PHYSICS 215 Exam 1 Name ______________________________

Please open the exam when I give the word.

Be sure to write out your algebra!

If you're stuck, still write out what you *can* show.
Then go on to other parts.

If you are missing a previous answer for a further step,
calculate the next step *symbolically* in terms of the previous result.

Use the back sides of sheets for scratch paper

The exam has a maximum of 100 points + 10 extra credit points
For 5 more extra credit points, turn in your Formula Card with your exam

Useful Constants:

1 calorie = 4.186 J
1 atmosphere = 1.01 E5 Pa
R = 8.31 J/mol K
σ = 5.67 E-8 W/m^2 K^4
N_A = 6.02 E23 /mol
Lf = 80 c/g water
Lv = 539 c/g water

1. [15] By some means, you double the speed of all the molecules in a monoatomic ideal gas contained in a rigid box, that is, v → 2v (or v × 2). Give the factor by which this action changes the following quantities. In each case explain why: don't just write down a factor.

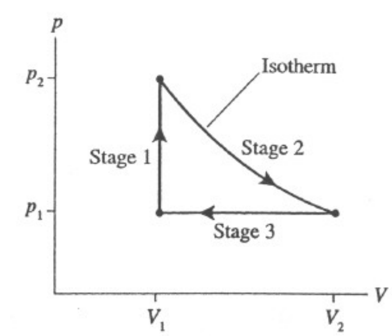
a) Kinetic energy per atom

b) Vrms

c) Temperature

2. [15] Let us approximate your presence at a party by a rectangular cardboard cutout 1.5 m high x .5 m wide. Assume any light falling on the cardboard is totally absorbed. Your temperature is 37°C. What is the power you radiate throughout the party? *Hint*: even a cardboard cutout has two sides to it.

3. [70] *n* moles of a monoatomic ideal gas are taken through the cyclic process as shown in the figure. The temperature during stage 1 starts at T1 and ends at twice T1.
Many of the answers are independent; if you are stuck, move on to another question, to sure to get the easy ones. Or define a symbol for answers you can't find and use it. No numerical calculations are needed: put away your calculator.

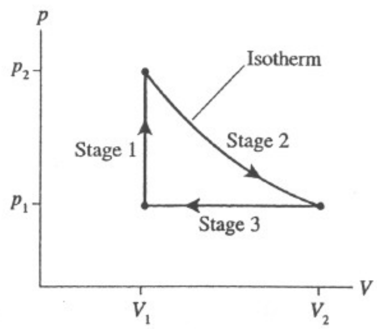


a) [10] What is the **largest theoretical efficiency** this cycle could possibly have, based solely on the temperature information given?

b) [10] Find p2 in terms of p1 and numerical constants.

c) [10] Find V2 in terms of V1 and numerical constants.

We continue to analyze the same cycle:



d) [15] For each stage, state whether heat is absorbed or released by the gas, and **justify your answer**.

1

2

3

e) [10] Calculate the heat transfer for stage 1 *in terms of n, constants, and T1*.

f) [15] For each stage, calculate the work done (including sign), *in terms of n, constants, and T1* (or p1 and V1 if you're stuck). *Hint*: use the ideal gas law to write p(V)

1

2

3

g) [10] Extra credit: Calculate the change in entropy of the gas during stage 1.