The label on a stock bottle of acid reads: 56% by mass and 1.25 specific gravity. If the molar mass of the acid is 56, what is the volume of the acid in cm^3 required to prepare 250 cm^3 of 1.5 molar acid?

1. Mass percentage:

$$c_{\%\,w/w} = \frac{m(acid)}{m(solution)} \cdot 100\%$$

so

$$m(acid) = \frac{c_{\%\,w/w} \cdot m(solution)}{100\%}$$

2. Specific gravity:

$$SG = \frac{\rho_{solution}}{\rho_{H_2O}}$$

so

$$\rho_{solution} = SG \cdot \rho_{H_2O}$$

3. Density:

$$\rho_{solution} = \frac{m(solution)}{V(solution)}$$

so

$$V(solution) = \frac{m(solution)}{\rho(solution)} = \frac{m(solution)}{SG \cdot \rho_{H_2O}}$$

4. Molar concentration

$$C_1 = \frac{n(acid)}{V(solution)} = \frac{m(acid)}{M(acid) \cdot V(solution)} = \frac{\frac{c_{\%\,w/w} \cdot m(solution)}{100\%}}{M(acid) \cdot \frac{m(solution)}{SG \cdot \rho_{H_2O}}} =$$

$$= \frac{c_{\%\,w/w} \cdot \cancel{m(solution)} \cdot SG \cdot \rho_{H_2O}}{M(acid) \cdot \cancel{m(solution)} \cdot 100\%} = \frac{c_{\%\,w/w} \cdot SG \cdot \rho_{H_2O}}{M(acid) \cdot 100\%}$$

$$[C_1] = \frac{\cancel{\%} \cdot \frac{\cancel{g}}{l}}{\frac{\cancel{g}}{mole} \cdot \cancel{\%}} = \frac{mole}{l}$$

$$C_1 = \frac{56 \cdot 1{,}25 \cdot 1000}{56 \cdot 100} = 12{,}5 \left(\frac{mole}{l}\right)$$

5. $C_1 \cdot V_1 = C_2 \cdot V_2$

where:

V_1 = volume of starting solution needed to make the new solution

C_1 = concentration of starting solution

V_2 = final volume of new solution

C_2 = final concentration of new solution

$$V_1 = \frac{C_2 \cdot V_2}{C_1} = \frac{1{,}5 \cdot 250}{12{,}5} = 30\ (cm^3)$$

Answer: 30 cm^3.