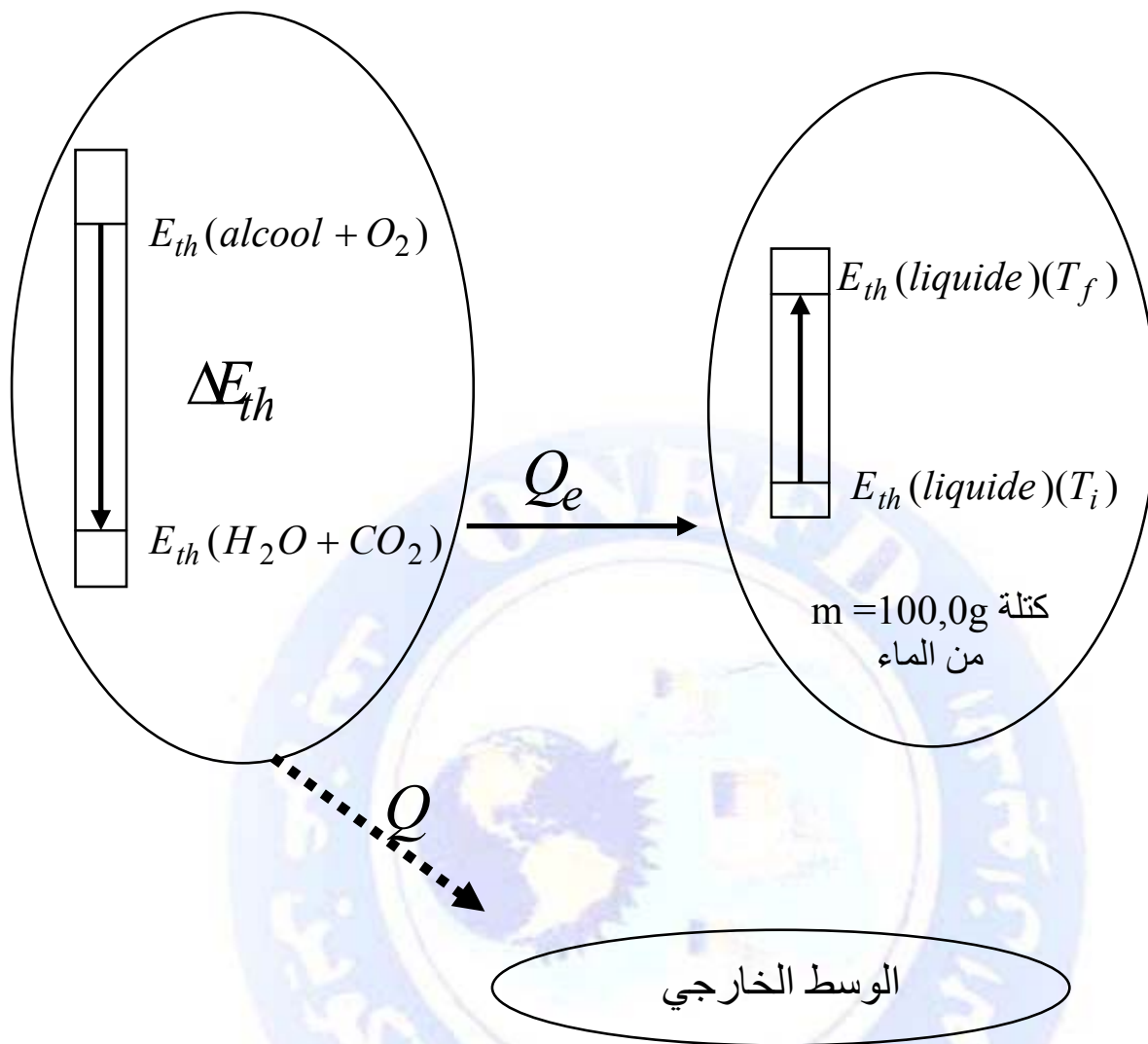
$$m_2 = 30,0 \text{ g}$$

$$m_3$$

$$m_e = m_2 - m_3$$

:

:1



$$m = 2,0 g$$

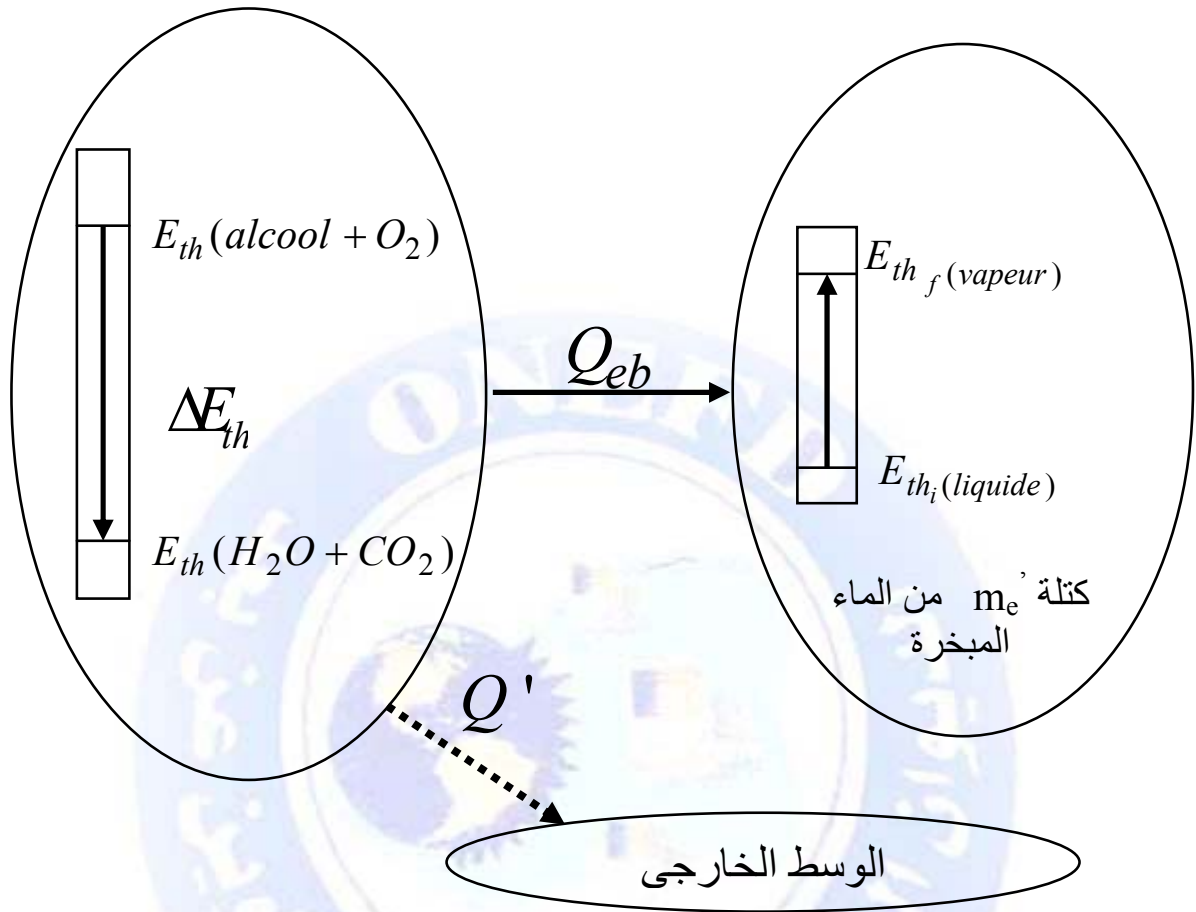
$$\Delta E_{Th}$$

$$Q_e$$

$$Q$$

$$\Delta E_{Th} = Q + Q_e$$

$$Q_e = \Delta E_{th} = E_{Th_f(liquide)} - E_{Th_i(liquide)} = 4,18 \times m_e \times (T_f - T_i)$$



$$m = 2,0 \text{ g}$$

$$m_e'$$

$$\Delta E_{Th}$$

$$Q_{eb}$$

$$Q'$$

$$Q' \quad Q$$

$$\Delta E_{Th} = Q + Q_e$$

$$\Delta E_{Th} = Q' + Q_{eb}$$

$$Q_e = Q_{eb} :$$

$$T_f = 78 \text{ } ^\circ\text{C} \quad T_i = 20 \text{ } ^\circ\text{C} \quad m = 100,0 \text{ g}$$

$$m_e' = 11,0 \text{ g}$$

$$78 \text{ } ^\circ\text{C} \quad 20 \text{ } ^\circ\text{C} \quad m = 100,0 \text{ g}$$

$$\Delta E_{th} = m.c.(\theta_f - \theta_i)$$

$$\Delta E_{th} = n.L$$

$$Q = Q' \Rightarrow m_1.c.(\theta_f - \theta_i) = \frac{m_e}{M} L$$

$$L = \frac{m_1.c.(\theta_f - \theta_i).M}{m_e} = \frac{100 \times 4,18 \times (72 - 20) \times 18}{11} = 40 \text{ KJ / mole}$$

1 mole :

.40 KJ

. L = 40 KJ / mole

m = 2 g

1

.78 °C 20°C

$$\Delta E > m.c.(\theta_f - \theta_i)$$

$$\Delta E > 100 \times 4,18 \times 58 = 24 \text{ KJ} :$$

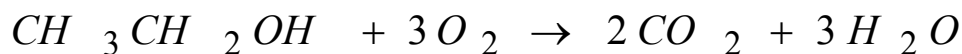
24 KJ

2 g

: 1

$$\Delta E > \frac{24 \times 46}{2} = 558 \text{ KJ / mole}$$

:



. 558 KJ / mole



---

$$\frac{558}{40} \approx 14 :$$



- VI \_\_\_\_\_ :

- 1

:1 \_\_\_\_\_

. 1 mol/ l

200 cm<sup>3</sup>

.  $\theta = 20,6\text{ }^{\circ}\text{C}$

. 1 mol/ l

200 cm<sup>3</sup>

.  $\theta = 20,6\text{ }^{\circ}\text{C}$

$\theta = 25,6\text{ }^{\circ}\text{C}$

. 5 °C

( OH<sup>-</sup> )<sub>aq</sub>

( H<sub>3</sub>O<sup>+</sup> )<sub>aq</sub>

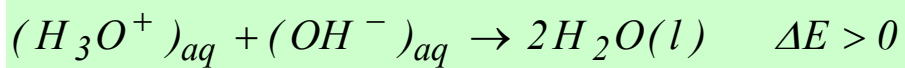
( OH<sup>-</sup> )<sub>aq</sub>

( H<sub>3</sub>O<sup>+</sup> )<sub>aq</sub>

( OH<sup>-</sup> )<sub>aq</sub>

( H<sub>3</sub>O<sup>+</sup> )<sub>aq</sub>

( )



57 KJ

( OH<sup>-</sup> )<sub>aq</sub>

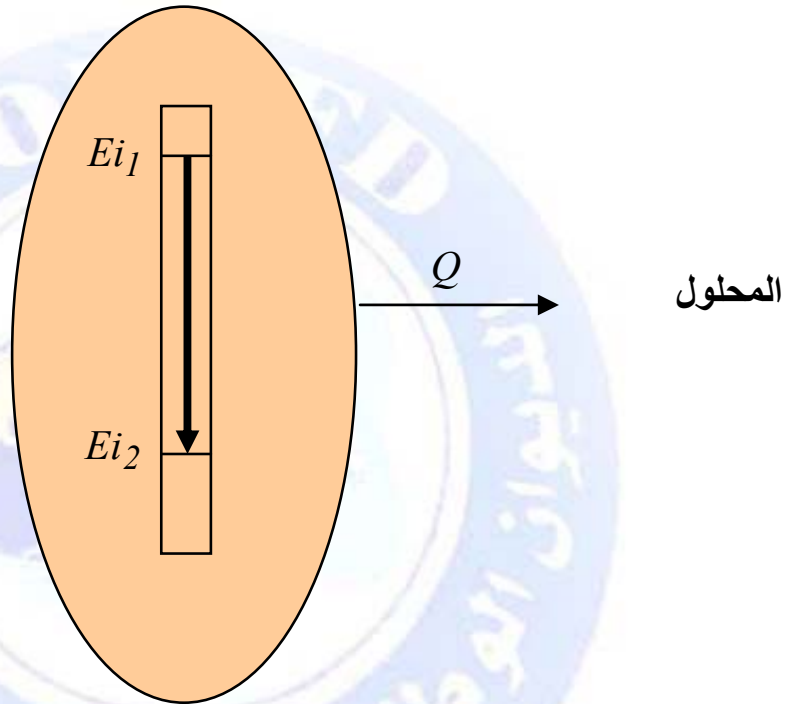
1

( H<sub>3</sub>O<sup>+</sup> )<sub>aq</sub>

1

\_\_\_\_\_ :

كل التفاعلات الكيميائية التي تجعل درجة حرارة وسط التفاعل ترتفع  
تدعى: تفاعلات ناشرة للحرارة



$$\Delta E = E_2 - E_1 = \Delta E_{Ec} + \Delta E_{Ep} + \Delta E_{Ei} = W_m + W_e + Q + E_r$$

(  $E_p$      $E_c$  )

(  $W_e = 0$      $W_m = 0$  )

$$\Delta E = E_2 - E_1 = \Delta E_{Ei} = Q$$

2:

$$\theta_1 = 20,4$$

200 ml

$$.(Na_2S_2O_3, 5H_2O) \quad m = 24,8 \text{ g}$$

\_\_\_\_\_ :

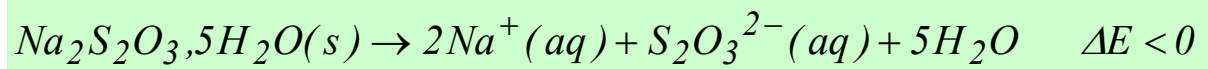
. 7 °C

( $Na_2S_2O_3, 5H_2O$ )

( $H_2O$ )

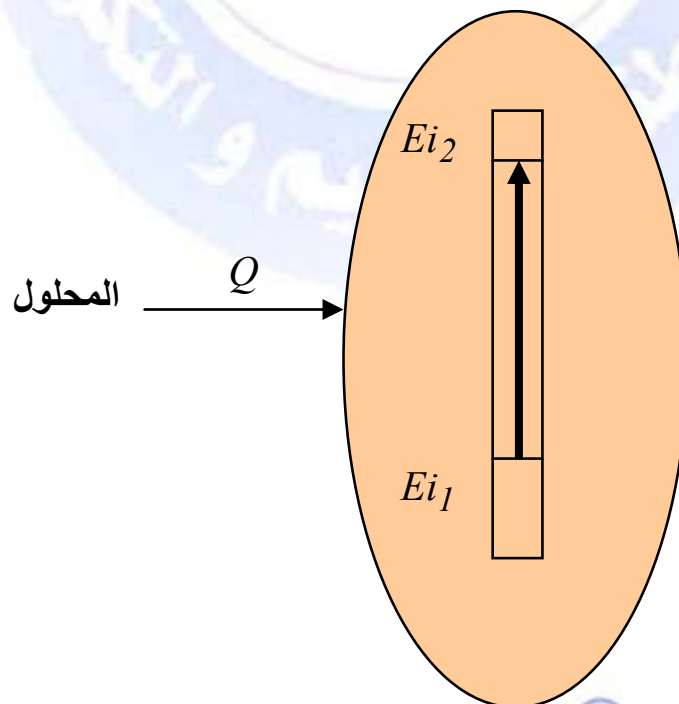
\_\_\_\_\_ : ( $Na_2S_2O_3, 5H_2O$ ) ( $H_2O$ )

:



\_\_\_\_\_ :

كل التفاعلات الكيميائية التي تجعل درجة حرارة المحلول تنخفض تدعى :  
تفاعلات ماصة للحرارة



$$\Delta E = E_2 - E_1 = \Delta E_c + \Delta E_p + \Delta E_i = W_m + W_e + Q + E_r$$

$$(\quad E_p \quad E_c)$$

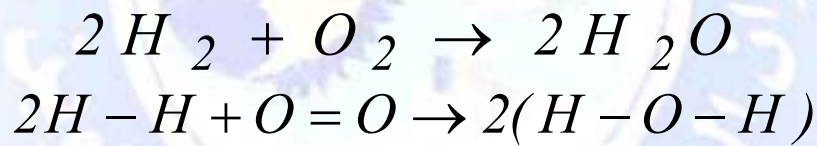
$$(W_e = 0 \quad W_m = 0)$$

$$\Delta E = E_2 - E_1 = \Delta E_i = Q$$

$$: \quad \underline{\quad \quad \quad - 2}$$

$$: \quad \underline{\quad \quad \quad}$$

2 mole



$$: \quad \underline{\quad \quad \quad}$$

$$E = (\sum D_{X-Y})_{\text{المحطمة}} - (\sum D_{X-Y})_{\text{متشكلة}}$$

$$E > 0$$

$$E < 0$$

$$.( \quad \quad \quad ) \quad D_{X-Y}$$



\_\_\_\_\_ :



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:

$$\sum D_{X-Y} \text{ محطمة} = 2 \times 432 + 494 = 1358 \text{ KJ / mole}$$

:



:

$$\sum D_{X-Y} \text{ متشكلة} = 4 \times 410 = 1640 \text{ KJ / mole}$$

:

$$E = (\sum D_{X-Y} \text{ المحطمة}) - (\sum D_{X-Y} \text{ ناتجة}) = 1358 - 1640 = -282 \text{ KJ / mole}$$

. E < 0

( ) - v

- 1

\_\_\_\_\_ :

-

-

-

\_\_\_\_\_ :

. T<sub>i</sub>

. M

( 0°C )

. T<sub>f</sub> <http://www.onefd.edu.dz>

جميع الحقوق محفوظة ©

\_\_\_\_\_ :

$$m_1 = 1860^\circ\text{C}$$

$$m_2 = 2160 \text{ g} :$$

$$M = m_2 - m_1 = 300 \text{ g} :$$

$$T_i = 20,7^\circ\text{C} :$$

$$m_3 = 2195 \text{ g} :$$

$$m = m_3 - m_2 = 35 \text{ g} :$$

$$T_f = 11,7^\circ\text{C} :$$

:

$$\underbrace{\mu \cdot (\theta_f - \theta_i) + M \cdot C_e (\theta_f - \theta_i)}_{\text{التحويل الطاقوي الذي يحدث للمسعر و الماء}} + \underbrace{m \cdot L_{fus} + m \cdot C_e (\theta_f - 0)}_{\text{التحويل الطاقوي الذي يحدث لقطعة الجليد}} = 0$$

التحويل الطاقوي الذي يحدث لقطعة الجليد

$$246,5 \cdot (11,7 - 20,7) + 300 \cdot 10^{-3} \cdot 4185 \cdot (11,7 - 20,7) + 35 \cdot 10^{-3} \cdot L_{fus} +$$

$$35 \cdot 10^{-3} \cdot 4185 \cdot (11,7 - 0) = 0$$

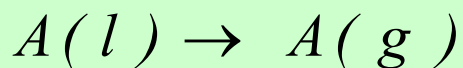
$$L_{fus} = 337 \text{ J/kg} :$$

$$337 \text{ J/kg}$$

\_\_\_\_\_ :

A (g)

A (l)



. KJ/ mol.

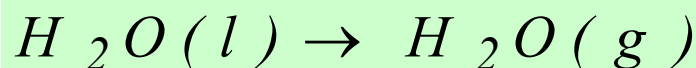
L<sub>v</sub>

\_\_\_\_\_ :

:

100° c

1,013.10<sup>5</sup> Pa



40,0 KJ/ mol.

100

1 mole ( 18 g )

40,0 KJ

. °C

100 °C

(

)

1 mole

<http://www.onefd.edu.dz>



جميع الحقوق محفوظة . 40,0 KJ

$L_v$

$\cdot 1,013 \cdot 10^5 \text{ Pa}$

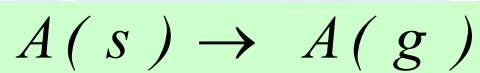
	$t_{eb} (^\circ\text{C})$	$L_v (\text{KJ} / \text{mol})$
	100	41,0
	64,5	37,4
	78,5	42,6
	56,2	30,8
	68,7	31,5
	98,4	36,6
	80,7	33,1
	80,1	33,8

	$L_s (\text{KJ} / \text{mol})$
	47
	40,6
	47,6
	36,5
	43,5
	50,6
	35,8
	43,6

\_\_\_\_\_ :

$A(s)$

$\cdot A(g)$



$\cdot \text{KJ} / \text{mol} :$

$L_s$

$A(s)$

m

$A(g)$

m

$L_s$



- 1

A-B

B

A

B

A

B

A

A-B

. A-B

( )

:-

( H<sub>2</sub> )

-

. T = 2000 °C

-

.λ = 0,494 μm

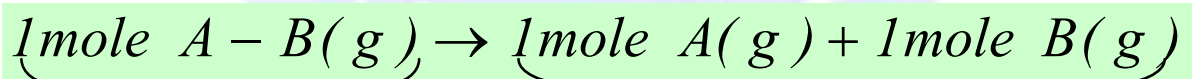
:

:-

A-B

KJ / mole

D<sub>A-B</sub>



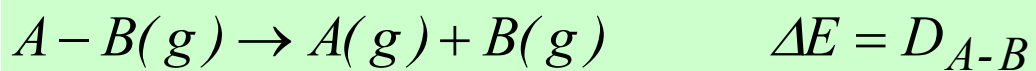
الحالة الابتدائية

الحالة النهائية

1

A-B

. mole



:

$$D_{A-B} = \text{Energie} [1 \text{ mole } A(g) + 1 \text{ mole } B(g)] - \text{Energie} [1 \text{ mole } A-B(g)]$$

B      A                                  A-B

$$. D_{A-B} > 0$$

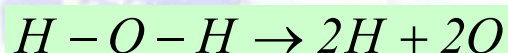
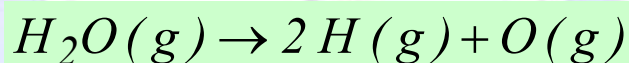
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طاقة رابطة كيميائية مقدار موجب

\_\_\_\_\_ - 2

\_\_\_\_\_ :

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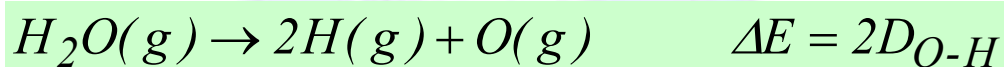


O-H

(

) O-H

1 mole



:

$$\Delta E_{A-B} = \text{Energie} [2 \text{ mole } H(g) + 1 \text{ mole } O(g)] - \text{Energie} [1 \text{ mole } H_2O(g)]$$

2 D<sub>O-H</sub>

O-H

	$D_{X-Y}$ ( KJ / mole)		$D_{X-Y}$ ( KJ/ mole )
H-H	432	C-H	410
F-F	155	C-C	348
Cl-Cl	240	C = C	612
Br-Br	190	C - O	356
I-I	150	C = O*	795
H-F	565	C = O**	708
H-Cl	428	C - Cl	327
H - Br	362	C - Br	285





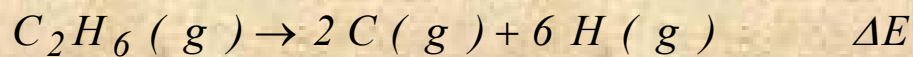
H-O	460		940
H-N	388	N = O	628
H-S	364	O = O	494

تطبيق :

أحسب طاقة التماسك الخاصة بجزيء الإيثان C<sub>2</sub>H<sub>6</sub>.

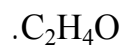
الإجابة:

طاقة التماسك في جزيء الإيثان هي الطاقة ΔE المحول أثناء التفاعل التالي:



$$\Delta E = D_{C-C} + 6 D_{C-H} = 348 + 6 \times 410 = 2820 \text{ KJ/ mole}$$

\_\_\_\_\_ :



- 2

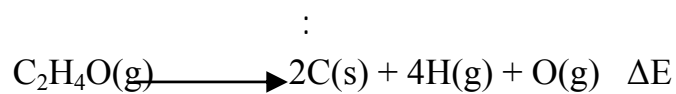
- 3

. 26,1 KJ / mole

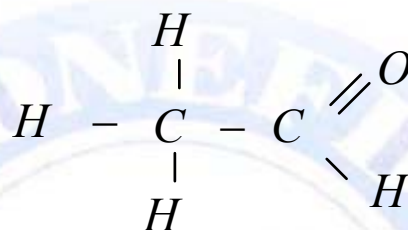
- 4

1 mole

:  
- 1



- 2



$$\Delta E = 4D_{\text{C-H}} + 1D_{\text{C-C}} + 1D_{\text{C-O}} :$$

- 3

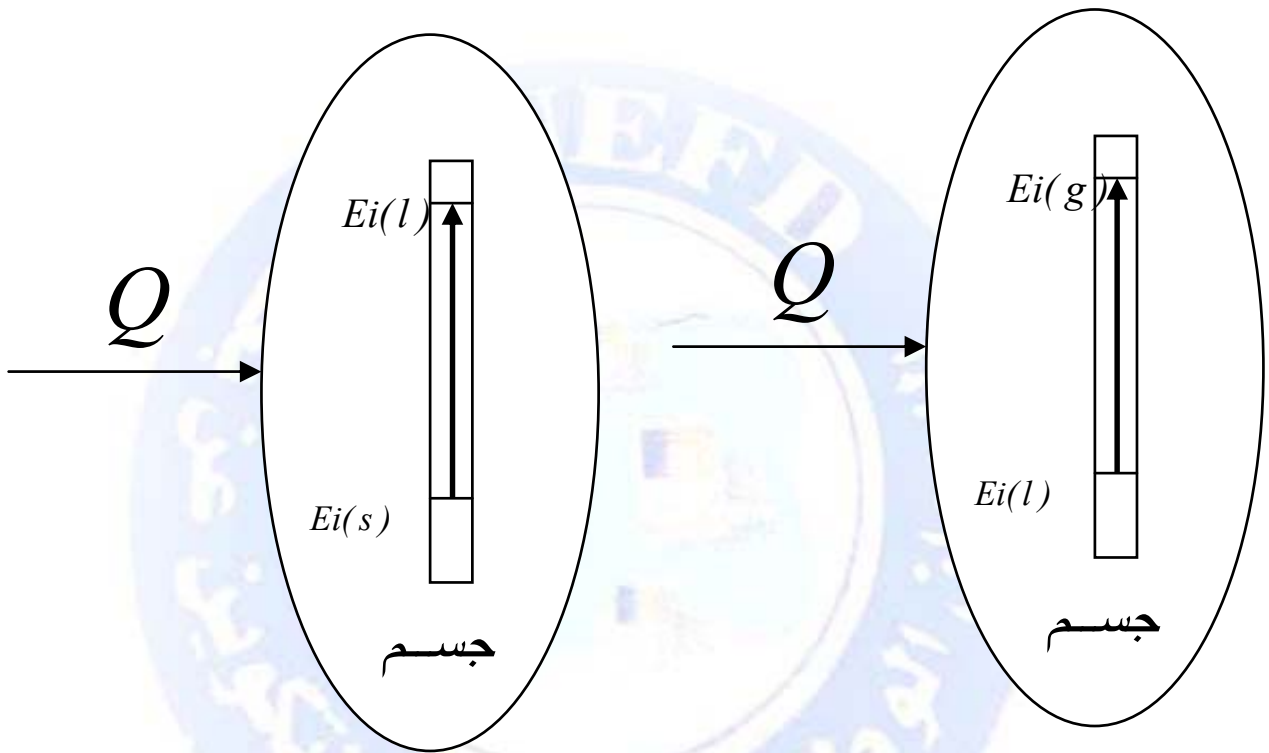
		KJ/mole	
C - H	4	410	1640
C - C	1	348	348
C = O	1	708	708
			$\Delta E = 2796 \text{ KJ / mole}$

- 4

1 mole

( )

-VII



:1

$$m = 50 \text{ g}$$
$$\rho = \frac{Q_{\text{لازمة}}}{Q_{\text{مقدمة}}} = 60\%$$

.  $150^{\circ}\text{C}$       $20^{\circ}\text{C}$

:2

$$\mu = 58,6 \text{ KJ/}^{\circ}\text{C}$$

$T_1 =$      .  $M = 150 \text{ g}$

.  $19,2^{\circ}\text{C}$

$T_2 = 70^{\circ}\text{C}$      - 1

.  $T_e$      .  $M_1 = 217 \text{ g}$

$M_2 = 20 \text{ g}$      - 2

.  $-3^{\circ}\text{C}$

.  $L_f = 333 \text{ KJ/ mole}$       $c_e = 4185 \text{ KJ/ kg.}^{\circ}\text{C}$       $c_{pb} = 129,5 \text{ KJ/ kg.}^{\circ}\text{C}$  :

:3

4 mole H ( g )     1 mole N ( g )      $\text{NH}_4(\text{g})$      1 mole

.  $1164 \text{ KJ / mole}$

- 1

. C-H     - 2

:4

1 mole      $\text{CH}_4$      1 mole

.  $1648 \text{ KJ}$      4 mole

- 1

. ( C - H )     - 2

:5

.  $\text{O}(\text{g})$       $\text{C}(\text{g})$       $\text{CO}_2$

.  $1608 \text{ KJ/ mole}$

- 1

– 2

. C = O

– 3

:6

V = 500 litre

– 1

– 2

– 3

( m

37 %

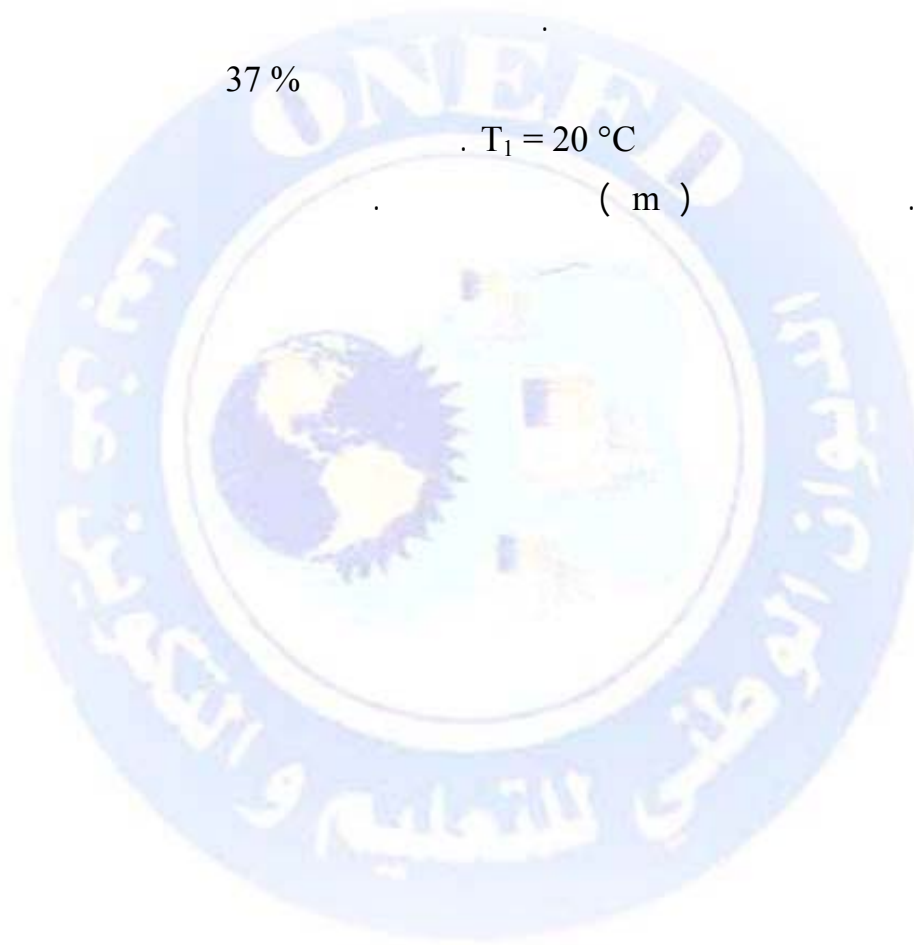
. T<sub>1</sub> = 20 °C

– 4

)

( m )

. T<sub>2</sub> = 70°C





:1

:

$$\begin{aligned}\Delta E = E_2 - E_1 &= \Delta E_c + \Delta E_p + \Delta E_i = W_m + Q + E_r + W_e \\ \Delta E = E_2 - E_1 &= 0 + 0 + \Delta E_i = 0 + Q + 0 + 0 \\ \Delta E = E_2 - E_1 &= \Delta E_i = Q_{\text{الازمة}} = m.c. (T_f - T_i) \\ \Delta E_i = Q_{\text{الازمة}} &= 0.05 \times 452 (150 - 20) = 2938 \text{ KJ}\end{aligned}$$

:

$$Q_{\text{مقدمة}} = \frac{Q_{\text{الازمة}}}{0,6} = 4896,7 \text{ KJ}$$

:2

: ( + + )

$$\Delta E = E_2 - E_1 = \Delta E_c + \Delta E_p + \Delta E_i = W_m + Q + E_r + W_e$$

$$\Delta E = E_2 - E_1 = 0 + 0 + \Delta E_i = 0 + 0 + 0 + 0$$

$$\Delta E_i = 0 \Rightarrow (\Delta E_{th})_{\text{مسعر}} + (\Delta E_{th})_{\text{ماء}} + (\Delta E_{th})_{Pb} = 0$$

$$\mu(T_e - T_1) + M.c_e.(T_e - T_1) + M_1.c_{Pb}(T_e - T_2) = 0$$

$$T_e = \frac{T_1(\mu + M.c_e) + M_1.c_{Pb}.T_2}{(\mu + M.c_e + M_1.c_{Pb})}$$

$$T_e = \frac{19,2(58,6 + 0.150 \times 4185) + 0.217 \times 129,5 \times 70}{(58,6 + 0,150 \times 4185 + 0.217 \times 129,5)}$$

$$T_e = 21,2 \text{ } ^\circ\text{C}$$

$$(\quad + \quad + \quad) \quad - 2$$

$$\Delta E = E_2 - E_1 = \Delta Ec + \Delta Ep + \Delta Ei = Wm + Q + Er + We$$

$$\Delta E = E_2 - E_1 = 0 + 0 + \Delta Ei = 0 + 0 + 0 + 0$$

$$\Delta Ei = 0 \Rightarrow (\Delta E_{th})_{\text{مسعر}} + (\Delta E_{th})_{\text{ماء}} + (\Delta E_{th})_{\text{جليد}} = 0$$

$$(T_e - T_1) + M.c_e.(T_e - T_1) + [M_2.(c_e)_{\text{صلب}}.(0 - (-3)) + L_f.M_2 + M_2.(c_e)_{\text{سائل}}.(T_e - 0)]_{\text{جليد}} = 0$$

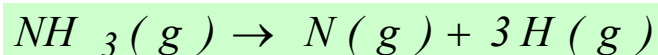
$$T_e = \frac{T_1(\mu + M.c_e) - 3M_2.(c_e)_{\text{صلب}} - L_f.M_2}{\mu + M.c_e + M_2.(c_e)_{\text{سائل}}}$$

$$T_e = \frac{19,2(58,6 + 0,150 \times 4185) - 3 \times 0,02 \times 2100 - 0,02 \times 333}{58,6 + 0,150 \times 4185 + 0,02 \times 4185}$$

$$T_e = 19,6^\circ\text{C}$$

:3\_\_\_\_\_

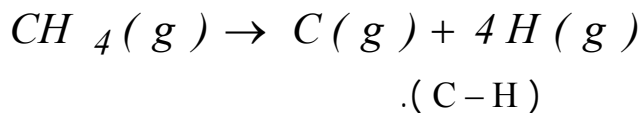
: - 1



$$E = 3 D_{N-H} \Rightarrow D_{N-H} = \frac{E}{3} = \frac{1164}{3} \Rightarrow D_{N-H} = 388 \text{ KJ / mole}$$

$$D_{N-H} = 388 \text{ KJ / mole}$$

:4\_\_\_\_\_



- 2

$$E = 4 D_{C-H} \Rightarrow D_{C-H} = \frac{E}{4} = \frac{1648}{4} \Rightarrow D_{C-H} = 412 \text{ KJ / mole}$$

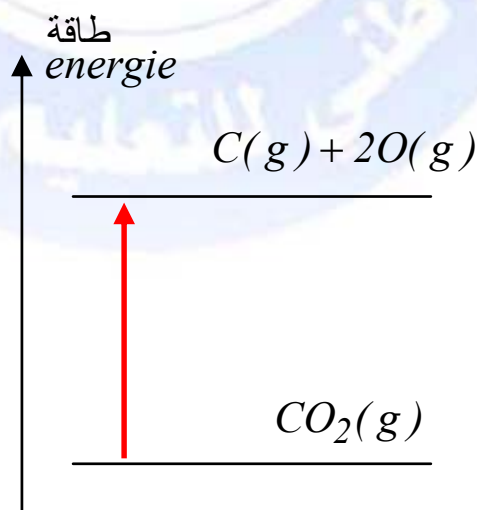
$$D_{C-H} = 412 \text{ KJ / mole}$$

:5\_\_\_\_\_



- 1

- 2

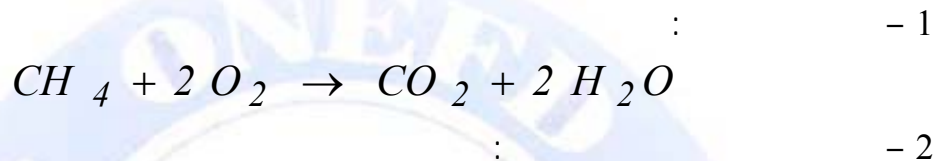


- 3

$$E = 2D_{C=O} \Rightarrow D_{C=O} = \frac{E}{2} = \frac{1608}{2} \Rightarrow D_{C=O} = 804 \text{ KJ / mole}$$

$$D_{C=O} = 804 \text{ KJ / mole}$$

:6



1648	412	4	C - H
992	496	2	O = O
2640			

$$E = (\sum D_{X-Y})_{\text{المحطمة}} - (\sum D_{X-Y})_{\text{متشكلة}}$$

$$E = 3460 - 2640 = - 820 \text{ KJ / mole}$$

litre 500

$$n = \frac{V}{22,4} = 22,32 \text{ mole}$$

22,32 mole

$$E = 22,32 \times (- 820 ) = - 18302 \text{ KJ}$$

$$E < 0 \quad - 3$$

$$. (m) \quad - 4$$

$$\Delta E = E_2 - E_1 = \Delta E_c + \Delta E_p + \Delta E_i = W_m + Q + E_r + W_e$$

$$\Delta E = E_2 - E_1 = 0 + 0 + \Delta E_i = 0 + Q + 0 + 0$$

$$\Delta E_i = Q = 0,37 \times 18302 = m \times 4185 \times (70 - 20)$$

:

$$m = \frac{0,37 \times 18302}{4185 \times 50} = 0,032 \text{ kg}$$