Honors Chemistry

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Mods: \_\_\_\_\_\_\_\_\_

*Energy & Thermochemistry*

1. Energy is defined as the ability to do work (w) or transfer heat (q). The SI unit for energy is the

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ( ). An older unit for describing energy is the calorie (**cal**). The **Calorie** is used to describe energy in food and is equal to 1000 calories or 1 kcal.

**1 cal = 4.184J**   **1 Cal = 1000 cal = 1 kcal**

1. Convert the following from one unit to the other using dimensional analysis and the conversion factors listed above.
2. 1.69 joules to calories
3. 196 calories to kilojoules
4. 68 calories to kilocalories
5. 74 Calories to kilocalories
6. 6.78 kilocalories to kilojoules
7. 449.6 joules to Calories
8. In a thermodynamic study, a scientist focuses on the properties of a solution in a flask that is sealed with a stopper.
   1. What is the system of this study? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. What are the surroundings of this study? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sign Conventions for q, w, and ∆E

|  |  |  |
| --- | --- | --- |
| For q | + = | * = |
| For w | + = | * = |
| For ∆E | + = | * = |

1. The change in energy of a system depends on heat (q) and work (w) in the following relationship: **ΔE = q + w**.

A system releases heat to its surroundings and has work done on it by the surroundings.

* 1. Sketch a box to represent the system. Use arrows to represent the heat and work transferred.
  2. Is it possible for ΔE to be positive for this process? Explain.
  3. Is it possible for ΔE to be negative for this process? Explain.

1. Calculate ΔE and determine whether the process is endothermic or exothermic for the following cases:
   1. A system releases 113 kJ of heat to the surroundings and does 39 kJ of work on the surroundings.
   2. The system absorbs 77.5 kJ of heat while doing 63.5 kJ of work on the surroundings.

*Additional Energy and Thermochemistry Practice Problems*

1. Convert the following from one unit to the other using dimensional analysis and the conversion factors:

**1 cal = 4.184 J and 1 Cal = 1000 cal = 1 kcal**

a) 8.5 x 10-2 calories to Calories

b) 444 calories to joules

c) 1.8 kilojoules to joules

d) 4.5 x 10-1 kilojoules to calories

e) 5.26 kilocalories to kilojoules

f) 23.5 joules to calories

1. Imagine a book is falling from a shelf. At a particular moment during its fall, it has a kinetic energy of 13 J and a potential energy with respect to the floor of 72 J.
   * 1. How do its kinetic and its potential energy change as it continues to fall?
     2. What is its total kinetic energy in the instant just before it strikes the floor?
2. The contents of the closed box in each of the following illustrations below represents a system, and the arrows show the changes to the system during some process. The lengths of the arrows represent the relative magnitudes of q and w.
3. Which of these processes is endothermic?
4. For which of these processes, if any, is ∆E < 0?
5. For which process, if any, is there a net gain in internal energy?
6. Imagine a container placed in a tub of water, as depicted in the diagram below.
7. If the contents of the container are the system and heat is able to flow through the container walls, what qualitative changes will occur in the temperatures of the system and its surroundings?
8. What is the sign of q associated with each change?
9. For the following processes, calculate the change in internal energy (∆E) and determine whether the process is endothermic or exothermic.

**ΔE = q + w**

1. A system absorbs 85 kJ of heat from its surroundings while doing 29 kJ of work on the surroundings.
2. q = 1.50 kJ and w = -657 J
3. The system releases 57.5 kJ of heat while doing 13.5 kJ of work on the surroundings.
4. A balloon is heated by adding 900 J of heat. It expands, doing 422 J of work on the atmosphere.
5. A 50 g sample of water is cooled from 30°C to 15°C, thereby losing approximately 3140 J of heat.
6. A chemical reaction releases 8.65 kJ of heat and does no work on the surroundings.