

Assignment 1 - solution

1.5.2. Demonstrate that Eq. (6.5) is dimensionally homogeneous

$$Q = C_d A \sqrt{2gh}$$

$$[Q] = L^3 T^{-1}, [C_d] = 1, [A] = L^2, [2] = 1, [g] = LT^{-2}, [h] = L$$

from equation: \uparrow dimensionless \rightarrow

$$[Q] = [C_d][A]\sqrt{[2][g][h]} = 1 \times L^2 \sqrt{1 \times LT^{-2} \times L} = L^2 \sqrt{L^2 T^{-2}} = L^3 T^{-1} \quad \text{OK}$$

1.5.6. From inside cover: 1 US gallon of water weights ?? (a) pounds

(b) newtons, (c) dynes

$$\begin{array}{l} \rightarrow \frac{1 \text{ imperial gallon}}{1.20094} = \frac{1.20094 \text{ U.S. gal}}{1.20094} \rightarrow W = \frac{10 \text{ lb}}{1.20094} \\ \text{DIVIDE BY} \end{array}$$

$$0.8326 \text{ imperial gallon} = 1 \text{ U.S. gallon} \rightarrow \underline{W = 8.33 \text{ lb}} \quad \text{(a)}$$

$$\text{(b) } W = 8.33 \text{ lb} = 8.33 \times 4.44822 \text{ N} = \underline{37.05 \text{ N}}$$

$$\text{(c) } W = 37.05 \text{ N} = \underline{37.05 \times 10^5 \text{ dyn}}$$

1.5.8. Convert 25 million U.S. gallons per day (gpd) into (a) ft^3/s (b) m^3/s

$$Q = 25 \times 10^6 \frac{\text{U.S. gal}}{\text{day}} = 25 \times 10^6 \times \frac{0.133681 \text{ ft}^3}{86400 \text{ s}} = \underline{38.68 \text{ ft}^3/\text{s}} \quad \text{(cfs)}$$

$$1 \text{ US gallon} = 0.133681 \text{ ft}^3$$

$$1 \text{ ft}^3 = 0.0283168 \text{ m}^3$$

$$1 \text{ day} = 24 \text{ hr} \times 60 \frac{\text{min}}{\text{hr}} \times 60 \frac{\text{s}}{\text{min}} = 86400 \text{ s}$$

$$Q = 38.68 \text{ ft}^3/\text{s} = 38.68 \times \frac{0.0283168 \text{ m}^3}{\text{s}}$$

$$\boxed{Q = 1.095 \text{ m}^3/\text{s}}$$