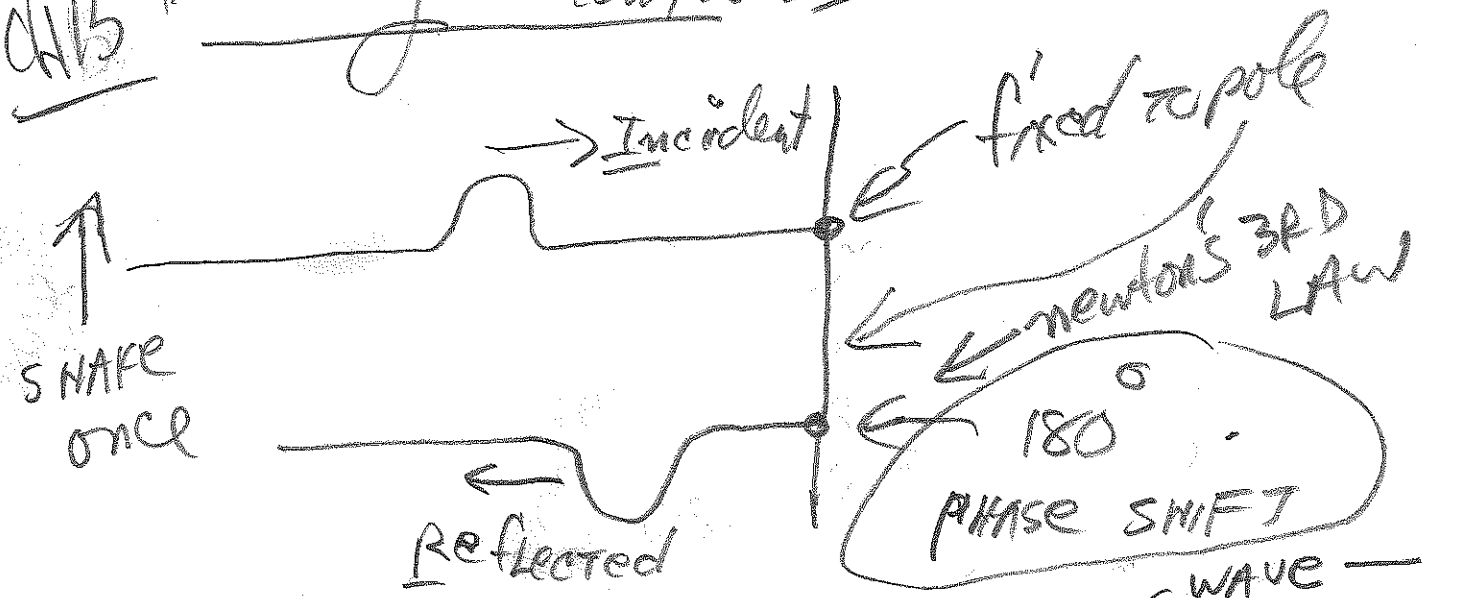
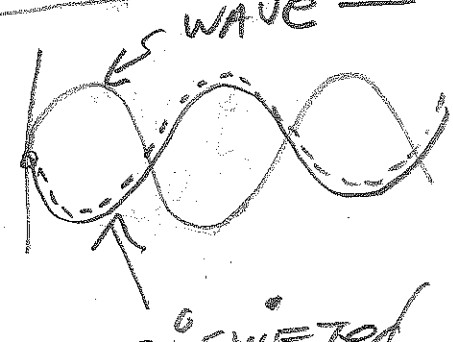
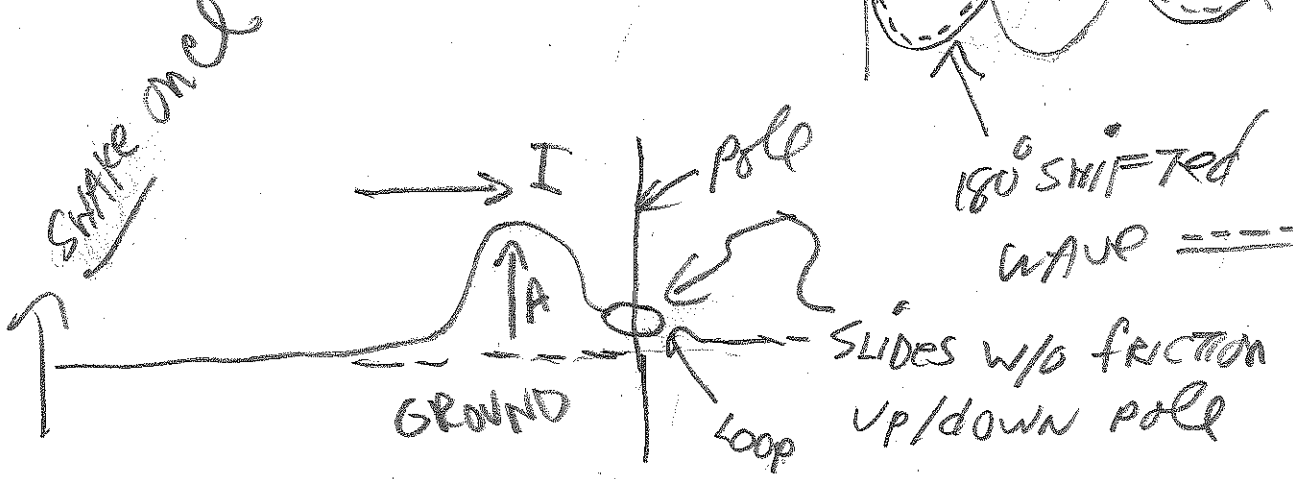
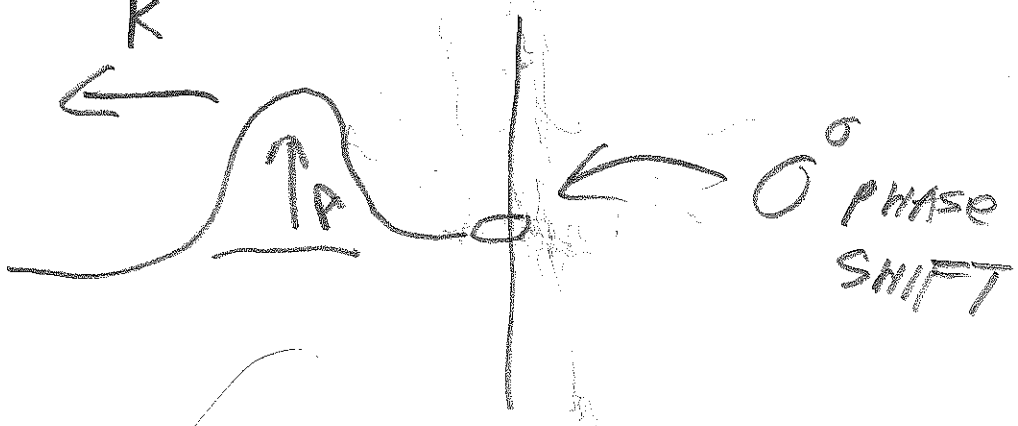
4C & 4E: 8-28-13

Boundary conditions:

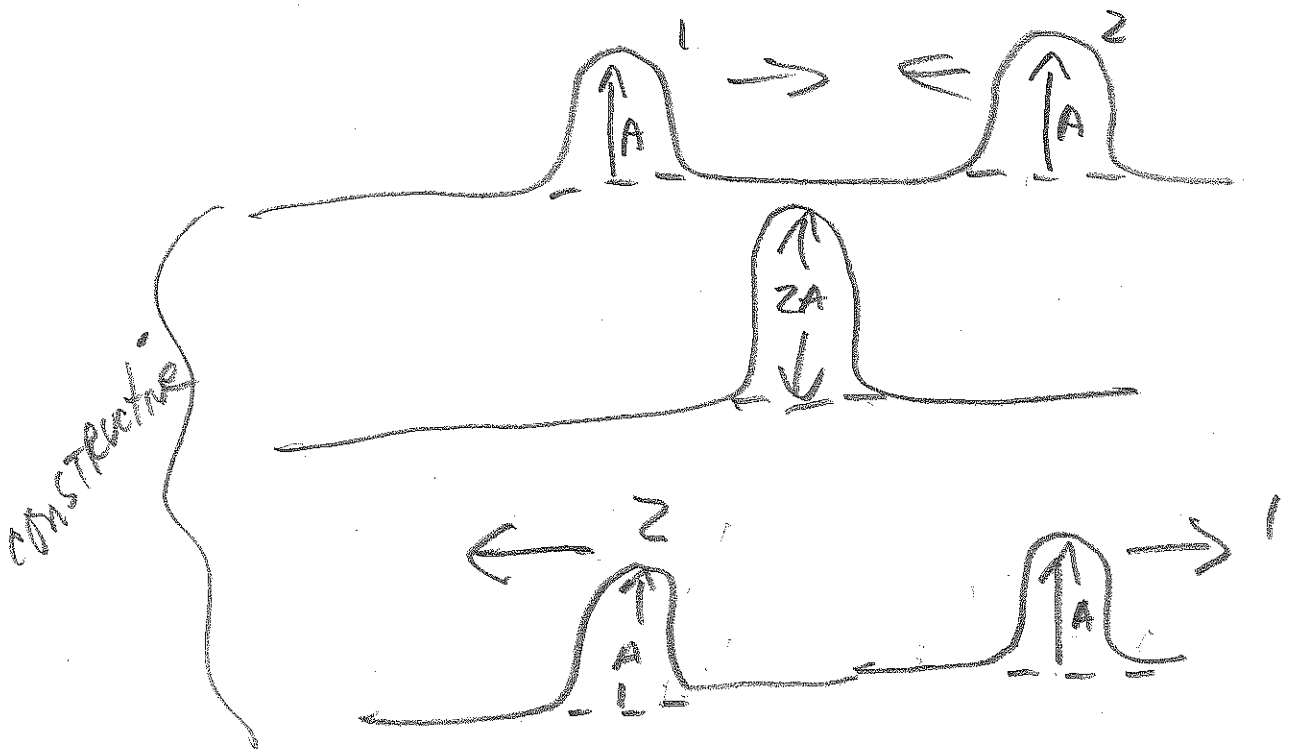


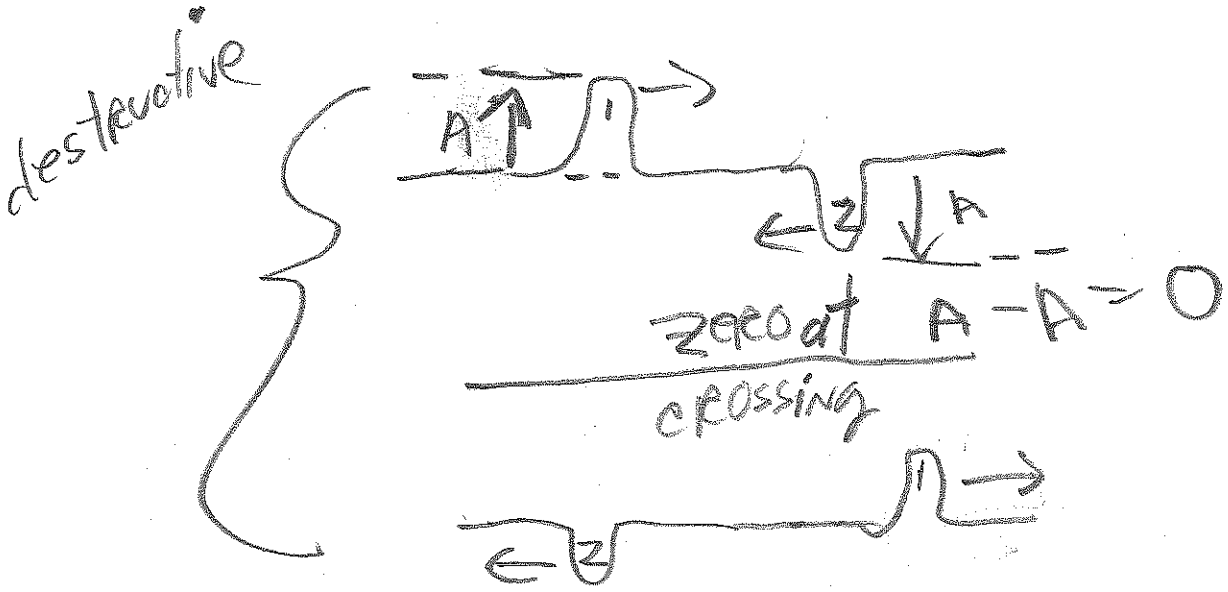






Interference

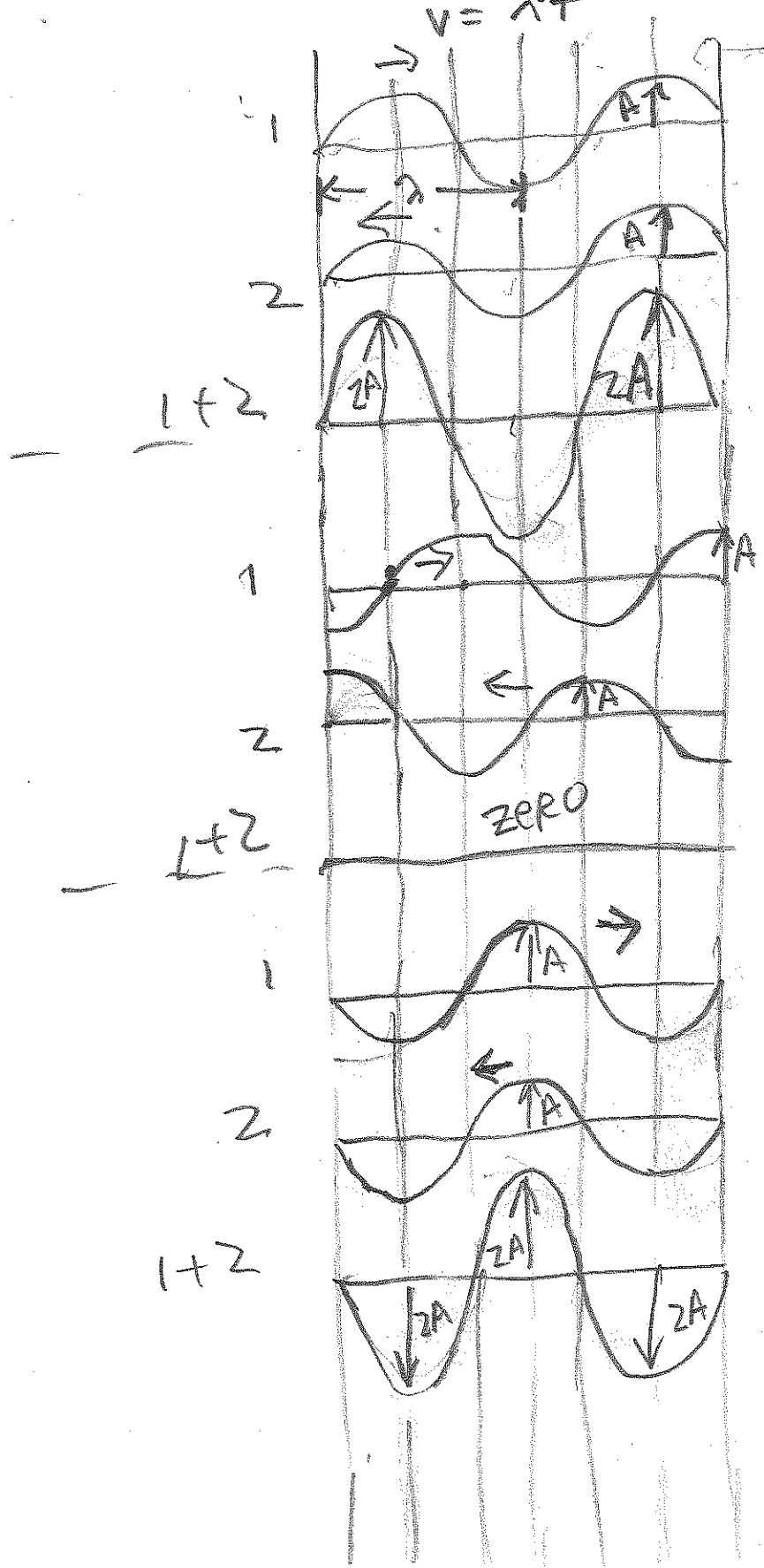




standing waves (prelec. CH15)

$v = \lambda \cdot f$

time



0

$y_1 = A \sin(kx - \omega t)$

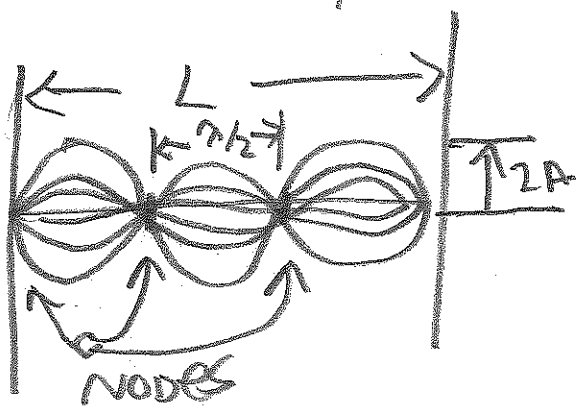
$y_2 = A \sin(kx + \omega t)$

$y_1 + y_2 = 2A \cdot \cos(\omega t) \cdot \sin(kx)$

TRY AT HOME OR TEST #1

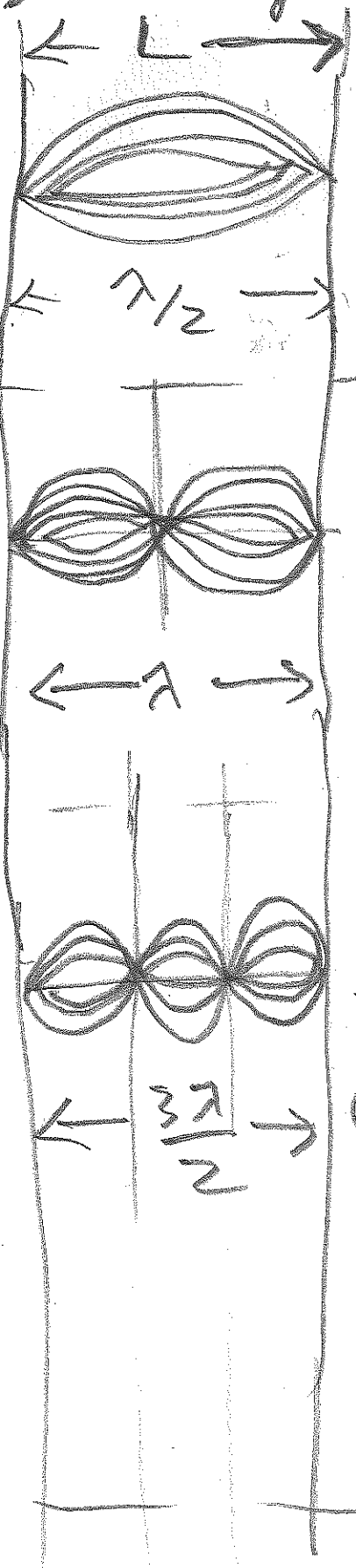
DRAW IMAGES for $t = \frac{3}{4}T$ and $t = T$

guess for remainder



standing waves (fixed ends)

Normal modes



$L = \frac{\lambda}{2}$

$f_1 = \frac{v}{2L} = \frac{v}{\lambda}$

Mode 1 (fundamental)

$L = \lambda$

$f_2 = \frac{v}{L} = \frac{v}{\lambda}$

Mode 2

$L = \frac{3\lambda}{2}$

$\lambda = \frac{2L}{3}$

$f_3 = \frac{v}{\lambda} = \frac{v}{\frac{2L}{3}} = \frac{3v}{2L}$

Mode 3

$f_n = \frac{nv}{2L}$; $n = 1, 3, 3, 4, \ldots$

Mode n

see prelecture on 15 problem (mastering)

Lab 1: Buoyancy and Density 8-28-13 (6)

Error analysis Addon:

accepted density = ρ_{acc} Given by instructor.

$\rho_{exp} - \Delta\rho < \rho_{acc} < \rho_{exp} + \Delta\rho$

If true, successful experiment within margin of errors. (random errors)

If false, a systematic error was larger than the random error margin above.

$$\rho_{acc} = \rho_{exp} \pm \Delta\rho$$

ρ_{exp} = average density of 4 trials

$$\rho = \frac{m_{ROD}}{V} = \frac{m_{ROD}}{\left(\frac{T - T'}{\rho_w \cdot g}\right)} = \frac{m_{ROD} \cdot g \cdot \rho_w}{T - T'}$$

$$\boxed{T - T' = \rho_w \cdot V \cdot g}$$

where T = weight in AIR

" T' = " " WATER

$$\rho = \frac{m_{ROD} \cdot g \cdot \rho_w}{(m - m') \cdot g} = \frac{m_{ROD} \cdot \rho_w}{(m - m')}$$

where $m - m' = \Delta m$ difference between in-AIR and under-water measurements via mass scale.

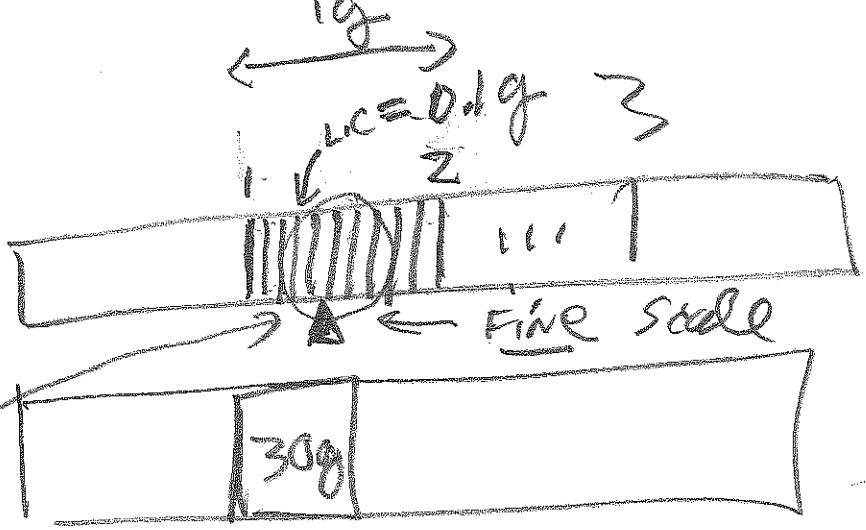
Note: $m_{ROD} = m$

$$\rightarrow \rho = \frac{m \cdot \rho_w}{(m - m')} \quad ; \text{ MEASURED 4 TIMES TO GET AVERAGE}$$

$$\Delta\rho = \frac{\rho_{MAX} - \rho_{MIN}}{2}$$

IF THIS APPROACH DOESN'T WORK WELL TRY ANOTHER BASED ON INHERENT ERRORS DUE TO INSTRUMENTATION

MASS scale measurements



MAJOR scale

30g + 1g

MENTALLY DIVIDE IN HALVES

1.4 1.5

ERROR = L.C. / 2 = 0.05g

BLOW up

MARKER → round up

MARKER (ROUND UP)

31.50 ± 0.05

accepted densities:

	kg/m^3	g/cm^3	
Al	2.7×10^3	2.7	← DIRTY white
Cu	8.9×10^3	8.9	← reddish
Brass	8.4×10^3	8.4	← yellowish
steel	7.88×10^3	7.8	← greyish (RUST)
Ni	8.8×10^3	8.8	←
Au	19.3×10^3	19.3	
Ag	10.5×10^3	10.5	

BUOYANCY AND DENSITY In this experiment, we will measure the density of 3 rods using Archimedes' Principle applied to objects weighed by a mass scale in air or completely submerged under water. Your results should be within the error bars discussed below. PROCEDURE:

1. See lecture notes on hydrostatics, Ch. 12, including hints to #27.

2. See model set up and listen carefully to instructor comments.

3. Pay attention to "Add on" notes on this lab in today's posted lecture (8-28-13).

BUOYANCY AND THE DETERMINATION OF DENSITY

USE RODS OF THREE DIFFERENT MATERIALS

Instrument	MASS SCALE				
Reading	Weight OF ROD in air	Weight OF ROD in water	**ROD VOLUME (SHOW WORK BELOW)**	**ROD DENSITY (SHOW WORK BELOW)**	**% ERROR**
ROD 1	18.56±0.05g				
	18.60±0.05g				
	18.50±0.05g				
	18.60±0.05g				

mass

standard deviation of mean

AV. = 18.55 ± ERROR ; ERROR = STDM OR 0.05g, WHICH EVER IS LARGER