

The piston in Figure has no mass and is free to move. The point force F acting on the piston is applied gently so that the piston moves slowly to the left. As the gas in the cylinder is compressed, the product of pressure and system volume, pV , remains constant. The piston area is 0.02 m^2 and when x is x_1 the system volume is 0.006 m^3 . Atmospheric pressure is 1 bar. Calculate the distance $(x_2 - x_1)$ moved by the piston as F increases from 0 to 70 N.

$$p_2 A = 70 + p_{atm} A$$

$$p_2 = \frac{70}{0.02} + 10^5 = 1.385 \times 10^5 \text{ Pa}$$

$$V_2 = \frac{p_1 V_1}{p_2} = \frac{10^5 \times 0.006}{1.385 \times 10^5} = 0.00433 \text{ m}^3$$

$$x_2 - x_1 = \frac{V_2 - V_1}{A} = 0.3 - 0.2166 = 0.0834 \text{ m} = 83.4 \text{ mm}$$