

THERMOCHEMISTRY

$$\Delta H_r = \Delta H_f(P_r) - \Delta H_f(R)$$

$$\Delta S_r = \Delta S_f(P_r) - \Delta S_f(R)$$

$$\Delta S_r = S(P_r) - S(R)$$

$$\Delta H_f[O_2(g)] = 0$$

$$\Delta H_f[\text{graphite}] = 0$$

$$\Delta H_f[Ar(s)] = 0$$

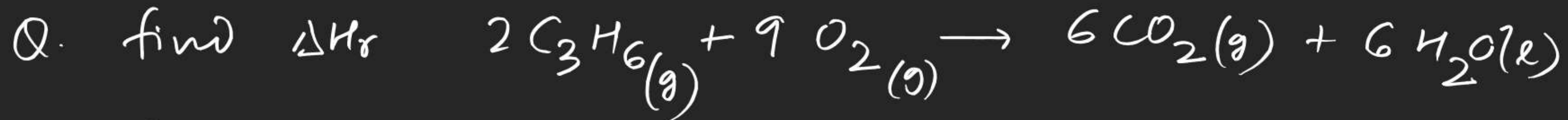
$$\Delta H_f[I_2(s)] = 0$$

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

$$\Delta G_r = \Delta G_f(P_r) - \Delta G_f(R)$$

$$\Delta G = \Delta G^\circ + RT \ln Q$$

 ΔH_f ΔS_f ΔG_f



Given $\Delta H_f[C_3H_6(g)] = -300 \text{ kJ/mol}$

$\Delta H_f[CO_2(g)] = -400 \text{ kJ/mol}$

$\Delta H_f[H_2O(l)] = -350 \text{ kJ/mol}$

$$\Delta H_r = 6 \times (-400) + 6 \times (-350) - 2 \times (-300) - 0$$

$$= -2400 - 2100 + 600$$

$$= -3900$$

$$-4200$$

$$-3900$$

$$-3100$$

$$1050$$

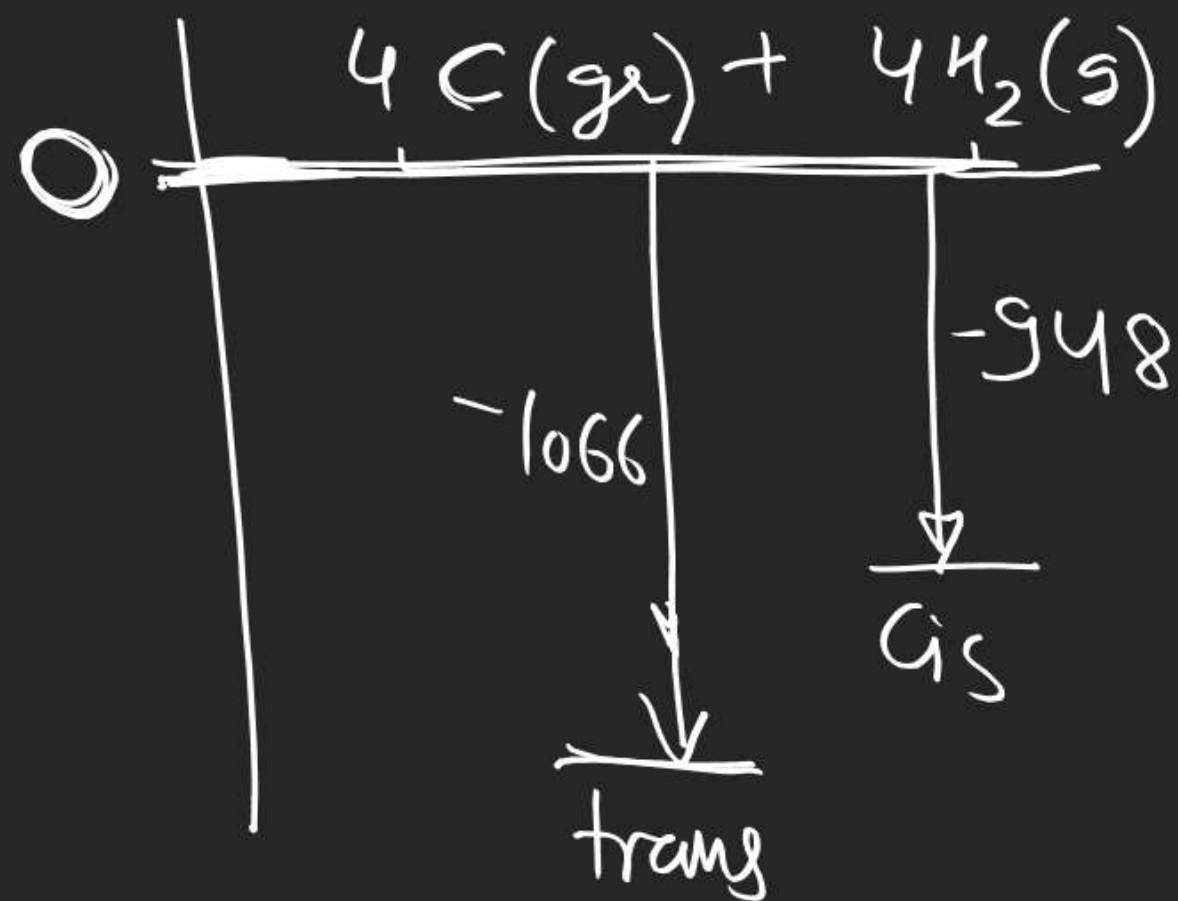
$$450$$

$$-450$$

(11) To compare energy of isomers or allotropes

$$\Delta H_f [\text{cis-2-butene (C}_4\text{H}_8)] = -948 \text{ kJ/mol}$$

$$\Delta H_f [\text{trans-2-butene (C}_4\text{H}_8)] = -1066 \text{ kJ/mol}$$

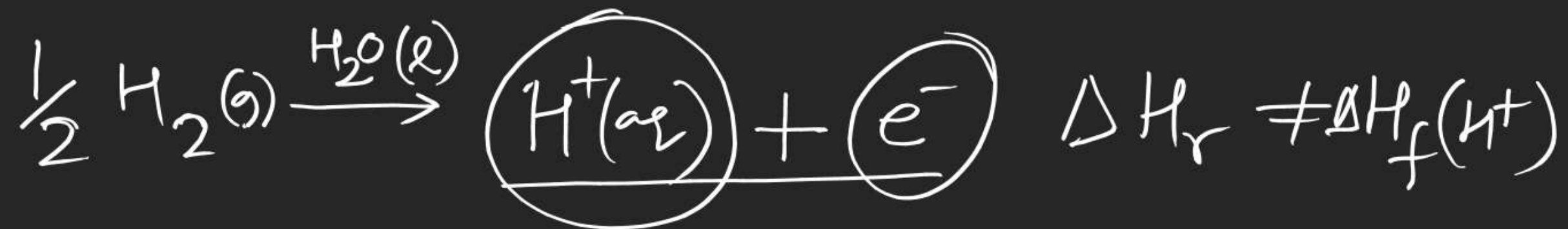


Substance with lower ΔH_f has low energy.

$$\rightarrow \Delta H_f^\circ(\text{graphite}) = 0$$

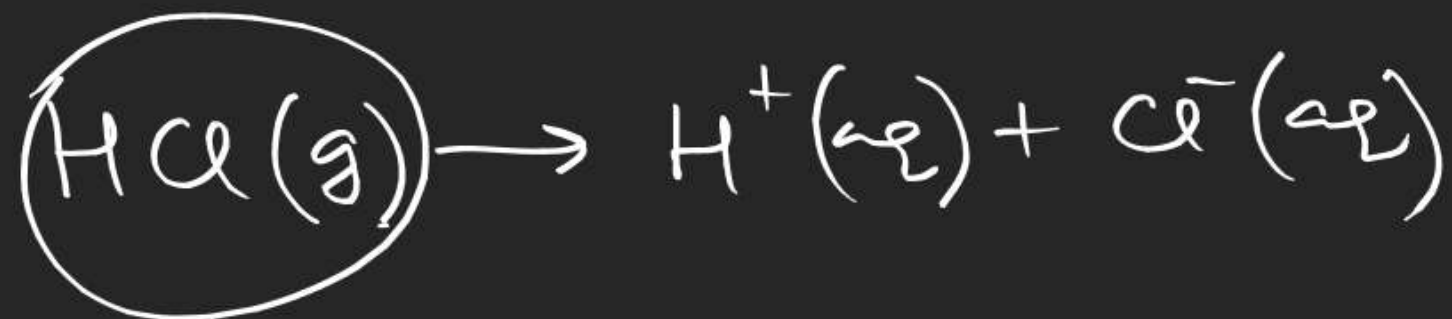
$$\Delta H_f^\circ(\text{diamond}) = 1.9 \text{ kJ/mol}$$

graphite less energy \rightarrow more stable

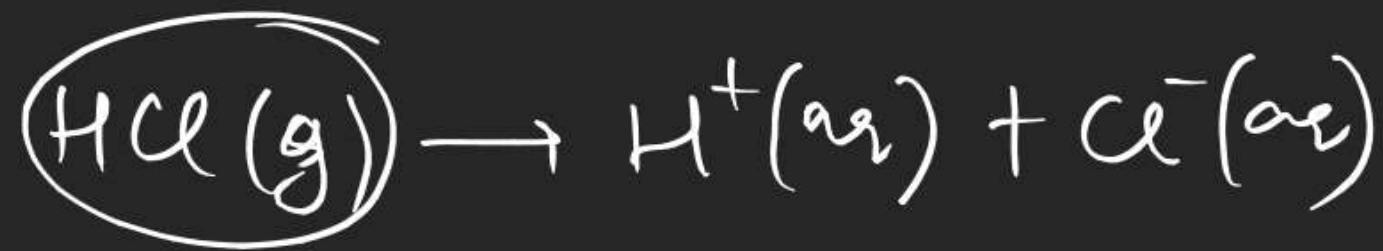
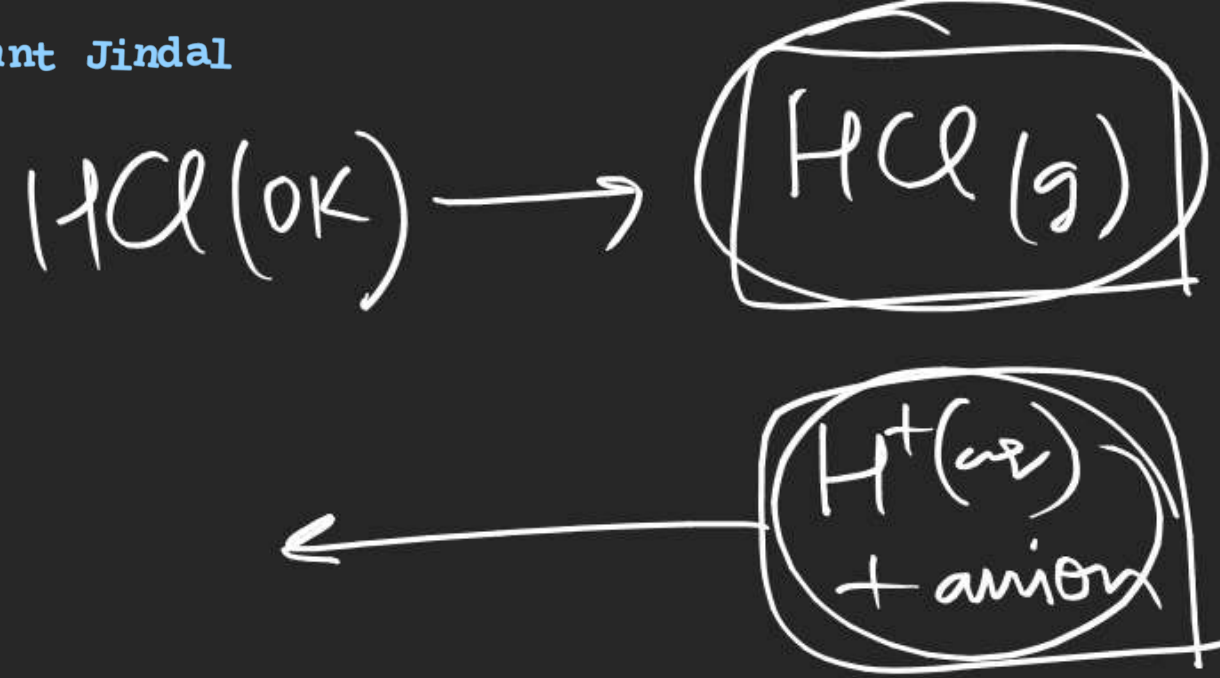


Assuming

$$\begin{aligned} \Delta H_f[\text{H}^+(\text{aq})] &= 0 \\ \rightarrow \Delta S_f[\text{H}^+(\text{aq})] &= 0 \\ \Delta G_f[\text{H}^+(\text{aq})] &= 0 \end{aligned}$$



$$\underline{\Delta H_r} = \underline{\Delta H_f(\text{pr})} - \underline{\Delta H_f(\text{r})}$$



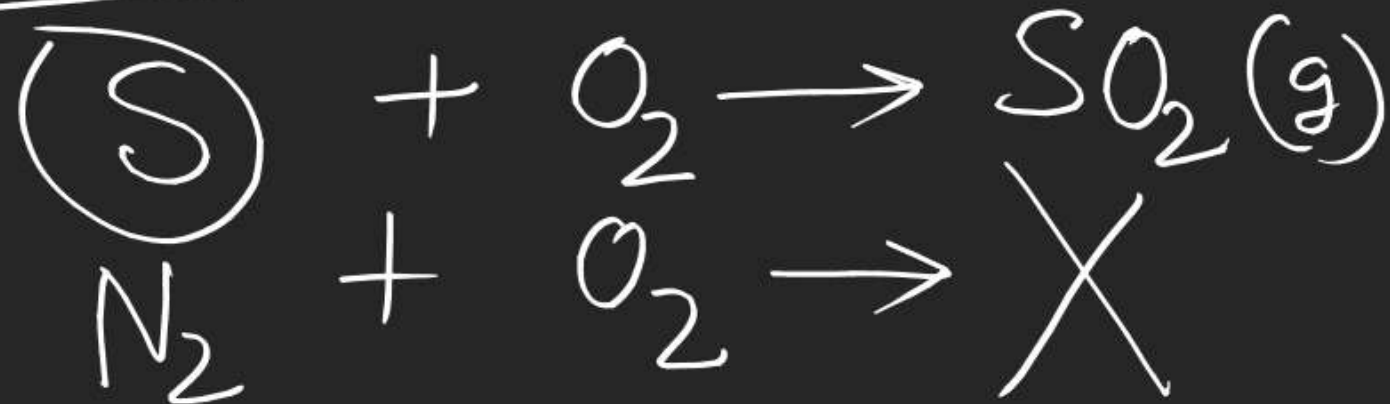
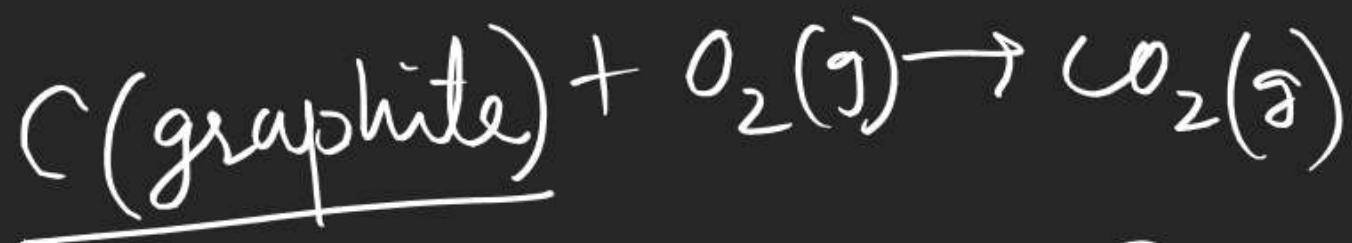
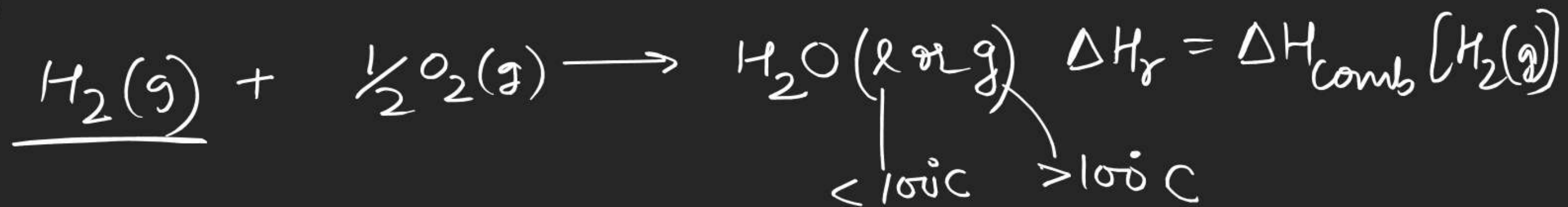
$$\underline{\Delta S_r} = S(\text{Pr}) - S(\text{R})$$

$$\Rightarrow S[\text{H}^+(\text{aq})] = 0$$

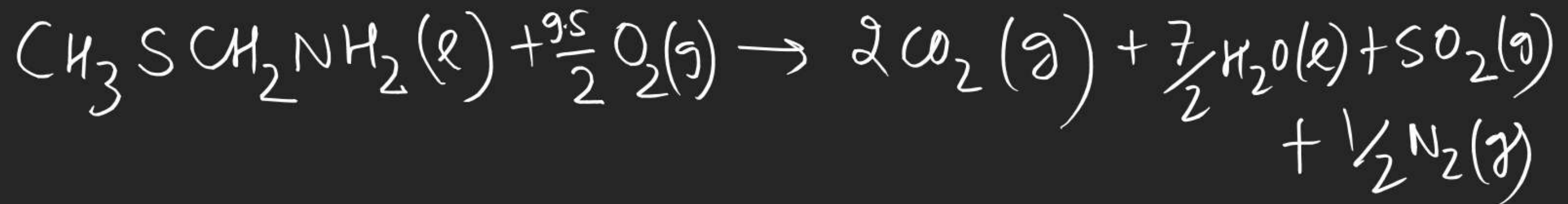
\Rightarrow entropies of ions may be -ive or +ive because they are wrt $\text{H}^+(\text{aq})$

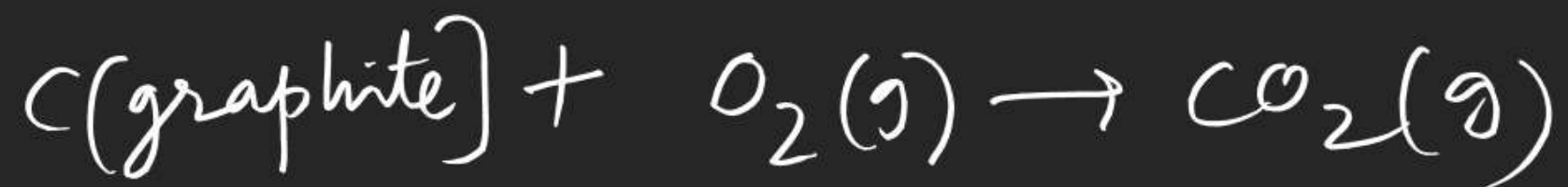
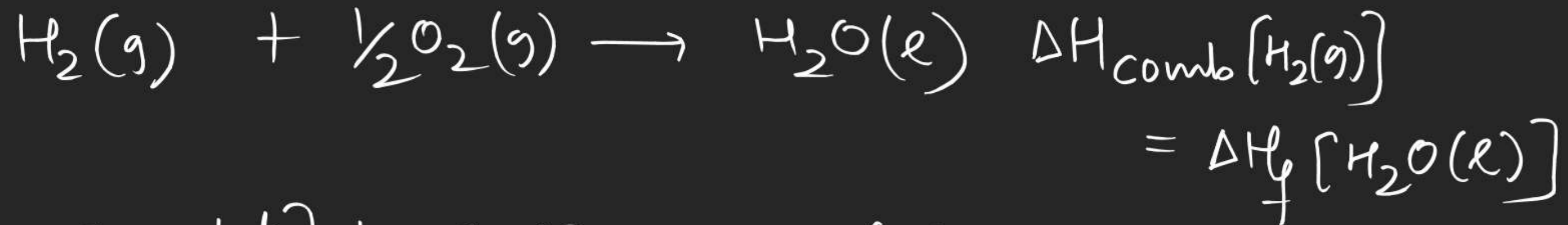
THERMOCHEMISTRY

Enthalpy of Combustion (ΔH_{comb}): — It is the enthalpy change when 1 mol substance is burnt with excess O_2 .



If temperature not given
then consider it to be room
temp.





$$\Delta H_{\text{comb}}[\text{graphite}] = \Delta H_f^\circ[\text{CO}_2(\text{g})]$$

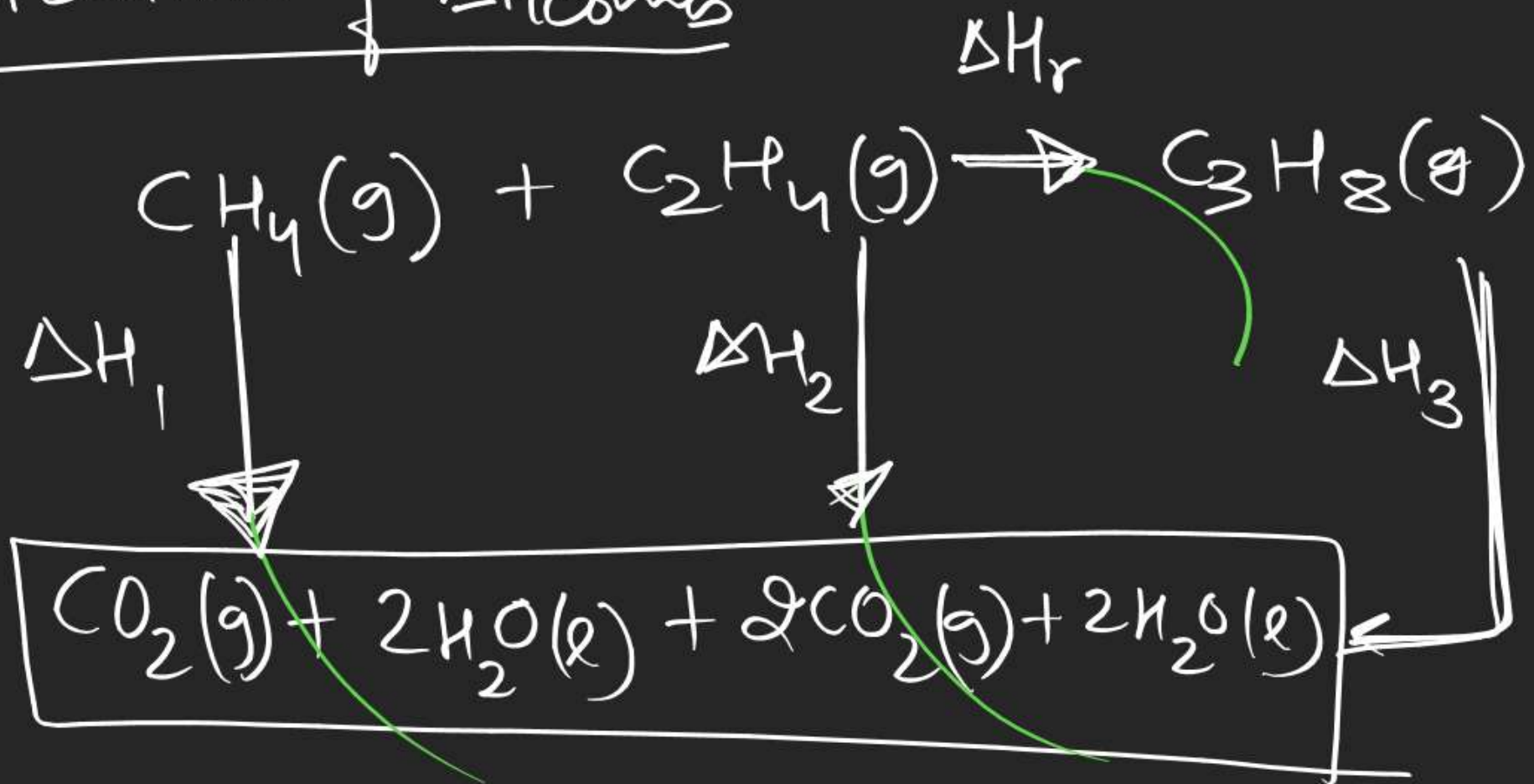
$$\Delta H_{\text{comb}} [\text{CO}_2(\text{g})] = 0$$

$$\Delta H_{\text{comb}} [\text{O}_2(\text{g})] = 0$$

$$\Delta H_{\text{comb}} [\text{Al}_2\text{O}_3(\text{s})] = 0$$

$$\Delta H_{\text{comb}} [\text{H}_2\text{O}(\text{l})] = 0$$

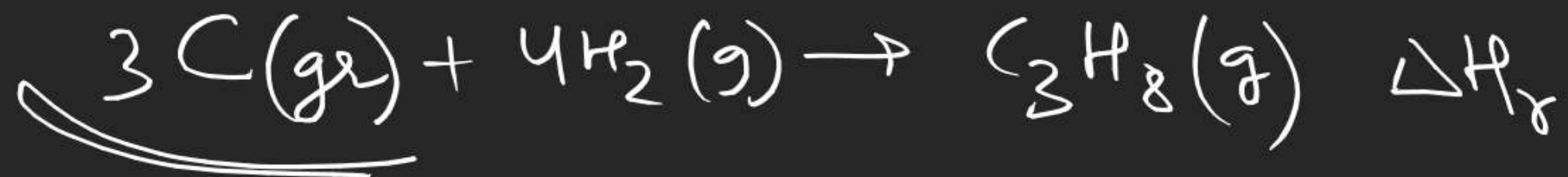
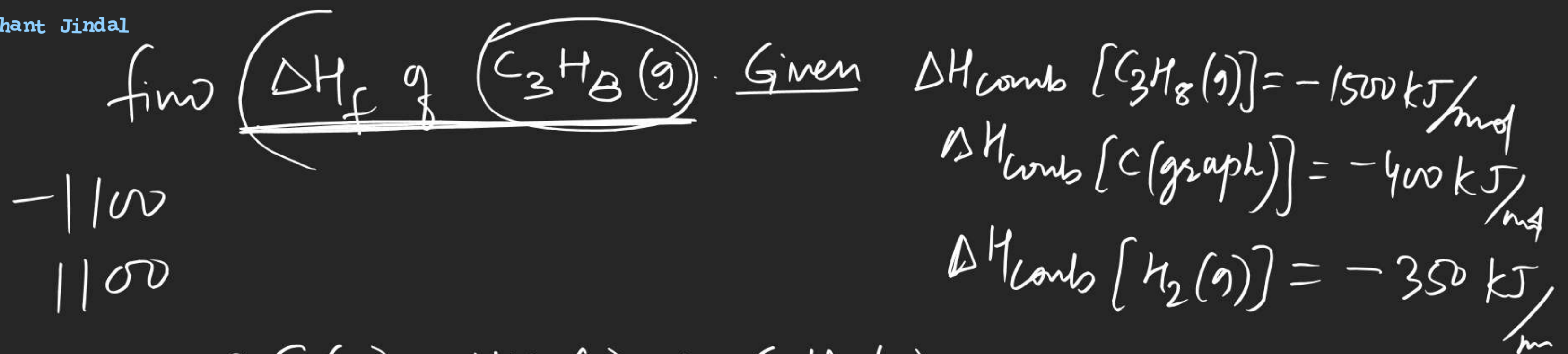
Application of ΔH_{comb}



$$\Delta H_r + \Delta H_3 = \Delta H_1 + \Delta H_2$$

$$\Delta H_r = \sum \Delta H_{\text{comb}}(R) - \sum \Delta H_{\text{comb}}(Pr)$$

$$\begin{aligned} &\Delta H_{\text{comb}}[\text{CH}_4(g)] \\ &\Delta H_{\text{comb}}[\text{C}_2\text{H}_4(g)] \\ &\Delta H_{\text{comb}}[\text{C}_3\text{H}_8(g)] \end{aligned}$$



$$\Delta H_f = \Delta H_r = \frac{\Delta H_{comb}(R)}{1} - \frac{\Delta H_{comb}(Pr)}{3}$$

$$= \Delta H_r = -1200 - 1400 + 1500$$

$$= \Delta H_r = -1100$$

0-I 1-9
5-L 1-G

0-II TD-2

⑧

$$\Delta S_{\text{sys}} = 0$$

 $S = \text{const}$ iso-entropic

⑨

A

$$\int \frac{dq}{T}$$

False

B

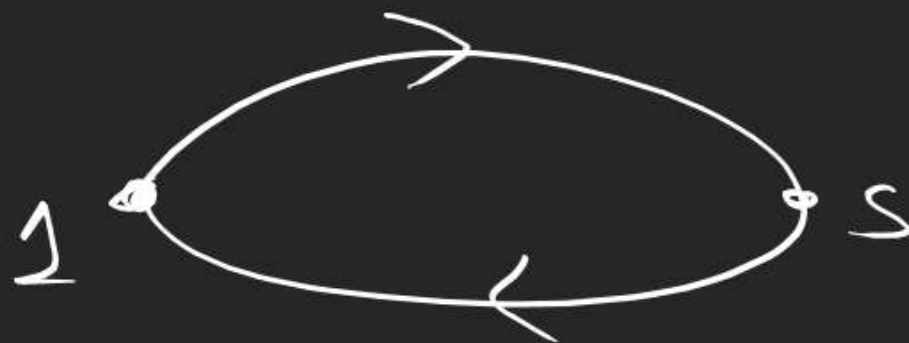
False

Surviv ↑

C

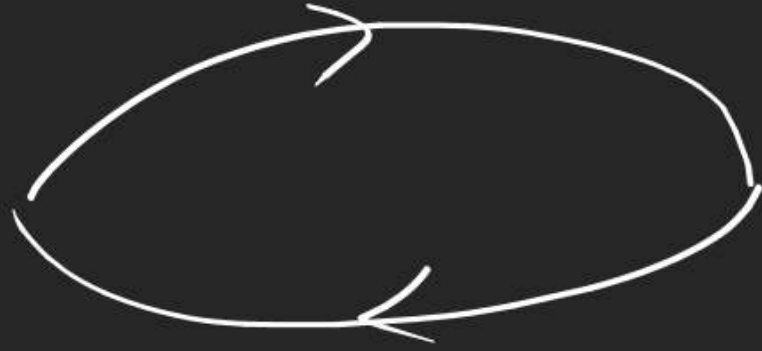
True

4

False

$$\Delta S = \int_1^2 \frac{q_{\text{rev}}}{T} + \left(\int_2^1 \frac{q_{\text{irr}}}{T} \right)$$

$$\Delta S_{\text{cycle}} = 0$$



$$\Delta S_{1-2} + \Delta S_{2-1} = 0$$

$$\sum \frac{q}{T} < 0$$

(10) AD

$$\underline{\int_1^2 \frac{q_{rev}}{T}} + \underline{\int_2^1 \frac{q_{irr}}{T}} < 0 = \underline{\Delta S_{cycle}}$$

①

$$(\Delta S_r)_{P_2} - (\Delta S_r)_{P_1} = \Delta n_g R \ln \frac{P_1}{P_2}$$

⑬



$$1 \text{ atm}, 400 \text{ K} \quad \Delta G_r = 0$$

$$\left[\begin{array}{ll} < 1 \text{ atm}, 400 \text{ K} & \Delta G_r < 0 \\ > 1 \text{ atm}, 400 \text{ K} & \Delta G_r > 0 \end{array} \right.$$

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(A)

True

$S > 0$

(B)

False

(C)

False

(D)

True

Remaining
0 - II