PHY 101 Exam #4 **Name _____**

Problem	Points	Score
1	8	
2	12	
3	15	
4	15	
Total	50	

Instructions:

1. Do all of your work in this booklet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place you **answers in a box**.
5. If you need more space, you may **use the back of the page** and write **On back** in the problem space.

1**. Multiple Guess (8 pts)** Find the answer which best fits the question and write it in the space provided.

a. When the pressure of a gas remains constant, an increase in the volume causes the temperature to
a) increase b) decrease c) remain the same.

_____

b. The thermodynamic statement of conservation of energy of a system is the
a) zeroth law; b) first law; c) second law; d) third law.

_____

c. Doubling the Kelvin temperature of a blackbody will _____ its radiant energy per second.
a) double; b) halve; c) quadruple; d) divide by 4;
e) none of these.

_____

d. A process in which the volume remains constant is called
a) isothermal; b) isobaric; c) adiabatic;
d) quasistatic; e) isochoric.

_____

e. The entropy of a system in a reversible adiabatic process
a) increases b) decreases c) remains constant
d) is always less than the entropy change for an irreversible process between the initial and final states

_____

f. A blackbody a) has an emissivity of zero; b) is the most efficient absorber; c) is the least efficient emitter;
d) none of these.

_____

g. A process in which no heat is exchanged with the surroundings is called
a) isothermal; b) isobaric; c) adiabatic;
d) quasistatic; e) isochoric.

_____

h. Spontaneous heat flow from a colder body to a warmer body is in violation of the
a) first law b) second law c) third law d) zeroth law

_____

Constants

1 atm = 1.013×10^{5} Pa R = 8.31 J/(mol K)

k = 1.38×10^{-23} J/K $\sigma = 5.67\times10^{-8}$ J/(s m^2 K^4)

2. **Definitions/Principles (11 pts)**
Provide the formulae for

a. Conversion of Fahrenheit to Celsius

b. Conversion of Celsius to Kelvin

c. Average velocity of a molecule in an ideal gas at temperature T.

d. Power transmitted per area through a material with conductivity k and thickness d

Name the three common types of heat transfer:

Bonus: Draw and label the Carnot Cycle in a pV diagram

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3. **(15 pts)**

a. What is the mass of a CO_2 molecule in kg?
(Atomic Weights C:12 O:16)

b. A person goes on a 1500 Cal/day diet. What is the equivalent energy in Joules?

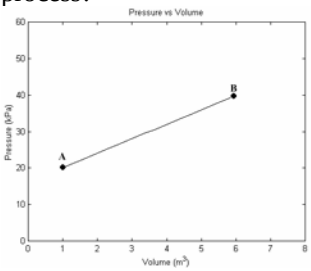
c. An ideal gas in a 2000 cm^3 container has a temperature of 0^oC and a pressure of 100 kPa. If the gas is now compressed to a volume of 500 cm^3 at a temperature of 200^oC, what is the new pressure in the container?

d. A 30.0 cm long piece of wire lengthens 1.62 mm when heated from 20^oC to 300^oC. What is the coefficient of linear thermal expansion for the material of the wire?

e. A cup contains 100 g of coffee at 90 ^oC. What mass M of ice at 0 ^oC must be added to change the coffee temperature to 70 ^oC? Neglect the heat flow to the coffee cup and assume that the coffee has the properties of water.

4. **(15 pts)**

a. A gas expands from state A to state B with the following pressure-volume relationship. How much work was done in the process?



b. The temperature of 2.0 moles of a substance is increased from 150^oC to 250^oC by a process in which 2500J of heat is added to the system.

(i) What is the change in internal energy of the system?

(ii) How much work was done by the system?

c. It has been proposed to use the temperature difference in the ocean to run a heat engine to generate electricity. The water temperature at the surface is 20 ^oC and that of the lowest depth is 5 ^oC. What would be the maximum efficiency of such an engine?

d. Which process has a greater change in entropy: 120 g of ice changing to water at 0 ^oC, or 25 g of steam condensing to water at 100 ^oC? [Compute the entropy in each case and compare!]