KEY

Chapter 16 Review

Honors Chemistry

1. Determine the original temperature of a 50.0-g piece of aluminum if 1500 joules were added, changing the temperature of the aluminum to78.3 °C. ($C_{aluminum}$ = 0.90 J/g x °C)

   $1500 = (50)(0.90)\Delta T \quad \Delta T = 33.3°C \quad \boxed{T_{original} = 45°C}$

2. In endothermic reactions, do the reactants or products have energy stored in chemical bonds? Explain.

   products (energy is absorbed into system)

3. In exothermic reactions, do the reactants or products have energy stored in chemical bonds? Explain.

   reactants (energy is released by system to surroundings)

4. When ice melts, it is gaining energy, but where does it get the energy from?

   From surroundings

5. When you put warm water in the freezer, what happens to the temperature of the water?

   decreases

6. When you put warm water in the freezer, what happens to the temperature of the air in the freezer?

   increases

7. What happens to the temperature of water during a phase change? Remains Constant

8. Use the equation below to determine the amount of energy required to produce 3 moles of water.
   $2NaHCO_3 + 129 \text{ kJ} \rightarrow Na_2CO_3 + H_2O + CO_2$

   $$\frac{3 \text{ moles } H_2O \;|\; 129 \text{ kJ}}{\;|\; 1 \text{ mol } H_2O} = \boxed{387 \text{ kJ}}$$

9. What is the difference between heat capacity and specific heat?

   heat capacity depends on mass; specific heat always for 1 gram

10. Which of the following has a larger specific heat, 5 grams of iron or 100 grams of iron? Explain.

    Same specific heat! only refers to 1 gram of a substance

11. When 20.0 g of diethyl ether ($C_4H_{10}O$) is converted to liquid at its boiling point, about how much heat is released? (ΔH_{cond} = -15.7 kJ/mol)

    $$\frac{20\text{g } C_4H_{10}O \;|\; 1 \text{ mol}}{\;|\; 74\text{g } C_4H_{10}O} \times \frac{-15.7 \text{ kJ}}{1 \text{ mol}} = \boxed{-4.2 \text{ kJ}}$$

12. What does the test tube feel like during an exothermic reaction?

    warm

13. What does the test tube feel like during an endothermic reaction?

    cold

14. What is the amount of heat needed to raise the temperature of a 350.0 g piece of iron by 25 °C? (C_{iron} = 0.45 J/g x °C)

    $q = (350\text{g})(0.45)(25°C) = \boxed{3937.5 \text{ J}}$

15. A piece of copper changes from 40 °C to 25 °C when 175 J of energy was removed from it. What is the mass of the copper? (C_{copper} = 0.39 J/g x °C)

    $175 = m(0.39)(15°C) \quad \boxed{m = 29.9 \text{ g}}$

16. Calculate the free energy change of a system at 275 K with an enthalpy change of 104 kJ and an entropy change of 270 J/K.

    $\Delta G = 104{,}000 - (275)(270) = \boxed{29{,}750 \text{ J} \rightarrow \text{not spontaneous}}$

17. Calculate ΔH for the following reaction: $2CO + O_2 \rightarrow 2CO_2$
    (ΔH^0_f for CO_2 = -394 kJ/mol; ΔH^0_f for CO = -111 kJ/mol)

    $[2(-394)] - [2(-111)] = \boxed{-566 \text{ kJ}}$

18. Use the following two equations to determine ΔH for $N_2(g) + 2H_2(g) \rightarrow N_2H_4(l)$

$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l)$ ΔH=-622.2 kJ

$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$ ΔH=-285.8 kJ

$\boxed{\Delta H = +50.6\text{ kJ}}$

$N_2(g) + 2H_2O(l) \rightarrow N_2H_4(l) + O_2(g)$ ΔH = +622.2 kJ

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ ΔH = -571.6 kJ

19. How much energy can be released if 96 grams of CH_4 reacts in the following reaction?

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (ΔH = -891 kJ)

$\frac{96\text{ g } CH_4}{} \left| \frac{1\text{ mol } CH_4}{16\text{ g } CH_4} \right| \frac{-891\text{ kJ}}{1\text{ mol } CH_4} = \boxed{-5346\text{ kJ}}$

20. A 40.0 g piece of iron was inserted into 100-mL of water at 10 °C. The final temperature of the water and iron was 12°C. What was the original temperature of the iron? (C_{iron} = 0.45 J/g x °C)

	Fe	H_2O
m	40	100
C	.45	4.18
ΔT	?	2 °C

$(40)(0.45)\Delta T = (100)(4.18)(2\,°C)$

$\Delta T = 46.4\,°C$

original temp of Fe = $\boxed{58.4\,°C}$

21. What is the specific heat of a 230 gram sample of an unknown substance if it absorbed 5.2 kJ raising its temperature from 10 °C to 32 °C?

$5200 = (230\text{g})C(22\,°C)$ $\boxed{C = 1.03\text{ J/g}\cdot°C}$

22. Explain the difference between a spontaneous and nonspontaneous reaction.

spontaneous (ideal) has −ΔH, +ΔS nonspontaneous (ideal) has +ΔH, −ΔS

23. What would happen to entropy as water evaporates?

increase in entropy (more randomness)

24. A 42.0 gram sample of steam at 108°C changes into ice at -14°C. Calculate the enthalpy change (in kJ) that takes place during this process.

① Tchange: 108→100 °C
$q = (42)(-2.01)(8) = -.7\text{ kJ}$

② phase change
$\frac{42\text{ g}}{} \left| \frac{1\text{ mol}}{18\text{ g}} \right| \frac{-40.7\text{ kJ}}{1\text{ mol}} = -95.0\text{ kJ}$

③ Tchange: 100→0 °C
$q = (42)(4.18)(100) = -17.6\text{ kJ}$

④ phase change
$\frac{42\text{ g}}{} \left| \frac{1\text{ mol}}{18\text{ g}} \right| \frac{-6.01\text{ kJ}}{1\text{ mol}} = -14.0\text{ kJ}$

⑤ T change: 0→ -14 °C
$q = (42)(-2.03)(14) = -1.2\text{ kJ}$

$\boxed{\Delta H = -128.5\text{ kJ}}$

25. A 54.0 gram piece of ice at -20°C changes into steam at 110°C. Calculate the enthalpy change (in kJ) that takes place during this process.

① Tchange: -20→0 °C
$q = (54)(2.03)(20) = +2.2\text{ kJ}$

② phase change
$\frac{54\text{ g}}{} \left| \frac{1\text{ mol}}{18\text{ g}} \right| \frac{6.01\text{ kJ}}{1\text{ mol}} = +18.0\text{ kJ}$

③ Tchange: 0→100 °C
$q = (54)(4.18)(100) = +22.6\text{ kJ}$

④ phase change
$\frac{54\text{ g}}{} \left| \frac{1\text{ mol}}{18\text{ g}} \right| \frac{40.7\text{ kJ}}{1\text{ mol}} = +122.1\text{ kJ}$

⑤ Tchange: 100 → 110 °C
$q = (54)(2.01)(10) = +1.1\text{ kJ}$

$\boxed{\Delta H = +166.0\text{ kJ}}$

26. If you add 2000- kJ of heat to a 50 g piece of iron and to a 50 g piece of aluminum at the same temperature, which will have a higher final temperature? Explain your answer.

(C_{iron} = 0.45 J/g x °C) ($C_{aluminum}$ = 0.90 J/g x °C)

Iron will have a higher final temperature because it has a lower specific heat.