



2020 Sec 3 Physics Pressure Assignment 5

AS 5 Answers

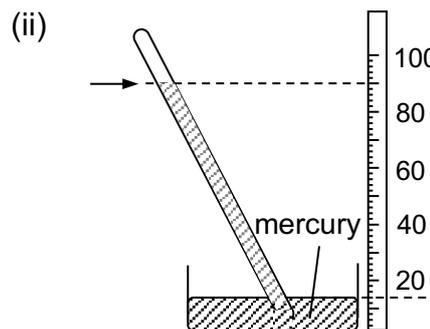
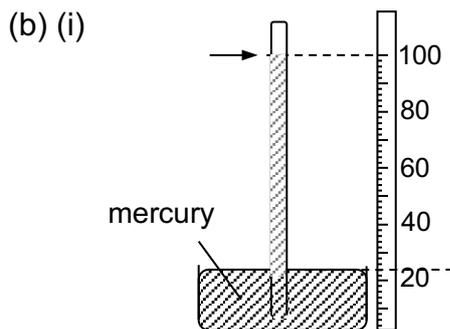
Note: Always state the formula or equation used!

- 1 Pressure due to column of air of height h = Pressure difference measured at top and base of mountain (using mercury barometer)

$$\begin{aligned}
 H \rho_{\text{air}} g &= h_{\text{bottom}} \rho_{\text{Hg}} g - h_{\text{top}} \rho_{\text{Hg}} g \\
 &= (h_{\text{bottom}} - h_{\text{top}}) \rho_{\text{Hg}} g \\
 &= (0.750 - 0.580) \times 13600 \times 10 \\
 H \times 1.2 \times 10 &= 23120 \text{ Pa} \\
 H &= 1926.7 \approx 1930 \text{ m (to 3 s.f.)}
 \end{aligned}$$

- 2 (a) (i) $90 - 14 = 76 \text{ cm Hg}$

(ii) $90 - 40 = 50 \text{ cm Hg}$



- 3 (a) $P = 75.0 \text{ cm Hg}$
 $P = h\rho g = 0.750 \times 13600 \times 10 = 1.02 \times 10^5 \text{ Pa}$

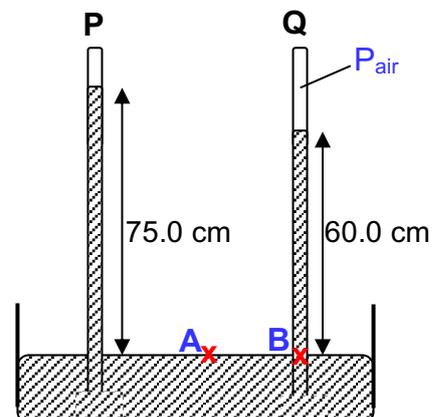
Note:

- tube P is like a normal mercury barometer, the space at upper end is a vacuum ($P = 0$)
- tube Q is like a faulty barometer, with air trapped at the upper end space (P_{air})
- Consider two points A & B at the same level of the mercury in the container which are at the same pressure.

(b)

$$\begin{aligned}
 P_A &= P_B \\
 75.0 \text{ cm Hg} &= P_{\text{air}} + 60.0 \text{ cm Hg} \\
 P_{\text{air}} &= 15.0 \text{ cm Hg}
 \end{aligned}$$

$$\begin{aligned}
 P_{\text{air}} &= h \rho_{\text{Hg}} g = 0.150 \times 13600 \times 10 \\
 &= 2.04 \times 10^4 \text{ Pa}
 \end{aligned}$$



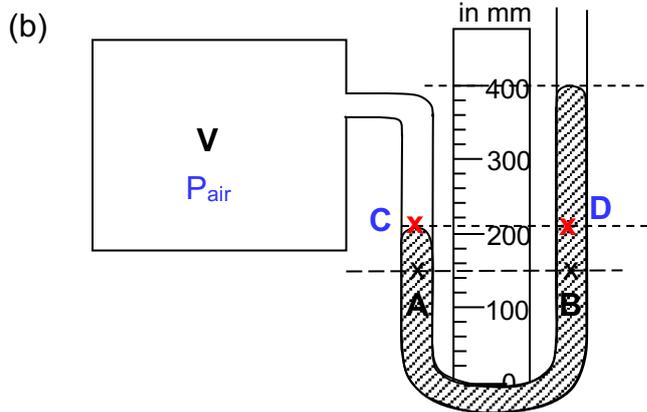
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Note:

- Consider two points **C** & **D** at the same level of the mercury in the manometer which are at the same pressure (choose the lower of the 2 levels).

(a)

$$\begin{aligned} P_C &= P_D \\ P_{\text{gas}} &= P_{\text{atm}} + (40 - 21) \text{ cm Hg} \\ &= 75 \text{ cm Hg} + (40 - 21) \text{ cm Hg} = 94 \text{ cm Hg} \end{aligned}$$



Note:

- Consider two points **C** & **D** (label these) at the same level of the mercury in the manometer which are at the same pressure (choose the lower of the 2 levels).

5 (a) $P_A = 76 \text{ cm Hg}$

Note:

- Consider a point **C** (label this point) at the same level of the mercury as point **B** so both points are at the same pressure.

(b) $P_B = 76 + 22 = 98 \text{ cm Hg}$

(c) Left tube level: $(42 + 5) \text{ cm mark} = 47 \text{ cm mark}$
Right tube level: $(20 - 5) \text{ cm mark} = 15 \text{ cm mark}$

(d) (i) **32 cm mark**

- (ii) Since the gas pressure remains constant, the excess pressure remains constant i.e. 22 cm Hg. The height difference between the left and right arm remains at 22 cm.

6 (a)

$$P_1V_1 = P_2V_2$$

$$(2.0 \times 10^7)(6.0 \times 10^{-3}) = (1.2 \times 10^5)(V_2)$$

$$V_2 = \mathbf{1.0 \text{ m}^3}$$

(b)

$$\text{Number of balloons} = 1.0 / 2.5 \times 10^{-3}$$

$$= \mathbf{400}$$

7 (a)

$$P_1V_1 = P_2V_2$$

$$P_{\text{tank}}(0.050) = (1.0 \times 10^5)(20)$$

$$P_{\text{tank}} = \mathbf{4.0 \times 10^7 \text{ Pa}}$$

(b)

$$P_1V_1 = P_2V_2$$

$$P_{\text{new}}(230 + 20) = (1.0 \times 10^5)(20)$$

$$P_{\text{new}} = \mathbf{8.0 \times 10^3 \text{ Pa}}$$

(c)

$$P_1V_1 = P_2V_2$$

$$(8.0 \times 10^3)(250) = (85\% \times 1.0 \times 10^5)(V_2)$$

$$V_{85\%} = \mathbf{24 \text{ m}^3} \text{ (actual volume of air at the required pressure)}$$

$$P_1V_1 = P_2V_2$$

$$(85\% \times 1.0 \times 10^5)(250 - 24) = (4.0 \times 10^7) V_{\text{tank}}$$

$$V_{\text{tank}} = \mathbf{0.48 \text{ m}^3}$$

$$\text{Minimum number of tanks} = 0.48 / 0.050 = 9.6 = 10$$