2.98

2.98 A river barge, whose cross section is approximately rectangular, carries a load of grain. The barge is 28 ft wide and 90 ft long. When unloaded its draft (depth of submergence) is 5 ft, and with the load of grain the draft is 7 ft. Determine: **(a)** the unloaded weight of the barge, and **(b)** the weight of the grain.

(a) For equilibrium,

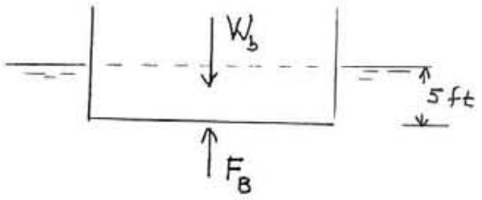
$$\Sigma F_{vertical} = 0$$

so that

$$W_b = F_B = \gamma_{H_2O} \times (\text{submerged volume})$$

$$= \left(62.4 \frac{lb}{ft^3}\right)(5\,ft \times 28\,ft \times 90\,ft)$$

$$= \underline{\underline{786{,}000\ lb}}$$



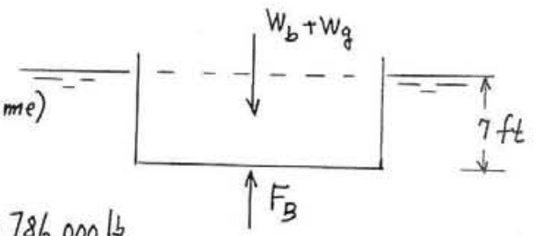
W_b ~ weight of barge (unloaded)

(b) $\Sigma F_{vertical} = 0$

$$W_b + W_g = F_B = \gamma_{H_2O} \times (\text{submerged volume})$$

$$W_g = \left(62.4 \frac{lb}{ft^3}\right)(7\,ft \times 28\,ft \times 90\,ft) - 786{,}000\,lb$$

$$= \underline{\underline{315{,}000\ lb}}$$



W_g ~ weight of grain