CheggSolutions - Thegdp

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## Fluid Mechanics

### Topic: Pressure Calculation at the Bottom of a Tank

**Given:**

- Tank filled with:
  - Air: 200 kPa (gauge pressure)
  - Oil: Specific Gravity $SG = 0.80$
  - Water at 85°C
- Height of oil: $h_{\text{oil}} = 1.5 \, \text{m}$
- Height of water: $h_{\text{water}} = 2.6 \, \text{m}$

**Theory:**

The pressure at the bottom of the tank can be found by applying the hydrostatic pressure equation and summing the contributions from each fluid layer.

1. Calculate the pressure exerted by the air:

   This is directly given as 200 kPa gauge pressure.

2. Calculate the pressure exerted by the oil layer:

   $$P_{\text{oil}} = \rho_{\text{oil}} g h_{\text{oil}}$$

   Where:

   - $\rho_{\text{oil}} = \text{SG} \times \rho_{\text{water}}$
   - $\rho_{\text{water}} = 1000 \, \text{kg/m}^3$
   - $g = 9.81 \, \text{m/s}^2$
   - $h_{\text{oil}} = 1.5 \, \text{m}$

   $\rho_{\text{oil}} = 0.80 \times 1000 \, \text{kg/m}^3 = 800 \, \text{kg/m}^3$

   $P_{\text{oil}} = 800 \, \text{kg/m}^3 \times 9.81 \, \text{m/s}^2 \times 1.5 \, \text{m}$

   $P_{\text{oil}} = 11772 \, \text{Pa} = 11.772 \, \text{kPa}$

3. Calculate the pressure exerted by the water layer:

   $$P_{\text{water}} = \rho_{\text{water}} g h_{\text{water}}$$

   Where:

   - $\rho_{\text{water}} = 1000 \, \text{kg/m}^3$
   - $h_{\text{water}} = 2.6 \, \text{m}$

   $P_{\text{water}} = 1000 \, \text{kg/m}^3 \times 9.81 \, \text{m/s}^2 \times 2.6 \, \text{m}$

   $P_{\text{water}} = 25406 \, \text{Pa} = 25.406 \, \text{kPa}$

**Solution:**

The total pressure at the bottom of the tank is the sum of the pressure exerted by all layers (air, oil, water):

1. Sum of the Pressure Contributions:

   $$P_{\text{total}} = P_{\text{air}} + P_{\text{oil}} + P_{\text{water}}$$

   $$P_{\text{total}} = 200 \, \text{kPa} + 11.772 \, \text{kPa} + 25.406 \, \text{kPa}$$

   $$P_{\text{total}} = 237.178 \, \text{kPa}$$

Since the calculated pressure value closely matches one of the given choices, it can be approximated as:

**Final Answer:**

$$P_{\text{total}} = 237.3 \, \text{kPa}$$

Thus, the correct answer is **237.3 kPa**.
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