HW 9

4) $2.0 \times 10^5 \text{ Pa} = W_{car}/(4 \cdot .024 \text{ m}^2)$

$\Longrightarrow W_{car} = 19200 \text{ N}$

16) The pressure exerted by one leg is:

$(70 \text{ kg} + 5 \text{ kg})(9.8 \text{ m/s}^2)/(2 \cdot \pi \cdot (.01 \text{ m})^2) = 1170000 \text{ Pa}$

18) gauge pressure $= P - P_0 = \rho g h$

$= (10^3 \text{ kg/m}^3) \cdot (9.8 \text{ m/s}^2) \cdot (1200 \text{ ft}) \cdot \left(\frac{1 \text{ m}}{3.281 \text{ ft}}\right) = 3.6 \times 10^6 \text{ Pa}$

20) a) The maximum force which can be "removed" from the top of the brick is:

$\underbrace{(1 \text{ atm})}_{\text{"}P_0\text{"}} \cdot \underbrace{\pi \cdot (.0286 \text{ m})^2}_{\text{area of nozzle}} \cdot \left(\frac{10^5 \text{ Pa}}{1 \text{ atm}}\right) = 256 \text{ N}$ (so this is the max. brick weight)

b) Similarly, the maximum force that the octopus can produce is:

$(1.013 \times 10^5 \text{ Pa} + (10^3 \text{ kg/m}^3) \cdot (9.8 \text{ m/s}^2) \cdot (32.3 \text{ m})) \cdot (.0286 \text{ m})^2 \cdot \pi = 1070 \text{ N}$

22) $1 \text{ atm} = 1.013 \times 10^5 \text{ Pa} = (984 \text{ kg/m}^3)(9.8 \text{ m/s}^2) \cdot h$

$\Longrightarrow h = 10.5 \text{ m}$

No, the vacuum would not be as good (wine vapor).

30) a) force of water on top of block =

$P_{top} \cdot A_{top} = \cancel{P_0 + \rho g h_{top}} \, A_{top} = [(1.013 \times 10^5 \text{ Pa}) + (10^3 \text{ kg/m}^3) \cdot (9.8 \text{ m/s}^2) \cdot (.05 \text{ m})] \cdot .01 \text{ m}^2$

$= 1018 \text{ N}$

force on bottom of block =

$$P_{bottom} \cdot A_{bottom} = \left[1.013 \times 10^5\ Pa + (10^3\ kg/m^3)\cdot(9.8\ m/s^2)\cdot(.17\ m)\right]\cdot .01\ m^2$$

$$\cancel{= 1018\ N} = 1030\ N$$

b) $\sum F = T - mg + B = T - (10\ kg)\cdot(9.8\ m/s^2) + (.0012\ m^3)(10^3\ kg/m^3)(9.8\ \frac{m}{s^2})$

$= 0 \Longrightarrow T = 86\ N$

c) $\underbrace{(.0012\ m^3)\cdot(10^3\ kg/m^3)\ (9.8\ \frac{m}{s^2})}_{\text{"bouyant force"}} = 12\ N$

$F_{bottom} - F_{top} = 12\ N$

32) For the ship to remain afloat, the change in its weight must equal the change in the bouyant force:

$$(50 \cdot 29{,}000\ kg)\cdot(9.78\ m/s^2) = (.11\ m)\cdot A \cdot (10^3\ kg/m^3)\cdot(9.78\ m/s^2)$$

$$\Longrightarrow A = 13000\ m^2$$

45) The velocity of the water as it exits the hole is given by: $1\ m = \frac{1}{2}(9.8\ m/s^2)t^2$; $.6\ m = vt$

substitution yields $v = 1.32\ m/s$

In addition, from Bernoulli's equation,

$$P_0 + \rho g h = \frac{1}{2}\rho v^2 + P_0 \Longrightarrow v = \sqrt{2gh}$$

So $h = (1.32\ m/s)^2/2g = .09\ m$