EXAM I

Name (Print): _____ SSN _____

TA (Circle One): Groechel Hicks Hoefer Rahi Torre

PROBLEM 3 (cont'd.) 40 PTS TOTAL

6 PTS (a) In words describe the distinct steps in the cooling of lead.

2 PTS EACH
1. LEAD IS COOLED FROM $T_F$ TO ITS MELTING POINT (MP).
2. LEAD FUSES AT ITS MELTING POINT
3. THE SOLID LEAD COOLS FROM ITS MP (327°C) TO THE EQUILIBRIUM TEMPERATURE (21.8°C)

5 PTS (b) How many calories of heat are absorbed by the calorimeter and the water it contains to reach 21.8°C?

$$Q_{GAINED} = m_W c_W (21.8°C - 10°C) + m_{CAL} c_{CAL} (21.8°C - 10°C)$$
$$= (200 gm)(1 cal/gm°C)(11.8°C) + (150 gm)(.215 cal/gm°C)(11.8°C)$$
$$Q_{GAINED} = 2740 cal$$

5 PTS (c) How many calories are lost by the lead in cooling from $T_F$ to the final equilibrium temperature of 21.8°C?

ACCEPT $Q_L$ = 2740 CAL LOST

$Q_{LOST} + Q_{GAINED} = 0$ MEANS

$$Q_{LOST} = -2740 cal$$

18 PTS (d) What was the original furnace temperature?

↓ A NEGATIVE NUMBER IN THIS SOLUTION TECHNIQUE

$$Q_{LOST} = -2740 cal = m_{Pb} c_{Pb} (327°C - T_F) + m_{Pb} L_F + m_{Pb} c_{Pb} (21.8°C - 327°C)$$
$$= (100 gm)(.0305 cal/gm°C)(327°C - T_F) - (100 gm)(6.0 cal/gm) - (100 gm)(.0305 cal/gm°C)(315.2°C)$$
$$= 997 cal - 3.05 cal/°C\, T_F - 600 cal - 961 cal$$
$$= -564 cal - 3.05 cal/°C\, T_F$$

$$T_F = \frac{2176 cal}{3.05 cal/°C} = 713°C$$

6 PTS (e) If the same mass of aluminum ($C_{Al}$ = 0.215 cal/gm°C and $L_M$ = 21.5 cal/gm) were used in the same furnace instead of lead, would the final equilibrium temperature be higher, less or the same as in the lead case? No calculation is need to answer this. Please explain.

SINCE BOTH $C_{AL} > C_{Pb}$ AND $L_M(AL) > L_M(Pb)$ AN EQUAL AMOUNT OF AL CAN STORE MORE THERMAL ENERGY THAN THE SAME AMOUNT OF Pb AT THE SAME T. THUS, THE FINAL $T_{EQ}$ OF THE SYSTEM WILL BE HIGHER FOR THE MOLTEN AL MATERIAL THAN FOR THE LEAD SYSTEM.