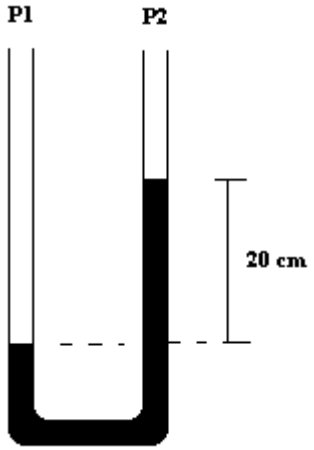
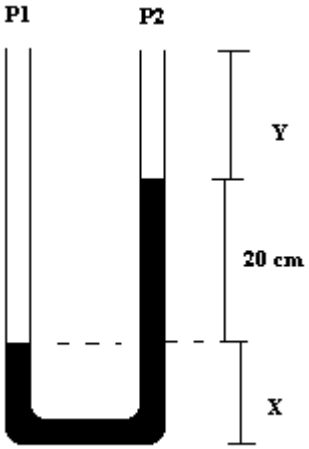
## TOPIC
Fluids – Section X – Question 3

## QUESTION
Consider the manometer shown. The dark fluid is mercury (density = $13.6\ \mathrm{gm/cm^3}$ and the light fluid is water (density =$1\ \mathrm{gm/cm^3}$). The difference in pressure $P_1 - P_2$ in kPa most nearly is




(A) 2.00
(B) 22.7
(C) 24.7
(D) 26.7

## HINTS
- Pressure in a fluid depends on height of fluid by $\rho g h$ where $h$ is the height of fluid.
- The pressure at the bottom of the tube is the same whether calculated from the left or the right branch.

## SOLUTION


Let the pressure at the bottom of the tube $=P_0$. Then $P_0$ is related to $P_1$ by

$$P_0 = P_1 + \rho_{water} g(Y + 20) + \rho_{mercury} gX$$

and is related to $P_2$ by

$$P_0 = P_2 + \rho_{water} g(Y) + \rho_{mercury} g(X + 20)$$

Equating the two expressions yields:

$$P_1 - P_2 = 20g(\rho_{mercury} - \rho_{water})$$
$$= (20\text{cm})(980\text{cm/s}^2)(13.6\text{gm/cm}^3 - 1\text{gm/cm}^3)$$
$$= (20\text{cm})(980\text{cm/s}^2)(12.6\text{gm/cm}^3)$$
$$= 247{,}000\text{gm/cm-s}^2 \times 1\text{kg}/1000\text{ gm} \times 100\text{cm}/1m$$
$$= 24{,}700\text{kg/m-s}^2$$
$$= 24{,}700\text{Pa}$$
$$= 24.7\text{kPa}$$

**ANSWER**

(C)

**CONTRIBUTOR**

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