

$$w = -P\Delta V \quad \Delta E = q + w \quad \Delta H = \Delta E + P\Delta V \quad q = \text{heat capacity} \times \text{mass} \times \Delta T$$

heat transferred at constant volume: $q_v = \Delta E$
 heat transferred at constant pressure: $q_p = \Delta H$
 101 J/L*atm

1. (2 points) Which of the following is not a type of energy or energy flow?
 a. Temperature b. Work c. $P\Delta V$ d. Heat e. Chemical energy

2. (2 points) Positive work is done on the system when:
 a. $\Delta V = 0$ b. $\Delta V < 0$ c. $\Delta E > 0$ d. $\Delta V > 0$ e. none of these

3. (2 points) What is the first law of thermodynamics?

4. (2 points) The enthalpy of fusion of water is positive and corresponds to which physical change
 a. $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$ d. $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
 b. $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g})$ e. $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{g})$
 c. $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$ f. none of these

5. (2 points) Calculate the work that is done (in kJ) on the surroundings when a gas expands from 11 L to 45 L against a constant external pressure (2.0 atm).

6. (4 points) Calculate ΔE for the reaction shown below when 2 moles of carbon monoxide react with a mole of oxygen. The reaction is carried out at constant pressure (1.2 atm) and the volume contracts from 20.0 L to 10.2 L. (Your answer should be in kJ.)

$$2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) \quad \Delta H = -566\text{kJ}$$

7. (5 points) Aluminum metal reacts with chlorine with a spectacular display of sparks. How much heat is released from the reaction of 20.00 grams of Al with an excess amount of chlorine gas.

$$2\text{Al}(\text{s}) + 3\text{Cl}_2(\text{g}) \rightarrow 2\text{AlCl}_3(\text{s}) \quad \Delta H = -1408.4\text{ kJ}$$

8. (3 points) The specific heat of copper is 0.385 (J/g °C). A piece of copper weighs 15.5 grams and starts out at 20°C. It then absorbs 1.689 kJ of energy. What is the new temperature?