TERMODINÂMICA (TRABALHO)

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1- (a) 68°F $\quad T(°F) = 1{,}8\,T(°C) + 32$

$$T(°F) - 32 = 1{,}8\,T(°C)$$

$$\boxed{T(°C) = \frac{T(°F) - 32}{1{,}8}}$$

$68°F = 20°C$

(b) $-40°F \Rightarrow T(°C) = \frac{-40 - 32}{1{,}8} = \frac{-72}{1{,}8}$

$-40°F = -40°C$

(c) $500°F \Rightarrow T(°C) = \frac{500 - 32}{1{,}8} = \frac{468}{1{,}8} = \underline{260°C}$

(d) $0°F \Rightarrow T(°C) = \frac{0 - 32}{1{,}8} = \underline{-17{,}78°C}$

(e) $212°F \Rightarrow T(°C) = \frac{212 - 32}{1{,}8} = \frac{180}{1{,}8} = \underline{100°C}$

(f) $-459{,}67°F \Rightarrow T(°C) = \frac{-459{,}67 - 32}{1{,}8} = \underline{-273{,}15°C}$

De Celsius para Kelvin

$$\boxed{T(°C) = T(K) - 273,15}$$

(a) 68°F = 20°C = 293,15 K

(b) -40°F = -40°C = 233,15 K

(c) 500°F = 260°C = 533,15 K

(d) 0°F = -17,18°C ≅ 256 K

(e) 212°F = 100°C = 373,15 K

(f) -459,67°F = -273,15°C = 0 K

$1 \text{bar} = 10^5 \text{ Pa}$

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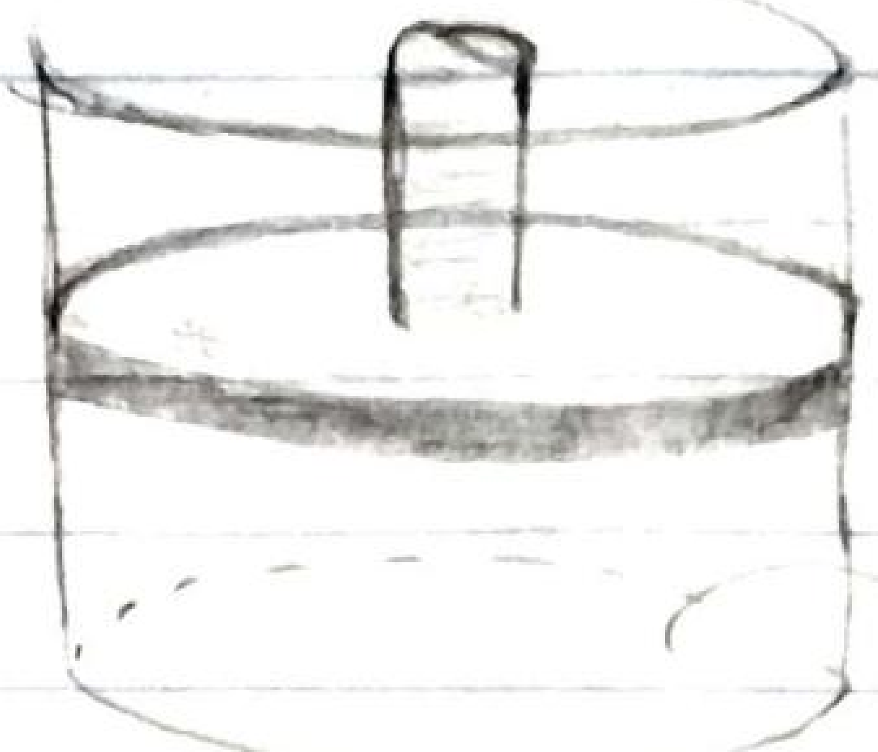

$m = 0{,}205 \text{ Kg}$

Pressão constante (Isobárico)

$$p = 5 \text{bar} = 5 \times 10^5 \text{ Pa}$$

Por ser um processo isobárico, o índice politrópico é 0. $(n = 0)$

$$pV^n = cte \quad \therefore \quad p = cte$$

$$\rho_0 = \frac{m}{V_0} \qquad \begin{aligned} \rho_0 &= 5 \text{ kg/m}^3 \\ m &= 0{,}250 \text{ kg} \\ V_0 &= ? \end{aligned} \quad \left\} \begin{aligned} V_0 &= 0{,}05 \text{ m}^3 \\ V_f &= ? \end{aligned} \right.$$

$$W = -15 \text{ kJ} \qquad W = \int_{V_0}^{V_f} p\,dV = \int_{0,05}^{V_f} 5 \times 10^5 \, dV$$

$$-15 \times 10^3 = 5 \times 10^5 \int_{0,05}^{V_f} dV = 5 \times 10^5 \left[V_f - 0{,}05\right]$$

$$-15 \times 10^3 = 5 \times 10^5 V_f - 2{,}5 \times 10^{-6}$$

$$V_f = \frac{-15 \times 10^3 + 2{,}5 \times 10^{-6}}{5 \times 10^5}$$

$$\underline{V_f = 0{,}029 \text{ m}^3}$$

3- Estado 1

$p_1 = 0,2 \times 10^6 Pa \qquad V_1 = 2,75 m^3$

Estado 2

$p_2 = 2 \times 10^6 Pa \qquad V_2 = ?$

$n = 1,35$ (índice politrópico)

$$p_1 V_1^n = p_2 V_2^n \therefore V_2^n = \frac{p_1 V_1^n}{p_2}$$

$$V_2 = \left(\frac{p_1 V_1^n}{p_2} \right)^{1/n} \cong \underline{\underline{0,5 m^3}}$$

$W = ? \qquad pV^n = CTE \therefore p = \frac{CTE}{V^n}$

$$W = CTE \int_{V_1}^{V_2} \frac{1}{V^n} = CTE \int_{V_1}^{V_2} V^{-n} = CTE \left[\frac{V^{-n+1}}{-n+1} \right]_{V_1}^{V_2}$$

$$= CTE \left[\frac{V^{1-n}}{1-n} \right]_{V_1}^{V_2}$$

$$W = CTE \left[\frac{V_2^{1-m}}{1-m} - \frac{V_1^{1-m}}{1-m} \right]$$

$$W = CTE \cdot \frac{V_2^{1-m}}{1-m} - CTE \cdot \frac{V_1^{1-m}}{1-m}$$

$$W = p_2 V_2^{m} \, \frac{V_2^{1-m}}{1-m} - p_1 V_1^{m} \cdot \frac{V_1^{1-m}}{1-m}$$

$$W = \frac{p_2 V_2}{1-m} - \frac{p_1 V_1}{1-m} = \frac{1}{1-m} \left(p_2 V_2 - p_1 V_1 \right)$$

$$W = \frac{1}{1-1{,}35} \left(2 \cdot 10^6 \cdot 0{,}5 - 0{,}2 \times 10^6 \times 2{,}75 \right)$$

$$W \cong -1{,}29 \times 10^6 \, J = \underline{\underline{-1{,}29 \, MJ}}$$

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$A = 0{,}018\,m^2$

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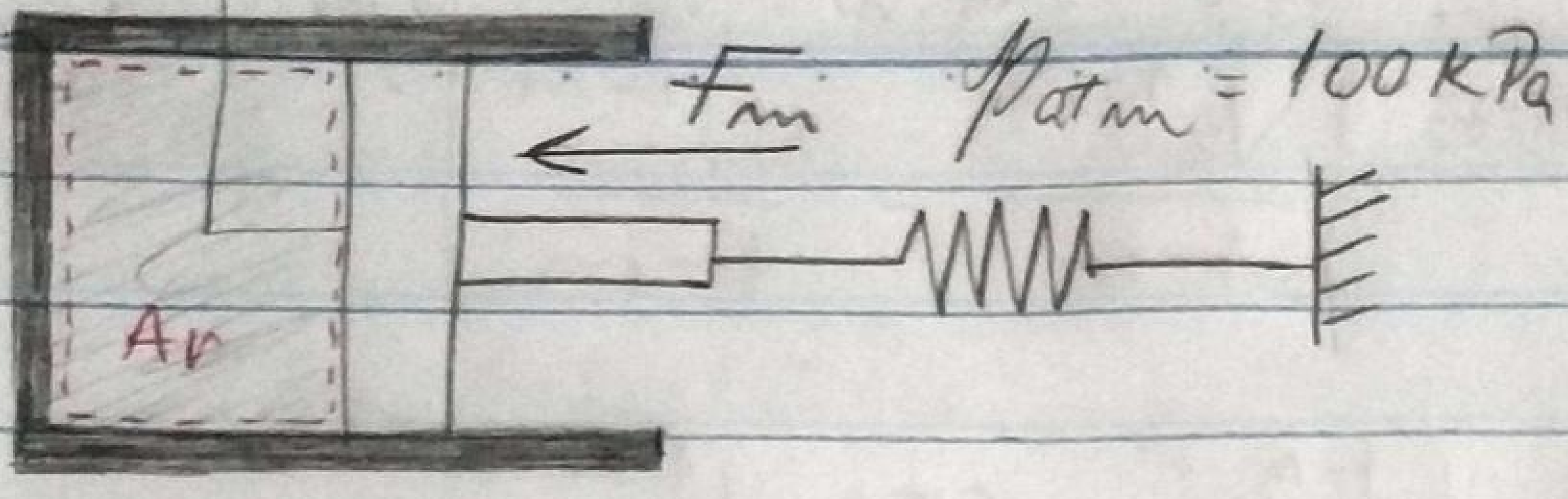


Estado 1

Considerando a influência da pressão atmosférica

$$\rightarrow \quad p_1 = p_{atm} + \frac{F_{m_1}}{A}$$

$$p_1 = 100\,kPa + \frac{900\,N}{0{,}018\,m^2} = 100\,kPa + 50\,kPa$$

$$\boxed{p_1 = 150\,kPa}$$

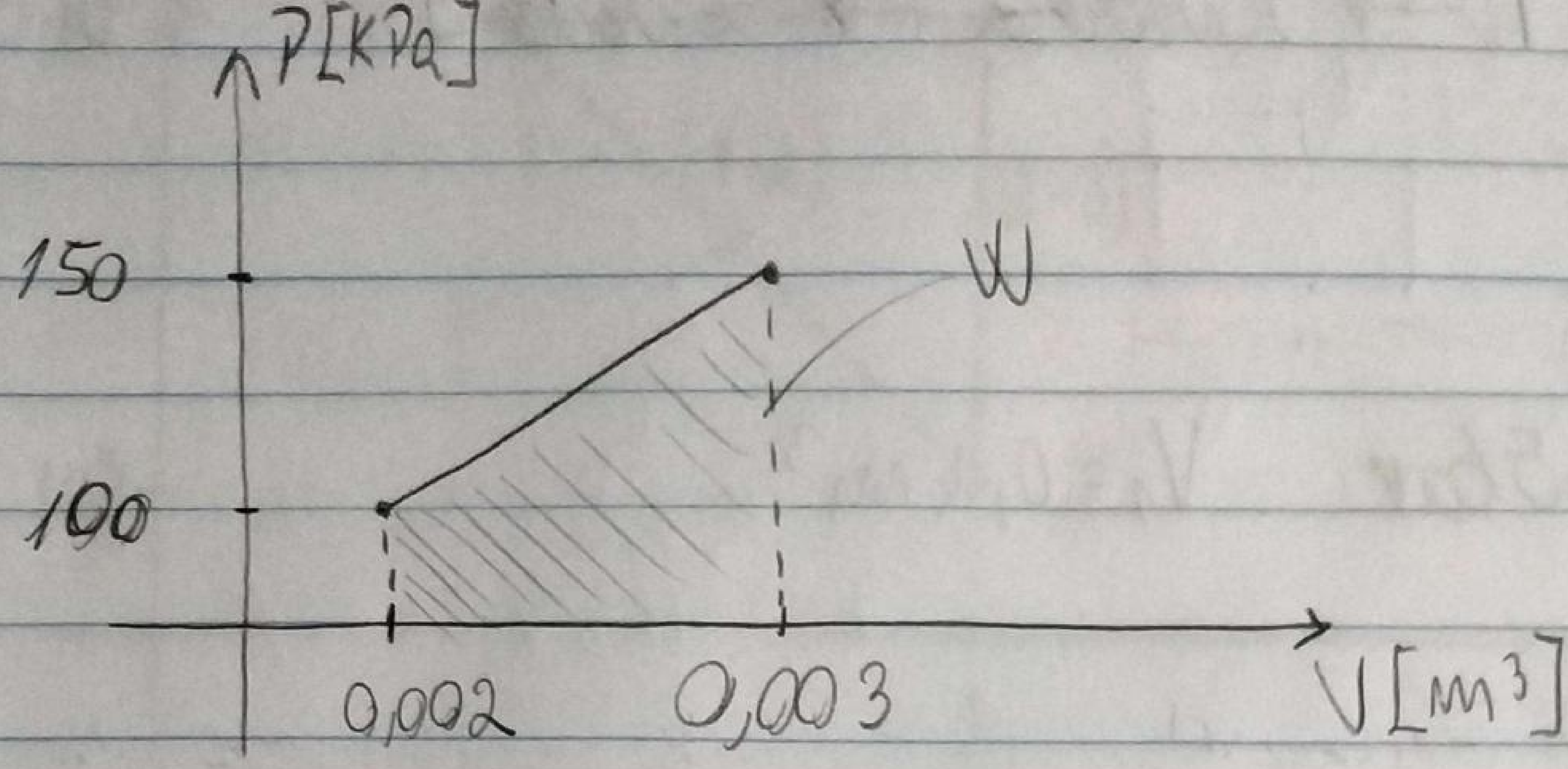
Estado 2

$$\rightarrow \quad p_2 = p_{atm} + \frac{F_{m_2}}{A}$$

$$p_2 = 100\,kPa + \frac{0}{A} = 100\,kPa$$

$$\boxed{p_2 = 100\,kPa}$$

Calculando o trabalho através do diagrama PV



$$W = \frac{(150-100)(0{,}003-0{,}002)}{2} + 100(0{,}003-0{,}002)$$

$$W = \frac{50 \cdot 0{,}001}{2} + 100 \cdot 0{,}001 = 25 \cdot 0{,}001 + 100 \cdot 0{,}001$$

$$W = 125 \cdot 0{,}001 = 0{,}125 \text{ KJ}$$

Trabalho que o pistão exerce sobre o volume de ar

$p = CTE \; ; \; m = 0$

5 - $\text{Estado 1} \xrightarrow{m=1} \text{Estado 2} \xrightarrow{V=cte} \text{Estado 3}$

Estado 1

$p_1 = 5\,bar \qquad V_1 = 0{,}2\,m^3$

Estado 2

$p_2 = ? \qquad V_2 = 1\,m^3$

Estado 3

$p_3 = 5\,bar \qquad V_2 = 1\,m^3$

Estado 1 → Estado 2

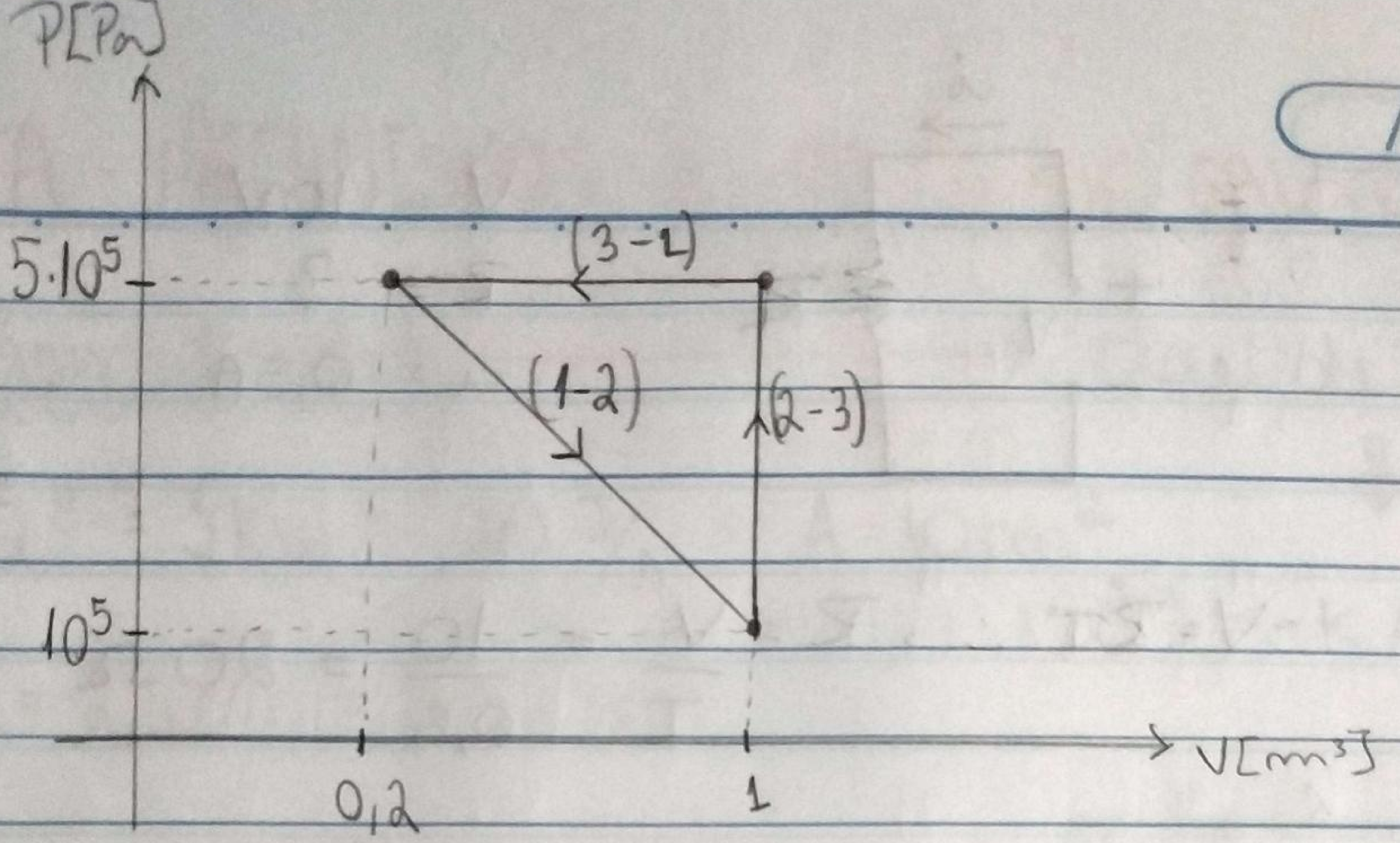
$$p_1 V_1 = p_2 V_2 \;\therefore\; p_2 = \frac{p_1 V_1}{V_2} = \frac{5bar \cdot 0{,}2}{1} = 1\,bar$$

fazer o diagrama PV

$p_1 = 5 \times 10^5\,Pa \quad , \quad V_1 = 0{,}2\,m^3$

$p_2 = 10^5\,Pa \quad , \quad V_2 = 1\,m^3$

$p_3 = 5 \cdot 10^5\,Pa \quad , \quad V_3 = 1\,m^3$

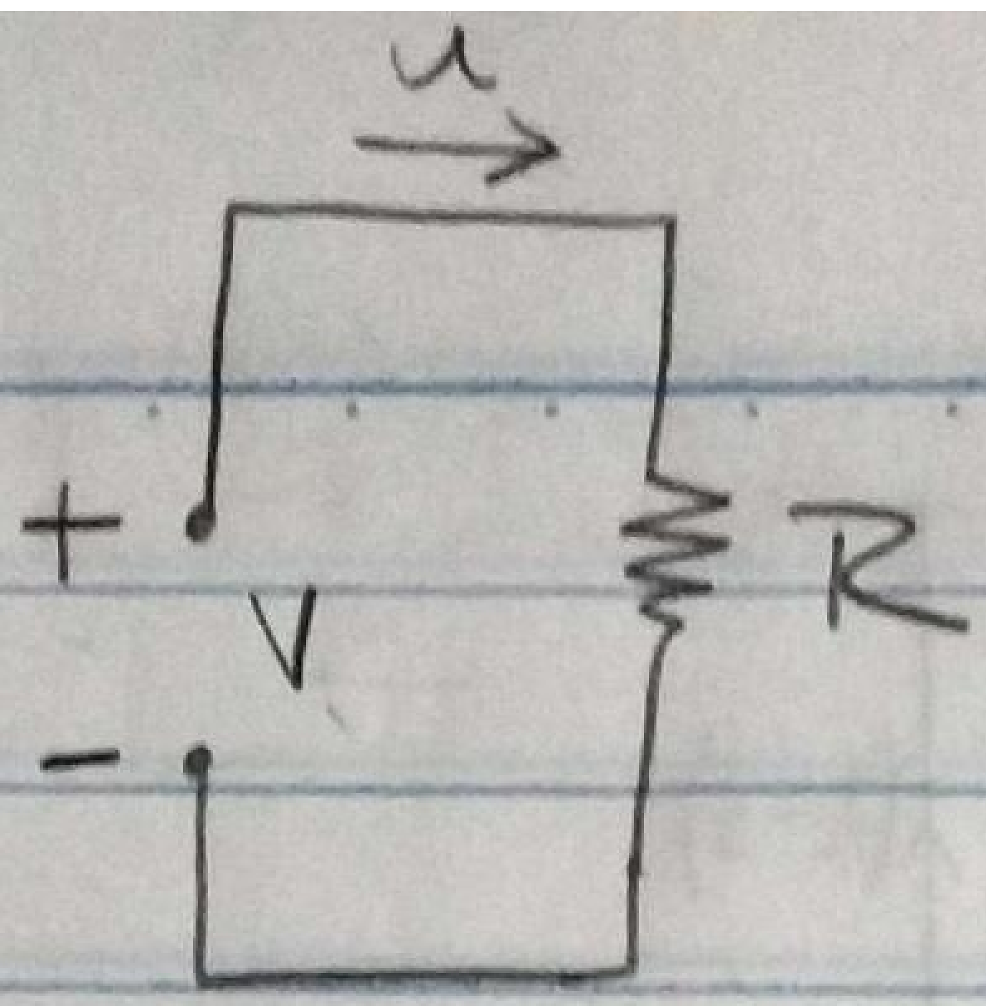


$$W_{12} = \frac{(5\times10^5 + 10^5)\,0{,}8}{2} = \frac{\cancel{6}^{3}\times10^5\cdot0{,}8}{\cancel{2}} = 2{,}4\times10^5\ J$$

$$W_{23} = 0$$

$$W_{31} = 0{,}8\cdot5\cdot10^5 = -4\cdot10^5\ J$$

6-



$V = 10V$

$R = ?$

$i = 0{,}5A$

$$V = RI \;\therefore\; R = \frac{V}{I} = \frac{10}{0{,}5} = 20\,\Omega$$

$$P = VI = 10 \cdot 0{,}5 = 5\,[J/s]$$

$$W = P \cdot t = 5\,\frac{J}{\cancel{s}} \cdot 30 \cdot 60\,\cancel{s}$$

$$W = 5 \cdot 1800\,J = 9000\,J = 9\,KJ$$