

TERMOKIMIA

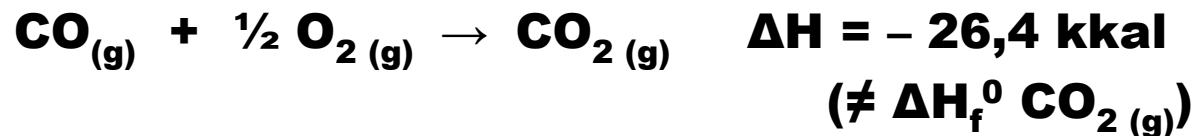
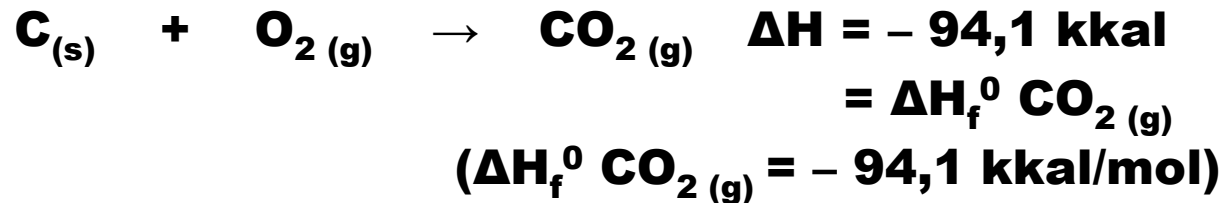
Kalor (Q) = m.c.ΔT

Kalor Reaksi (ΔH)

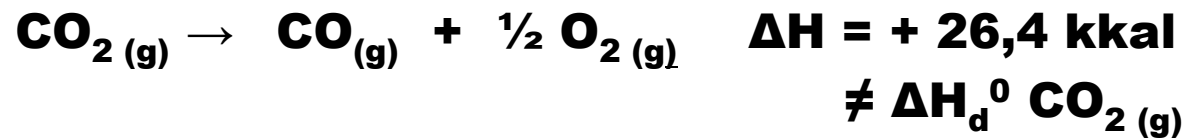
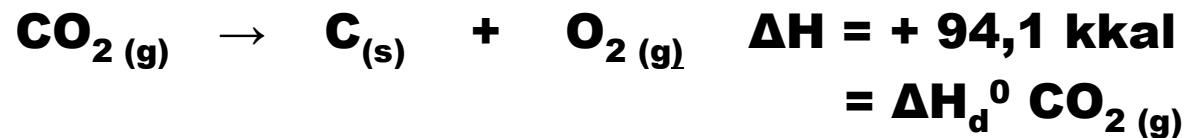
ΔH < 0 → **eksoterm (menghasilkan kalor)**

ΔH > 0 → **endoterm (memerlukan kalor)**

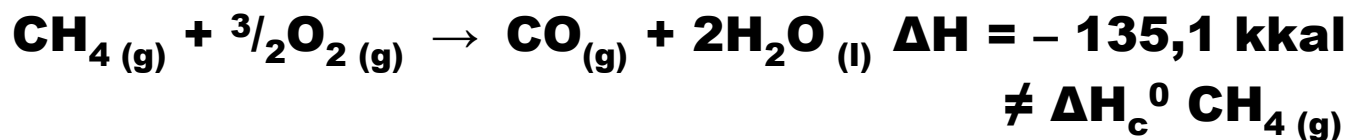
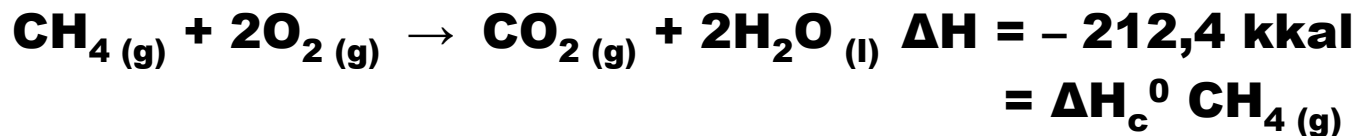
➤ **ΔH Pembentukan Standar (ΔH_f⁰)**



➤ **ΔH Penguraian Standar (ΔH_d^0)**



➤ **ΔH Pembakaran Standar (ΔH_c^0)**

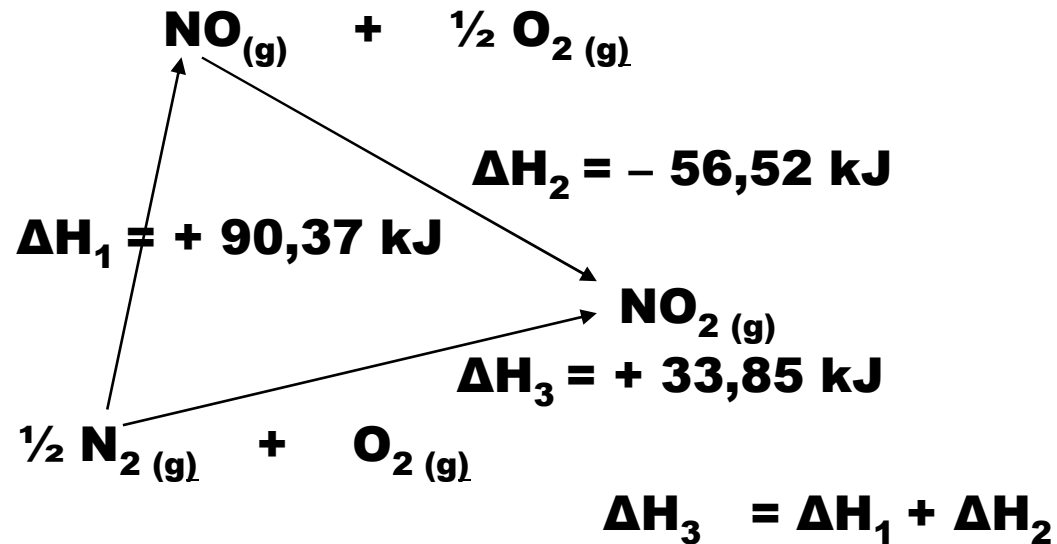


✓ **Hukum Laplace (*Marquis de Laplace*)**

ΔH reaksi ke kiri = - ΔH reaksi ke kanan

$$\Delta H_d^0 = -\Delta H_f^0$$

✓ **Hukum Hess (*Germain Hess*)**



Contoh soal: Diketahui:

ΔH penguraian $C_3H_8(g) = + 24,8$ kkal/mol.

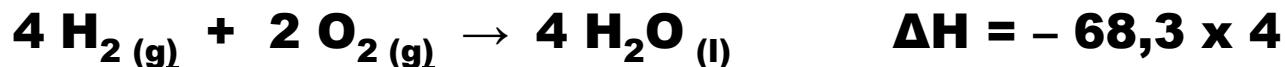
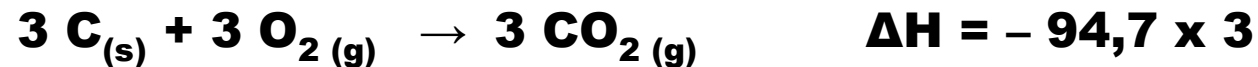
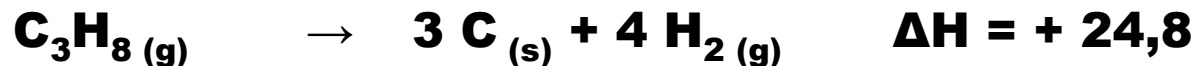
ΔH pembentukan $CO_2(g) = - 94,7$ kkal/mol.

ΔH pembentukan $H_2O(l) = - 68,3$ kkal/mol.

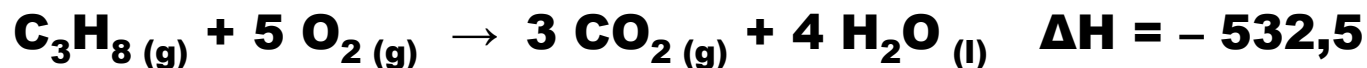
Hitunglah berapa ΔH pembakaran $C_3H_8(g)$?

Reaksinya: $C_3H_8(g) + 5 O_2(g) \rightarrow 3 CO_2(g) + 4 H_2O(l)$

Jawab:

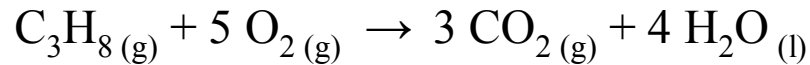


+



Penguraian

Pembentukan



$\Delta H = \Delta H$ penguraian pereaksi + ΔH pembentukan produk

$$= (\Delta H_d^0 \text{C}_3\text{H}_{8(g)} + 5 \Delta H_d^0 \text{O}_{2(g)}) + (3 \Delta H_f^0 \text{CO}_{2(g)} + 4 \Delta H_f^0 \text{H}_2\text{O}_{(l)})$$

$$= [-\Delta H_f^0 \text{C}_3\text{H}_{8(g)} + (-5\Delta H_f^0 \text{O}_{2(g)})] + [3\Delta H_f^0 \text{CO}_{2(g)} + 4\Delta H_f^0 \text{H}_2\text{O}_{(l)}]$$

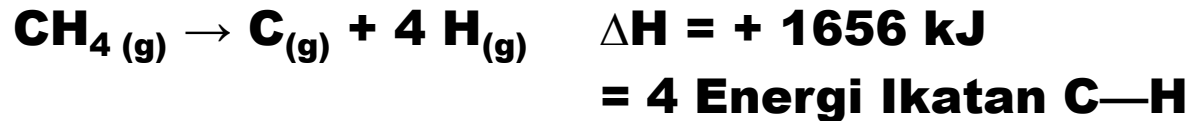
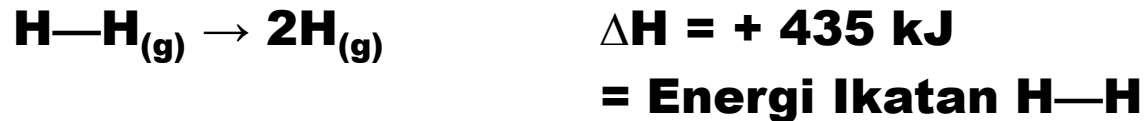
$$= (3 \Delta H_f^0 \text{CO}_{2(g)} + 4 \Delta H_f^0 \text{H}_2\text{O}_{(l)}) - [\Delta H_f^0 \text{C}_3\text{H}_{8(g)} + 5 \Delta H_f^0 \text{O}_{2(g)}]$$

$$= [3 \times (-94,7) + 4 \times (-68,3)] - [(-24,8) + 5 \times 0]$$

$$= -532,5 \text{ kkal/mol}$$

$$\Delta H \text{ reaksi} = \sum \Delta H_f^0 \text{ produk} - \sum \Delta H_f^0 \text{ pereaksi}$$

Energi Ikatan = ΔH pemutusan ikatan



$$\text{Energi Ikatan C—H} = + 1656 \text{ kJ} : 4 = + 414 \text{ kJ}$$

$$\Delta H \text{ pembentukan ikatan} = - \Delta H \text{ pemutusan ikatan}$$

= - Energi Ikatan

$$\Delta H \text{ reaksi} = \sum \Delta H \text{ pemutusan ikatan pereaksi} + \sum \Delta H \text{ pembentukan ikatan produk}$$

$$\Delta H \text{ reaksi} = \sum \text{EI pereaksi} - \sum \text{EI produk reaksi}$$

Contoh soal. Diketahui:

$$\text{EI N}\equiv\text{N} = 946 \text{ kJ/mol}$$

$$\text{EI N—N} = 163 \text{ kJ/mol}$$

$$\text{EI N—H} = 389 \text{ kJ/mol}$$

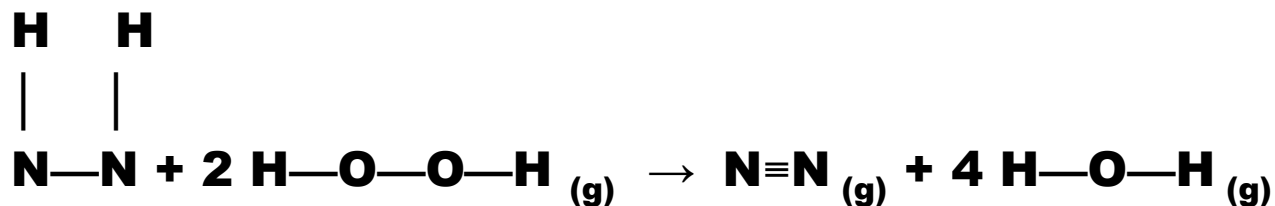
$$\text{EI O—O} = 144 \text{ kJ/mol}$$

$$\text{EI O—H} = 464 \text{ kJ/mol}$$

Hitunglah berapa ΔH reaksi berikut:



Jawab. Reaksinya dapat dituliskan:



$$\Delta H = (\text{EI N—N} + 4\text{EI N—H} + 2\text{EI O—O} + 4\text{EI O—H}) - (\text{EI N}\equiv\text{N} + 8\text{EI O—H})$$

Proses Spontan dan Tidak Spontan

$$\Delta H < 0$$

$$\Delta S > 0$$

$$\Delta G < 0$$

$$\Delta H > 0$$

$$\Delta S < 0$$

$$\Delta G > 0$$

$$\Delta G = \Delta H - T \cdot \Delta S$$

Soal

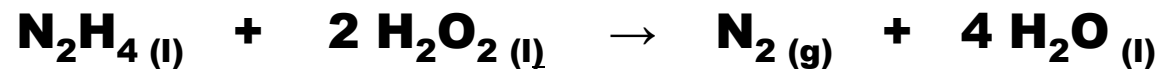
1. Diketahui:

ΔH pembentukan $\text{N}_2\text{H}_4 (\text{l}) = + 50,63 \text{ kJ/mol}$

ΔH pembentukan $\text{H}_2\text{O}_2 (\text{l}) = - 187,78 \text{ kJ/mol}$

ΔH pembentukan $\text{H}_2\text{O} (\text{l}) = - 285,85 \text{ kJ/mol}$

Hitunglah berapa ΔH reaksi berikut:



2. Diketahui:

ΔH pembakaran $\text{C}_6\text{H}_{12}\text{O}_6 (\text{s}) = - 2820 \text{ kJ/mol}$

ΔH pembakaran $\text{C}_2\text{H}_5\text{OH} (\text{l}) = - 1380 \text{ kJ/mol}$

Hitunglah berapa ΔH reaksi berikut:



3. Diketahui:

Energi Ikat C=C = 611 kJ/mol

Energi Ikat C—C= 347 kJ/mol

Energi Ikat C—H = 414 kJ/mol

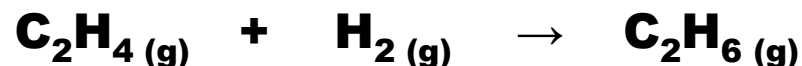
Energi Ikat H—H = 435 kJ/mol

ΔH pembentukan $C_2H_6(g) = -84,68$ kJ/mol

ΔH pembentukan $CO_2(g) = -393,5$ kJ/mol

ΔH pembakaran $C_2H_6(g) = -1559,7$ kJ/mol

a. Berapa ΔH reaksi berikut:



b. Berapa ΔH pembentukan 2,8 gram $C_2H_4(g)$

c. Berapa ΔH pembakaran 2,8 gram $C_2H_4(g)$