Unit 12 Part 14: EZPZ Review

This is called an "E-Z-P-Z" Review. This review only hits the basic and foundation of the unit.
The extended and more difficult questions were on your QUEST homework so look there! ☺
This is just to make sure you at least know the **basics**!

Part 1: Temperature and Heat

1) One form of energy can be converted to another. Here are some examples:

   a) A flaming hot Cheeto is burned in chemistry lab.
   As Chemical energy is converted to Thermal energy.

   b) A space heater is plugged into an electrical outlet and used to warm up a room.
   As electrical energy is converted to Thermal energy.

   c) The process of photosynthesis is used to make a tasty carrot.
   As radiant energy is converted to chemical energy.

2) Complete the chart below:

	ΔH (+ or - ?)	**Heat** (Absorbed or released?)	**Type of Reaction** Endothermic or Exothermic?
energy + 2 H_2S + SO_2 → 3 S + 2 H_2O	+	A	Endo
N_2 (g) + 3 H_2 (g) → 2 NH_3 + energy	−	R	Exo
Ice freezing	−	R	Exo
Dry ice sublimation	+	A	Endo

Part 2: mCΔT and Calorimetry

1) A 1.5 g iron nail is heated to 95.0 °C and placed into a beaker of water. Calculate the heat gained by the water if the final equilibrium temperature is 57.8 ° C. The specific heat capacity of iron = 0.449 J/ g° C, and the specific heat capacity of water = 4.18 J/ g ° C.

$q_m = -q_w$ $\quad q_m = -25.1$

$q_w = 25.1$

2) A 32.5 g cube of aluminum initially at 45.8 °C is submerged into 105.3 g of water at 15.4 °C. What is the final temperature of both substances at thermal equilibrium? The specific heat of aluminum is 0.903 J/ g° C.

3) A block of copper of unknown mass has an initial temperature of 65.4 °C. The copper is immersed in a beaker containing 95.7 g of water at 22.7 °C. When the two substances reach thermal equilibrium, the final temperature is 24.2 °C. What is the mass of the copper block? (C of copper is 0.385 J/g°C)

37.9g

Part 3: Enthalpy

For each reaction:

a) Use the heats of formation in the chart below to determine the heat of each reaction.
b) Write the thermochemical equation.

Name	Formula	$\Delta H°_f$	Name	Formula	$\Delta H°_f$
Calcium oxide	CaO	-634.9 kJ/mole	Carbon monoxide	CO	-110.5 kJ/mole
Hydrochloric acid	HCl	-167.2 kJ/mole	Iron (II) oxide	FeO	-272.0 kJ/mole
Iron (III) oxide	Fe_2O_3	-824.2 kJ/mole	Hydrobromic acid	HBr	-36.4 kJ/mole
Carbon dioxide	CO_2	-393.5 kJ/mole	Ethane	C_2H_6	-83.8 kJ/mole
Calcium carbonate	$CaCO_3$	-1207.6 kJ/mole	Water (liquid)	H_2O	-285.8 kJ/mole

1) Calcium carbonate decomposes to calcium oxide and carbon dioxide.

$CaCO_3 \rightarrow CaO + CO_2$

a) 179.2

b) $179.2 + CaCO_3 \rightarrow CaO + CO_2$

2) $2\ C_2H_6\ (g) + 7\ O_2\ (g) \rightarrow 4\ CO_2\ (g) + 6\ H_2O\ (\ell)$

a) -11695.2 kJ

b) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O + 11695$

Part 4: Energy Stoich

1) The main engines of the space shuttle burn hydrogen to produce water. How much heat (in kJ) is associated with this process if 1.32×10^5 kg of liquid H_2 is burned?

$2\ H_2\ (\ell) + O_2\ (\ell) \rightarrow 2\ H_2O\ (\ell)$ $\quad \Delta H°_{rxn} = -571.6$ kJ

-3.77×10^{10} kJ

a) An LP gas tank in a home barbeque contains 13.2 kg of propane, C_3H_8. Calculate the heat (in kJ) associated with the complete combustion of all of the propane in the tank.

$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 3\ CO_2\ (g) + 4\ H_2O\ (g)$ $\quad \Delta H°_{rxn} = -2044$ kJ

$-612{,}000$ kJ

Part 5: Heating Curves

Determine the amount of heat gained (+) or lost (–) during each of the following changes.

Molar Heats of Fusion (H_f)	
aluminum	10.8 kJ/mol
titanium	18.8 kJ/mol
water	6.02 kJ/mol

Molar Heats of Vaporization (H_v)	
aluminum	284 kJ/mol
benzene	30.8 kJ/mol
water	40.7 kJ/mol

Specific Heat Capacity (C)	
aluminum	0.903 J / g · °C
water (solid)	2.06 J / g · °C
water (liquid)	4.18 J / g · °C
water (gas)	2.02 J / g · °C

1) Melting 55.8 g of Ti at 1677 °C. (The melting point of titanium is 1677 °C)

2) Heating 6.9 g of solid aluminum from 32 °C to 320. °C.

3) Converting 45.0 g of water at 20.0 °C to steam at 115 °C.

Part 6: Bond Energy

Thermochemical Equation	Endo- or Exothermic	Which is greater in energy: Bonds Broken or Bonds Formed
A + B + 127 kJ → C	Endo	
2 NO (g) + O_2 (g) → 2 NO_2 (g) + energy	Exo	

Part 7: Hess's Law

1) Use Hess's Law to determine ΔH for the following target reaction.

a) $2\ NOCl\ (g) \rightarrow N_2\ (g) + O_2\ (g) + Cl_2\ (g)$ $\quad \Delta H = \ ?$

$\frac{1}{2}\ N_2\ (g) + \frac{1}{2}\ O_2\ (g) \rightarrow NO\ (g)$ $\quad \Delta H = -90.3\ kJ \times 2$

$NO\ (g) + \frac{1}{2}\ Cl_2\ (g) \rightarrow NOCl\ (g)$ $\quad \Delta H = +38.6\ kJ \times 2$

$-103.4\ kJ$

b) $N_2\ (g) + 2\ O_2\ (g) \rightarrow 2\ NO_2\ (g)$ $\quad \Delta H = ?$

$N_2\ (g) + O_2\ (g) \rightarrow 2\ NO\ (g)$ $\quad \Delta H = 180\ kJ$

$2\ NO\ (g) + O_2\ (g) \rightarrow 2\ NO_2\ (g)$ $\quad \Delta H = -112\ kJ$

$68\ kJ$

c) $2\ N_2 + 6\ H_2O \rightarrow 3\ O_2 + 4\ NH_3$ $\quad \Delta H = ?$

$NH_3\ (g) \rightarrow \frac{1}{2}\ N_2\ (g) + \frac{3}{2}\ H_2\ (g)$ $\quad \Delta H = 46\ kJ$

$2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$ $\quad \Delta H = -484\ kJ$

$1268\ kJ$

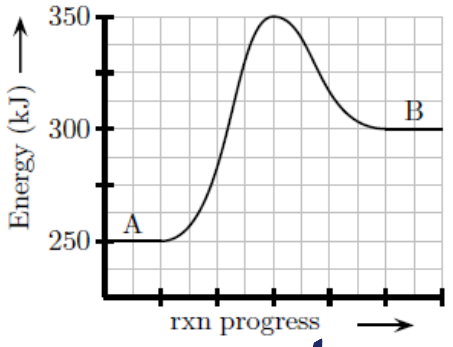
Part 8: Mixed Practice

For Problems 1) and 2), determine:

a) Whether the reaction is endothermic or exothermic.

b) Whether energy absorbed or released.

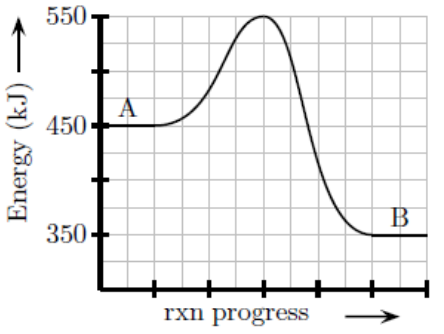
1)



a) Endo

b) +50 kJ

2)



a) Exo

b) −100 kJ

3) For the following reaction:

$$C_4H_{10}\ (g) + 13/2\ O_2\ (g) \rightarrow 4\ CO_2\ (g) + 5\ H_2O\ (g) \qquad \Delta H_{rxn} = -2658\ kJ$$

a) What mass of butane in grams is necessary to produce 1.5×10^3 kJ of heat?

32.7g

b) What mass of CO_2 is produced?

99.3g

4) If 5750 J of energy is added to 455g piece of glass, what was the temperature change of the glass? The specific heat of glass is 0.50 J/ g° C.

$\Delta T = 25.3\,^{\circ}C$

Determine the amount of heat gained (+) or lost (–) during each of the changes in problems 5) – 8).

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aluminum	10.8 kJ/mol
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water	6.02 kJ/mol

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aluminum	284 kJ/mol
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water (gas)	2.02 J / g · °C

5) Condensing 14.2 g of water at 100°C.

6) Melting 27.3 g of Al at 660 °C. (The melting point of aluminum is 660 °C.)

7) 220.0 g of ice at –35.0°C is converted to liquid water at 50.0°C.

8) 5.00 g of steam at 155°C is converted to liquid water at 100.0°C.

9) Given the reaction

$$Ba(OH)_2 \cdot 8H_2O + NH_4Cl + 164\ kJ \rightarrow BaCl_2 + 2\ NH_3 + 10\ H_2O$$

a) How much heat is absorbed or released if 223 g of ammonium chloride react completely with barium oxide octahydrate?

684 kJ

b) When this reaction occurs in a calorimeter, what will the temperature change be? (Assume the total mass of the calorimeter is 420. g and the specific heat of solution is 4.18 J/g°C).

−0.390

For Problems 10) and 11):

a) Use the heats of formation in the chart below to determine the heat of each reaction.
b) Write the thermochemical equation.

Name	Formula	$\Delta H°_f$	Name	Formula	$\Delta H°_f$
Calcium oxide	CaO	-634.9 kJ/mole	Carbon monoxide	CO	-110.5 kJ/mole
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10) Hydrobromic acid reacts with chlorine.

a) −261.6 kJ

b) $2\ HBr + Cl_2 \rightarrow 2\ HCl + Br_2$ +261

23362 kJ $Fe_2O_3\ (s) + 3\ CO\ (g) \rightarrow 2\ Fe\ (s) + 3\ CO_2\ (g)$

a) 23362

b)