Instructions: You have a total of 55 minutes to complete this test. Answer each of the following questions completely providing details and correct SI units.

Time Start_____ Time finish _____pledged _____

[1] An ideal 3 dimensional **diatomic** gas (with rotational and vibrational modes realized) has the equation of state $PV = nRT$ where n is the number of moles and R=8.314 J/(K mol). Suppose that 1 mole of this ideal gas goes through an **isovolumeric** (V=constant) process. If the change is pressure is $\Delta P=1x10^5$ Pa, and the change in temperature is $\Delta T=300K$, answer the following using correct SI units.

(a) What is the volume of the gas when the pressure is $P=1x10^5$ Pa and the temperature is T=300K?

(b) What are the values of c_v and c_p for this gas?

c_v=_____ c_p=_____

(c) What is the change in internal energy of the gas?

ΔU=_____

(d) How much heat was supplied (or evolved) from the gas?

Q=_____

[2] A copper cube with a density of 8960 kg/m^3 has a coefficient of linear expansion of $16.6x10^{-6}$ /^{0}C and a specific heat of 385 J/(kg ^{0}C). Suppose a 1 Kg block of copper is heated from a temperature of 0^0C to a temperature of 100^0C.

(a) if the cube is isotropic, what is the coefficient of volume expansion?

γ=_____

(b) How much heat is added to the system?

Q=_____

(c) What is the change in volume of the cube?

ΔV=_____

(d) If this expansion was in the presence of a pressure of $1x10^5$Pa, how much work was done by the cube?

W=_____

(e) What was the change in internal energy of the cube?

ΔU=_____

[3] A heat engine is observed to operate with 55% efficiency when a heat input of Q_H=100J is provided.
(a) What is the work that was measured from this engine?

(b) Suppose the engine went through a Carnot cycle with heat input was from a source which has a temperature of T_H=100 ^{0}C. What is the temperature (in K) of the colder reservoir?

[4] For water, L_f=3.33x10^5 J/kg and c=4186 J/Kg ^{0}C.
(a) If a 1 kg mass of ice at 0^{0}C melts to become water at 0^{0}C, calculate the change in entropy of the system.

ΔS=_____
(b) If 1 kg of water at 0^{0}C is mixed with 1 kg of water at 50^{0}C, calculate the final equilibrium temperature of the mixture.

T_f=_____
(c) Calculate the change in entropy of the water as a result of the mixing described in part b.

ΔS=_____