Exam #4

PHYS 201-1M

17 November 2006

Answer each of the following questions. Circle your final answer. Full credit will be given only for the correct answer. For errors in the calculations but where the method is correct, only one point will be deducted. If the chosen method is incorrect, no credit will be given for that section of the problem. However, if subsequent questions depend on the missed answer, no points will be deducted if the method and calculations for those sections are correct, even though the final answer may be wrong.

1) (20 pts) The function \( x = 4.0 \cos \left[ 2\pi t + \pi / 3 \right] \) gives the simple harmonic motion of a body. At \( t = 3.0 \) s, what are the
   a. Displacement?
   b. Velocity?
   c. Acceleration?
   d. Phase of the motion?
   e. What is the frequency of the motion?
   f. What is the period of the motion?
2) (15 pts) In the phase angle of a block-spring system in simple harmonic motion is \( \pi / 3 \) rad and the block’s position is given by \( x = x_n \cos[\omega t + \phi] \), what is the ratio of the kinetic energy to the potential energy at time \( t=2 \) seconds?
3) (10 pts) What mass of steam at 120°C must be mixed with 0.2 kg of ice at its melting point, in a thermally insulated container, to produce liquid water at 45°C?

(For water: latent heat of vaporization=2.26×10^6 J/kg, latent heat of fusion=3.33×10^5 J/kg, and specific heat=4186 J/kg°C.)
4) (20 pts) When a system is taken from state $i$ to state $f$ along path $iaf$ in this figure, $Q=40$ cal and $W=15$ cal. Along path $ibf$, $Q=36$ cal.

a. What is the work along path $ibf$?

b. If $W=-10$ cal for the return path $fi$, what is $Q$ for this path?

c. If $E_{\text{int},i}=10$ cal, what is $E_{\text{int},f}$?

d. If $E_{\text{int},b}=22$ cal, what is $Q$ for path $ib$?

e. If $E_{\text{int},b}=22$ cal, what is $Q$ for path $bf$?
5) (20 pts) A sample of an ideal gas is taken through the cyclic process $abca$ shown in this figure. At point $a$, $T=225$ K.

![Graph showing cyclic process abca](image_url)

a. How many moles of gas are in the sample?

b. What is the temperature of the gas at point $b$?

c. What is the temperature of the gas at point $c$?

d. What is the net energy added to the gas as heat during the cycle?
6) (15 pts) Suppose 1.1 m³ of a gas with \( \gamma = 1.20 \), initially at 0°C and 1×10⁵ Pa, is suddenly compressed adiabatically to half its initial volume. Find its final

a. Pressure

b. Temperature

c. If the gas is then cooled to 250 K at constant pressure, what is its final volume?