Physics 212	Midterm I		21 October 98
7:30–8:50 PM	Closed Book		No Notes
$p = p_0 + \rho gh$	$1\text{atm} = 1.01 \times 10^5 \text{Pa}$	$A_1 v_1 = A_2 v_2$	$p + \frac{1}{2}\rho v^2 + \rho g y = \text{constant}$
$x = A\cos(\omega t + \phi)$	$a(x) = -\omega^2 x$	$k = \frac{2\pi}{\lambda}$	$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{g}{L}} = \sqrt{\frac{I}{mgh}}$
$y(x,t) = A\sin(kx \mp \omega t)$	$c = \frac{\omega}{k} = \lambda f$	$c = \sqrt{\frac{\tau}{\mu}} = \sqrt{\frac{B}{\rho}}$	$I = \frac{P}{A}$, $g = 9.8 m/s^2$
$\beta = (10\text{dB}) \log \frac{I}{I_0}$	$F_{\text{beat}} = F_1 - F_2$	$f' = f\frac{v \pm v_d}{v \mp v_s}$	$T_K = T_C + 273^o$
$\Delta L = L\alpha\Delta T$	$\Delta V = V\beta\Delta T$	1 cal = 4.186 J	$Q = C\Delta T = cm\Delta t$
$Q = Lm$	$W = \int dW = \int pdV$	$Q = \Delta U + W$	c_{Ag}=0.0564 cal/g·K
$L_f = L_{\text{melt(water)}} = 333$ kJ/kg	$L_v = L_{\text{boil(water)}} = 2256$ kJ/kg	ρ_{Ag}=11 g/cc	$PE = \frac{1}{2}kx^2$
$L_f = L_{\text{melt(Ag)}} = 105$ kJ/kg	$L_v = L_{\text{boil(Ag)}} = 2336$ kJ/kg	$\sin A + \sin B =$	$2\sin\frac{1}{2}(A+B)\cos\frac{1}{2}(A \pm B)$

- There are 4 questions. For full credit [n points] show physics-based reasoning, work, and units.
- Use no auxiliary aids. Calculators *without* stored equations are OK.
- Place all books, notes, packs, etc up front.
- All answer sheets must be handed in (do not separate them).
- The back of pages will *not* be graded *unless* you so indicate on the front.

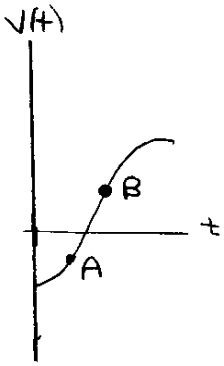
1. A 75 g sphere of unknown material floats in a container of water, with the bottom of the sphere 2 m below the surface of the water.

   (a) What net force (magnitude and direction) does the water exert on the sphere? [6]

   (b) What is the pressure at the lowest point on the sphere? [5]

   (c) If the sphere has 70% of its volume submerged, what is its density? [10]

   (d) When dropped into a container of oil, the same sphere comes to rest on the bottom of the container holding the oil. What value can we deduce about the density of the oil? [5]



2. A particle undergoes simple harmonic motion with x_m its maximum displacement from rest position. The velocity $v(t)$ of this particle as a function of time is drawn in the figure to the left. [4 ea]
   Is the particle momentarily stationary, headed toward $-x_m$, or headed toward $+x_m$ at (a) point A on the graph and (b) point B?
   Is the the particle at $-x_m$, at $+x_m$, at 0, between $-x_m$ and 0, or between 0 and $+x_m$ when its velocity is represented by (c) point A and (d) point B?
   Is the speed of the particle increasing or decreasing at (e) point A and (f) point B?

3. A string 200 cm long has one end fixed and the other end *free* to slide up and down. This string is made to resonate as a standing wave with amplitude 2 cm and with two nodes between the ends (there may also be nodes at the ends). The wave speed is 145 m/s.

   (a) Draw a picture of this wave. [5]

   (b) Draw pictures of the fundamental and all *overtones* with frequencies less than this wave. [5]

   (c) What is the frequency and wavelength of this wave? [10]

   (d) Write equations for two waves that, when combined, will result in this standing wave. [5]

4. A 300 g silver (Ag) bowl contains 440 g of water, both at 40.0°C. A very hot 600 g silver cylinder is dropped into the water, causing the water to boil and 10.0 g of water to be converted to steam. The final temperature of the system is 100°C.

   (a) Calculate the heat transferred to the water. [10]

   (b) Calculate the heat transferred to the bowl. [5]

   (c) Calculate the original temperature of the cylinder. [10]