Fluids

WORKSHEET #1

Name: _____

1. A marble cylinder that has a diameter of 42.0 cm and stands 1.25 m tall rests on a flat tile deck. What is the pressure exerted on the deck by the cylinder?

$P=F/A$ A = area of circle on bottom of cylinder, F = weight of cylinder

$A = \pi r^2 = \pi \cdot (0.21\ m)^2 = 0.138544236\ m^2$

$F = w = mg = (\rho \cdot V) \cdot g = \rho \cdot (\pi r^2 h) \cdot g$

$P = F/A = (\rho \cdot (\pi r^2 h) \cdot g)/\pi r^2 = \rho \cdot h \cdot g$

$= 2.7 \times 10^3\ kg/m^3 \cdot 1.25\ m \cdot 9.8\ m/s^2 = 33075\ Pa =$ **33 100 Pa or 33.1 kPa**

2. What is the force exerted on the surface of a bowling ball that has a diameter of 32.0 cm immersed in water to a depth of 555 m?

$P = F/A$

$F = P \cdot A = (P_0 + \rho gh) \cdot 4\pi r^2$

$= (101{,}300\ Pa + 1000\ kg/m^3 \cdot 9.8\ m/s^2 \cdot 555\ m) \cdot 4\pi \cdot (0.16\ m)^2$

$= (101{,}300\ Pa + 5{,}439{,}000\ Pa) \cdot 0.3217\ m^2 = 1{,}782{,}309\ N =$ **1 780 000 N or 1.78 MN**

If you were interested in just the force due to the water alone, then you'd leave out P_0 as part of P in the equations above.

3. A man weighs like 786 N. He lies on a bed of nails. Find the average pressure exerted on him by each of the nail heads. Figure that there are 950 nails in contact with the man and that the point of each is slightly flattened and has a diameter of 2.00 mm.

$F = 786\ N/950\ nails = 0.8273684211\ N/nail$

$P = F/A = F_{nail}/A_{nail} = 0.8273684211\ N/(\pi \cdot 0.001^2) =$ **263 000 Pa or 263 kPa**

or

$P = F/A = 786\ N/(950 \cdot \pi \cdot 0.001^2) =$ **263 000 Pa or 263 kPa**

4. A sheet of paper lies on a table. The paper measures 20.0 cm by 30.0 cm. Calculate the force exerted on the paper by the atmosphere. Figure that the pressure exerted by the atmosphere is 1.013×10^5 Pa.

$P = F/A$

$F = P \cdot A = 101300\ Pa \cdot (0.200\ m \cdot 0.300\ m) = 6078\ N =$ **6080 N or 6.08 kN**

5. A submarine in the Pacific Ocean cruises along at a depth of 678 m. Find (a) the pressure acting on the sub and (b) the force exerted on a hatch that measures 1.00 m by 1.50 m.

a. $P = \rho gh = 1000\ kg/m^3 \cdot 9.8\ m/s^2 \cdot 678\ m$
$= 6\ 644\ 400\ Pa =$ **6 640 000 Pa or 6 640 kPa or 6.64 MPa**

b. $P = F/A$
$F = P \cdot A = 6{,}644{,}400\ Pa \cdot (1.00\ m \cdot 1.50\ m) = 9\ 966\ 600\ N =$ **9 970 000 N or 9.97 MN**

6. What is the (a) buoyant force acting on a cube of copper that measures 2.00 cm on its each side if it is immersed in water and (b) the apparent weight of the cube?

a. $F_b = \rho Vg = 1.0 \times 10^3\ kg/m^3 \cdot (0.0200\ m)^3 \cdot 9.8\ m/s^2 =$ **0.0784 N**

b. $w_{app} = w - F_b = mg - F_b = (\rho V)g - F_b$
$= 8900\ kg/m^3 \cdot (0.0200\ m)^3 \cdot 9.8\ m/s^2 - 0.0784\ N =$ **0.619 N**