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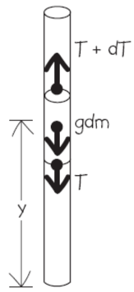
44. One can solve Equation 14.15 for u (with the minus sign appropriate to an approaching source) with the result: $u = v(1 - f/f') = (343 \text{ m/s})(1 - 1400/1600) = 42.9 \text{ m/s} = 154 \text{ km/h}$. (We used the value of 343 m/s for the speed of sound in air).

48. The tension in the cable can be found by integrating Newton's second law, applied to a small element at rest. With quantities defined in the sketch, $0 = T + dT - T - g\, dm$, or $dT = g\, dm$. For a uniform cable, $dm = \mu\, dy$ where the linear density μ is a constant, so $T = \mu g y$ (the constant of integration is zero for y measured from the bottom of the cable). It follows from Equation 14.5 that $v = \sqrt{T/\mu} = \sqrt{gy}$.



74. The initial wave leaves the stationary ultrasound source with a frequency f, which is then observed by the heart moving at speed u as the frequency $f' = f/(1 + u/v)$. The heart then acts as a moving source that sends the wave with frequenc f' back to the stationary ultrasound device, where the observed frequency is $f'' = f'/(1 - u/v) = f(1 + u/v)/(1 - u/v)$. The frequency shift is $\Delta f = f'' - f = f[(v + u)/(v - u) - 1] = 2uf/(v - u)$. Taking $u << v = 1497$ m/s (where we approximate the speed of sound in tissue with the speed of sound in water), we can use the above expression for the frequency shift to write $u \approx v\Delta f/2f = (1497 \text{ m/s})(100 \text{ Hz})/(2 \times 5 \text{ MHz}) = 1.497 \text{ cm/s}$.

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42. The pressure force on the (presumably flat) window is simply $F = \Delta P \cdot A = (0.75 - 0.25)(101.3 \text{ kPa}) \times (0.5 \times 0.9 \text{ m}^2) = 22.8 \text{ kN} = 2.56$ tons. It is unlikely any passenger is this strong.

48. **(a)** As in the solution to Exercise 30, as $w_{\text{app}} = w(1 - \rho_w/\rho_c) = (25 \text{ N})(1 - 1/19.3) = 23.7 \text{ N}$, where the density of the crown, ρ_c, is the density of pure gold. **(b)** For the alloy crown, $\rho_c/\rho_w = (0.75)(19.3) + (0.25)(10.5) = 17.1$ (see solution to Exercise 17), so $w_{\text{app}} = 23.5 \text{ N}$.

54. The weight of the water displaced by the styrofoam block's entire volume must equal the weight of the block plus the swimmer. Thus, $\rho_w g V = \rho_s g V + mg$, or $V = m/(\rho_w - \rho_s) = (55 \text{ kg})/(10^3 - 160)(\text{kg/m}^3) = 6.55 \times 10^{-2} \text{ m}^3$.

78. **Interpret** We find the pressure at the bottom of 1 m of blood, expressed in mmHg.
Develop Pressure is $p = \rho g h$, where in this problem $\rho = 1060 \text{ kg/m}^3$ and $h = 1$ m. We calculate p, and compare it with a typical value for diastolic blood pressure.
Evaluate

$$p = \rho g h = 10{,}400 \text{ Pa} \times \frac{1 \text{ mmHg}}{133 \text{ Pa}} = 78 \text{ mm Hg}$$

Assess This is a typical value for diastolic pressure.