**Scheller Physics 175 Fall 2016**

 **Exam #4 9 a.m.**

**Read these instructions carefully**. Work rapidly. Answers without units are incomplete.

**Constants:** ρwater= 1000 kg/m3 Patm= 1 atm =1.01x105 N/m2 cwater= 4186 J/kg C0

 Lv(water)=22.6x105 J/kg Lf(water)=3.33x105 J/kg k=1.38x10-23 J/K

 N­A= 6.02x1023 molec/mole cAl= 900 J/kg Co cice=2100 J/kg oC

 1 amu = 1.66x10-27 kg αAl=24x10-6 1/Co m(O2)=32 amu

1. A hole in an aluminum plate has a diameter of 1.178 cm at 23oC. At what temperature is the diameter of the hole equal to 1.176 cm?

-47.70C

2. A 0.5 kg block of metal with an initial temperature of 30 oC is dropped into a .1 kg aluminum container holding 0.0112 m3 of water at 20 oC. If the final temperature of the block/water system is 21.4 oC, what is the specific heat of the metal?

15,293 J/kg C0

3. The efficiency of a Carnot engine with a cold reservoir at a temperature of 295K is 21%.

a) If the engine exhausts 3300 Joules to the cold temperature reservoir each cycle, how much work does it do each cycle?

877J

b) Assuming the temperature of the hot reservoir remains the same, what temperature would the cold reservoir need to be for the efficiency to increase to 25%?

280 K

4. Two moles of oxygen gas (O2) are placed in a container with a volume of 0.0025 m3. If the temperature of the gas is 305oC,

 a) What is the pressure of the gas in the container?

3.8x106 N/m2

 b) What is the kinetic energy and the average speed of the molecules in the container?

1.2x10-20 Joules per molecule

671 m/s

5. The specific heat of liquid mercury is 140 J/kg Co. When 1 kg of solid mercury at its melting point of -39oC is placed in a 0.5 kg aluminum calorimeter filled with 1.2 kg of water at 20oC, the final temperature of the combination is found to be 16.5oC. What is the latent heat of fusion of mercury?

11,386 J/kg

6. Two moles of an ideal gas are taken through the processes shown in the figure.

a) Fill in the missing entries in the box below for the three steps.

Indicate + or – on all entries.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Q | W | ∆U |
| A→B | -53 J | 0 | -53 J |
| B→C | -280 J | -130 J | -150 J |
| C→A | +353 | +150 J | +203 J |

b) What is the change in temperature of the gas in step BC?

-6 K

7. A heat engine operates between a high temperature reservoir at 610 K and a low temperature reservoir at 320 K. In one cycle, the engine absorbs 6400 J of heat from the high temperature reservoir and does 2200 J of work. What is the net change in entropy as a result of this cycle?

+2.63 J/K