April 21, 2016
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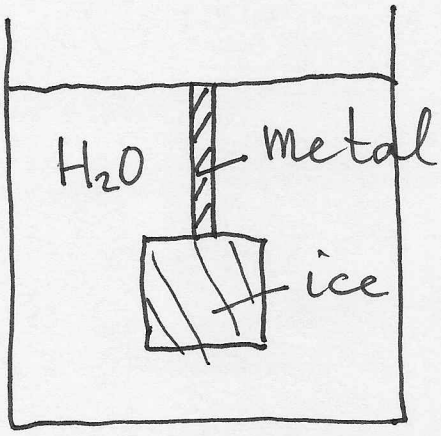
4B QUIZ #2

This Quizz is closed book and no notes and no crib sheet. Calculators are ok but they should not contain physics equations nor text in their memory. Make sure to always define an appropriate coordinate system and indicate its origin and positive directions. Make large and neat figures. Specify the units of numerical answers.

PROBLEM 1 (15 points)

An ice cube is held under water with a thin metal rod. The water is in a container, see the Figure. The ice cube melts. The density of ice is $0.9\,\mathrm{g/cm^3}$ and the cube is 5 cm on the side. By how much will the water level in the container change? Explain in detail with a calculation.

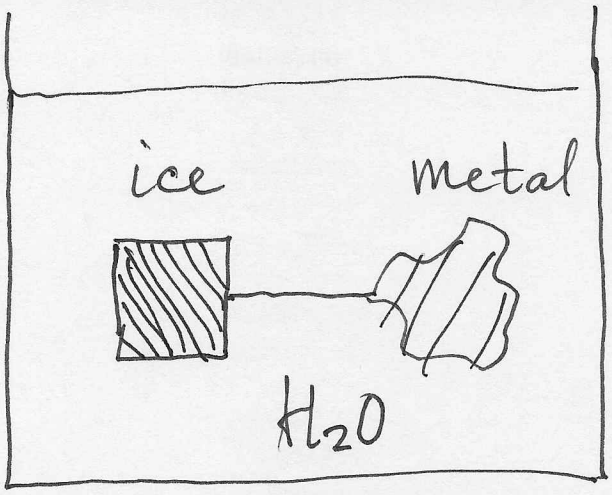


PROBLEM 2 (15 points)

An ice cube and a piece of metal are connected by a thin metal rod and are suspended under water as shown in the Figure. The ice cube is 5 cm on the side. The combination of the two objects is neither sinking nor floating. The mass density of the metal is $7.8\,\mathrm{g/cm^3}$.

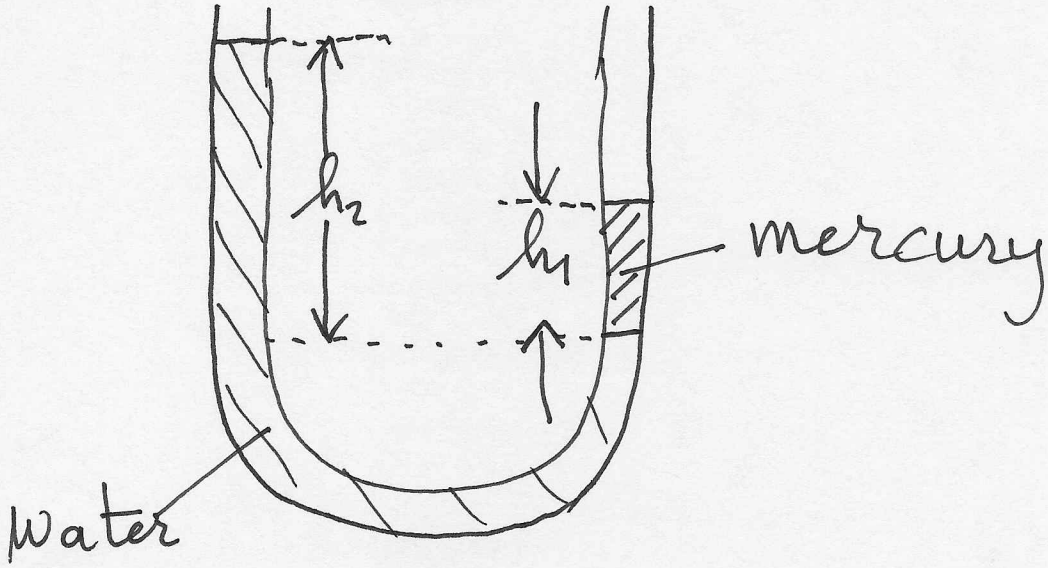
a. What is the volume of the metal?

b. Does it matter what the shape of the metal is? Explain your answer.



PROBLEM 3 (15 points)

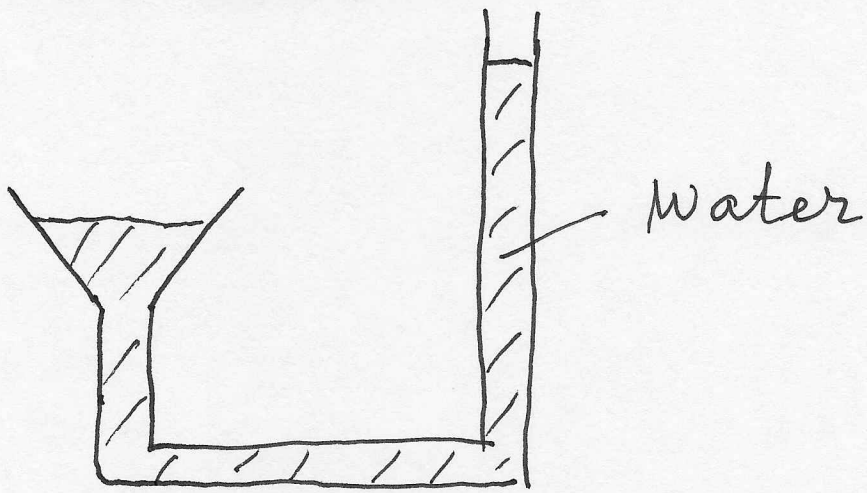
A U-shape glas tube of constant diameter is filled with mercury and water as shown in the Figure. The heights h_1 and h_2 are defined in the Figure. The density of mercury is $13.9\,g/\text{cm}^3$.
Find a relation between h_1 and h_2.



PROBLEM 4 (15 points)

A glas object shown in the Figure. The object is filled with water. A person explains that the water level in the wider vertical extensions must be lower than in the narrower ones because the atmospheric pressure is equal for both but the wider one has a larger area and therefore the force acting on the wider vertical extensions will be larger (force equals pressure times area).

Is this a correct argument? Explain why or why not.



PROBLEM 5 (15 points)

A transverse wave's shape is presented by

$$y(x,t) = y_m e^{\frac{-(x+vt)^2}{2a^2}} \tag{1}$$

where y is the displacement, x a coordinate, and t the time.

a. Is this a periodic wave form?

b. Is this a traveling wave or a standing wave?

c. If it is traveling what is its velocity (specify magnitude and direction)?

d. Is the wave damped?

PROBLEM 6 (25 points)

A string with linear mass density μ and length ℓ is attached to the wall at one end and runs over a pulley as shown in the Figure. A mass m is attached

to the string's other end as shown. The pulley can rotate without friction. The string has transverse vibration.

a. What is the lowest frequency that the string can vibrate at?

b. What is the frequency of the second harmonic?