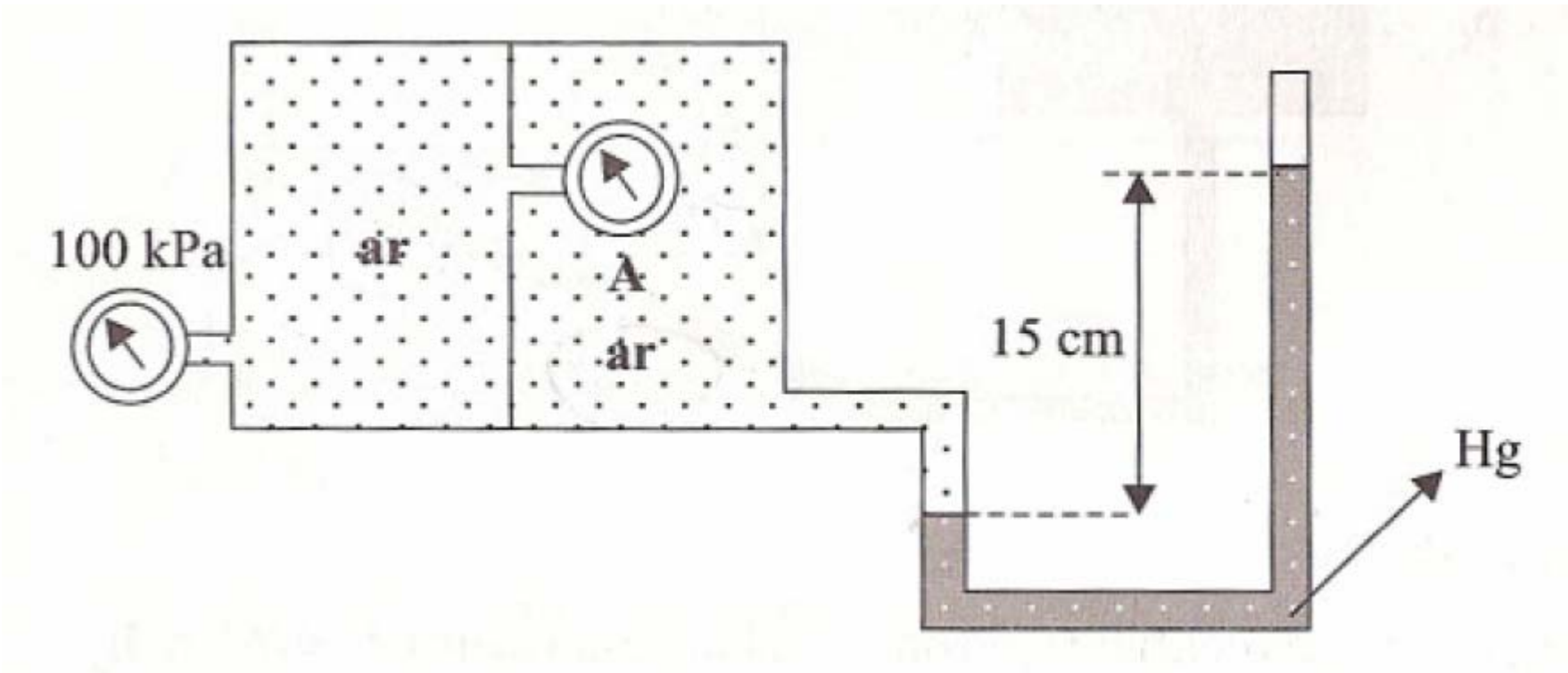
Importante resolver exercícios

2.7 – 2.8 – 2.9 - 2.12 – livro professor Brunetti e ...

2.7



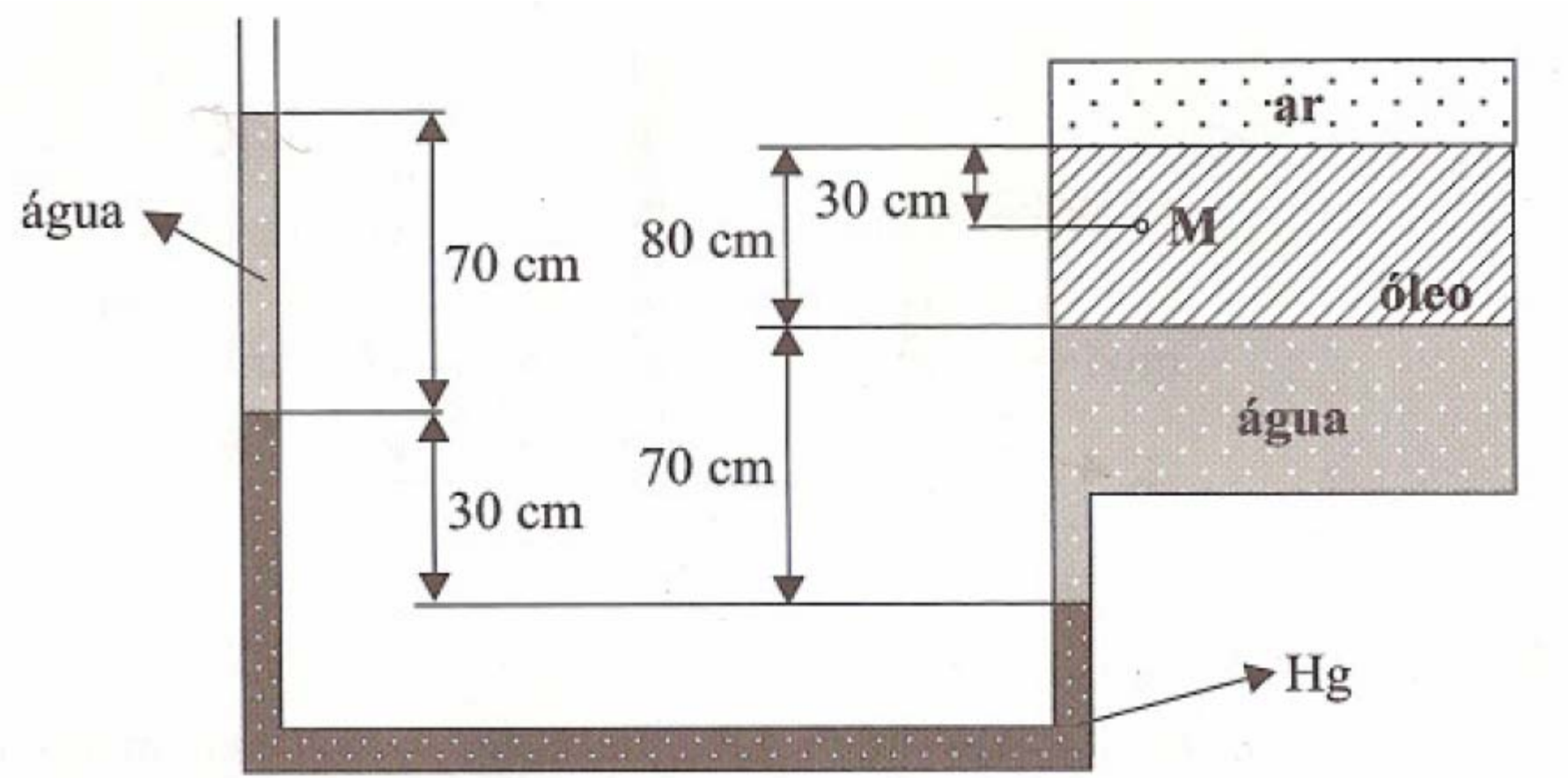
Resolução

$$p_m = 100 - p_A$$

$$p_A = \gamma_{Hg} \times 0{,}15 = 136.000 \times 0{,}15 = 20.400\,\text{Pa} = 20{,}4\,\text{kPa}$$

$$p_m = 100 - 20{,}4 = 79{,}6\,\text{kPa}$$

2.8



Resolução

$$p_{atm} + 0{,}70 \times \gamma_{H_2O} + 0{,}30 \times \gamma_{Hg} - 0{,}70 \times \gamma_{H_2O} - 0{,}80 \times \gamma_{\text{óleo}} = p_{ar}$$

Escala efetiva $\Rightarrow p_{atm} = 0$

$$0{,}30 \times 136000 - 0{,}80 \times 8500 = p_{ar}$$

$$\therefore p_{ar} = 34000 \frac{N}{m^2} = 34 kPa$$

$$p_{ar_{abs}} = p_{ar} + p_{atm} = 34 + \frac{0{,}74 \times 136000}{1000}$$

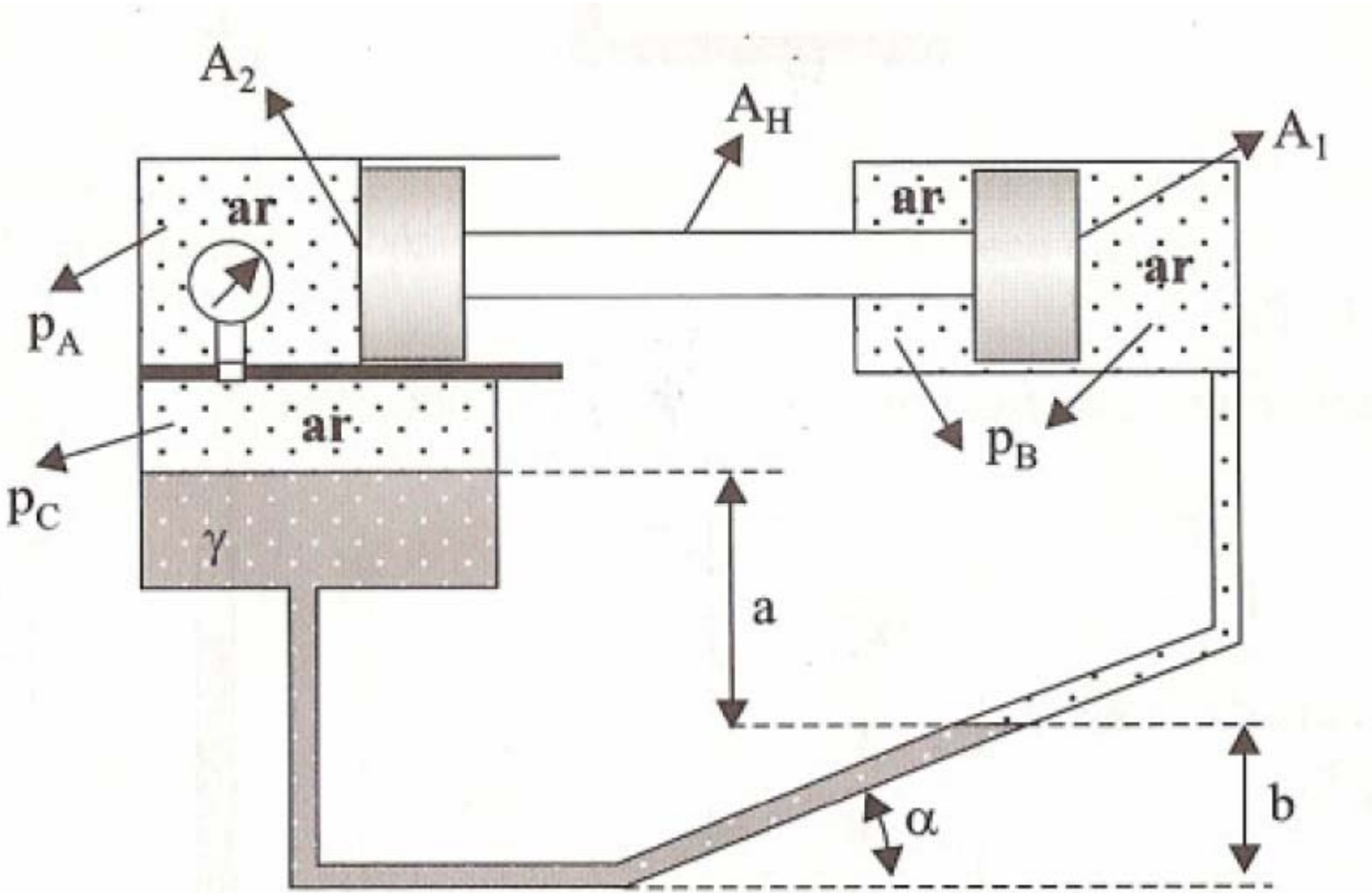
$$\therefore p_{ar_{abs}} = 134{,}64 kPa$$

$$p_M = p_{ar} + 0{,}30 \times \gamma_{\text{óleo}} = 34 + \frac{0{,}30 \times 8500}{1000}$$

$$\therefore p_M = 36{,}55 kPa$$

$$p_{M_{abs}} = 36{,}55 + \frac{0{,}74 \times 136000}{1000} = 137{,}19 kPa$$

2.9



Resolução

$$p_C - p_A = 30\text{kPa}$$

$$\frac{A_2}{A_1} = 2$$

$$p_A A_2 = p_B A_1 - p_B (A_1 - A_H) \quad \rightarrow \quad p_A A_2 = p_B A_H$$

$$\frac{A_2}{A_1} \times \frac{A_1}{A_H} = \frac{A_2}{A_H} = 4 \quad \rightarrow \quad p_B = 4p_A$$

$$p_C - p_A = 30.000$$

$$p_C + \gamma a = p_B \quad \rightarrow p_C = p_B - 27.000$$

$$p_B - 27.000 - p_A = 30.000 \quad \rightarrow \quad p_B - p_A = 57.000$$

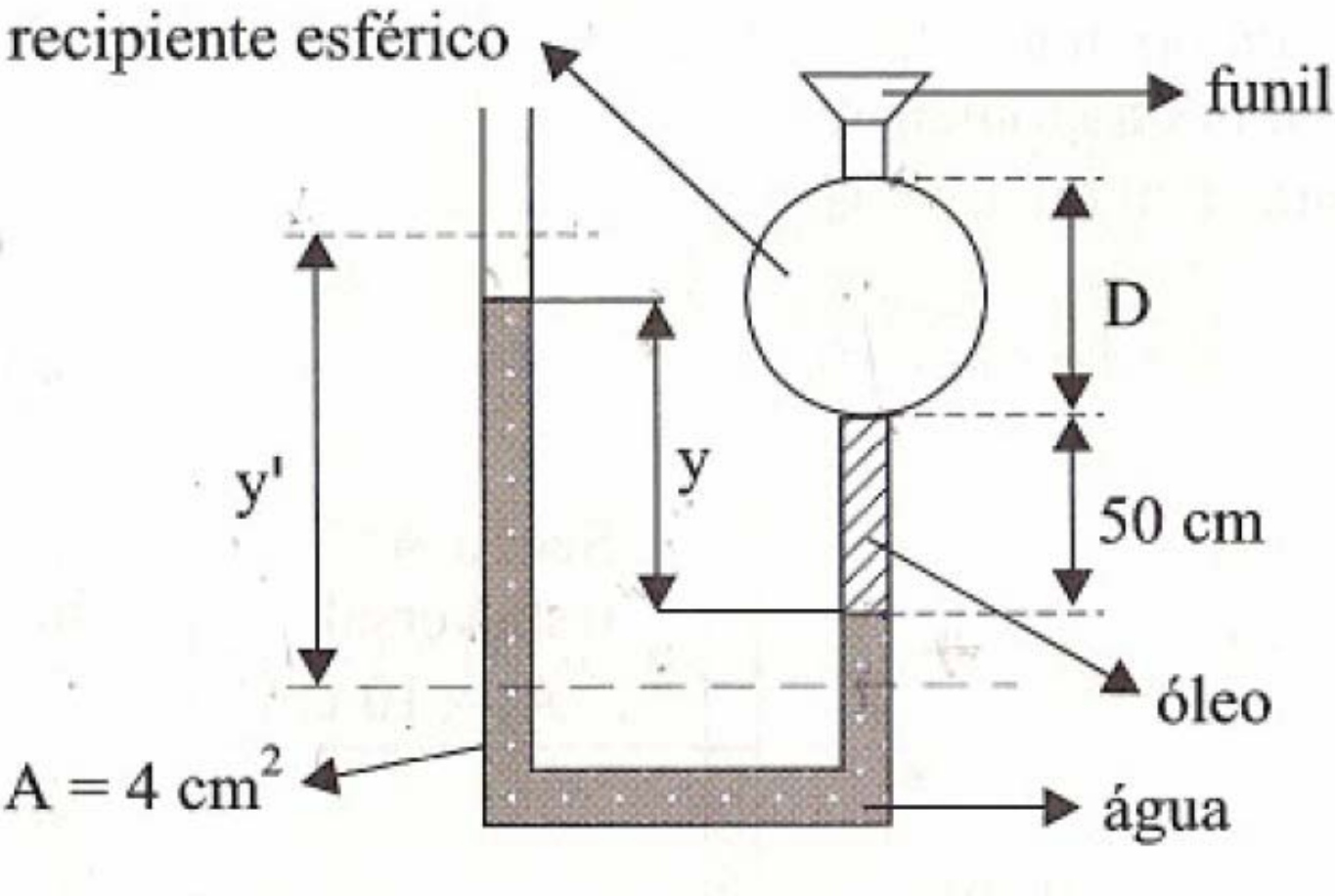
$$p_B - \frac{p_B}{4} = 57.000 \quad \rightarrow \quad p_B = 76.000\,\text{Pa}$$

$$p_{atm} = 0{,}7 \times 136.000 = 95.200\,\text{Pa}$$

$$p_{B_{abs}} = p_{B_{ef}} + p_{atm} = 76.000 + 95.200 = 171.200\,\text{Pa(abs)}$$

$$h_{H_2O} = \frac{p_{B(abs)}}{\gamma_{H_2O}} = \frac{171.000}{10.000} = 17{,}12\,\text{mca(abs)}$$

2.11



Resolução

a) $\gamma_o \times 0{,}5 = \gamma_{H_2O} \times y$

$$y = \frac{8.000 \times 0{,}5}{10.000} = 0{,}4\,m$$

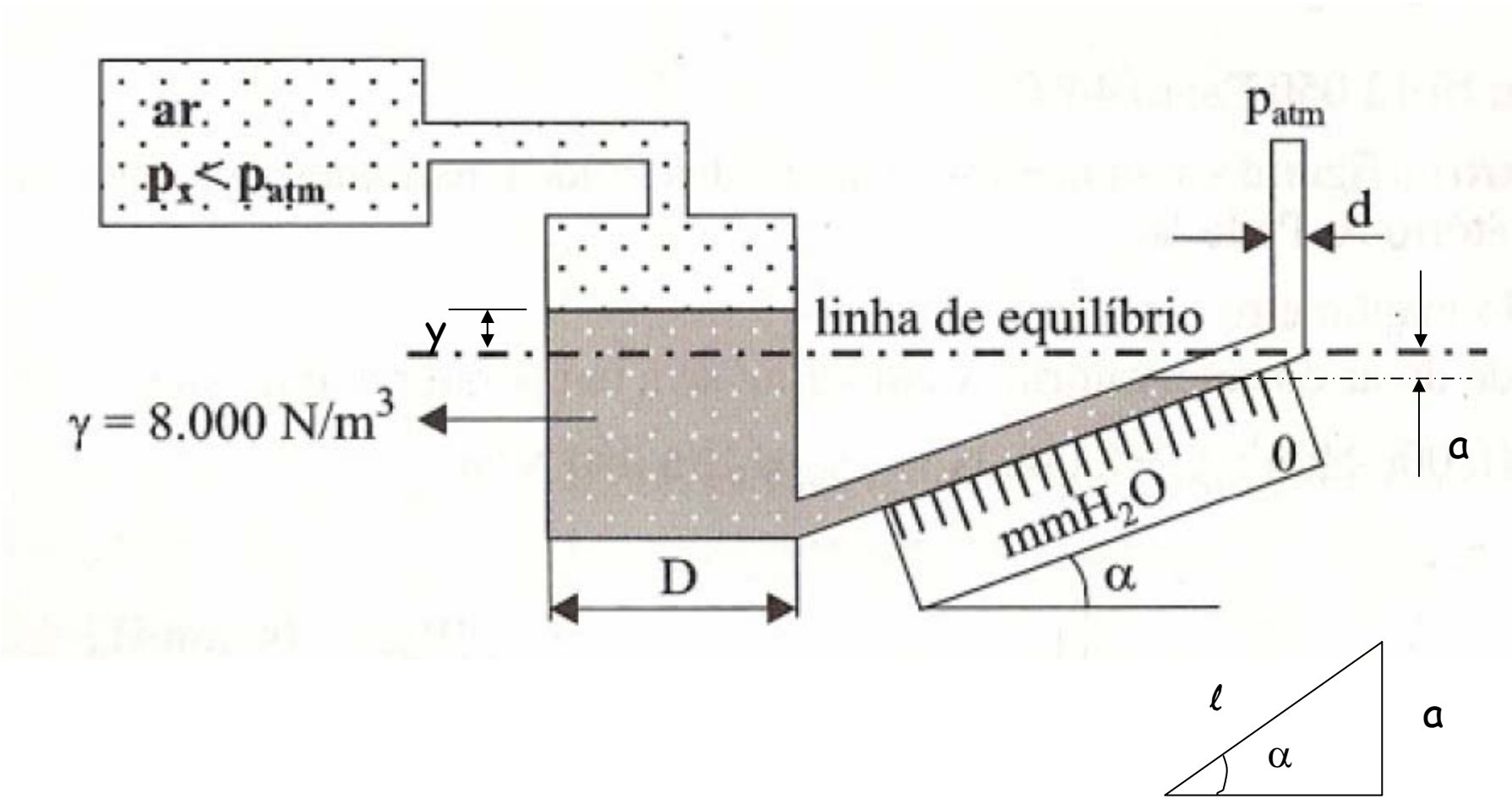
b) $\gamma_o (D + 0{,}5 + x) = \gamma_{H_2O} (y + 2x)$

$$2x + y = y' \quad \rightarrow \quad x = \frac{y' - y}{2} = \frac{1 - 0{,}4}{2} = 0{,}3\,m$$

$$D = \frac{\gamma_{H_2O} (y + 2x)}{\gamma_o} - 0{,}5 - x = \frac{10.000(0{,}4 + 0{,}6)}{8.000} - 0{,}5 - 0{,}3 = 0{,}45\,m$$

c) $$V = \frac{\pi D^3}{6} + xA = \frac{\pi \times 0{,}45}{6} + 0{,}3 \times 4 \times 10^{-4} = 4{,}7833 \times 10^{-2}\ m^3 = 47.833\,cm^3$$

2.12


ar
$p_x < p_{atm}$
p_{atm}
d
y
linha de equilíbrio
$\gamma = 8.000\ N/m^3$
a
0
mmH_2O
α
D
ℓ
α
a

Resolução

$$p_{ar} + y \times 8000 + a \times 8000 = p_{atm}$$

Escala efetiva :

$$-1 \times 10^{-3} \times 10000 + 8000y + 8000a = 0$$

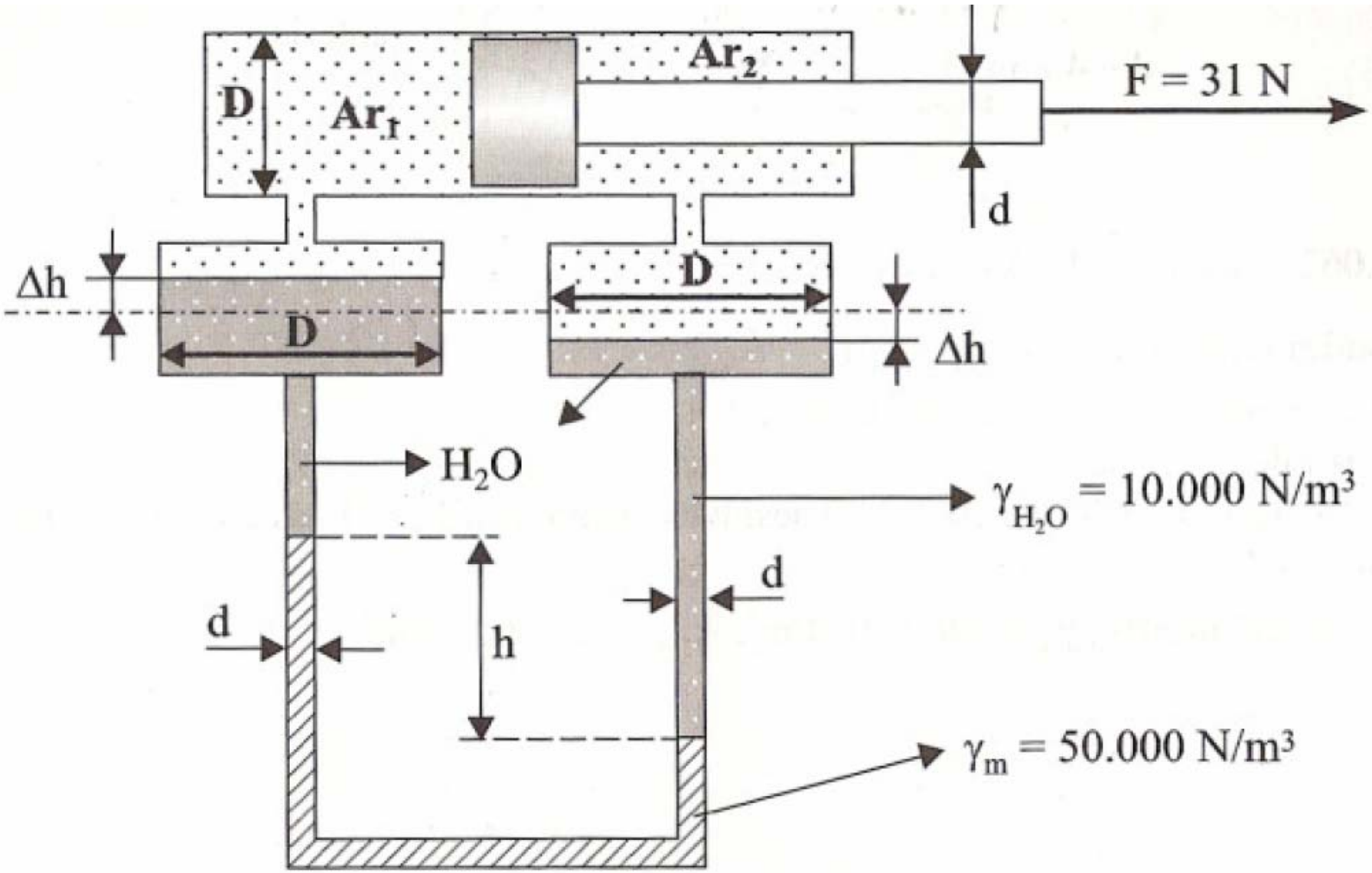
$$y \times \frac{\pi D^2}{4} = \ell \times \frac{\pi d^2}{4} \Rightarrow y = \ell \times \left(\frac{d}{D}\right)^2 = 4{,}94 \times 10^{-2}\,\ell$$

$$\text{sen}\alpha = \frac{a}{\ell} \Rightarrow a = \ell \times \text{sen}11{,}5^\circ$$

$$-10 + 4{,}94 \times 10^{-2}\,\ell \times 8000 + \ell \times \text{sen}11{,}5^\circ \times 8000 = 0$$

$$\ell \approx 5\,\text{mm}$$

2.13



Resolução

a) $p_{ar_1}\frac{\pi D^2}{4}+F=p_{ar_2}\frac{\pi}{4}\left(D^2-d^2\right)$

$p_{ar_1}\frac{\pi\times 0{,}0714^2}{4}+31=p_{ar_2}\frac{\pi}{4}\left(0{,}0714^2-0{,}0357^2\right)$

$4\times10^{-3}p_{ar_1}+31=3\times10^{-3}p_{ar_2}\qquad(1)$

$p_{ar_1}+2\gamma_{H_2O}\Delta h+\gamma_m h-\gamma_{H_2O}h=p_{ar_2}$

$\Delta h\frac{\pi D^2}{4}=\frac{h}{2}\frac{\pi d^2}{4}\quad\rightarrow\quad\Delta h=\frac{h}{2}\left(\frac{d}{D}\right)^2=\frac{0{,}4}{2}\left(\frac{35{,}7}{71{,}4}\right)^2=0{,}05\,\text{m}$

$p_{ar_1}\times2\times10.000\times0{,}05+50.000\times0{,}4-10.000\times0{,}4=p_{ar_2}$

$p_{ar_1}+17.000=p_{ar_2}$

Substituindo na (1): $4\times10^{-3}p_{ar_1}+31=3\times10^{-3}\left(p_{ar}+17.000\right)$

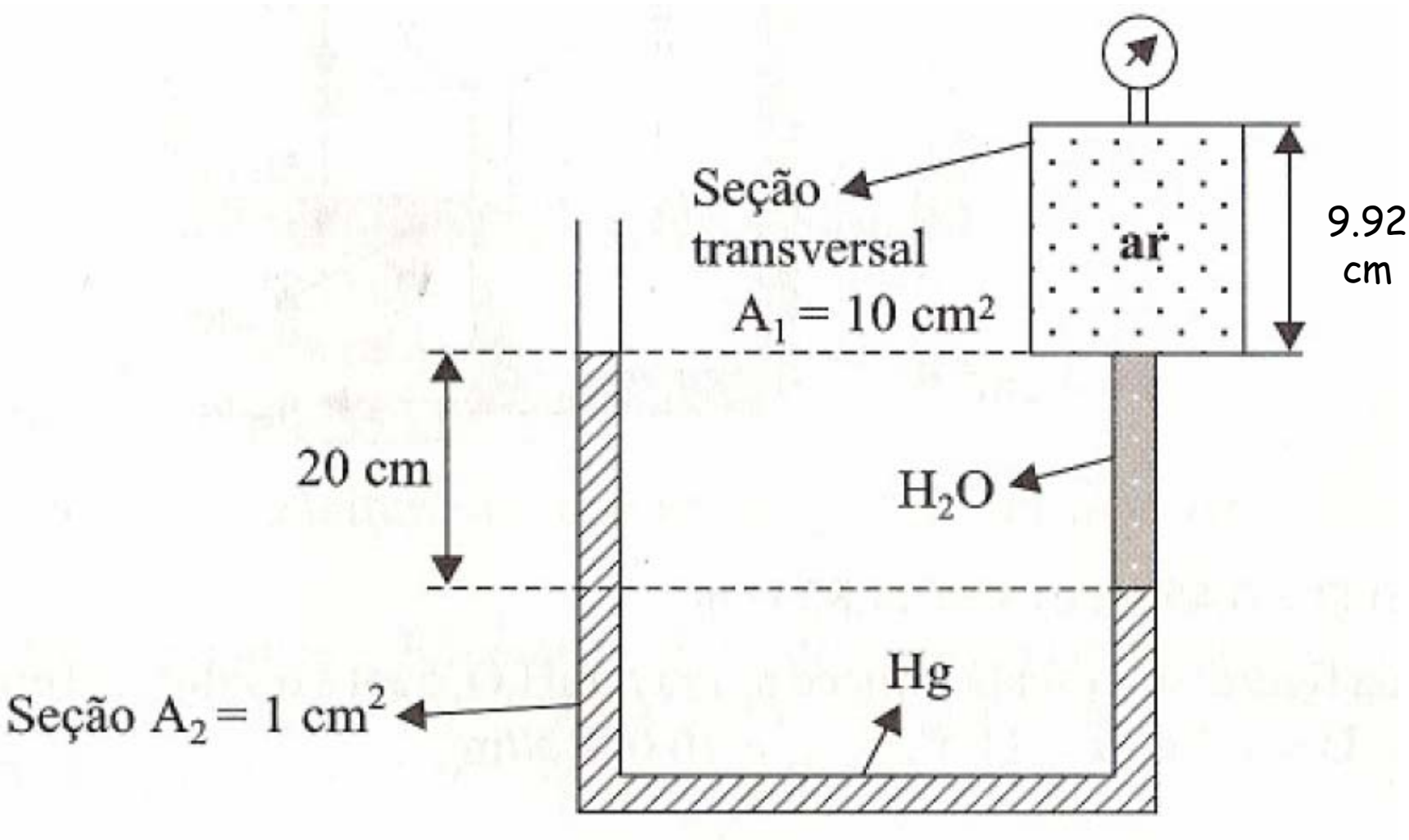
$p_{ar_1}=20.000\text{Pa}=\frac{20.000}{136.000}=0{,}147\,\text{m}=147\,\text{mmHg}$

$p_{ar_{1abs}}=147+684=831\,\text{mmHg(abs)}$

b) $p_{ar_2}=p_{ar_1}+17.000=20.000+17.000=37.000\text{Pa}$

$p_{ar_2}=\frac{37.000}{10.000}=3{,}7\,\text{mca}$

2.14

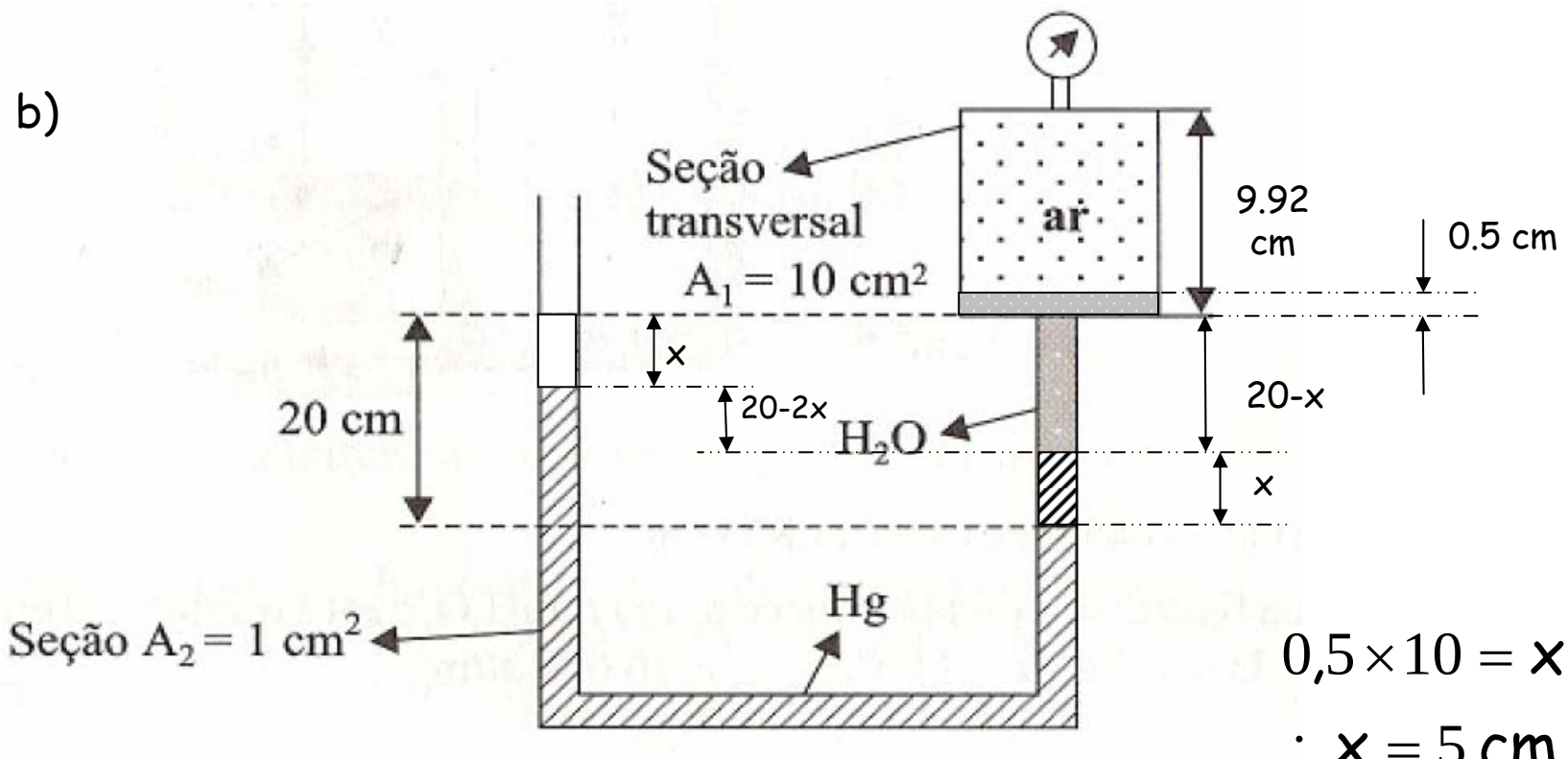

Seção
transversal
$A_1 = 10\ cm^2$
ar
9.92
cm
20 cm
H_2O
Hg
Seção $A_2 = 1\ cm^2$

Resolução

a) $0{,}20 \times 136000 - 0{,}20 \times 10000 = p_{ar_{inicial}} = p_{mi}$

$\therefore p_{mi} = 25200\ Pa = 25{,}2\ kPa$

b)



$0{,}5 \times 10 = x$

$\therefore x = 5\ cm$

$0{,}10 \times 136000 - 0{,}155 \times 10000 = p_{ar_{final}} = p_{mf}$

$\therefore p_{mf} = 12050\ Pa = 12{,}05\ kPa$

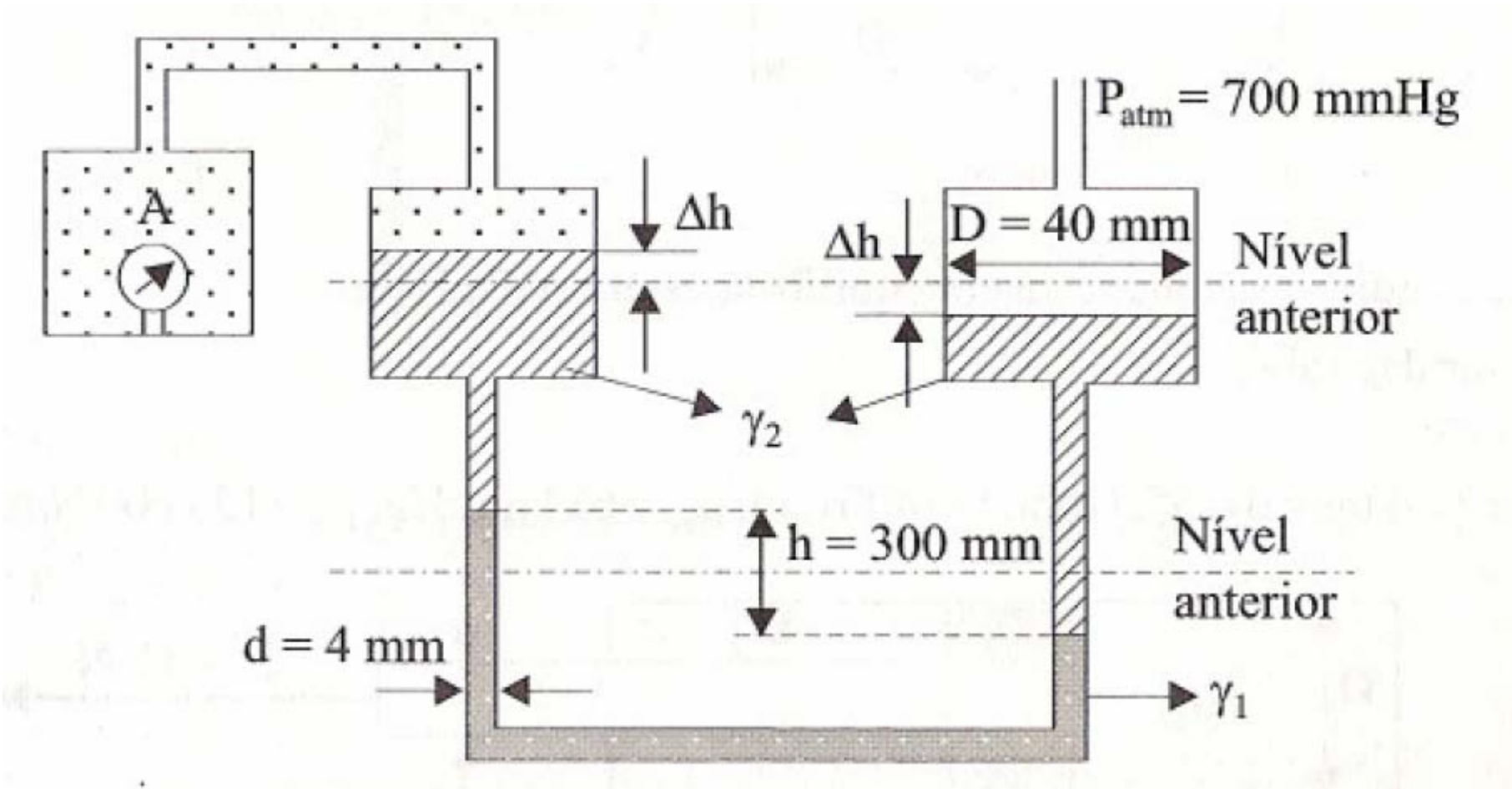
Resolução (cont.)

$$\frac{p_i V_i}{T_i} = \frac{p_f V_f}{T_f}$$

$$\frac{(25200 + 100000) \times 10 \times 9{,}92}{(273 + 100)} = \frac{(12050 + 10000) \times 10 \times (9{,}92 - 0{,}5)}{(273 + t_f)}$$

$$t_f \cong 44^\circ C$$

2.15


A
Δh
Δh
D = 40 mm
P_{atm} = 700 mmHg
Nível
anterior
γ_2
h = 300 mm
Nível
anterior
d = 4 mm
γ_1

Resolução

a) $p_A + \gamma_2 2\Delta h + \gamma_1 h - \gamma_2 h = 0$

$p_A = 8.000 \times 0{,}3 - 10.000 \times 0{,}3 - 8.000 \times 2\Delta h$

$$\Delta h \frac{\pi D^2}{4} = \frac{h}{2}\frac{\pi d^2}{4} \quad \rightarrow \quad \Delta h = \frac{h}{2}\left(\frac{d}{D}\right)^2 = \frac{0{,}3}{2}\left(\frac{4}{40}\right)^2 = 0{,}0015\,\text{m}$$

$p_A = -600 - 8.000 \times 2 \times 0{,}0015 = -624\,\text{Pa}$

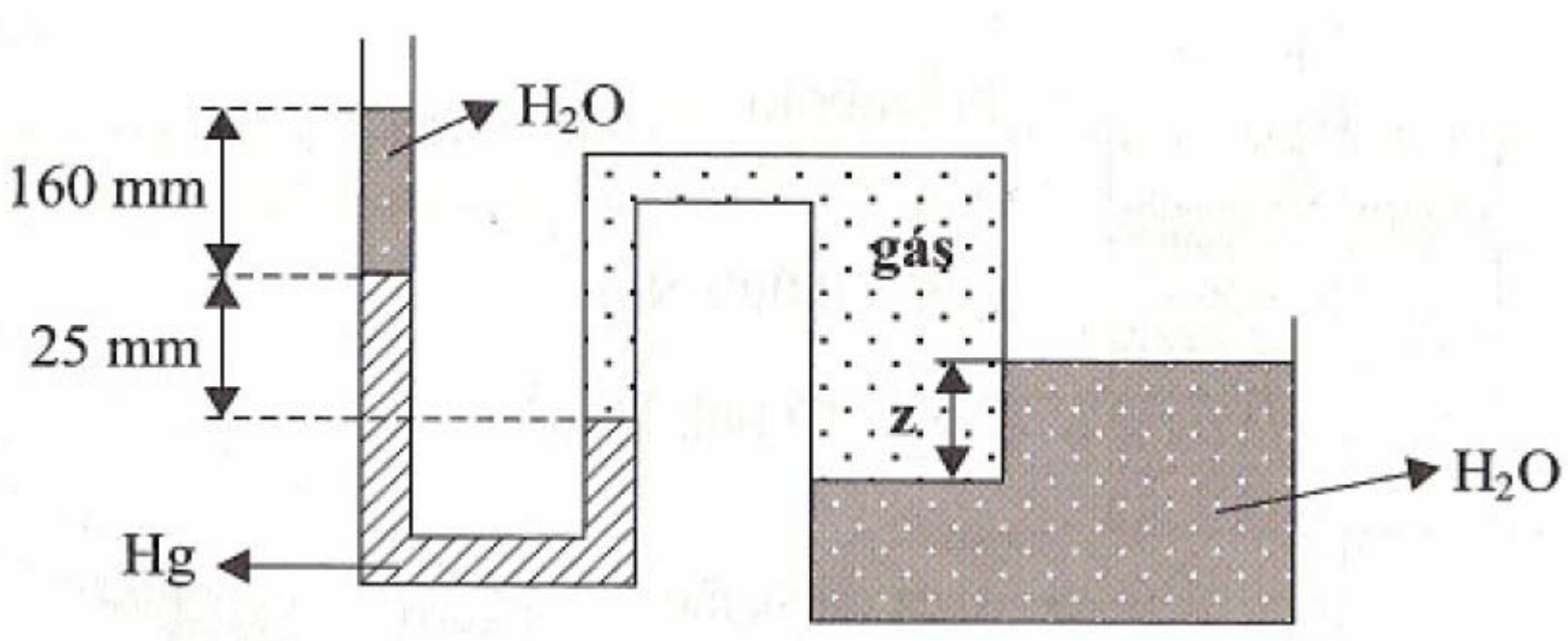
$$h_{H_2O} = \frac{p_A}{\gamma_{H_2O}} = -\frac{624}{10.000} = -0{,}0624\,\text{mca}$$

b) $p_{atm} = 0{,}7 \times 136.000 = 95.200\,\text{Pa}$

$p_{Aabs} = p_A + p_{atm} = -624 + 95.200 = 94.576\,\text{Pa(abs)}$

$$\rho_A = \frac{p_A}{RT_A} = \frac{94.576}{287 \times 293} = 1{,}12\,\frac{\text{kg}}{\text{m}^3}$$

2.16



Resolução

a) $0 + 0{,}16 \times 10000 + 0{,}025 \times 136000 = p_{gás}$

$\therefore p_{gás} = 5000\ Pa$

$p_{gás_{abs}} = 5000 + 0{,}662 \times 136000 = 95032 kPa$

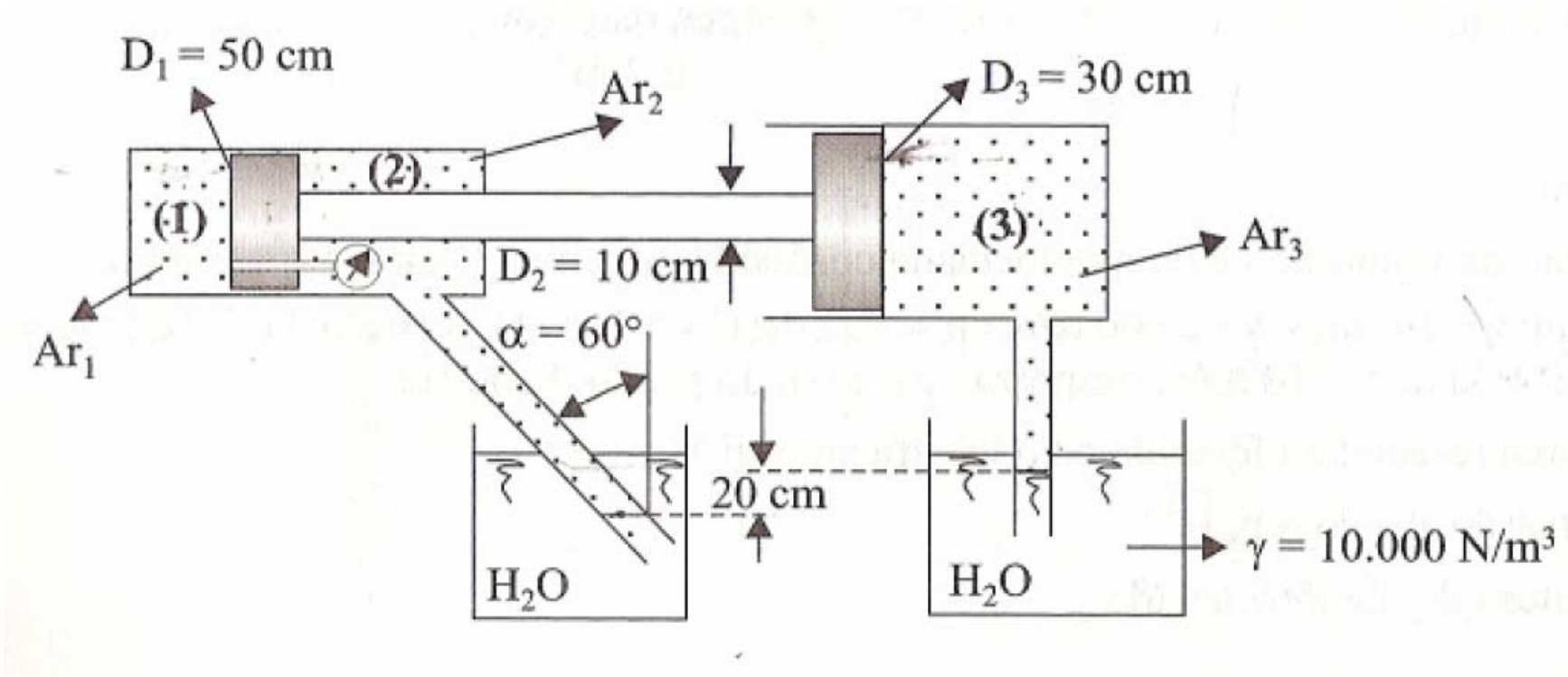
b) $5000 - 10000 \times z = 0 \therefore z = 0{,}5m$

c) $p_{gás_f} - 1 \times 10000 = 0 \therefore p_{gás_f} = 10000 \frac{N}{m^2}$

$p_{gás_{fabs}} = 10000 + 0{,}662 \times 136000 = 100032 \frac{N}{m^2}$

$\frac{p_i V_i}{T_i} = \frac{p_f V_f}{T_f} \Rightarrow \frac{95032 \times 2}{(273 + 20)} = \frac{100032 \times V_f}{(273 + 60)} \therefore V_f = 2{,}16 m^3$

2.17


$D_1 = 50$ cm
Ar_2
$D_3 = 30$ cm
(1)
(2)
(3)
Ar_3
$D_2 = 10$ cm
Ar_1
$\alpha = 60°$
20 cm
H_2O
H_2O
$\gamma = 10.000$ N/m³

Resolução

$$p_1 - p_2 = 10.000$$

$$p_2 - p_3 = 10.000 \times 0,2 = 2.000$$

$$p_1 \frac{\pi D_1^2}{4} = p_2 \frac{\pi}{4}\left(D_1^2 - D_2^2\right) + p_3 \frac{\pi D_3^2}{4} \quad \rightarrow \quad p_1 \times 0,5^2 = p_2 \times \left(0,5^2 - 0,1^2\right) + p_3 \times 0,3^2$$

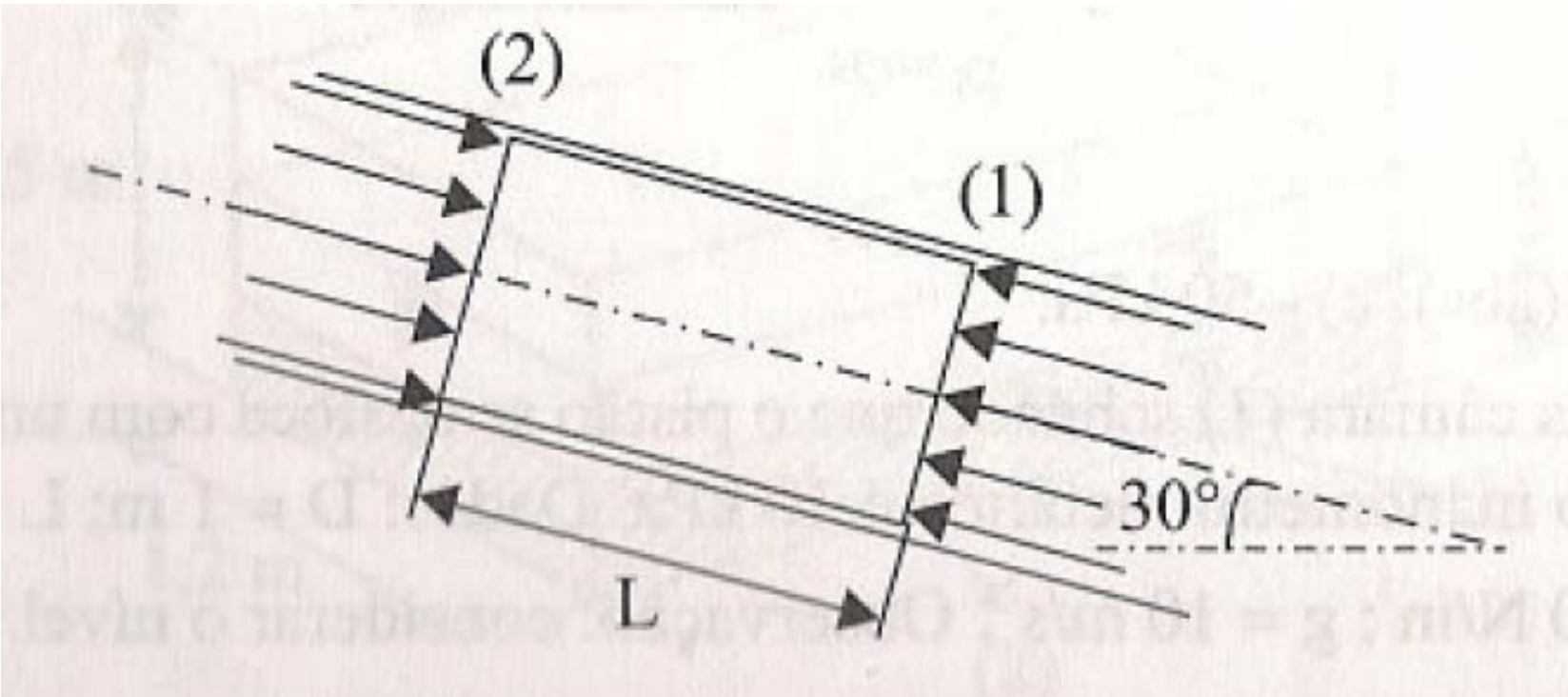
$$0,25p_1 = 0,24p_2 + 0,09(p_2 - 2.000)$$

$$0,25p_1 = 0,33p_2 - 180$$

$$0,25p_1 = 0,33(p_1 - 10.000) - 180$$

$$0,08p_1 = 3480 \quad \rightarrow \quad p_1 = 43.500\text{Pa} = 43,5\text{kPa}$$

2.18



Resolução

a) $F_1 = p_1 \times A_1 = 50000 \times \frac{\pi \times 0{,}5^2}{4} \cong 9817{,}5\text{N}$

$G_t = G\text{sen}30^\circ = 3950 \times 0{,}5 = 1975\text{N}$

$F_2 = p_2 \times A_2 = 40000 \times \frac{\pi \times 0{,}5^2}{4} \cong 7854\text{N}$

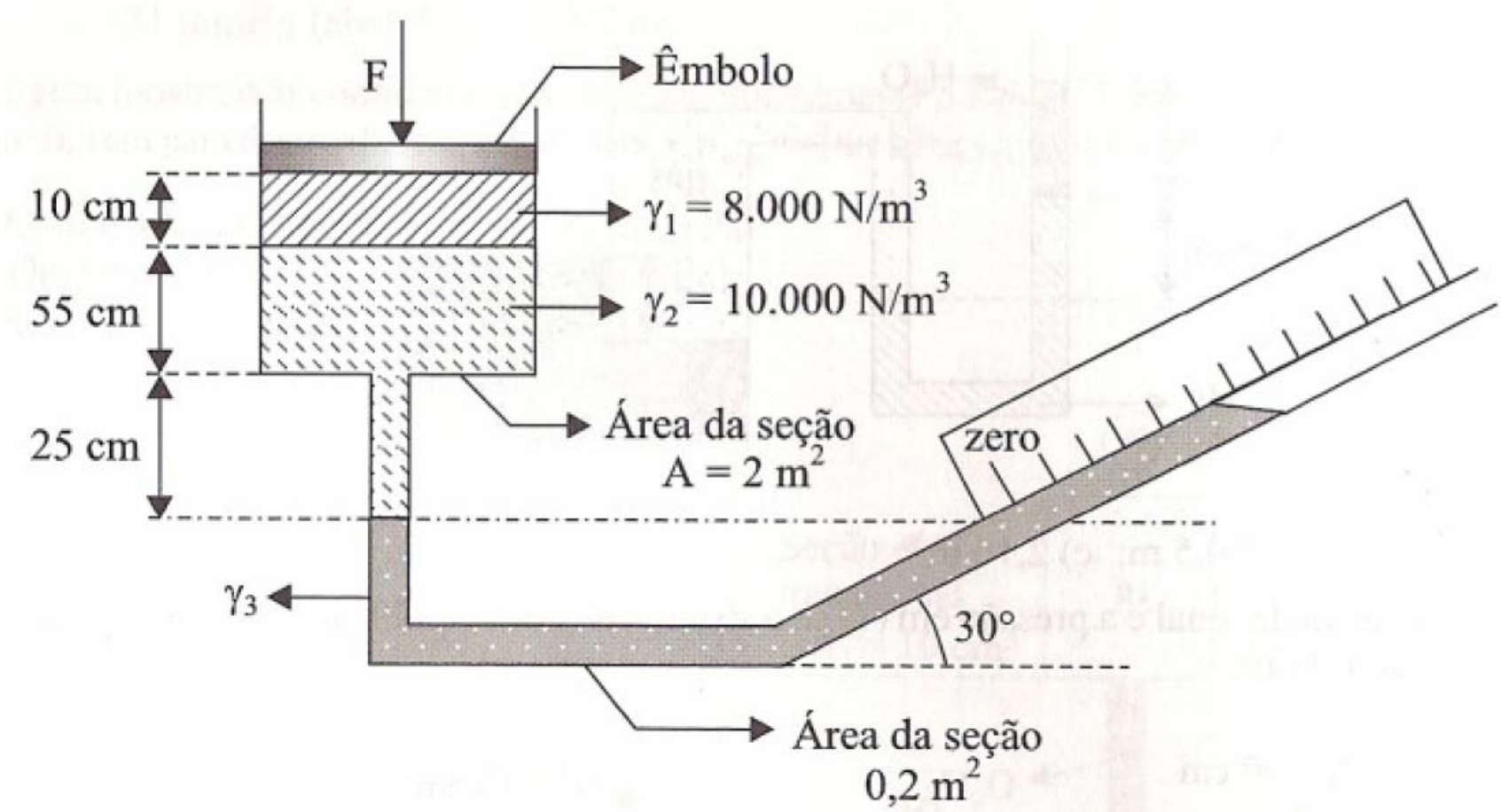
Como $F_2 + G_t > F_1 \Rightarrow$ o corpo desce

b) $F_2 + G_t = F_1 + F_\mu \therefore F_\mu = 11{,}5\text{N} = 10^{-2} \times \frac{2}{\frac{0{,}501 - 0{,}5}{2}} \times \pi \times 0{,}5 \times L$

$\therefore L \cong 0{,}183\,\text{m}$

c) $\rho = \frac{3950 / 9{,}8}{\frac{\pi \times 0{,}5^2}{4} \times 0{,}183} \cong 11217{,}3 \frac{\text{kg}}{\text{m}^3}$

2.19


F
Êmbolo
10 cm
55 cm
25 cm
$\gamma_1 = 8.000\ N/m^3$
$\gamma_2 = 10.000\ N/m^3$
Área da seção
$A = 2\ m^2$
zero
γ_3
30°
Área da seção
$0{,}2\ m^2$

Resolução

$$\frac{F}{A} + \gamma_1 \times 0{,}1 + \gamma_2 \times 0{,}8 - \gamma_3 L \operatorname{sen} 30^o = 0$$

$$\gamma_3 = \frac{\frac{F}{A} + \gamma_1 \times 0{,}1 + \gamma_2 \times 0{,}8}{L \operatorname{sen} 30^o} = \frac{\frac{55.600}{2} + 8.000 \times 0{,}1 + 10.000 \times 0{,}8}{1 \times \operatorname{sen} 30^o} = 73.200 \frac{N}{m^3}$$

$$\frac{2F}{A} + \gamma_1 \times 0{,}1 + \gamma_2 \times 0{,}8 + \gamma_2 .x - \gamma_3 .x. \operatorname{sen} 30^o - \gamma_3 .L. \operatorname{sen} 30^o$$

Sendo : $x = L - 1$

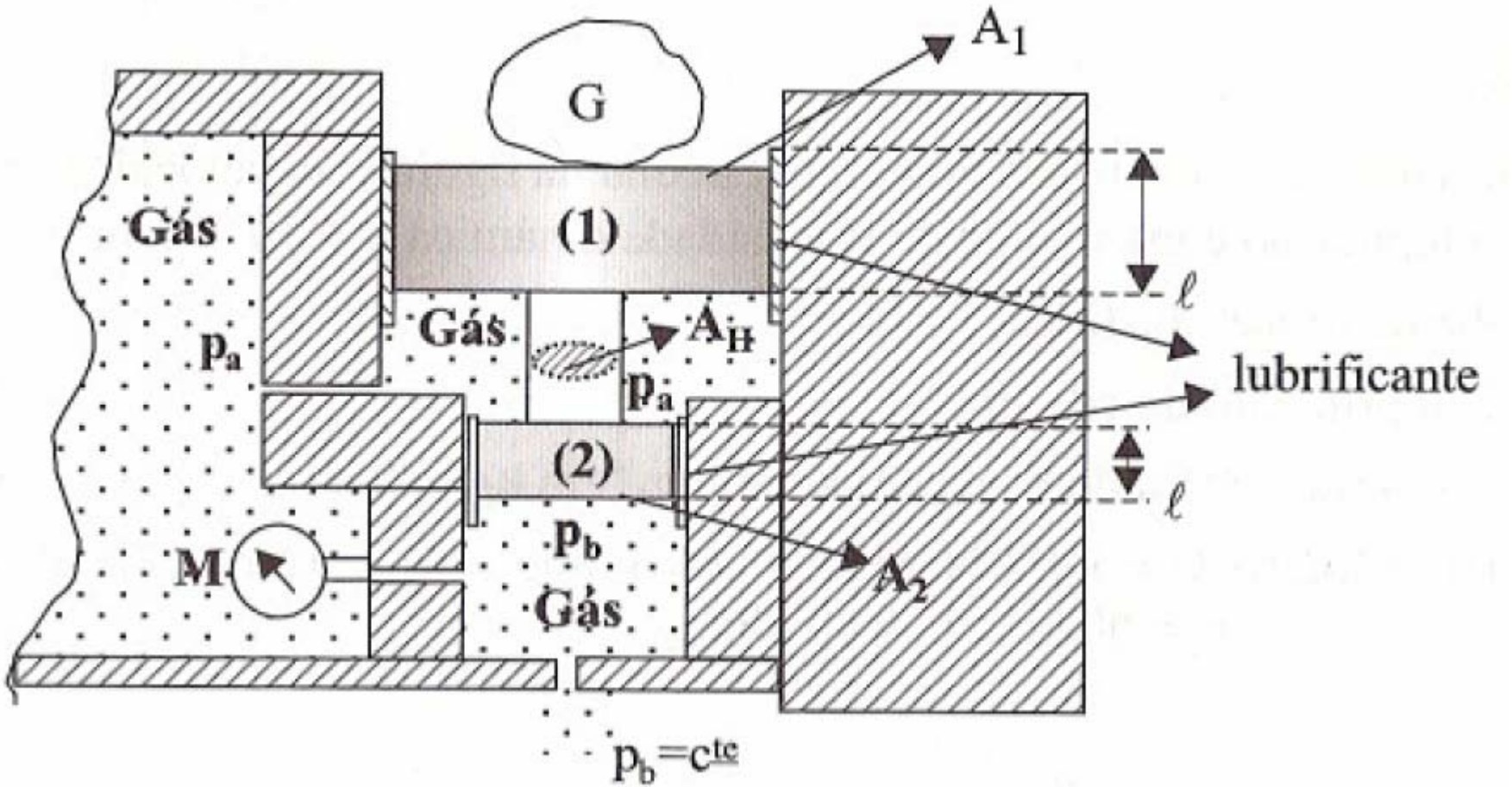
$$\frac{2 \times 55600}{2} + 8000 \times 0{,}1 + 10000 \times 0{,}8 + 10000L - 10000 - 73200 \times 0{,}5L +$$

$$+ 73200 \times 0{,}5 - 73200.L.0{,}5 = 0$$

$$91.000 = 63.200L$$

$$L = 1{,}44\,m = 144\,cm$$

2.20



Resolução

a) $F_\mu = 10^{-3} \times \frac{8000}{10} \times \frac{5}{0,001} \times \pi \times 0,05 \times (0,16 + 0,08)$

$\therefore F_\mu = 150,8N$

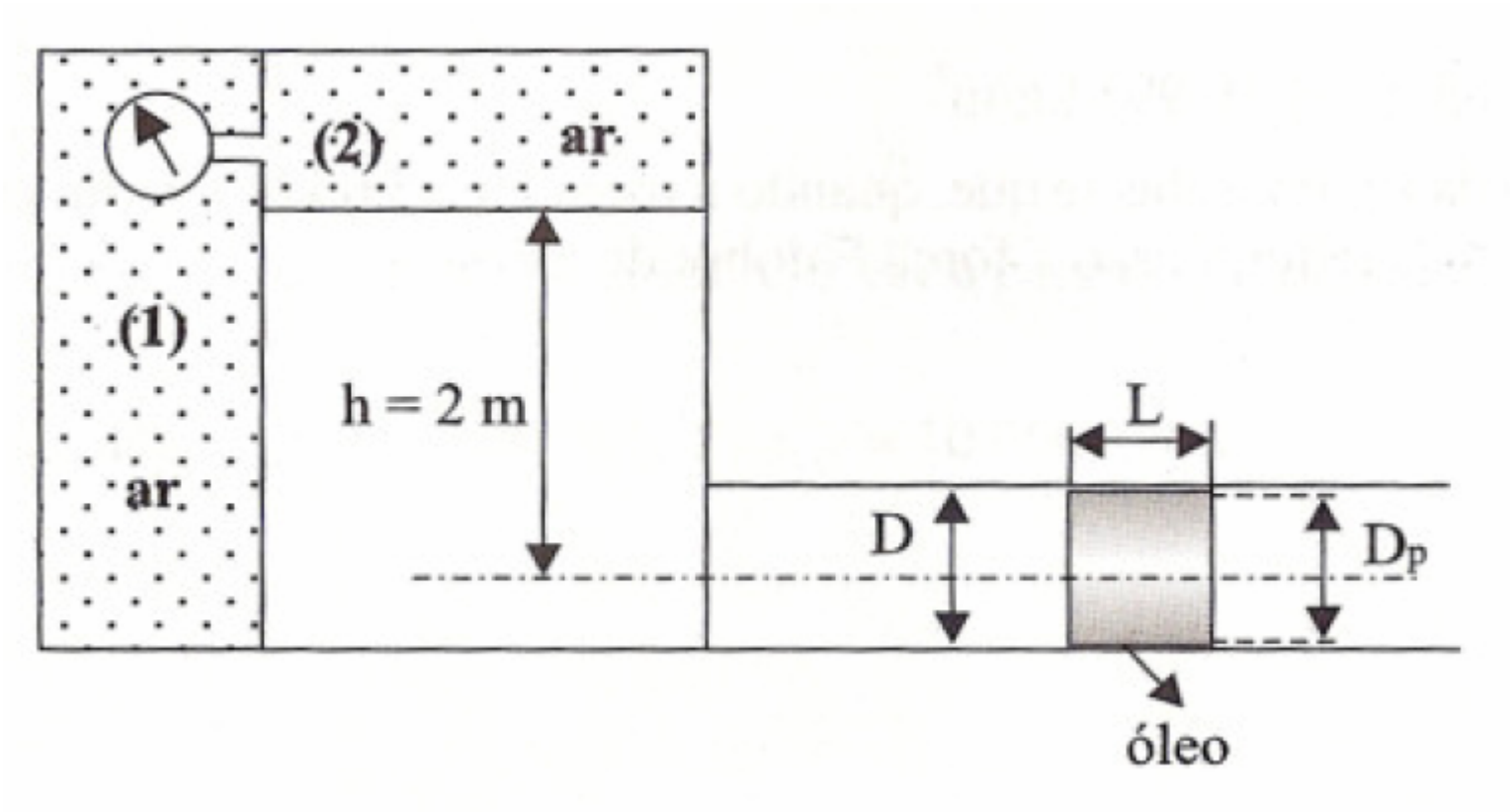
b) $10000 \times (\frac{\pi \times 0,08^2}{4} - 20 \times 10^{-4}) + 100 = 150,8 +$

$10000 \times (\frac{\pi \times 0,16^2}{4} - 20 \times 10^{-4}) + p_{gás} \times \frac{\pi \times 0,08^2}{4}$

$p_{gás_B} = -40,1kPa \Rightarrow p_{gás_{Babs}} = -40,1 + 100 = 59,9kPa$

c) $p_m = p_{gás_B} - p_a = -40,1 - 10 = -50,1kPa$

2.21



Resolução

$$p_2 - p_1 = 10.000$$

$$p_2 + \gamma h = p_p \quad \text{onde} \quad p_p = \text{pressão média no pistão}$$

$$p_p \frac{\pi D_p^2}{4} = \tau \pi D_p L$$

$$p_p \frac{D_p}{4} = \mu \frac{v}{\varepsilon} L \quad \rightarrow \quad p_p = \frac{4 \mu v L}{\varepsilon D_p}$$

$$\varepsilon = \frac{D - D_p}{2} = \frac{1 - 0{,}998}{2} = 0{,}001\,\text{m}$$

$$\mu = \frac{\nu \gamma}{g} = \frac{10^{-3} \times 8.000}{10} = 0{,}8 \frac{\text{N.s}}{\text{m}^2}$$

$$p_p = \frac{4 \times 0{,}8 \times 1{,}2 \times 0{,}2}{0{,}001 \times 0{,}998} = 769{,}5\,\text{Pa}$$

$$p_2 = p_p - \gamma h = 769{,}5 - 8.000 \times 2 = 15.230 \frac{\text{N}}{\text{m}^2}$$

$$p_1 = p_2 - 10.000 = -15.230 - 10.000 = -25.230\text{Pa} = -25{,}23\text{kPa}$$