Homework Solutions
10/23/2007

Conceptual

6. Temperature is the measure of the average molecular kinetic energy of a substance. Heat is the transfer of energy between an area of higher temperature to an area of lower temperature. Internal energy is the total molecular kinetic energy of a substance in addition to its chemical energy.

8. The more energy the steam has the more potential for the steam to do work on a piston and convert more energy to electricity.

Problems

5. a.

$$W = -P\Delta V$$

$$W = -\left(4atm \bullet \frac{1.013 \bullet 10^{5}\, Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3}\, L}{1m^{3}}\right) = -810J$$

b.

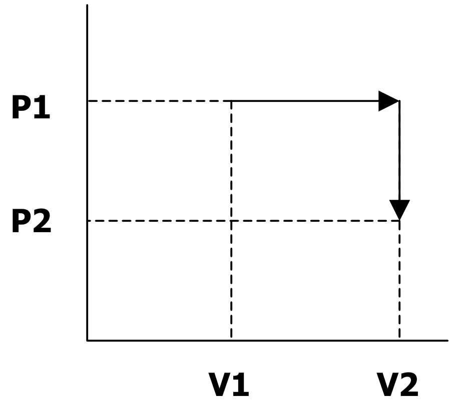
$$W = -P\Delta V$$

$$W = -\left[\begin{array}{l} \frac{1}{2}\left(3atm \bullet \frac{1.013 \bullet 10^{5}\, Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3}\, L}{1m^{3}}\right) \\ +\left(1atm \bullet \frac{1.013 \bullet 10^{5}\, Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3}\, L}{1m^{3}}\right) \end{array}\right] = -507J$$

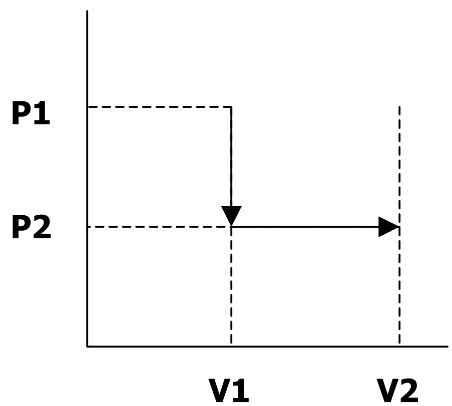
c.

$$W = -\left(1atm \bullet \frac{1.013 \bullet 10^{5}\, Pa}{1atm}\right)\left(2.0l \bullet \frac{1 \bullet 10^{-3}\, L}{1m^{3}}\right) = -203J$$

6. a.



b.



c. More work is done in A because the area under the graph is larger. In other words there is a greater change in volume at a higher pressure.

10. a.

$$W_{if} = -P\Delta V$$

$$W_{if} = -\left[(6 \bullet 10^{6}\,Pa)(1m^{3}) + \frac{1}{2}(4 \bullet 10^{6}\,Pa)(1m^{3}) + (2 \bullet 10^{6}\,Pa)(2m^{3}) \right]$$

$$W_{if} = -1.2 \bullet 10^{7}\,J$$

b.

$$W_{fi} = -W_{if} = +1.2 \bullet 10^{7}\,J$$

14. Work is positive because is the negative of the area under the graph and the area under the graph is negative. Since pressure doubles while volume halves, then the temperature must remain constant according to the ideal gas law. Thus delta U must be zero and heat must be negative.

16. a. In a cyclic process the system returns to its original state. Therefore delta U must be zero. The total work done can be found by finding the sum of the work during each step. Alternatively – and in order to save a little time – you can solve for the area INSIDE the loop.

$$W_{ABC} = -P\Delta V = -\frac{1}{2}(6 \bullet 10^3 Pa)(4m^3) = -1.2 \bullet 10^4 J$$

$$\Delta U = Q + W$$

$$\Delta U = 0$$

$$Q = -W$$

$$Q = -(-1.2 \bullet 10^4 J) = 1.2 \bullet 10^4 J$$

b.

$$W_{CBA} = 1.2 \bullet 10^4 J$$

$$Q = -W$$

$$Q = -1.2 \bullet 10^4 J$$