Assignment 1

刘锦坤
行健-能源 2
2022013352

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Content

1 Question 1

The specific weight can be calculated as

$$\text{specific weight} = \frac{8\text{N}}{400\text{ml}} = 20000\text{N} \cdot \text{m}^{-3}$$

The density can be calculated as

$$\text{density} = \frac{8\text{N}}{400\text{ml} \cdot 9.81\text{N} \cdot \text{kg}^{-1}} = 2038.74\text{kg} \cdot \text{m}^{-3}$$

The specific gravity can be calculated as

$$\text{specific gravity} = \frac{2038.74\text{kg} \cdot \text{m}^{-3}}{1000\text{kg} \cdot \text{m}^{-3}} = 2.03874$$

2 Question 2

The dimension of c is $[c] = \mathrm{L} \cdot \mathrm{T}^{-1}$, the dimension of E_v is $[E_v] = \mathrm{M} \cdot \mathrm{L}^{-1} \cdot \mathrm{T}^{-2}$, the dimension of ρ is $[\rho] = \mathrm{M} \cdot \mathrm{L}^{-3}$, due to that $c = {E_v}^a \cdot \rho^b$ is dimensionally homogeneous, we can get

$$\begin{cases} a + b = 0 \\ -a - 3b = 1 \\ -2a = -1 \end{cases} \Rightarrow \begin{cases} a = \frac{1}{2} \\ b = -\frac{1}{2} \end{cases}$$

So we can get the relationship between c, E_v and ρ as

$$c = \sqrt{\frac{E_v}{\rho}}$$

Therefor

$$E_v = \rho \cdot c^2 = 2000 \times 2000^2 \text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2} = 8 \times 10^9 \text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}$$

3 Question 3

The dimension of Q is $[Q] = \mathrm{L}^3 \cdot \mathrm{T}^{-1}$, the dimension of Δp is $[\Delta p] = \mathrm{M} \cdot \mathrm{L}^{-1} \cdot \mathrm{T}^{-2}$, the dimension of R and L is L, the dimension of μ is $[\mu] = \mathrm{M} \cdot \mathrm{L}^{-1} \cdot \mathrm{T}^{-1}$. Considering that the equation $Q = \frac{cR^4 \Delta p}{\mu L}$ is dimensionally homogeneous, we can finally get that **c is a dimensionless constant.** Actually this equation is called Poiseuille's law, in which c is equal to $\frac{\pi}{8}$.