Phy132 First Homework Assignment
Due Wednesday April 10

Figures for the questions can be found the the last page of the assignment

Question 1. Determine the absolute pressure at the bottom of a lake, which is 100 meters deep. Express your answer in units of Pascal, and also in atmospheres.

Question 2. Consider the water tank shown on the last page. It is filled with water that is 2 meters deep. At the bottom of one side is a hinged rectangular door, whose dimensions are 2 meters wide and 1 meter high.

a) Determine the net force on the rectangular door. Express your answer in Newtons. Hint: you need to integrate the pressure over the surface of the door. Divide the door into horizontal strips of width Δy.

b) Determine the net torque in N-M exerted by the door about the hinge. Hint: you also need to integrate over the surface of the door. Remember that torque equals force times "moment arm".

Question 3. Wally wants to use helium balloons to lift him off the ground. Each balloon has a radius of 30cm. If Wally's mass is 70 Kg, how many balloons does he need? Take the density of helium to be 0.18 kg/m^3, and the density of air to be 1.29 kg/m^3. You can neglect the weight of the balloon (i.e. the rubber part) itself.

Question 4. The U-tube shown on the last page contains water and oil. From the measurements shown in the figure (on the last page) determine the density of the oil.

Question 5. A block of wood has 2/3 of its volume submerged when it floats in water. When it is placed in oil, it has 9/10 of its volume submerged. Find:

a) The density of the wood.

b) The density of the oil.

Question 6. A tank is filled with water to a height H. (See the figure on the last page) A hole is punched in one of the walls a distance h from the bottom. Water flows horizontally out of the hole and lands a distance x from the tank.

a) Find an expression for the distance x in the figure. Express your answer in terms of H and h. **Hint**: assume that the top of the water is hardly moving. Determine the time it takes an object to fall a distance h, and multiply this time by v to find the range.

b) For what height h is x a maximum?

Question 7. Air flows over the top of an airplane wing with a speed of v_t (see the figure on the last page). Air flows under the bottom of the wing with a speed of v_b. If the wing has an area A, find an expression for the upward force on the wing. Express your answer in terms of v_t, v_b, A and the density of air ρ_{air}.

**Question 8**. Try to solve the problem that Archemedes did:
The king gave the goldsmith an amount of gold, m, to make a crown. This much gold has a volume of 100 cm^3. However, the king suspects that the goldsmith has stolen some gold ad mixed in some other metal. He asks Archemedes to check it out. So Archemedes takes the crown and an equal amount (mass m) of gold and the other metal. That is, each of the three objects has the same mass m. Archemedes measures the volume of the objects and obtains: crown = 120 cm^3, gold = 100 cm^3, and metal = 210 cm^3.

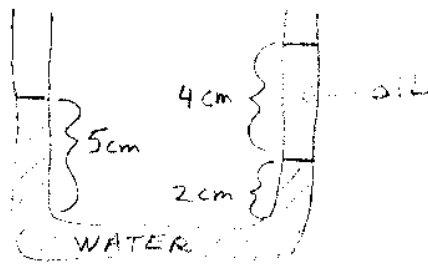How much gold in cm^3 did the goldsmith steal?

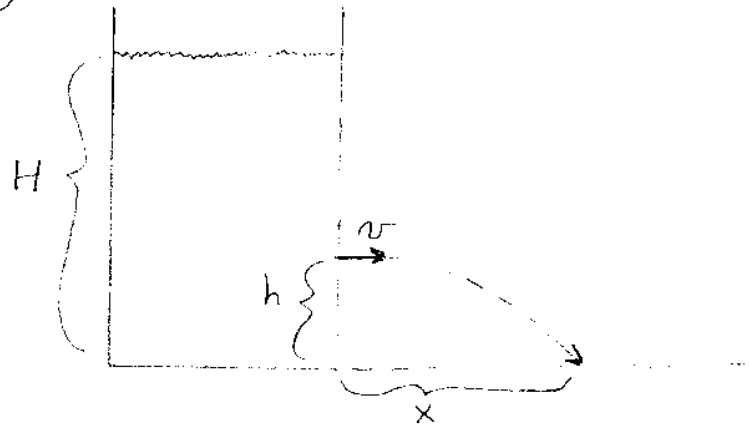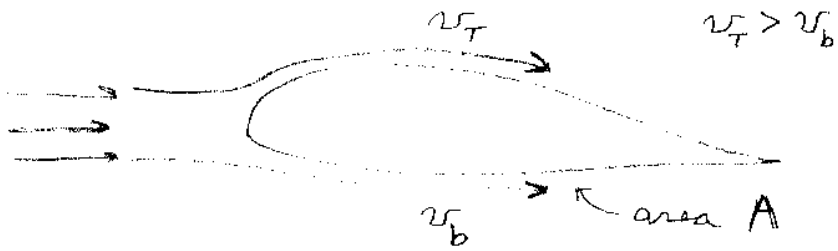*See the next two pages for the figures*

Figures for Problem Set 1

(2)

1m

1m

2m

(4)

4 cm

oil

5cm

2 cm

WATER

(6)

H
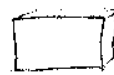
h

v

x

(7)

v_T
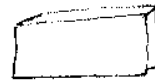
$v_T > v_b$

v_b ← area A
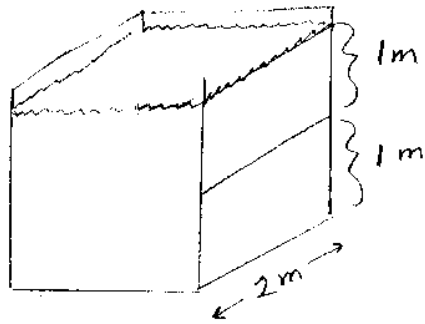
(8)

$V = 120 \, cm^3$

CROWN
mass m

$V = 100 \, cm^3$

GOLD
mass m

$V = 210 \, cm^3$

METAL
mass m