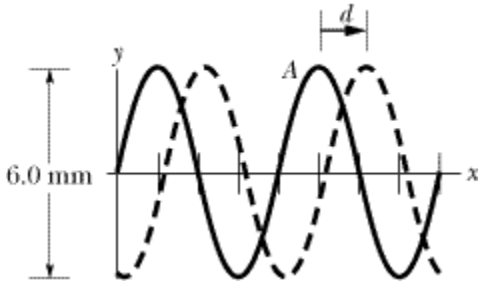
Test 4 for PHYS 2130 section 091
Date: 25th April 2007

Student First Name: Student Last Name:
Student Rocket ID:

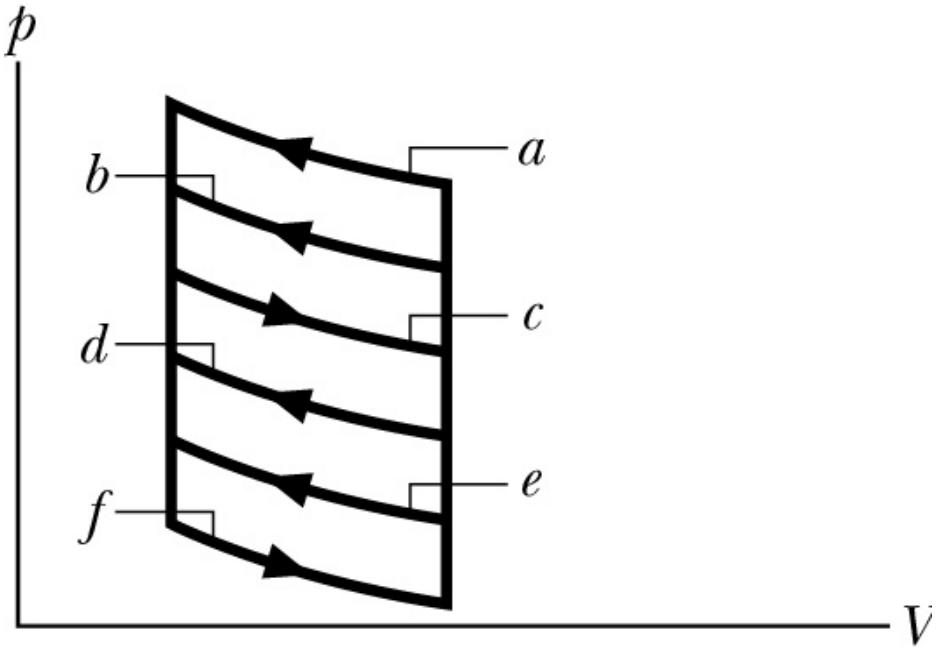
You may use the backside of all pages. No calculators are allowed. Express all answers only in terms of given quantities.

Questions 1: A sinusoidal wave moving along a string is shown twice in the figure below, as crest *A* travels in the positive direction of an *x* axis by distance $d = 6.0$ cm in 4.0 ms. The tick marks along the axis are separated by 10 cm. If the wave equation is of the form $y(x, t) = y_m \sin(kx \pm \omega t)$, what are (a) k and (b) ω? Express each answer in proper units and using the symbol π if needed. (**2 points**)



Question 2: A bat is flitting about in a cave, navigating via ultrasonic bleeps. Assume that the sound emission frequency of the bat is f. During one fast swoop directly toward a flat wall surface, the bat is moving at x times the speed of sound in air where ($0 < x < 1$). A scientist hiding behind the wall has a tape recorder kept in a hole in the wall. Express all answers only in terms of given quantities f and x. (a) What frequency does he detect in his recorder.? (b) What frequency does the bat hear reflected off the wall? (**2 points**)

Question 3: The p-V diagram here shows six curved paths (connected by vertical paths) that can be followed by an ideal gas. (a) Which two of them should be part of a closed cycle where the net work done by the gas is negative but highest in magnitude? (b) Suppose all the lettered paths (i.e. portions that are not vertical) are known to be isotherms. Then on which of these lettered paths does the gas have the lowest internal energy? (**2 points**)



Question 4: Two containers are at the same temperature. The first contains gas with pressure p_1, molecular mass m_1, and rms speed v_{rms1}. The second contains gas with pressure $2.0p_1$, molecular mass m_2, and average speed $v_{avg2} = 2.0v_{rms1}$. Find the mass ratio of their atoms m_1/m_2. (**2 points**)

Question 5: The figure below shows a reversible cycle through which n moles of a monatomic ideal gas is taken. Assume that $p = 3p_0$, $V = 3V_0$. Calculate (a) the change in internal energy of the gas during the stroke *cda*, (b) What is the efficiency of a Carnot engine operating between the highest and lowest temperatures that occur in the cycle? Express all answers only in terms of known quantities p_0, V_0, n, and the gas constant R. (**2 points**)