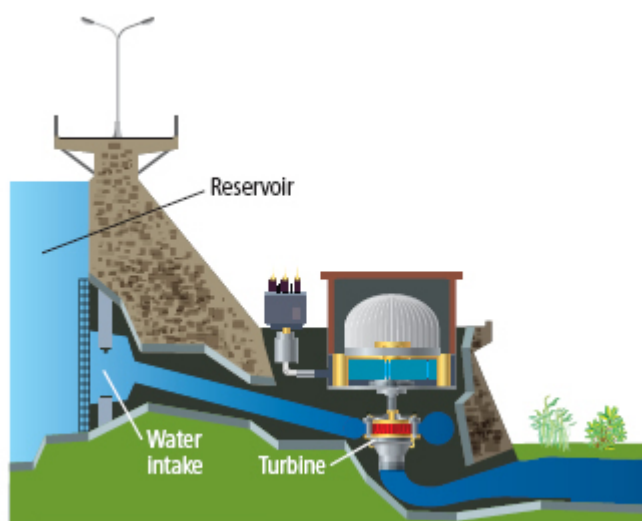


Chapter Self-Check

Energy and Chemical Change

Score: **50%** (5 out of 10 correct)

1. Before the water behind the dam is taken in through the water intake valve, what sort of useful energy does it possess?



- A. ☐ heat energy
- B. ☐ kinetic energy
- C. ☒ potential energy
- D. ☐ mass energy

Feedback: The water behind the dam has potential energy by virtue of its height.

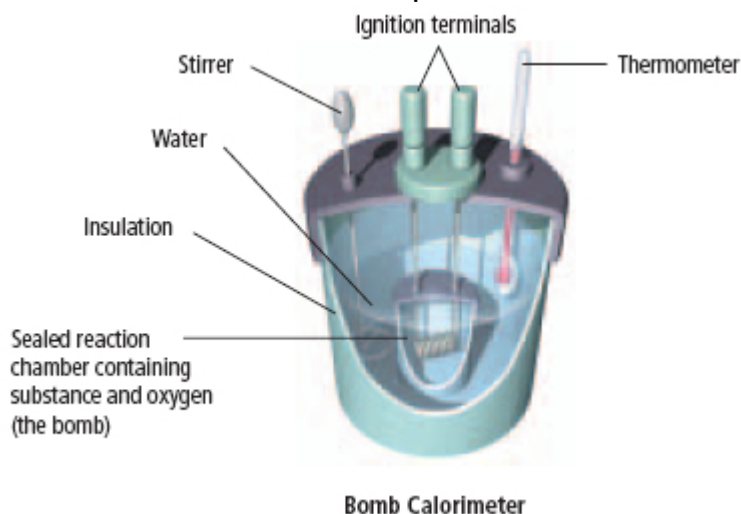
2. A 5 gram piece of aluminum foil at 100 degrees C is dropped into a 25 gram container of water at 20 degrees C. What is the final temperature of the aluminum?

Substance	Specific heat J/(g·°C)
Water(l)	4.184
Ethanol(l)	2.44
Water(s)	2.03
Water(g)	2.01
Beryllium(s)	1.825
Magnesium(s)	1.023
Aluminum(s)	0.897
Concrete(s)	0.84
Granite(s)	0.803
Calcium(s)	0.647
Iron(s)	0.449
Strontium(s)	0.301
Silver(s)	0.235
Barium(s)	0.204
Lead(s)	0.129
Gold(s)	0.129

- A. ☒ 16.4 degrees C
- B. ☒ 23.6 degrees C
- C. ☐ 96.4 degrees C
- D. ☐ 103.6 degrees C

Feedback: Set the energy gained by water equal to the energy lost by aluminum and the sum of the changes in temperature equal to 80 degrees. Solve these two simultaneous equations for change in temperature.

3. In the bomb calorimeter pictured, what is the function of the water?



- A. ☐ The water insulates the reaction.
- B. ☐ The water prevents an explosion.
- C. ☒ The water absorbs or provides energy.
- D. ☐ The water provides hydrogen gas for ignition.

Feedback: The water changes temperature as heat is either released or absorbed by the reacting substances.

4. 125 grams of water are placed in a foam cup. The initial temperature is 22.3 degrees Celsius. An 11.8 gram sample of metal is placed in the water at 108 degrees Celsius. The final temperature is 24.0 degrees Celsius. What is the specific heat of the metal, and what metal might the sample be?

Substance	Specific heat J/(g·°C)
Water(l)	4.184
Ethanol(l)	2.44
Water(s)	2.03
Water(g)	2.01
Beryllium(s)	1.825
Magnesium(s)	1.023
Aluminum(s)	0.897
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Iron(s)	0.449
Strontium(s)	0.301
Silver(s)	0.235
Barium(s)	0.204
Lead(s)	0.129
Gold(s)	0.129

- A. ☒ 0.897, aluminum
 B. ☐ 1.825, beryllium
 C. ☐ 0.449, iron
 D. ☐ 1.023, magnesium

Feedback: $c = 125 \text{ grams water} \times 4.184 \times 1.7 \text{ degrees} / (11.8 \text{ grams unknown} \times 84 \text{ degrees}) = 0.897$

5. Spraying ethanol on your hand makes your hand feel cool. How much heat is absorbed in turning 3.00 grams of ethanol from a liquid to a vapor?

Substance	Formula	$\Delta H_{\text{vap}}^{\circ}$ (kJ/mol)	$\Delta H_{\text{fus}}^{\circ}$ (kJ/mol)
Water	H ₂ O	40.7	6.01
Ethanol	C ₂ H ₅ OH	38.6	4.94
Methanol	CH ₃ OH	35.2	3.22
Acetic acid	CH ₃ COOH	23.4	11.7
Ammonia	NH ₃	23.3	5.66

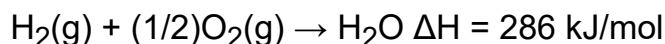
- A. ☐ 115.8 kJ
 B. ☐ 1.19 kJ

C. ☐ 0.321 kJ

D. ☒ 2.51 kJ

Feedback: 3.00 g ethanol = 0.0651 mol ethanol. $0.0651 \times 38.6 \text{ kJ/mol} = 2.51 \text{ kJ}$ absorbed.

6. A hydrogen balloon containing 0.250 moles of hydrogen gas explodes in the presence of oxygen such that all the hydrogen reacts. How much heat is released?



A. ☐ 143 kJ

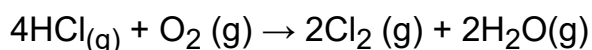
B. ☐ 286 kJ

C. ☒ 71.5 kJ

D. ☐ 0.25 kJ

Feedback: $0.250 \text{ mol} \times 286 \text{ kJ/mol} = 71.5 \text{ kJ}$

7. From the following data, $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g}) \quad \Delta H^\circ = -185 \text{ kJ}$, $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g}) \quad \Delta H^\circ = -483.7 \text{ kJ}$, calculate ΔH° for the following reaction.



A. ☐ 299 kJ

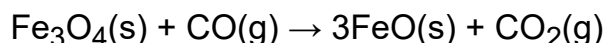
B. ☒ -114 kJ

C. ☐ -299 kJ

D. ☐ 114 kJ

Feedback: HCl is a reactant in the final equation but a product in the original equation. In addition, the amount of HCl in the final equation is twice that of the original. Therefore, the first original equation must be reversed and multiplied by 2. The second original equation does not need to change. The enthalpy of the final equation is $-2(-185 \text{ kJ}) + (-483.7 \text{ kJ}) = -114 \text{ kJ}$

8. Calculate ΔH° for the following reaction. The standard enthalpies of formation for the two reactants and two products are, in order, -1118, -110.5, -272, -393.5



A. ☐ -263 kJ

- B. ☐ 54 kJ
C. ☒ 19 kJ
D. ☐ -50 kJ

Feedback: The enthalpy of the reaction is the sum of the enthalpies of the products less the sum of the enthalpies of the reactants. Enthalpy of reaction = $[3 \text{ mol FeO} \times (-272 \text{ kJ/mol}) + (1 \text{ mol CO}_2 \times (-393.5 \text{ kJ/mol}))] - [1 \text{ mol Fe}_3\text{O}_4 \times (-1118 \text{ kJ/mol}) + (1 \text{ mol CO} \times (-110.5 \text{ kJ/mol}))] = +19 \text{ kJ}$

9. Exothermic chemical reactions accompanied by an increase in entropy are all _____.

- A. ☐ impossible
B. ☐ nonspontaneous
C. ☒ spontaneous
D. ☐ positive

Feedback: Exothermic chemical reactions accompanied by an increase in entropy are all spontaneous.

10. For a particular process, $\Delta H_{\text{system}} = -160 \text{ kJ}$ and $\Delta S_{\text{system}} = -400 \text{ J/K}$. Find ΔG_{system} at 298 K. Is the process spontaneous?

$$\Delta G_{\text{system}} = \Delta H_{\text{system}} - T\Delta S_{\text{system}}$$

- A. ☒ -40.8 kJ, spontaneous
B. ☐ -40.8 kJ, nonspontaneous
C. ☐ 40.8 kJ, spontaneous
D. ☐ 40.8 kJ, nonspontaneous

Feedback: $-160 - (-0.4 \times 298) = -40.8 \text{ kJ}$. The negative sign indicates that the reaction is spontaneous.

Retake Test

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