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# Fluid Mechanics Fundamentals and Applications

## (3rd Edition)

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### Problem

A cylindrical tank of methanol has a mass of 40 kg and a volume of 51 L. Determine the methanol's weight, density, and specific gravity. Take the gravitational acceleration to be 9.81 m/s<sup>2</sup>. Also, estimate how much force is needed to accelerate this tank linearly at 0.25 m/s<sup>2</sup>.

### Step-by-step solution

#### Step 1 of 4

Calculate the weight of the methanol.

$$W = mg$$

Here,  $m$  is the mass of methanol and  $g$  is the acceleration due to gravity.

Substitute 40 kg for  $m$  and 9.81 m/s<sup>2</sup> for  $g$ .

$$\begin{aligned} W &= 40 \times 9.81 \\ &= 392.4 \text{ N} \end{aligned}$$

Therefore, the weight of the methanol is **392.4 N**.

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#### Step 2 of 4

Convert the units for 1 L to m<sup>3</sup>.

$$\begin{aligned} 1 \text{ L} &= \left(\frac{1}{10}\right)^3 \times \text{m}^3 \\ &= 0.001 \text{ m}^3 \end{aligned}$$

Calculate the density of methanol.

$$\rho = \frac{m}{V}$$

Here,  $m$  is the mass of methanol and  $V$  is the volume of a methanol.

Substitute 40 kg for  $m$  and 51 × 0.001 m<sup>3</sup> for  $V$ .

$$\begin{aligned} \rho &= \frac{40}{51 \times 0.001} \\ &= 784.31 \text{ kg/m}^3 \end{aligned}$$

Therefore, the density of methanol is **784.31 kg/m<sup>3</sup>**.

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Calculate the specific gravity of

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$$\text{S.P} = \frac{\rho}{\rho_{\text{water}}}$$

Here,  $\rho$  is the density of methanol and  $\rho_{\text{water}}$  is the density of water.Substitute  $784.31 \text{ kg/m}^3$  for  $\rho$  and  $1000 \text{ kg/m}^3$  for  $\rho_{\text{water}}$ .

$$\begin{aligned} \text{S.P} &= \frac{784.31}{1000} \\ &= 0.784 \end{aligned}$$

Therefore, the specific gravity of the methanol is **0.784**.[Comment](#)**Step 4 of 4**

Calculate the force require to accelerate the tank.

$$F = ma$$

Here,  $m$  is the mass of methanol and  $a$  is the acceleration of the tank.Substitute  $40 \text{ kg}$  for  $m$  and  $0.25 \text{ m/s}^2$  for  $a$ .

$$\begin{aligned} F &= 40 \times 0.25 \\ &= 10 \text{ N} \end{aligned}$$

Therefore, the forces require to accelerate the tank is **10 N**.[Comment](#)

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