

Physics 113 - November 15, 2012

one of you wrote -

I am just wrapping up PS9, and I am pretty confused by part a of #71. I just have no clue how the answer key comes to the conclusion that torque will cause the bicycle to veer to the right. I tried a bunch of orientations of r and F using the RH rule, and I am still lost.

71. A boy rolls a tire along a straight level street. The tire has mass 8.0 kg , radius 0.32 m and moment of inertia about its central axis of symmetry of $0.83 \text{ kg}\cdot\text{m}^2$. The boy pushes the tire forward away from him at a speed of 2.1 m/s and sees that the tire leans 12° to the right (Fig. 11-46). (a) How will the resultant torque affect the subsequent motion of the tire? (b) Compare the change in angular momentum caused by this torque in 0.20 s to the original magnitude of angular momentum.

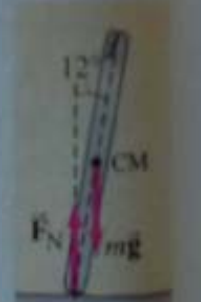
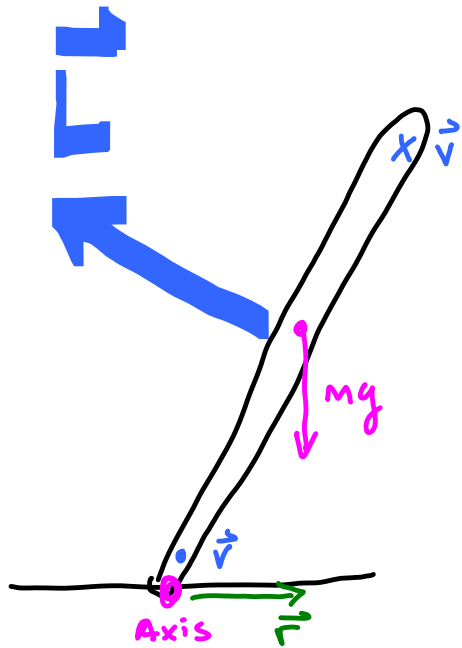
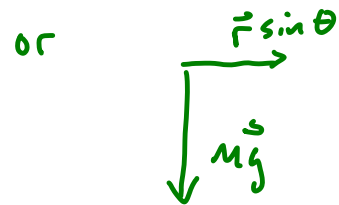
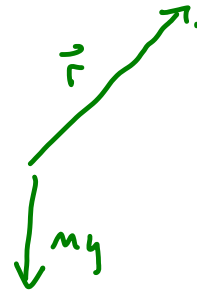


FIGURE 11-46
Problem 71



$$\frac{d\vec{L}}{dt} = \vec{\tau}$$

$\vec{r} \times m\vec{g}$ into board



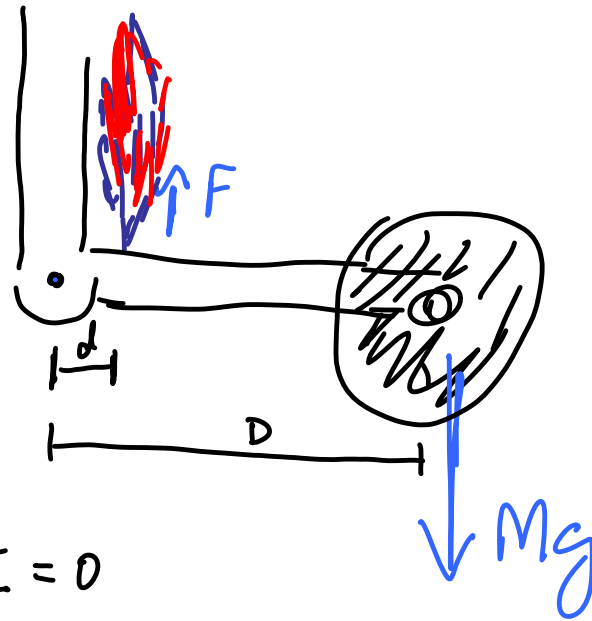
So \vec{L} rotates into board... meaning wheel MUST turn to the right as you are looking at it.

Static
Equilibrium

$$\sum \vec{F} = 0$$

$$\sum \vec{L} = 0$$

any
axis



We are neglecting
mass of arm

$$\sum \vec{L} = 0$$

$$0 \approx dF - MgD$$

For same $|\vec{F}|$, M supported
"scales" with d

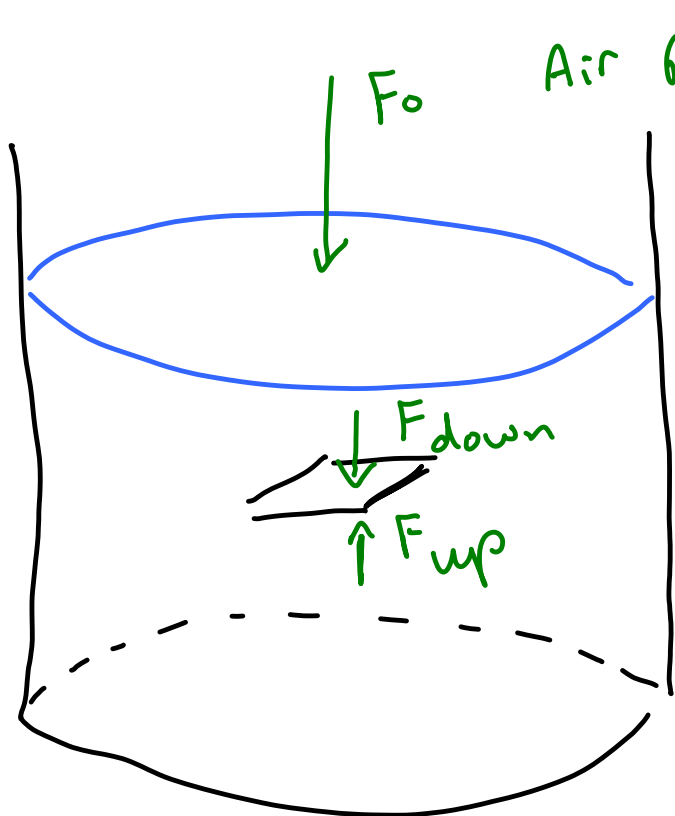
Fluid Mechanics

STATICS - Hydrostatics

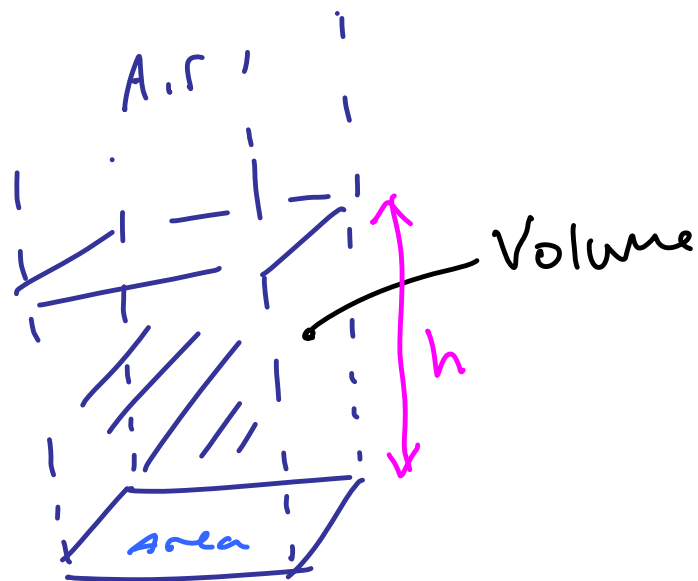
For us \rightarrow incompressible

ρ volume density $\frac{\text{Mass}}{\text{Vol.}}$ $\frac{\text{kg}}{\text{m}^3}$

Specific gravity of material = $\frac{\rho_{\text{material}}}{\rho_{\text{H}_2\text{O at } 4^\circ\text{C}}}$ > 1 Sink
 < 1 float



Air pushing on water



$$\frac{F_{down}}{Area} = \frac{F_{Air}}{Area} + \frac{\rho V g_{water}}{Area}$$

$$\frac{\text{Force}}{\text{Area}}$$

≡ pressure

$$\frac{\text{N}}{\text{M}^2} \equiv \text{Pascal}$$

for MICS

$$P_{\text{Top Paper}} = P_{\text{top Water}} + \rho g h$$

↑ height of water

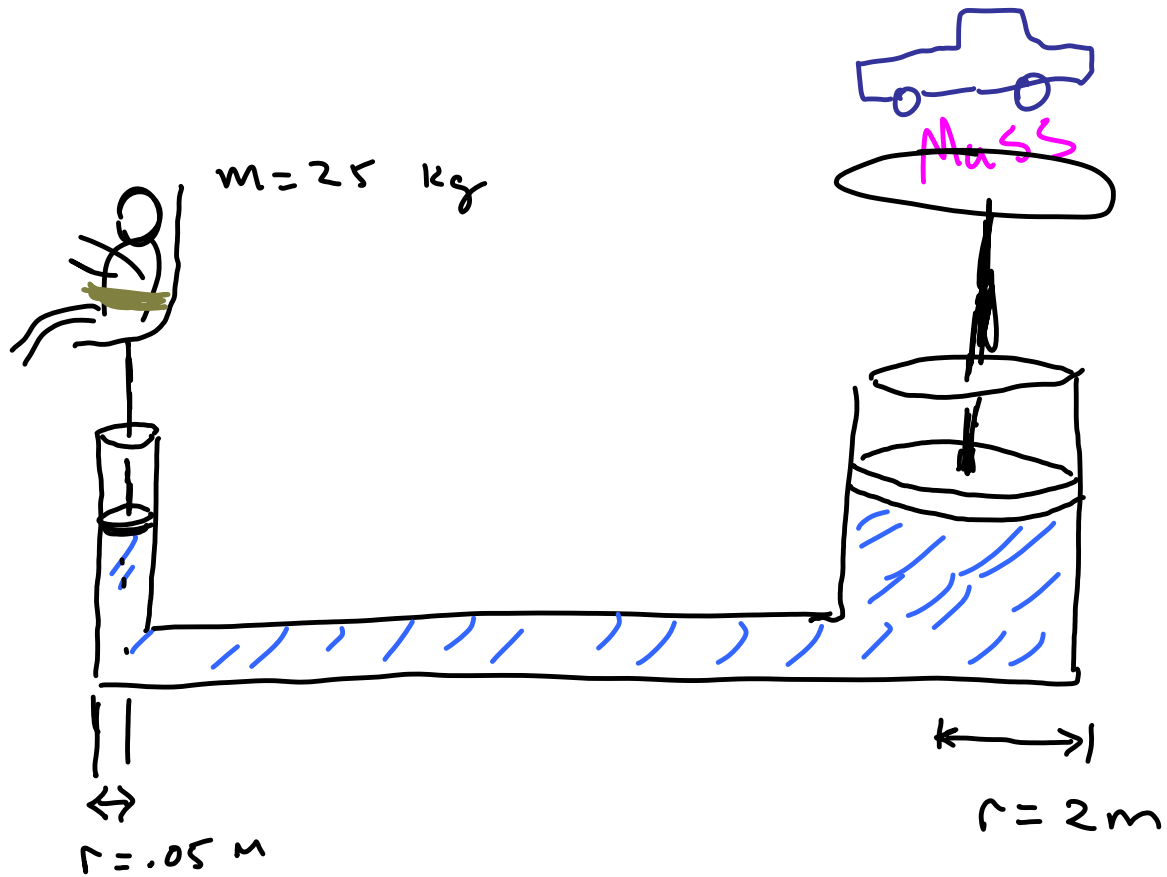
1 Atmosphere

$$= 1.013 \times 10^5 \text{ Pa}$$

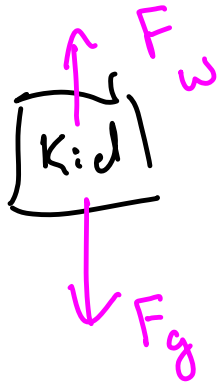
$$= 1013 \text{ millibar}$$

$$= 14.70 \text{ lb/in}^2$$

Pascal's Law : Pressure applied to a enclosed fluid is transmitted undiminished to every point in the fluid and the container walls



Hydraulics

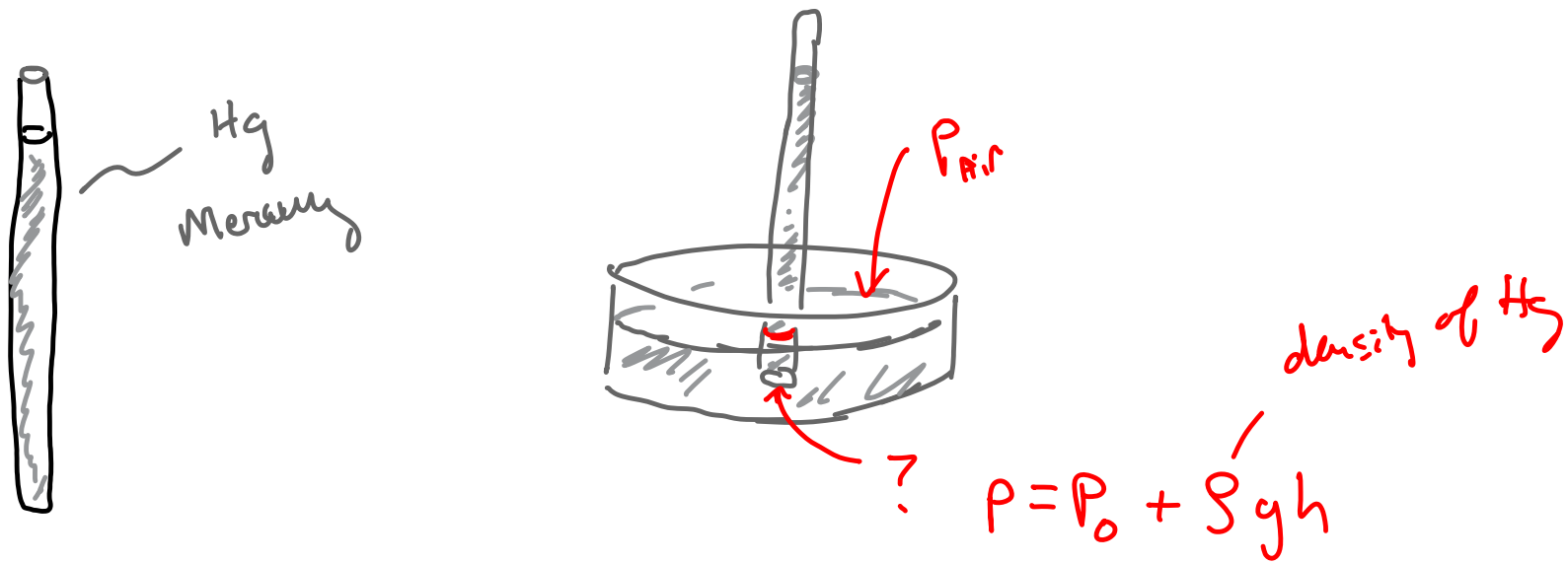


$$P_{\text{kid}} = \frac{F}{A}$$

Pascal

$$= \frac{(25 \text{ kg})(9.8 \text{ m/s}^2)}{\pi (.05)^2} = \frac{(\text{Mass})(9.8)}{\pi (2)^2}$$

$$\text{Mass} = 40,000 \text{ kg}$$
$$\sim 80,000 \text{ lbs}$$

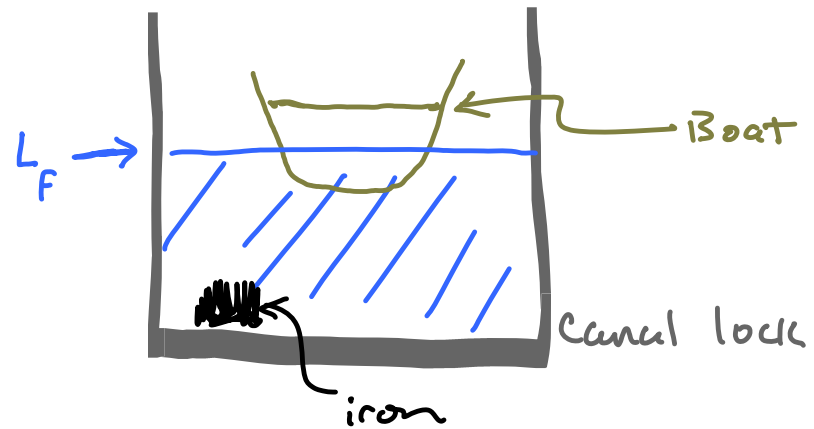
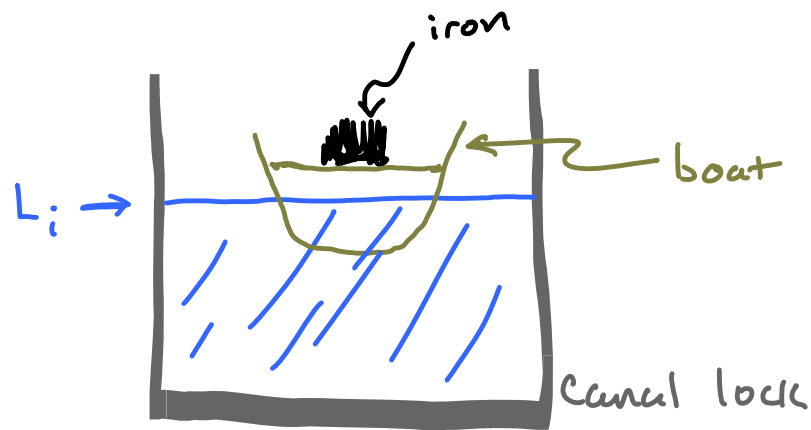


pressure of 1 Torr = 1 mmHg

1 atm = 760 Torr = 760 mm Hg

Archimede's Principle

When a body is completely or partially submerged, the fluid exerts an upward force on the body equal to the weight of the displaced fluid.



- (a) Water level unchanged
- (b) Water level rises ($L_f > L_i$)
- (c) Water level Drops ($L_f < L_i$)