

1. 100 g of steam at  $100^{\circ}\text{C}$  condenses to water at  $100^{\circ}\text{C}$  out in the open inside a large building. The air in that building is at  $70^{\circ}\text{F}$  and its temperature does not significantly change as the result of the condensation.
- (a) Determine the change in the entropy of the  $\text{H}_2\text{O}$  as a result of this condensation.

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- (b) Determine the change in the entropy of the air in that building as a result of this condensation.

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- (c) Determine the total change in entropy of the universe due to the condensation of the steam in the air in that building.

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2. A cylinder contains 2 moles of an ideal monatomic gas that is initially at state  $A$  with a volume of  $1.0 \times 10^{-2} \text{ m}^3$  and a pressure of  $4.0 \times 10^5 \text{ Pa}$ . The gas is brought by an isobaric process to state  $B$ , where the volume is  $2.0 \times 10^{-2} \text{ m}^3$ . The gas is then brought by an isochoric process to state  $C$ , where its temperature is the same as at state  $A$ . The gas is then brought isothermally back to state  $A$ .

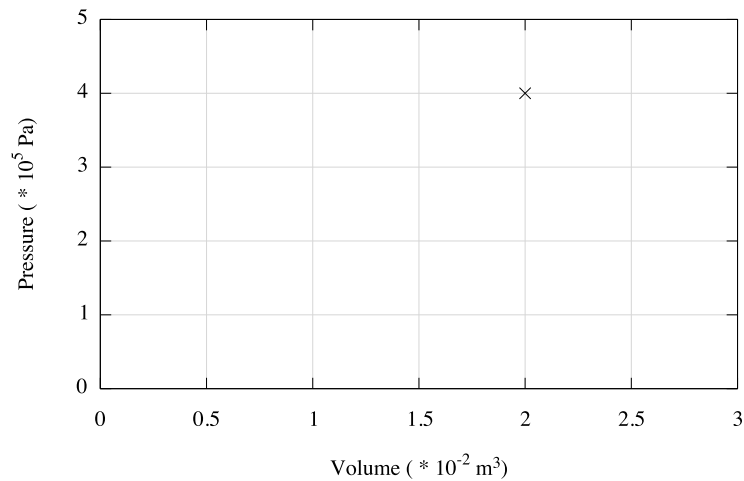
- (a) Find the temperature of this gas when in state  $A$ .

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- (b) Find the total energy of this gas when in state  $A$ .

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- (c) On the axes below, state  $B$  is represented by the point “ $\times$ .” Sketch the plot of one complete cycle. Label points  $A$  and  $C$  to represent states  $A$  and  $C$ , respectively.



- (d) Determine the pressure of the gas at state  $C$ .

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(e) Find the total energy of this gas when in state  $B$ .

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(f) Find the amount of work done by the gas as it goes from state  $A$  to state  $B$ .

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(g) How much heat  $Q$  is given to the gas as it goes from state  $A$  to state  $B$ ?

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(h) How much heat  $Q$  is given to the gas as it goes from state  $B$  to state  $C$ ?

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(i) State whether the net work done by the gas during one complete cycle is positive, negative, or zero. Justify your answer.

(j) State whether this device is a refrigerator or a heat engine. Justify your answer.

3. Use the schematic diagram below to help you describe what goes on with an air conditioner as it cools the interior of a house. Be sure to include in your description the rôle played by each of the four components of the AC system and the refrigerant. Also note where the evaporator and the condenser are located, namely, inside or outside of the house.

