Chapter **14** (Benson)

E03 (a) $\rho = M/(4\pi r^3/3) = 8.95\times10^{14}$ kg/m^3; (b) $V = 4\pi r^3/3 = M/\rho$, $r = 1.17$ km .

E06 $B = -\Delta P\,V/\Delta V = 1.05\times10^9$ N/m^2 .

E09 $F = AY\Delta L/L$, thus $F = (3\times10^{-4})(10^{10})(10^{-2}) = 3\times10^4$ (N) .

E12 (a) $P = \rho gH$, $PA = \rho gHA = mg$, so $m = (4\pi R^2)P/g$, where R is the radius of Earth. $m = 5.25\times10^{18}$ kg; (b) $V = 4\pi[(R+h)^3 - R^3]/3 \sim 4\pi R^2 h$ & $m = \rho V$, thus $h = 8$ km .

E17 Let $y = 0$ at the Hg-H_2O interface in one arm. $V_w = Ah_w = (\pi r^2)h_w = 25$ mL, so $h_w = 49.74$ cm. $\rho_m g h_m = \rho_w g h_w \Rightarrow h_m = 3.66$ cm, then $h_w - h_m = 46.1$ cm .

E21 $\rho_1\, gh_1 = \rho_2\, gh_2$, thus $\rho_2 = \rho_1 h_1/h_2 = 4.8/4.4 = 1.09$ (g/cm^3) .

E25 $P = P_a + \rho gh = 101.3\,\text{kPa} + 3\,\text{kPa} = 104\,\text{kPa}$.

E29 $\Delta F_B = \rho(\pi r^2 h)g = mg$, thus $m = 6.03$ g .

E42 $mg = (V_b + Ah)\rho_w g = [V_b + A(h + 1.5\,\text{cm})]\rho_l g$. Use $(V_b + Ah) = m/\rho_w = 5\,\text{cm}^3$ to find $\rho_l = 0.944\,\text{g/cm}^3$.

E48 $V_2 = \sqrt{2gh} = 14$ m/s. $P_1 - P_2 = \rho v_2^2/2 + \rho gH = 118$ kPa .

E50 $P_1 - P_2 = \rho(v_2^2 - v_1^2)/2 = 4.90\,\text{kN/m}^2$, so $F = (P_1 - P_2)A = 392$ kN .

P01 $dF = (Wdy)(\rho gy)$; $F = \rho gW\int_0^H y\,dy = \rho gWH^2/2 = (10^3)(9.80)(200)(60^2) = 3.53\times10^9$ (N) .

P03 Consider a thin layer of thickness Δy_0 at depth h. $\Delta p = \rho gh \cdots$ ①. By definition, $\Delta p = -B\Delta V/V_0 = -B\Delta y/\Delta y_0 \cdots$ ②. Combine ① and ②, we obtain $\Delta\rho/\rho = -\Delta y_0/\Delta y = \rho_0 gh/B$, or $\Delta\rho = \rho_0^2 gh/B$. Using $\rho_0 = 1025\,\text{kg/m}^3$ & $h = 10.9$ km, $\Delta\rho = 53.5\,\text{kg/m}^3$.

P08 $A_1v_1 = A_2v_2$ gives $R^2v_0 = r^2v$. $v^2 = v_0^2 + 2gy$, thus $(R^2v_0^2/r^2)^2 = v_0^2 + 2gy$ or $r^4 = R^4/(1 + 2gy/v_0^2)$.

P09 $A_1v_1 = A_2v_2$; $v_1^2 = v_2^2 + 2gh$, so $v_1^2 = 2gh/(1 - A_1^2/A_2^2)$.

P11 (a) $P_1 + \rho v_1^2/2 + \rho gy_1 = P_2 + \rho v_2^2/2 + \rho gy_2$, $P_1 = P_2 = P_a$, $v_1 \sim 0$, thus $v_2 = \sqrt{2g(y_2 - y_1)} = \sqrt{2g(H-h)}$. $t = \sqrt{2h/g}$, $R = v_2\,t = 2\sqrt{h(H-h)}$; (b) Set $y_2 = H - h$, we obtain the same R.

(Teacher: Jyh-Shinn Yang, 90.03.06)

P04 $dF = dm\,\omega^2 r = (2\pi r\rho h dr)\,\omega^2 r = dP(2\pi rh)$,
thus $dP = \rho\,\omega^2 r dr$. Integrate it, $P = P_a + \rho\,\omega^2 r^2/2$.