

29:029 Physics III

Exam III

December 1, 2000

Closed book exam. Please show all work to get full credit. Point values for each problem are indicated. Please ask questions if you need clarification. If you don't show your work, or make written comments, then there is no way for me to give partial credit.

1) (12 points) A well-insulated bucket contains 300g of ice at 0°C . If 20g of steam at 100°C is introduced into the bucket:

a) [6] How much, if any, ice will be left when equilibrium is reached?

b) [6] What is the equilibrium temperature?

Hint: $C=4.18\text{J/g}^{\circ}\text{C}$, $L_f=333\text{J/g}$, $L_v=2257\text{J/g}$

2) (12 points) One mole of a monatomic ideal gas is initially at 273K and 1atm.

a) [6] What is the initial internal energy?

b) [6] Find its final internal energy and the work done when 500J of heat is added at constant pressure.

3) (12 points) A Carnot engine operates in such a way that work is performed. The temperature changes from 100K to 200K in the adiabatic compression process and the entropy changes from 300J/K to 600J/K in the isothermal expansion process.

a) [6] How much net work is performed during the complete cycle?

b) [6] What is the efficiency of the engine?

4) (12 points) n moles of a diatomic ideal gas goes through the cyclic process shown in the figure. The path of the process can be followed by introducing an angle θ between 0 and 2π such that :

$$P=P_0 + P_1 \sin(\theta) \quad ; \quad V=V_0 - V_1 \cos(\theta)$$

a) [6] What is the internal energy $U(\theta)$?

b) [6] What is the net work accomplished each cycle?

