

**Phy132 First Homework Assignment**  
**Due Monday April 6**

*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 area of the door.

b) Determine the net torque in N-M exerted by the door about the hinge.

**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  $0.18 \text{ kg/m}^3$ , and the density of air to be  $1.29 \text{ kg/m}^3$ . 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).

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  $\rho_{air}$ .

**Question 8.** Try to solve the problem that Archimedes did:

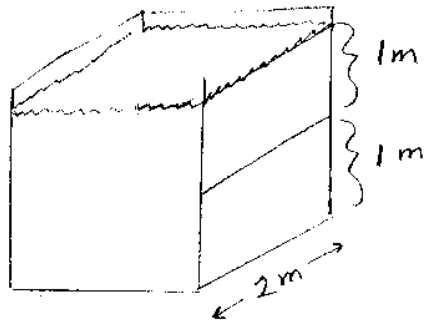
The king gave the goldsmith an amount of gold,  $m$ , to make a crown. This much gold has a volume of  $100 \text{ cm}^3$ . However, the king suspects that the goldsmith has stolen some gold and mixed in some other metal. He asks Archimedes to check it out. So Archimedes takes the crown and an equal amount (mass  $m$ ) of gold and the other metal. That is, each of the three objects has the same mass  $m$ . Archimedes measures the volume of the objects and obtains: crown =  $120 \text{ cm}^3$ , gold =  $100 \text{ cm}^3$ , and metal =  $210 \text{ cm}^3$ .

How much gold in  $\text{cm}^3$  did the goldsmith steal?

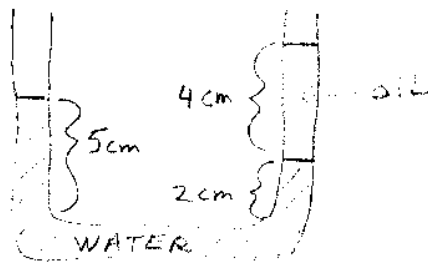
*See the next two pages for the figures*

Figures for Problem set 1

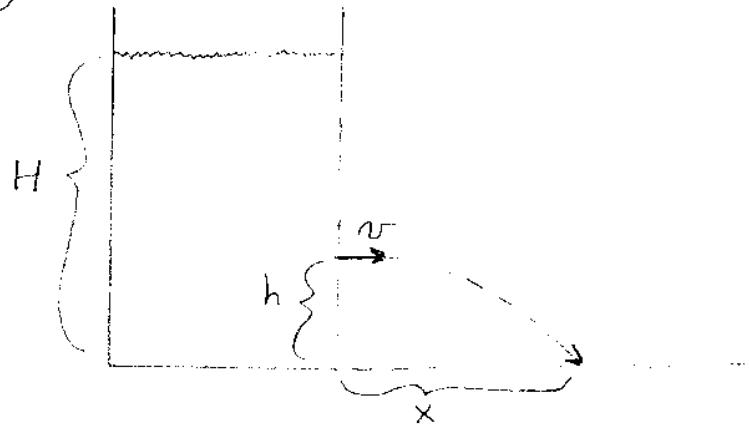
2



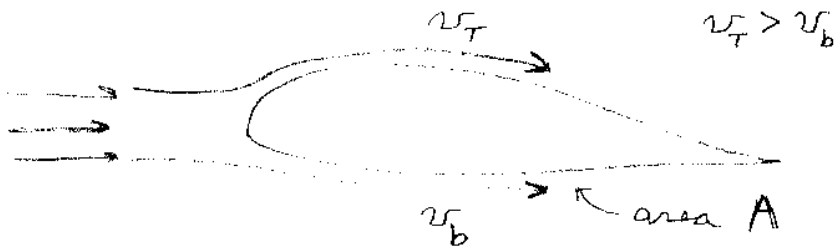
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6



7



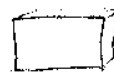
8

$V = 120 \text{ cm}^3$



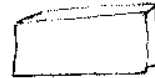
CROWN  
mass  $m$

$V = 100 \text{ cm}^3$



GOLD  
mass  $m$

$V = 210 \text{ cm}^3$



METAL  
mass  $m$