Answer on Question #37652 - Physics - Other

A glass tube has several different cross-sectional areas with the values indicated in the figure. A piston at the left end of the tube exerts pressure so that mercury within the tube flows from the right end with a speed of 8.0 m/s. Three points within the tube are labeled A, B, and C.


Notes: The drawing is not drawn to scale.
Atmospheric pressure is 1.01 × 10^5 N/m^2; and the density of mercury is 13 600 kg/m^3.
What is the total pressure at point B?

Solution:
First, let's find speed at which mercury flowing past point B:

\[ S_c V_c = S_B V_B \]

\[ V_B = \left( \frac{S_c}{S_B} \right) V_c = \left( \frac{6.0 \text{ cm}^2}{5.6 \text{ cm}^2} \right) \cdot 8 \text{ m/s} = 8.6 \text{ m/s} \]

Now, let's find the total pressure at point B (pressure equation):

\[ \frac{1}{2} \rho V_B^2 + p_B = \frac{1}{2} \rho V_C^2 + p_C \]  \hspace{1cm} (1)

\[ p_C = p_{atm} = 1.01 \times 10^5 \frac{N}{m^2} \]  \hspace{1cm} (2)

(2) in (1):

\[ p_B = \frac{1}{2} \rho (V_C^2 - V_B^2) + p_{atm} = 1.01 \times 10^5 \frac{N}{m^2} + \frac{1}{2} \cdot 13600 \frac{kg}{m^3} \cdot \left( \left( 8 \text{ m/s} \right)^2 - \left( 8.6 \text{ m/s} \right)^2 \right) \]

\[ = 3.1 \times 10^4 \text{Pa} \]

**Answer:** total pressure at point B is 3.1 × 10^4 Pa.