

Problem Set XI- Assign November 27, 2006 Due December 6, 2006.

Fall 2006 Physics 200a

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1. How much heat is needed to convert 1 kg of ice at  $-10^{\circ}\text{C}$  to steam at  $100^{\circ}\text{C}$ ?. Remember ice and water do not have the same specific heat.
2. If 400g of ice at  $-2^{\circ}\text{C}$  is placed in 1kg of water at  $21^{\circ}\text{C}$  what is the end product when equilibrium is reached?
3. To find  $c_X$ , the specific heat of material  $X$ , I place 75g of it in a 30g copper calorimeter that contains 65g of water, all initially at  $20^{\circ}\text{C}$ . When I add 100g of water at  $80^{\circ}\text{C}$ , the final temperature is  $49^{\circ}\text{C}$ . What is  $c_X$ ?
4. How many moles of ideal gas are there in a room of volume  $50\text{m}^3$  at atmospheric pressure and  $300\text{K}$ ?
5. A spherical air bubble of radius  $2\text{cm}$  is released  $30\text{m}$  below the surface of a pond at  $280\text{K}$ . What is its volume when it reaches the surface which is at  $300\text{K}$  assuming it is in thermal equilibrium the whole time? Ignore the size of the bubble compared to other dimensions like  $30\text{m}$ .
6. What is the volume of one mole of an ideal gas at STP: Standard Temperature ( $273\text{K}$ ) and Pressure (1 atmosphere)?
7. One mole of ideal Nitrogen gas is at 2 atmospheres and occupies a volume of  $10\text{m}^3$ . Find  $T$  in Kelvins,  $U$  the internal energy (assumed to be just kinetic energy) in Joules, and the typical velocity of the gas molecules which have a mass  $4.65 \cdot 10^{-26}\text{kg}$ ?
8. A copper rod of length  $50\text{cm}$  and radius  $2\text{cm}$  has one end dipped in an ice-water mixture and the other in boiling water. What is the heat flow  $dQ/dt$ ?
9. How much heat flows out per second through a concrete roof of area  $100\text{m}^2$  and thickness  $20\text{cm}$  if the outside is at  $0^{\circ}\text{C}$  and the inside is at  $17^{\circ}\text{C}$ ?
10. A gas goes over the cycle ABCA as in Figure 1 where AC is an isotherm and AB is an isobar. (Note  $L$  stands for Liter, with  $1\text{L} = 10^{-3}\text{m}^3$ .) Find the  $(P, V)$  coordinates of C. What is the work done in each part of the cycle and the heat absorbed or rejected in the full cycle?
11. One mole of a gas with  $\gamma = 4/3$  goes over the cycle ABCA as in Figure 2 where one of AB or AC is isothermal and the other adiabatic. (You figure out which.) Write down the  $(P, V, T)$  coordinates of A, B and C (some of which are already given). What is the work done in each part of the cycle and the heat absorbed or rejected in the full cycle?

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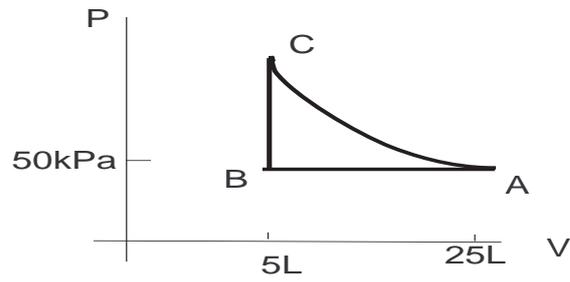


FIG. 1: The gas goes in a loop ABCA, where the section AC is isothermal.

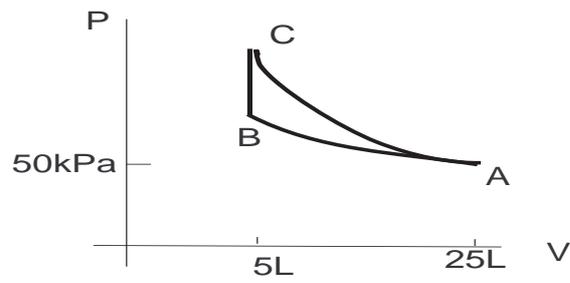


FIG. 2: The gas goes in a loop ABCA, where either AB or AC is isothermal and the other is adiabatic.

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