

## 17.4

## CALCULATING HEATS OF REACTION

## Section Review

## Objectives

- Apply Hess's law of heat summation to find enthalpy changes for chemical and physical processes
- Calculate enthalpy changes using standard heats of formation

## Vocabulary

- Hess's law of heat summation
- standard heat of formation

## Key Equation

- $\Delta H^0 = \Delta H_f^0 (\text{products}) - \Delta H_f^0 (\text{reactants})$

## Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Hess's law of heat summation states that for a chemical equation that can be written as the 1 of two or more steps, the 2 change for the final equation equals the sum of the enthalpy changes for the individual steps. Hess's law makes it possible to measure the heat of a reaction 3. When a reaction is reversed, the sign of  $\Delta H$  must be 4.

Sometimes it is hard to measure the heat for a reaction. In such cases, the 5 is used to calculate heats of reaction at standard conditions. The standard heat of formation of a compound is the 6 in enthalpy that accompanies the formation of 7 mole of a compound from its elements. The symbol used for standard heat of formation is 8. The standard heat of formation of a free element in its standard state is 9. The standard heat of reaction is determined by 10 the  $\Delta H_f^0$  of all the reactants from the  $\Delta H_f^0$  of all the products.

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## Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- \_\_\_\_\_ 11. The standard heat of formation for a substance is determined at 100°C.
- \_\_\_\_\_ 12. Hess's law of heat summation is not related to the law of conservation of energy.
- \_\_\_\_\_ 13. When using Hess's law of heat summation, intermediate reactions are summed and terms are canceled, as in algebra, to arrive at a final equation.
- \_\_\_\_\_ 14. The  $\Delta H_f^0$  for  $I_2(g)$  is zero.
- \_\_\_\_\_ 15. The  $\Delta H_f^0$  for  $H_2O(l)$  and  $H_2O(s)$  are the same.

## Part C Matching

Match each description in Column B to the correct term in Column A.

### Column A

- \_\_\_\_\_ 16. standard heat of formation
- \_\_\_\_\_ 17. Hess's law of heat summation
- \_\_\_\_\_ 18.  $\Delta H_f^0$
- \_\_\_\_\_ 19.  $\Delta H^0$  for  $Br_2(g) \rightarrow Br_2(l)$
- \_\_\_\_\_ 20. zero

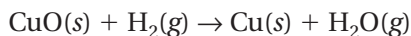
### Column B

- a. symbol for the standard heat of formation
- b. the change in enthalpy that accompanies the formation of 1 mole of a compound from its elements
- c. in going from a particular set of reactants to a particular set of products, the enthalpy change is the same whether the reaction takes place in one step or in a series of steps
- d.  $-30.91$  kJ
- e.  $\Delta H_f^0$  of  $Cl_2(g)$

## Part D Questions and Problems

Answer the following in the space provided.

21. Determine the heat of reaction for the following reaction.



Use the following thermochemical equations.

- 1)  $CuO(s) \rightarrow Cu(s) + \frac{1}{2}O_2(g)$      $\Delta H = 155$  kJ
- 2)  $H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$      $\Delta H = 242$  kJ

22. Calculate the change in enthalpy for the following reaction using standard heats of formation. (Refer to Table 17.4 in your textbook.)

