AP2 FIZZIX: EXAM #2 2015 SA Section Ch 11-15

Directions: ***Show all work & make reasoning clear***. Choose three, and ***ONLY three***, of the following five AP-Style problems to turn in for grading.

DUE: All ***paper*** solutions are due no later than ***2:15 PM ET Friday 10/23/2015***. All ***electronic*** *versions* are due HTTP time-stamped no later than ***2:15 PM ET Friday 10/23/2015***.

1. (10 pts) A bowling ball of unknown mass is thrown downward from the top of the Science Building in an evil attempt to crush the ***Great & Powerful Fizzix Guy*** from a height of 20m with an initial speed of 20 m/s exactly vertically and later strikes and dents the poorly constructed concrete walkway after the ***Great & Powerful Fizzix Guy*** used his cat-like reflexes to dodge to safety . Surprisingly, this bowling ball bounces back up to a height of 12-m above the floor. Neglect air resistance and monsters.

(A) Calculate the speed of the ball immediately after it bounces from the walkway.

(B) Calculate what percent of the initial energy of the ball apparently disappears.

(C) Assuming a specific heat of bowling balls is $500\,{}^{J}\!/_{kg \cdot K}$, what is the increase in the temperature of the ball in degrees Celsius if all the "lost" mechanical energy is absorbed as heat?

2. (10 pts) A 500-g sample of an unknown toxic substance is sitting on my desk. It is initially a solid at room temp (945 room temp) of 20°C. I decide to do a little experiment and add heat to this toxic sample at a constant rate of 100 *J/s* until the temperature of the sample is 60°C. I noted the following strange thing; when the sample reached 40°C after heating for 40 seconds, the temperature did not rise again until t = 140 seconds. I stopped taking readings after 300 seconds.

(A) Below, sketch the temperature as a function of time graph for this little experiment.

(B) Calculate the specific heat of this toxic substance in the solid phase.

(C) Calculate the heat of fusion of this stuff.

3. (10 pts) The PV-statements below describe a monatomic ideal gas during one complete cycle of a reversible heat engine. The cycle consists of the following four processes.

Process	**Nature of Process**
AB	Constant temperature (T_h = 500 K) & heat energy added; Q_h = 1,000 ***J***. $P_A = P_o$ & $V_A = V_o$, & $V_B = 2V_o$
BC	Adiabatic between T_h ***and*** T_C.
CD	Constant temperature (T_c = 200 K) & heat energy given off to environment; Q_C.
DA	Adiabatic.

(A) In terms of P_o, determine the pressure at point ***B***.

(B) Determine the work done on or by the gas during ***AB***. Clearly state if the work is on or by the gas.

(C) During ***AB***, does the entropy of the gas increase, decrease, or remain the same? *Justify your answer*.

(D) Determine the heat energy Q_c given off by the gas in ***CD***.

(E) During the full cycle ***ABCDA*** is the net work on the gas positive, negative, or zero? *Justify your answer*.

4. (10 pts) Yet another ideal monatomic gas starts out with pressure P_i , volume V_i , and absolute temperature T_i . Then, an evil super-genius named *Vector* makes the gas go on a 4-step trip outlined here.

I. It is heated up so the volume stays the same, but the pressure doubles.

II. It is heated up so the pressure stays the same, but the volume triples.

III. It is cooled down so the volume stays the same, but the pressure is cut in half.

IV. It is cooled so the pressure stays the same, but the volume is cut in third (V/3).

(A) Sketch the PV diagram that demonstrates this 4-step process. Be sure to label both axes properly. Also, label each "turning" point with the temperature at that point in terms of T_i .

(B) Determine each of the following in terms of P_i and V_i .

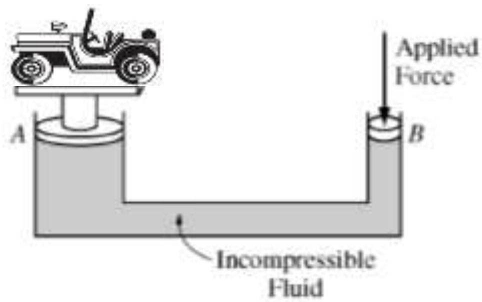
(i) The net work done by a complete cycle. Is this done *on* or *by* the gas?

(ii) The total change in internal energy after one cycle.

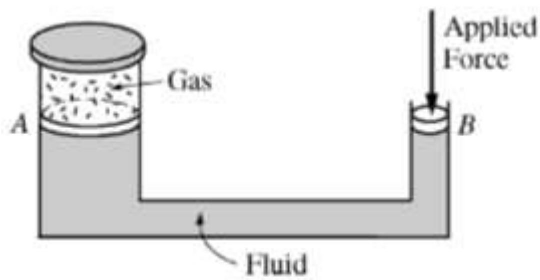
(iii) The net heat absorbed by one cycle.

(iv) Given that $C_V = 3R/2$ and $C_P = 5R/2$, what is the heat transferred during the 2nd step?

5. (10 pts) Remember Jeep Man's problem from Exam #1? Here's the diagram, just in case your memory is as faulty as mine:



Now, for Exam #2, instead of this situation, an immovable cap is fixed to the top of the pipe on the left where the Jeep used to be. The space between ***A***, the bottom of the piston, and the cap is filled with a toxic ideal gas. Then, the mechanic applies a force to the right cylinder causing the gas to compress, as shown below.



(A) Assume the mechanic has the means of causing this compression at a constant temperature. Sketch the ***PV*** diagram of this process below on an empty ***PV*** graph YOU make. Be sure to indicate the direction of the process with an arrow.

(B) Now, assume instead that the compression occurs at constant pressure. Sketch the ***PV*** diagram of this process below on an empty ***PV*** graph YOU make. Be sure to indicate the direction of the process with an arrow.

(C) In Part (***B***) above, is heat added, removed, or constant? Justify.