2.3. Using a single dimensional equation, estimate the number of golf balls it would take to fill your classroom.

2.4. You are trying to decide which of two automobiles to buy. The first is American-made, costs \$14,500, and has a rated gasoline mileage of 28 miles/gal. The second car is of European manufacture, costs \$21,700, and has a rated mileage of 19 km/L. If the cost of gasoline is \$1.25/gal and if the cars actually deliver their rated mileage, estimate how many miles you would have to drive for the lower fuel consumption of the second car to compensate for the higher cost of this car?

2.5. A supersonic aircraft consumes 5320 imperial gallons of kerosene per hour of flight and flies an average of 14 hours per day. It takes roughly seven tons of crude oil to produce one ton of kerosene. The density of kerosene is 0.965 g/cm^3. How many planes would it take to consume the entire annual world production of 4.02×10^9 metric tons of crude oil?

2.6. A waste treatment pond is 50 m long and 15 m wide, and has an average depth of 2 m. The density of the waste is 85.3 lb_m/ft^3. Calculate the weight of the pond contents in lb_f, using a single dimensional equation for your calculation.

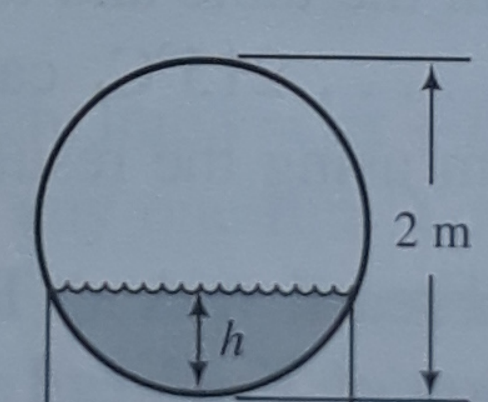
2.7. Five hundred lb_m of nitrogen is to be charged into a small metal cylinder at 25°C, at a pressure such that the gas density is 11.5 kg/m^3. Without using a calculator, estimate the required cylinder volume. Show your work.

2.8. According to Archimedes' principle, the mass of a floating object equals the mass of the fluid displaced by the object. Use this principle to solve the following problems.

(a) A wooden cylinder 30.0 cm high floats vertically in a tub of water (density = 1.00 g/cm^3). The top of the cylinder is 14.1 cm above the surface of the liquid. What is the density of the wood?

(b) The same cylinder floats vertically in a liquid of unknown density. The top of the cylinder is 20.7 cm above the surface of the liquid. What is the liquid density?

2.9. A horizontal cylindrical drum is 2.00 m in diameter and 4.00 m long. The drum is slowly filled with benzene (density = 0.879 g/cm^3). Derive a formula for W, the weight in newtons of the benzene in the tank, as a function of h, the depth of the liquid in centimeters.



2.10. A **poundal** is the force required to accelerate a mass of 1 lb_m at a rate of 1 ft/s^2, and a **slug** is the mass of an object that will accelerate at a rate of 1 ft/s^2 when subjected to a force of 1 lb_f.

(a) Calculate the mass in slugs and the weight in poundals of a 175 lb_m man (i) on earth and (ii) on the moon, where the acceleration of gravity is one-sixth of its value on earth.

(b) A force of 355 poundals is exerted on a 25.0-slug object. At what rate (m/s^2) does the object accelerate?

2.11. The **fern** is defined as the unit of force required to accelerate a unit of mass, called the **bung,** with the gravitational acceleration on the surface of the moon, which is one-sixth of the normal gravitational acceleration on earth.

(a) What is the conversion factor that would be used to convert a force from the natural unit to the derived unit in this system? (Give both its numerical value and its units.)

(b) What is the weight in ferns of a 3-bung object on the moon? What does the same object weigh in Lizard Lick, North Carolina?

FACTORS FOR UNIT CONVERSIONS

Quantity	Equivalent Values
Mass	1 kg $= 1000$ g $= 0.001$ metric ton (tonne) $= 2.20462\ lb_m = 35.27392$ oz $1\ lb_m = 16$ oz $= 5 \times 10^{-4}$ ton $= 453.593$ g $= 0.453593$ kg
Length	1 m $= 100$ cm $= 1000$ mm $= 10^6$ microns (μm) $= 10^{10}$ angstroms (Å) $= 39.37$ in $= 3.2808$ ft $= 1.0936$ yd $= 0.0006214$ mile 1 ft $= 12$ in $= 1/3$ yd $= 0.3048$ m $= 30.48$ cm
Volume	$1\ m^3 = 1000$ L $= 10^6\ cm^3 = 10^6$ mL $= 35.3145\ ft^3$ $= 219.97$ imperial gallons $= 264.17$ gal $= 1056.68$ qt $1\ ft^3 = 1728\ in^3 = 7.4805$ gal $= 29.922$ qt $= 0.028317\ m^3 = 28.317$ L
Density	$1\ g/cm^3 = 1000\ kg/m^3 = 62.43\ lb_m/ft^3$ = density of liquid water at 4°C (reference for specific gravities)
Force	1 N $= 1\ kg \cdot m/s^2 = 10^5$ dynes $= 10^5\ g \cdot cm/s^2 = 0.22481\ lb_f$ $1\ lb_f = 32.174\ lb_m \cdot ft/s^2 = 4.4482$ N $= 4.4482 \times 10^5$ dynes
Pressure	1 atm $= 1.01325 \times 10^5\ N/m^2$ (Pa) $= 101.325$ kPa $= 1.01325$ bar $= 1.01325 \times 10^6\ dynes/cm^2 = 14.696\ lb_f/in^2$ (psi) $= 760$ mm Hg at 0°C (torr) $= 10.333$ m $H_2O(l)$ at 4°C $= 29.921$ inches Hg at 0°C $= 406.8$ inches $H_2O(l)$ at 4°C
Energy	1 J $= 1\ N \cdot m = 10^7$ ergs $= 10^7$ dyne·cm $= 1\ kg \cdot m^2/s^2$ $= 2.778 \times 10^{-7}$ kW·h $= 0.23901$ cal $= 0.23901 \times 10^{-3}$ kcal (food calorie) $= 0.7376\ ft \cdot lb_f = 9.486 \times 10^{-4}$ Btu
Power	1 W $= 1$ J/s $= 1\ N \cdot m/s = 0.23901$ cal/s $= 0.7376\ ft \cdot lb_f/s$ $= 9.486 \times 10^{-4}$ Btu/s $= 1.341 \times 10^{-3}$ hp

Example: The factor to convert grams to lb_m is $\left(\frac{2.20462\ lb_m}{1000\ g}\right)$ or $\left(\frac{1\ lb_m}{453.593\ g}\right)$.