NAME: **HONORS CHEMISTRY**

SECTION: Energy Review Sheet

**After studying chapter 10 you should be able to:**

* State the general properties of energy.
* Define and give examples of state functions.
* Compare and contrast temperature and heat.
* Compare and contrast endothermic and exothermic processes.
* Describe in words and diagrams the heat changes that occur in melting, freezing, boiling, and condensing, and calculate the heat changes involved.
* Calculate the heat changes that occur in chemical and physical processes
* Apply Hess’ Law of heat summation to find heat changes for chemical and physical properties.
* State two reasons why reactions occur.
* State the reasons that enthalpy changes occur in chemical reactions.
* Calculate enthalpies of formation and use them to calculate enthalpies of reaction.
* Explain how the quality of energy changes as it is used.
* Describe and give examples of changes in entropy.
* Calculate Gibb’s free energies, and relate Gibb’s free energy to the spontaneity of reactions.

1. State the first and second laws of thermodynamics.
2. Does condensation absorb or release energy? Explain what happens to the particles during

condensation.

3. Why do phase changes occur with no change in temperature?

4. Calculate the energy needed to change 9.00 g of ice at –20.0 oC to steam at 100.0oC. Include a sketch.

Use the following constants in your problems:

Cp(ice) = 2.077 J /g oC

Cp(water) = 4.180 J /g oC

Cp(water vapor) = 2.042 J /g oC

Hfus = 6.00 kJ/mol= 333 J/g

Hvap = 40.6 kJ/mol = 2254 J/g

5. State the primary reason that enthalpy changes may occur during chemical reactions.

6. Calculate the enthalpy change for the reaction A2 + B 🡪 A2B

Given the following information: AB + A 🡪 A2 + B Ho = + 27.1 kJ/mol

A2B 🡪 A + AB Ho = -30.4 kJ/mol

a) Is the total reaction endothermic or exothermic? How can you tell?

b) What is the value of Ho for the reverse reaction A2B 🡪 A2 + B?

7. Calculate the heat of reaction for the formation of 2 mol of solid carbon from the decomposition of carbon dioxide. Use the following data.

C(s) + CO2(g) 🡪 2 CO(g) H = +173 kJ

2CO(g) + O2(g) 🡪 2CO2(g) H = -567 kJ

8. With one exception, the standard heats of formation of all the following substances are identical: Na(s), O2(g), Br2(l), CO(g), Fe(s), He(g). What is the standard heat of formation for all but one? What is the exception? Explain the difference.

9. Use enthalpy of formation data to find the enthalpy change for the reaction: (Refer to <http://fizyczna.chem.pg.gda.pl/files/2012/10/chf_epm_cr_00.pdf> or your coral handout)

C2H4(g) + 3 O2(g) 🡪 2 CO2(g) + 2 H2O(g)

10. What is meant by entropy change? What is the symbol?

11. Give examples of situations which result in a change in entropy, and explain them.

12. Why is the “quality” of energy decreasing in the universe?

13. What is the entropy change for the single displacement reaction between NaCl and F2? The entropy of sodium fluoride is 51.5 J/mol K—refer to (Refer to <http://fizyczna.chem.pg.gda.pl/files/2012/10/chf_epm_cr_00.pdf> or your lilac handout)

14. A large box is divided into two compartments with a door between them. Equal quantities of two different monatomic gases are placed in the two compartments, as shown in the overhead view in a. The door between the compartments is opened and the gas particles immediately start to mix as shown in b. Why would it be highly unlikely for the situation in b to progress to the situation shown in c?

A B C

  

15. How is Gibb’s Free Energy calculated?

16. How can you predict whether a reaction will proceed spontaneously?

17. Under what conditions might you expect an endothermic reaction to proceed spontaneously?

18. Why are “matter spread” and “energy spread” considered to be driving forces?

19. Use <http://fizyczna.chem.pg.gda.pl/files/2012/10/chf_epm_cr_00.pdf> to calculate Hfo, So, and Gfo for the following reaction:

2 H2S(g) + 3O2(g) 🡪 2 H2O(g) + 2 SO2(g)

20. Calculate the free energy changes for each of the following reactions. Determine if each reaction will be spontaneous.

a) C(s) + 2H2(g) 🡪 CH4(g) S = -80.7 J/K, H = -75.0 kJ, T = 298 K

b) 3 Fe2O3(s) 🡪 2 Fe3O4(s) + ½ O2(g) S = 134.2 J/K, H = 235.8 kJ, T = 298 K

1. For reaction b, find the minimum temperature above which the reaction will become spontaneous. Calculate G for this reaction if 1 mol of oxygen gas is formed at 298 K.

21. Use the following terms to fill in the blanks provided. Each word may be used once, more than once, or not at all.

Decrease

Dependent

Equilibrium

Increase

Independent

Maximum

Minimum

Negative

Positive

Temperature

Zero

The enthalpy of a system is a) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the path taken in going from the initial state to the final state. Natural processes tend to move toward states of b) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ disorder and c) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. In an exothermic reaction, the H will have a

Answers to selected questions

4. 27600 J

7. +788 kJ

9. -1323 kJ

13. -21.2 J

19. -1036 kJ, -152.9 J/K, -990.5 kJ

20. (a) -51.0 kJ; spon

b) +195.8 kJ; non

c) T = 1757 K; G = +391.6 kJ per mole O2 formed

d) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sign. Endothermic reactions and weak exothermic reactions often can take place spontaneously if the e) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is raised. The sign of S is

f) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when the system is becoming less disordered. When the free energy of a system is zero, the system is at g) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In a spontaneous reaction, the sign of the free energy will be h) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.