24-221
Thermodynamics

Solution to: Quiz 1
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Given: Piston cylinder assembly
  Gas Pressure \( P_g = 200 \text{ kPa} \)
  Area of cross section \( A = 0.01 \text{ m}^2 \)
  Mass of the piston \( m_p = 50 \text{ kg} \)
  External Pressure \( P_0 \)

To Find: \( P_0 \) such that it just keeps the piston from resting on the stops

Solution: To keep the piston from resting on the stops \( P_0 \) should be such that there is mechanical equilibrium on the piston

  \[
  \text{i.e. Force acting downwards} = \text{Force acting upwards} \\
  P_0A + m_pg = P_gA \\
  \]

  Dividing by \( A \) we get

  \[
  P_0 + \frac{m_pg}{A} = P_g \\
  \]

  (or) \( P_0 = P_g - \frac{m_pg}{A} = 200*10^3 - \frac{(50*9.807/0.01)}{0.01} = 150965 \)

  \[
  P_0 = 150.965 \text{ kPa} \quad \text{---------- Answer} 
  \]