Printed Name: ________________________________

Problem 1	/ 20
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Problem 3	/ 15
Total	**/ 50**

PHYSICS 221 – Section 1

EXAM 1

February 4, 2008

Do not open this booklet until instructed. The exam will end promptly at 50 minutes after the hour.

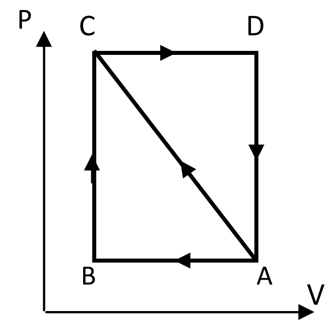
Instructions: When you are told to begin, check that this examination booklet contains all the numbered pages from 2 through 4. Read each problem carefully so that you are certain what it is asking. Do not panic or be discouraged if you cannot do every part of every problem. If a part of a problem depends on a previous answer you have not obtained, define a symbol for it and proceed to maximize your credit. Keep moving to finish as much as you can!

You must show your work. The purpose of this exam is to show how well you understood the material we have covered. You must include an adequate explanation, including correct equations where applicable, for full credit. Unless otherwise indicated, a number with no explanation will not get credit. **Show your answer's units**, and give an adequate number of significant digits. Completely numerical solutions showing no equations are not eligible for partial credit. Do not use scratch paper. Indicate any work on the back that you wish to be considered.

Box your answers.

This examination is administered under the Cadet Honor Code. All suspected violations must be reported appropriately. The seat next to you must be unoccupied. No talking is permitted during the examination, apart from questions to the instructor. You may use a scientific calculator, but may not use "advanced features", including graphing, solving, or equation storage capabilities. Any other electronic devices, including headphones, cell phones, PDAs, and MP3 players, may not be used during the exam in any way. You may use the equation sheet distributed with the exam. No other notes or textbooks may be open during the exam.

1. **Problem 1: [20pt]** A gas is kept in a cylinder fitted with a piston. In the figure, the change in internal energy of a gas that is taken from A to C along the diagonal path is +800 J. The work done on the gas when it is compressed isobarically from point A to point B is +500 J.



   (a) [5pt] How much heat is added to or removed from the gas as it goes from A through B and on to C?

   (b) [5pt] If the pressure at point C is five times that of point B, how much work does the gas do on the piston when it expands from C to D?

   (c) [5pt] How much heat flows into or out of the gas when it goes from C to D and back to A. Specify whether the flow is into or out of the gas.

   (d) [5pt] How much work is done on the gas in the diagonal process AC?

2. [15pt] During the compression stroke of a certain gasoline engine, the pressure increases from 1.00 atm to 20.0 atm. The process is adiabatic and the fuel-air mixture behaves as a diatomic ideal gas. The volume of the piston is 500 cm^3 at the beginning of the compression stroke.

(a) [5pt] What is the volume of the gas at the end of the compression stroke?

(b) [5pt] If the gas starts out at 30.0^{o}C, what is its temperature at the end of the compression stroke? [You may express your answer in ^{o}C or K.]

(c) [5pt] Find the work done on the gas to compress the gas. [If you don't have an answer to part (b), use the final temperature 630^{o}C.]

3. **[15pt]** A refrigerator has a coefficient of performance of 3.00. The ice tray compartment is at $-20.0°\mathrm{C}$, and the room temperature is $16.0°\mathrm{C}$. The refrigerator can convert 36.0 g of water at 16.0°C to 36.0 g of ice cubes at $-20.0°\mathrm{C}$ each minute.

(a) **[5pt]** How much heat must be removed from the water each minute to freeze it to ice cubes at the given temperature?

(b) **[5pt]** If the coefficient of performance of the refrigerator is 3.00, how much power, in Watts, is needed to run it? [If you don't have an answer to part (a), assume 20.0 kJ of heat is removed per minute.]

(c) **[5pt]** If the refrigerator had the maximum theoretical efficiency for the given temperatures, how much power, in Watts, would be needed to run it?