

## The First Law of Thermodynamics

1. For the following processes, calculate the change in the internal energy,  $\Delta E$ , of the system and indicate if the process is exothermic or endothermic.

a) a balloon is cooled with 0.687 kJ of heat released. The balloon decreases in size when cooled and the atmosphere does 365 J of work on the balloon.

$$\Delta E = q + w \quad q = -687 \text{ J} \quad w = 365 \text{ J}$$

$$\Delta E = -687 \text{ J} + 365 \text{ J} = -322 \text{ J}$$

This process is exothermic

b) An insulated vessel contains a gas. The gas is compressed in an insulated vessel. The surroundings do 1.58 kJ of work when compressing the gas.

$$\Delta E = w \quad q = 0 \text{ J} \quad w = 1.58 \text{ kJ}$$

$$\Delta E = 1.58 \text{ kJ}$$

This process is neither exothermic or endothermic

c) A 100 g sample of aluminum is heated from 22.0°C to 65.0°C and absorbs 364 J of heat. Assume the volume of the aluminum sample is constant.

$$W = 0, \quad q = +364 \text{ J} \quad \Delta E = q = 364 \text{ J}$$

This process is endothermic

2. Indicate which of the following is not dependent on the path taken by which a change occurs.

a) the change in potential energy when a calculator is transferred from a table to a shelf.

Is independent. Potential Energy is a state function.

b) the heat that is evolved when a teaspoon of sugar (sucrose) is oxidized to  $\text{CO}_2$  (g) and  $\text{H}_2\text{O}$  (g).

Dependent. Some of the energy released could be used to perform work. This is done when sugar is metabolized in the body. Heat is not a state function.

c) the work accomplished when a gallon of propane is burned.

Dependent. The amount of work depends on if the propane is used in an engine, burned in an open flame, etc. Work is not a state function.