2025 Ch H1 Q18

Section: Chemistry in Society

Topic: Chemical Energy (Hess's Law)

Question summary

According to Hess's law, choose how to manipulate equations 1 and 2 to obtain equation 3.

Worked solution

Eq 1: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Eq 2: $2CO + O_2 \rightarrow 2CO_2$

Eq 3 target: $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$

Step 1: Multiply Eq 1 by 2 to match CH_4 and H_2O in Eq 3: $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$.

Step 2: Reverse Eq 2 so CO appears on the product side: $2CO_2 \rightarrow 2CO + O_2$.

Add the two manipulated equations; $2CO_2$ cancels:

$2CH_4 + 4O_2 \rightarrow 2CO + O_2 + 4H_2O \rightarrow 2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$ (after cancelling one O_2).

Therefore: Eq 1 multiplied by 2; Eq 2 reversed.

Final answer

B. Equation 1 multiplied by 2; Equation 2 reversed

Revision tips

- With Hess's Law, multiply, reverse, and add equations to build the target; cancel species appearing on both sides.

- Reversing an equation changes the sign of ΔH; multiplying changes the magnitude accordingly.

- Write species you need on the correct side first, then choose operations to make them match.