Name _____ Section _____

Period 6b Activity Sheet: The Laws of Thermodynamics

6.3 Equilibrium and the Second Law of Thermodynamics

Your instructor will discuss equilibrium, which is a system or object that does not change over time.

1) Equilibrium Examples

a) List of examples of objects or systems in equilibrium.

b) Which sets of photographs illustrate systems going toward equilibrium?

2) Equilibrium and Entropy

Explain how equilibrium is related to entropy.

3) The Second Law of Thermodynamics

Your instructor will discuss several statements of the second law of thermodynamics. Give examples from the classroom to illustrate each statement.

a) The entropy of a physical system left to itself will increase or, if the system is already at its maximum entropy, the entropy will remain the same.

b) Any system, when left to itself, tends toward equilibrium with its surroundings.

c) The entropy of a system that is in equilibrium with its surroundings remains constant.

Your instructor will discuss the relationship between irreversible processes and perpetual motion machines. Another version of the second law is shown below. Give examples to illustrate it.

d) All physical processes are irreversible.

e) Group Discussion Question: What happens to entropy of the dorm room of a typical college student over the course of the academic year? What must be done to the room to decrease its entropy?

6.4 Reversible Processes and Perpetual Motion

4) Sand Mix together the two different colors of sand.

a) Will the mixed colors of sand naturally go back to its unmixed state? _____

b) What must be done to separate the two colors of sand?

c) Is the process of mixing the sand a reversible or irreversible process?

5) The Dippy Duck revisited

Is the Dippy Duck a perpetual motion machine? If not, what is its source of energy?

6) Perpetual Motion Machines?

Your instructor will show you examples of "perpetual motion" machines.

Can a machine run on its own forever without some kind of energy input? Why or why not?

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6.5 Efficiency and Irreversible Processes

7) Engines Your instructor will discuss and demonstrate several types of engines, heat engines and motors.

a) What is the difference between a heat engine and an electric motor?

b) How is work related to equilibrium?

c) Can a system ever return to a non-equilibrium state?

8) Air Conditioners Your instructor will demonstrate an air conditioner.

a) How does the palm glass filled with freon apply to an air conditioner (or a refrigerator)?

b) What is the cooling mechanism in an air conditioner (or refrigerator)?

9) Calculations with Heat Engines, Heat Pumps, and Refrigerators

a) What is the maximum efficiency of a heat engine that has 100 ^{o}C at the high temperature region and 20 ^{o}C in the low temperature region? (Hint: First, convert the temperatures from Celius to Kelvin by adding 273 K.)

b) You use a heat pump to warm your house. If the air temperature outside of the house is – 10 ^{o}C and the temperature inside is 23 ^{o}C, what is the maximum coefficient of performance for this heat pump? (Hint: First, convert the Celsius temperatures to Kelvin by adding 273 degrees. Then use equation 6.7.)

c) Group Discussion Question: What is the difference between a heat pump and a refrigerator?