What is Hess's Law?

Worksheet

Hess's Law allows us to calculate H for any reaction by combining other reactions whose enthalpy changes are known. When combining reactions, reverse any that need reversing (flip the sign of H) and multiply reactions by coefficients as needed. The sum of all H values gives the overall H.

H(total) = H + H + ... + H

Questions

1. Hess's Law states H is:

A) independent of temperature
B) dependent on the pathway
C) independent of the pathway
D) always negative

2. Reverse reaction: A B, H = 500 kJ/mol. New H?

A) 500 kJ/mol
B) +500 kJ/mol
C) 0 kJ/mol
D) 250 kJ/mol

3. 3A 3B, H = 600 kJ/mol. If you double the reaction:

A) H = 300 kJ/mol
B) H = 1200 kJ/mol
C) H = 600 kJ/mol
D) H = +600 kJ/mol

4. Given H = 100, H = 200, H = +50 kJ/mol:

A) 250
B) 350
C) 150
D) 50

5. Given: (1) C + O CO, H = 393 kJ/mol. (2) 2CO + O 2CO, H = 566 kJ/mol. Find H for: 2C + O 2CO.

6. H = 200 kJ/mol, H = 150 kJ/mol, H = +50 kJ/mol. Total H?

7. Reaction A has H = 400 kJ/mol. If you reverse it, what is H?

8. Define: What is Hess's Law?

9. Define: Why is Hess's Law useful?

10. Define: When you reverse a reaction, what happens to H?

Answer Key

1. C) independent of the pathway - H depends only on initial and final states, not on how many steps occur.

2. B) +500 kJ/mol - Reversing gives: B A, H = +500 kJ/mol.

3. B) H = 1200 kJ/mol - Multiply the reaction by 2: 6A 6B, H = 2(600) = 1200 kJ/mol.

4. B) 350 - H(total) = 100 + (200) + 50 = 250 kJ/mol.

5. Write target: 2C + O 2CO Use reaction (1) twice, reverse (2) and divide by 2: Reaction (1) 2: 2C + 2O 2CO, H = 2(393) = 786 kJ/mol Reverse (2)2: CO CO + O, H = +566/2 = +283 kJ/mol Add them: 2C + 2O 2CO (H = 786) + CO CO + O (H = +283) Cancel O and CO: 2C + O 2CO, H = 786 + 283 = 503 kJ/mol

6. H(total) = H + H + H H(total) = (200) + (150) + (+50) H(total) = 300 kJ/mol

7. When reversing a reaction, flip the sign of H. Reversed: H = +400 kJ/mol This is useful when combining reactions and a particular pathway must go backwards.

8. The enthalpy change of a reaction is independent of the pathway; it depends only on the initial and final states.

9. It allows us to calculate H for reactions that are difficult or impossible to measure directly.

10. The sign of H is reversed (positive becomes negative, negative becomes positive).