

Chemistry CP

Name:

Thermochemistry Review Sheet

Section:

After studying this unit, you should be able to:

- Distinguish between temperature and heat.
- Explain the heat capacity of objects and express it in standard units of heat.
- Describe heat changes in terms of a system and its surroundings.
- Use specific heat capacity to calculate the heat changes that occur in chemical and physical properties.
- Construct equations that show the heat changes for chemical and physical processes.
- Describe in words and in diagrams the heat changes that occur in melting, freezing, boiling, and condensing.
- Apply Hess' Law of heat summation to find heat changes for chemical and physical processes.
- Show how changes in entropy relate to a change of state, a change in temperature, and a change in the number of product particles compared with reactant particles.
- Explain how changes in energy and changes in entropy both influence the spontaneity of a reaction.

Use the following constants in your problems:

$$C_p(\text{ice}) = 2.077 \text{ J /g } ^\circ\text{C}$$

$$C_p(\text{water}) = 4.180 \text{ J /g } ^\circ\text{C}$$

$$C_p(\text{water vapor}) = 2.042 \text{ J /g } ^\circ\text{C}$$

$$\Delta H_{\text{fus}} = 6.00 \text{ kJ/mol} = 333 \text{ J/g}$$

$$\Delta H_{\text{vap}} = 40.6 \text{ kJ/mol} = 2254 \text{ J/g}$$

Problems for you to try:

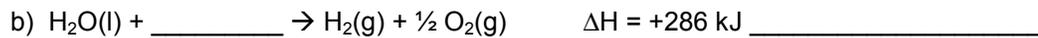
1. A 55.6 g sample of water is cooled from 50.0°C to 35.5 °C. How many joules are released? (3370 J)

2. A 22.2 g sample of silver absorbs 65.5 J of heat energy when its temperature is raised from 31.0°C to 43.5°C. Find the specific heat of silver. (.236 J/g oC)

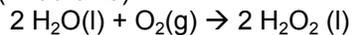
3. A sample of an unknown metal weighed 15.2 g and released 274 J when it was cooled from a temperature of 110°C to 90.0°C. Another sample of metal weighed 17.3 g and absorbed 417 J of heat energy when its temperature was raised from 55.5°C to 82.3°C. Use your knowledge of specific heat to determine whether the two samples were composed of the same type of metal and explain your conclusions.

4. How much heat is lost when 28.3 g of H₂O vapor at 100°C are converted to liquid at 100°C?
(64 kJ)
5. How much heat is lost when 12.4 g of water vapor at 110°C are converted to liquid at 50.0°C?
Include a sketch or diagram in your answer. (30.8 kJ)
6. Suppose you add 0.05 mol NaOH to 100 mL of water at 20.0°C in a plastic cup calorimeter.
The temperature of the resulting solutions increased to 27.0°C. What is the heat change (in
kJ) of this reaction? (2.7 kJ) What is the heat change per moles of NaOH?
7. Rewrite the following equations to show the heat changes. Draw potential energy diagrams
showing the relative energies of the reactants and products.
- a) $\text{CaO(s)} + \text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2$ Exothermic, $\Delta H = 65.2 \text{ kJ}$
- b) $2 \text{NaHCO}_3\text{(s)} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O(g)} + \text{CO}_2\text{(g)}$ Endothermic, $\Delta H = 129 \text{ kJ}$

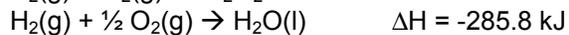
8. Fill in the missing pieces of information in the blanks and state whether the reaction is endothermic or exothermic.



9. What is the enthalpy change, ΔH , for the combination of water and oxygen to form hydrogen peroxide? (+195.8 kJ)



Use the following two thermochemical equations:



10. Do the following reactions show an increase or decrease in entropy?

- a) $\text{CuO(s)} \rightarrow \text{Cu(s)} + \frac{1}{2} \text{O}_2(\text{g})$
- b) $\text{H}_2\text{O(g)} \rightarrow \text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g})$
- c) $2 \text{NaCl(s)} \rightarrow 2 \text{Na(s)} + \text{Cl}_2(\text{g})$
- d) $\text{Ba}^{2+}(\text{aq}) + \text{Sn(s)} \rightarrow \text{Ba(s)} + \text{Sn}^{2+}(\text{aq})$