Chapter 11

Problems & Exercises

1.

1.610 cm^3

3.

(a) 2.58 g

(b) The volume of your body increases by the volume of air you inhale. The average density of your body decreases when you take a deep breath, because the density of air is substantially smaller than the average density of the body before you took the deep breath.

4.

2.70 g/cm^3

6.

(a) 0.163 m

(b) Equivalent to 19.4 gallons, which is reasonable

8.

$7.9 \times 10^2\ kg/m^3$

9.

15.8 g/cm^3

10.

(a) $10^{18}\ kg/m^3$

(b) 2×10^4 m

11.

3.59×10^6 Pa; or 521 lb/in^2

13.

2.36×10^3 N

14.

0.760 m

16.

$$\begin{aligned}(h\rho g)_{\text{units}} &= (\mathrm{m})\left(\mathrm{kg/m^3}\right)\left(\mathrm{m/s^2}\right) = \left(\mathrm{kg\cdot m^2}\right)/\left(\mathrm{m^3\cdot s^2}\right)\\ &= \left(\mathrm{kg\cdot m/s^2}\right)\left(1/\mathrm{m^2}\right)\\ &= \mathrm{N/m^2}\end{aligned}$$

18.

(a) 20.5 mm Hg

(b) The range of pressures in the eye is 12–24 mm Hg, so the result in part (a) is within that range

20.

$1.09\times10^3\ \mathrm{N/m^2}$

22.

24.0 N

24.

2.55×10^7 Pa; or 251 atm

26.

5.76×10^3 N extra force

28.

(a) $V = d_\mathrm{i}A_\mathrm{i} = d_\mathrm{o}A_\mathrm{o} \Rightarrow d_\mathrm{o} = d_\mathrm{i}\left(\frac{A_\mathrm{i}}{A_\mathrm{o}}\right)$.

Now, using equation:

$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow F_\mathrm{o} = F_\mathrm{i}\left(\frac{A_\mathrm{o}}{A_\mathrm{i}}\right)$.

Finally,

$W_\mathrm{o} = F_\mathrm{o}d_\mathrm{o} = \left(\frac{F_\mathrm{i}A_\mathrm{o}}{A_\mathrm{i}}\right)\left(\frac{d_\mathrm{i}A_\mathrm{i}}{A_\mathrm{o}}\right) = F_\mathrm{i}d_\mathrm{i} = W_\mathrm{i}$.

In other words, the work output equals the work input.

(b) If the system is not moving, friction would not play a role. With friction, we know there are losses, so that $W_{\text{out}} = W_{\text{in}} - W_\mathrm{f}$; therefore, the work output is less than the work input. In other words, with friction, you need to push harder on the input piston than was calculated for the nonfriction case.

29.

Balloon:

$$\begin{aligned}P_\mathrm{g} &= 5.00\ \mathrm{cm\ H_2O},\\ P_{\text{abs}} &= 1.035\times10^3\ \mathrm{cm\ H_2O}.\end{aligned}$$

Jar:

$$\begin{aligned} P_{\mathrm{g}} &= -50.0 \text{ mm Hg}, \\ P_{\mathrm{abs}} &= 710 \text{ mm Hg}. \end{aligned}$$

31.

4.08 m

33.

$$\Delta P = 38.7 \text{ mm Hg},$$
$$\text{Leg blood pressure} = \tfrac{159}{119}.$$

35.

22.4 cm^2

36.

91.7%

38.

815 kg/m^3

40.

(a) 41.4 g

(b) 41.4 cm^3

(c) 1.09 g/cm^3

42.

(a) 39.5 g

(b) 50 cm^3

(c) 0.79 g/cm^3

It is ethyl alcohol.

44.

8.21 N

46.

(a) 960 kg/m^3

(b) 6.34%

She indeed floats more in seawater.

48.

(a) 0.24

(b) 0.68

(c) Yes, the cork will float because $\rho_{\text{obj}} < \rho_{\text{ethyl alcohol}} (0.678\ \text{g/cm}^3 < 0.79\ \text{g/cm}^3)$

50.

The difference is 0.006%.

52.

$F_{\text{net}} = F_2 - F_1 = P_2 A - P_1 A = (P_2 - P_1)\, A$

$= (h_2 \rho_{\text{fl}} g - h_1 \rho_{\text{fl}} g)\, A$

$= (h_2 - h_1)\, \rho_{\text{fl}} \text{gA}$

where ρ_{fl} = density of fluid. Therefore,

$F_{\text{net}} = (h_2 - h_1) A \rho_{\text{fl}} g = V_{\text{fl}} \rho_{\text{fl}} g = m_{\text{fl}} g = w_{\text{fl}}$

where is w_{fl} the weight of the fluid displaced.

54.

$592\ \text{N/m}^2$

56.

2.23×10^{-2} mm Hg

58.

(a) 1.65×10^{-3} m

(b) 3.71×10^{-4} m

60.

6.32×10^{-2} N/m

Based on the values in table, the fluid is probably glycerin.

62.

$$\begin{aligned} P_{\text{w}} &= 14.6\ \text{N/m}^2, \\ P_{\text{a}} &= 4.46\ \text{N/m}^2, \\ P_{\text{sw}} &= 7.40\ \text{N/m}^2. \end{aligned}$$

Alcohol forms the most stable bubble, since the absolute pressure inside is closest to atmospheric pressure.

64.

5.1

This is near the value of $\theta = 0$ for most organic liquids.

66.

-2.78

The ratio is negative because water is raised whereas mercury is lowered.

68.

479 N

70.

1.96 N

71.

-63.0 cm H_2O

73.

(a) 3.81×10^3 N/m^2

(b) 28.7 mm Hg, which is sufficient to trigger micturition reflex

75.

(a) 13.6 m water

(b) 76.5 cm water

77.

(a) 3.98×10^6 Pa

(b) 2.1×10^{-3} cm

79.

(a) 2.97 cm

(b) 3.39×10^{-6} J

(c) Work is done by the surface tension force through an effective distance $h/2$ to raise the column of water.

81.

(a) 2.01×10^4 N

(b) 1.17×10^{-3} m

(c) 2.56×10^{10} N/m^2

83.

(a) 1.38×10^4 N

(b) 2.81×10^7 N/m^2

(c) 283 N

85.

(a) 867 N

(b) This is too much force to exert with a hand pump.

(c) The assumed radius of the pump is too large; it would be nearly two inches in diameter—too large for a pump or even a master cylinder. The pressure is reasonable for bicycle tires.