PHY11, HW11

All densities from the table in the text.

1] Granite: $\rho = 2.7 \times 10^3 \text{kg/m}^3$.
$M = (\rho)(V) = (2.7 \times 10^3) \times (10^8) = 2.7 \times 10^{11}\text{kg}$.

2] Air: $\rho = 1.29\text{kg/m}^3$.
$M = (\rho)(V) = (1.29) \times (5.6 \times 3.6 \times 2.4) = 62.4\text{kg}$.

3] Gold: $\rho = 19.3 \times 10^3 \text{kg/m}^3$.
$M = (\rho)(V) = (19.3 \times 10^3) \times (0.54 \times 0.31 \times 0.22) = 7.1 \times 10^2\text{kg}$.

4] If your mass is M, then $V = M/10^3\text{m}^3$.
For example, if $M = 60\text{kg}$, $V = 0.06\text{m}^3$.
(Plausible? Say you are, on average, 5″ thick (13cm), 12″ wide (30cm), and 5′6″ high (1.65m), then your volume would be $0.13 \times 0.3 \times 1.65 \approx 0.06\text{m}^3$.)

23] If the volume of the iron is V, and the fraction that is submerged in mercury is f, then the submerged volume will be fV. (For example, if the fraction were $1/2 = 0.5$, then $0.5V$ would be submerged.) The weight of the displaced mercury, $\rho_{\text{merc}} \times (fV) \times g$, will balance the weight of the iron, $\rho_{\text{iron}} \times (V) \times g$:

$$\rho_{\text{merc}}(fV)g = \rho_{\text{iron}}(V)g.$$

Canceling V and g, we get

$$f = \frac{\rho_{\text{iron}}}{\rho_{\text{merc}}} = \frac{7.8 \times 10^3}{13.6 \times 10^3} = \frac{7.8}{13.6} = 0.57.$$

24] Use formula from slide 25 in Wk. 11 notes (replace crown with moon rock),

$$\frac{\rho_{\text{moonrock}}}{\rho_{\text{w}}} = \frac{9.28}{9.28 - 6.18} = 3.$$

Therefore, $\rho_{\text{moonrock}} = 3 \times 10^3\text{kg/m}^3$.

24] $V_{\text{hull}} = M/\rho_{\text{steel}} = (18 \times 10^3)/(7.8 \times 10^3) = 2.3\text{m}^3$.
(b) $T = Mg = 18 \times 10^3 \times 9.8 \approx 1.8 \times 10^5\text{N}$.
(a) Buoyant force is weight of displaced water:
$F_b = Mg = \rho_w \times V_{\text{hull}} \times g = 10^3 \times 2.3 \times 9.8 \approx 0.23 \times 10^5\text{N}$.
So $T = 1.8 \times 10^5 - 0.23 \times 10^5 = 1.57 \times 10^5\text{N}$.