# Termologia – FUVEST 2ª fase 1991 a 2018: Resolução

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**1**

a) $Q_T = Q_{calorimetro} + Q_{água}$

$Q_T = 1600(22{,}20 - 22) + 200.4.(22{,}2 - 22)$

$\boxed{Q_T = 480\ J}$

b) $E_T = mgh$

$E_T = 1{,}5.10.(8.6)$

$E_T = 720\ J$

$f = \frac{Q}{E_T}$

$f = \frac{480}{720} \Rightarrow \boxed{f = \frac{2}{3}}$

**2**

Início: $P_0$, $V_0$, $T_0$

Transformação I (isobárica): $P_1 = P_0$, $V_1 = ?$, $T_1 = 2T_0$

$\frac{V_0}{T_0} = \frac{V_1}{T_1}$

$\frac{V_0}{T_0} = \frac{V_1}{2T_0}$

$\therefore \boxed{V_1 = 2V_0}$

Transformação II: $V_2 = 2V_0$ isocórica

$T_2 = T_0$, $P_2 = ?$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{P_0}{2T_0} = \frac{P_2}{T_0}$

$\therefore \boxed{P_2 = P_0/2}$

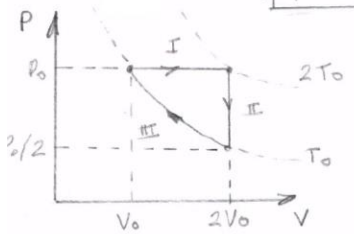
Transformação III: $T_3 = T_0$ isotérmica

$P_3 = P_0$, $V_3 = ?$

$P_2V_2 = P_3V_3$

$\frac{P_0}{2}2V_0 = P_0V_3$

$\therefore \boxed{V_3 = V_0}$




**3**

a) $d = \frac{m}{V}$

$0{,}9 = \frac{m}{0{,}01}$

$\boxed{m = 9.10^{-3}\ g}$

gota — volume ($cm^3$)

100 — 1

1 — V

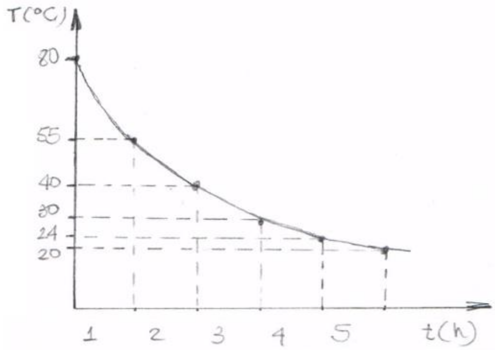
$V = 0{,}01\ cm^3$

b) $\Delta V = V_0\, \gamma\, \Delta T$

$(1{,}01 - 1) = 1\, \gamma . (60 - 10)$

$\boxed{\gamma = 2.10^{-4}\ °C^{-1}}$

**4**




b) $P = \frac{E}{\Delta t}$ ← $Q = mc\Delta T$

$P = \frac{3600.1.(20-80)}{5.3600}$

$\boxed{P = -12\ cal/s}$

↓ cede para o ambiente

**5**

a) $Q_{água} = mc\Delta T$ $\qquad Q_{recipiente} = mc\Delta T$

$Q_{água} = 500.1.\Delta T$ $\qquad Q_{recip.} = 500.0{,}2.\Delta T$

$\frac{Q_{água}}{Q_{recipiente}} = \frac{500.1.\Delta T}{500.0{,}2.\Delta T}$

$\boxed{\frac{Q_{água}}{Q_{recipiente}} = 5}$

b) $Q_T = Q_{água} + Q_{recipiente}$

$Q_T = 500.1.1 + 500.0{,}2.1$

$\boxed{Q_T = 600\ cal}$

**6**

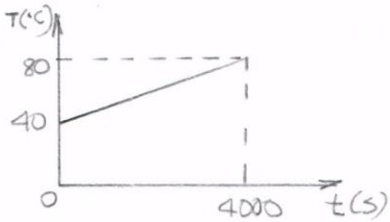
a) $P = \frac{E}{\Delta t}$ (com $Q = mc\Delta T$)

$$80 = \frac{0{,}4 \cdot c \cdot (80-40)}{1000}$$

$$\boxed{c_{subs} = 5000\ J/kg^{\circ}C}$$

b) $P = \frac{U^2}{R}$ se $U' = \frac{U}{2} \Rightarrow P' = \frac{P}{4}$

∴ para se ter a mesma variação de temperatura é necessário um tempo 4 vezes maior.

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**7**

a) $PV = nRT$

$$P \cdot (500 \cdot 20 \cdot 10^{-6}) = 0{,}5 \cdot 8 \cdot 300$$

$$P_{gás} = 1{,}2 \cdot 10^5\ Pa$$

$$P_{gás} = P_{êmbolo} + P_{atm}$$

$$1{,}2 \cdot 10^5 = \frac{m \cdot 10}{500 \cdot 10^{-4}} + 1 \cdot 10^5$$

$$\boxed{m_{êmbolo} = 100\ kg}$$

b) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$$\frac{500 \cdot 20 \cdot 10^{-6}}{300} = \frac{V_2}{420} \Rightarrow V_2 = 0{,}014\ m^3$$

$$\tau = P\Delta V$$

$$\tau = 1{,}2 \cdot 10^5\ (0{,}014 - 0{,}01)$$

$$\boxed{\tau = 480\ J}$$

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**8**

a) de 0 a 50 a temperatura é constante. Logo o calor recebido = calor cedido

∴ 30 J

b) $P = \frac{E}{\Delta t}$ (com $Q = mL$)

$$(43-30) = \frac{100 \cdot L}{200}$$

$$L_f = 26\ J/g$$

∴ 26 J

c) $P = \frac{E}{\Delta t}$ (com $Q = mc\Delta T$)

$$(43-30) = \frac{100 \cdot c\ (347-327)}{10}$$

$$c_{liq} = 0{,}065\ J/g^{\circ}C$$

∴ 0,065 J

d) $P = \frac{E}{\Delta t}$

$$(43-30) = \frac{100 \cdot c \cdot 20}{20}$$

$$c_{sól} = 0{,}13\ J/g^{\circ}C$$

∴ 0,13 J

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**9**

$1{,}4V_0$ ↑ 2m ↓ $0V_0$

a) $\Delta P = P_{sup} - P_{fundo}$

$$\Delta P = P_{atm} - (P_{atm} + dgh)$$

$$\Delta P = -10^3 \cdot 10 \cdot 2$$

$$\boxed{\Delta P = -2 \cdot 10^4\ N/m^2}$$

b) $P_0 V_0 = P_1 V_1$

$$(P_{atm} + 2 \cdot 10^4)\ V_0 = P_{atm}\ 1{,}4\ V_0$$

$$P_{atm} + 2 \cdot 10^4 = 1{,}4\ P_{atm}$$

$$\boxed{P_{atm} = 5 \cdot 10^4\ N/m^2}$$

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**10**

a) $T_{fusão} = 60^{\circ}C$

b) Fase sólida

$T_e = 60^{\circ}C$, $T = 200^{\circ}C$

$$Q_{Fe} + Q_{sub} = 0$$

$$m_{Fe} \cdot c_{Fe}\Delta T_{Fe} + m_s \cdot c_s \cdot \Delta T_s = 0$$

$$m_s \cdot 0{,}8 \cdot 0{,}1 \cdot (60-200) + m_s \cdot c_s \cdot (60-20) = 0$$

$$\boxed{c_s = 0{,}28\ cal/g^{\circ}C}$$

c) $Q_{Fe}$ (Aquec. ferro) $+ Q_s$ (Aquec. subst.) $+ Q_s$ (Fusão subst.) $= 0$

$$m_{Fe} c_{Fe} \Delta T_{Fe} + m_s c_s \Delta T_s + m_s L_f = 0$$

$$m_s\ 0{,}8 \cdot 0{,}1\ (60-450) + m_s \cdot 0{,}28\ (60-20) + m_s \cdot L_f = 0$$

$$\boxed{L_{fusão\ subs.} = 20\ cal/g}$$

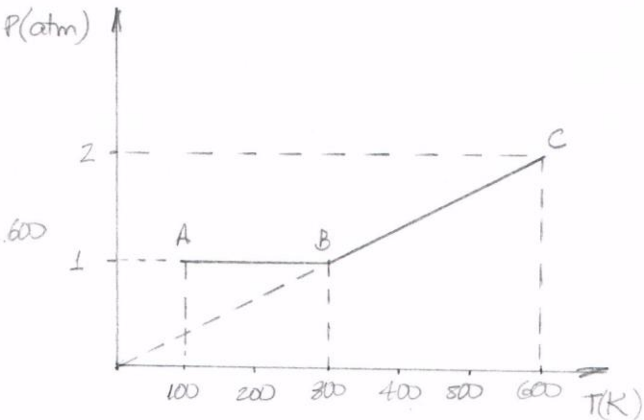
obs: final da Fusão: $T_e = 60^{\circ}C$

$T_{Fe} = 450^{\circ}C$

**11**

a) AB = Pressão

BC = Volume




b) $P_A V_A = n_A R T_A$

$P_A \cdot 8{,}2 = 1 \cdot 0{,}082 \cdot 100$

$\boxed{P_A = 1\,atm}$

$P_C V_C = n_C R T_C$

$P_C \cdot 24{,}6 = 1 \cdot 0{,}082 \cdot 600$

$\boxed{P_C = 2\,atm}$

c) BC = Volume constante:

$PV = nRT$

$P = \dfrac{1 \cdot 0{,}082}{24{,}6} \cdot T \Rightarrow \boxed{P = \dfrac{1}{300} \cdot T}$

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**12**

a) $P = \dfrac{E}{\Delta t}$ ⤳ $Q = mL$

$20 = \dfrac{50 \cdot L}{(90-30)}$

$\boxed{L_B = 24\,cal/g}$

b) Balanço energético:

Calor necessário p/ esfriar A de 280 a 80°C:

$P = \dfrac{E}{\Delta t}$

$20 = \dfrac{E}{(65-15)} \Rightarrow \boxed{E_1 = 1000\,cal}$

Calor necessário p/ aquecer B de 20 a 80°C:

$P = \dfrac{E}{\Delta t}$

$20 = \dfrac{E}{(30-0)} \Rightarrow \boxed{E_2 = 600\,cal}$

Como $E_1 > E_2$, sobram $1000 - 600 = 400$ cal para fundir B.

$Q = mL$

$400 = m_{fundida} \cdot 24$

$\boxed{m_{fundida} \cong 16{,}7\,g}$

Portanto: $T_e = 80°C$

$m_{B\ sólida} \cong 33{,}3\,g$

$m_{B\ líquida} \cong 16{,}7\,g$

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**13**

a) $P_{cili.} = \dfrac{F}{A}$

$P_{cilindro} = \dfrac{50 \cdot 10}{0{,}01}$

$\boxed{P_{cilindro} = 0{,}5 \cdot 10^5\,N/m^2}$

$P_0 V_0 = P_1 V_1$

$10^5 (0{,}01 \cdot 6) = (10^5 + 0{,}5 \cdot 10^5) \cdot (0{,}01 \cdot Y_1)$

$\boxed{Y_1 = 4\,m}$

b) $P_3 = P_{atm} + P_{cilindro}$

$P_3 = 1 \cdot 10^5 + 0{,}5 \cdot 10^5 = 1{,}5 \cdot 10^5\,N/m^2$

$P_2 = P_3 + P_{cilindro}$

$P_2 = 1{,}5 \cdot 10^5 + 0{,}5 \cdot 10^5 = \boxed{2 \cdot 10^5\,N/m^2}$

$P_3 V_0 = P_2 V_2$

$10^5 (0{,}01 \cdot 6) = 2 \cdot 10^5 (0{,}01 \cdot Y_2)$

$\boxed{Y_2 = 3\,m}$

c) $P_4 V_4 = P_3 V_3$

$1 \cdot 10^5 [0{,}01(6 - 4 - 0{,}5)] = 1{,}5 \cdot 10 \cdot 10 \cdot 0{,}01 Y_3$

$\boxed{Y_3 = 1\,m}$

Obs: O índice 4 se refere ao gás da Fig 2 acima do cilindro Q.

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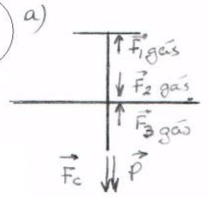
**14**

a)




Lentamente = MU

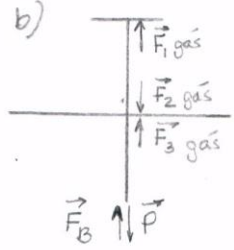
∴ equilíbrio das forças

$F_1 + F_3 = F_2 + F_c + P$

$1 \cdot 10^5 \cdot 1{,}2 + 1 \cdot 10^5 \cdot 3{,}6 = 1 \cdot 10^5 \cdot 3{,}6 + F_c + 8 \cdot 10^4$

$\boxed{F_c = 4 \cdot 10^4\,N}$

b)




$F_1 + F_3 + F_B = F_2 + P$

$5 \cdot 10^5 \cdot 1{,}2 + 1 \cdot 10^5 \cdot 3{,}6 + F_B = 5 \cdot 10^5 \cdot 3{,}6 + 8 \cdot 10^4$

$\boxed{F_B = 9{,}2 \cdot 10^5\,N}$

c) $\tau_T = \tau_{subida} + \tau_{descida}$

$\tau_T = F_C \cdot L + F_B \cdot L$

$\tau_T = 4 \cdot 10^4 \cdot 0{,}5 + 9{,}2 \cdot 10^5 \cdot 0{,}5 = \boxed{4{,}8 \cdot 10^5\,J}$

**15** a) $P = \frac{E}{\Delta t}$ → $Q = mc\Delta T$

$$\frac{120^2}{40} = \frac{M \cdot 4 \cdot (40-20)}{16 \cdot 60}$$

$M = 4320\,g = \boxed{4{,}32\,kg}$

b) $P = \frac{E}{\Delta t}$ → $Q_{água} + Q_{bloco}$

$$\frac{120^2}{40} = \frac{4320 \cdot 4 \cdot (35-25) + 5400 \cdot c_B (35-25)}{10 \cdot 60}$$

$\boxed{c_B = 0{,}8\ J/g°C}$ ou $\boxed{800\ J/kg°C}$

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**16** a) 15 litros de combustível liberam $15 \cdot 36 \cdot 10^6 = 5{,}4 \cdot 10^8\,J$

$\therefore\ P_T = \frac{E}{\Delta t}$

$P_T = \frac{5{,}4 \cdot 10^8}{3600} = 150\,kW$

$P_T = P_u + P_d$

$150 = 25 + P_d$

$\boxed{P_d = 125\,kW}$

b) $P = \frac{E}{\Delta t}$

$$125000 = \frac{m \cdot 4000 \cdot (100-25) + m \cdot 2{,}2 \cdot 10^6}{\Delta t}$$

$\frac{m}{\Delta t} = 0{,}05$

$\therefore\ \boxed{V = 0{,}05\ kg/s}$

c) $R = \frac{P_u}{P_T}$

$R = \frac{25}{150}$

$\boxed{R \cong 16{,}7\%}$

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**17** a) $P = P_{atm} + dgh$

$P = 10^5 + 10^3 \cdot 10 \cdot 40$

$\boxed{P = 5 \cdot 10^5\ Pa}$

b) Gráfico curva C (adiabática)

$1\,m^3$ na superfície tem volume de $0{,}3\,m^3$ a $5 \cdot 10^5\,Pa$.
Como o compartimento tem volume de $6\,m^3$ na superfície, a $5 \cdot 10^5\,Pa$ seu volume será $0{,}3 \cdot 6 = 1{,}8\,m^3$

$V = A \cdot h \Rightarrow 1{,}8 = 3 \cdot H \Rightarrow \boxed{H = 0{,}6\,m}$

c) $\frac{P_0 V_0}{T_0} = \frac{P_1 V_1}{T_1}$

$$\frac{10^5 \cdot 3 \cdot 2}{300} = \frac{5 \cdot 10^5 \cdot 3 \cdot 0{,}6}{T_1}$$

$\boxed{T_1 = 450\,K}$

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**18** Pistão = massa desprezível

a) $P_0 V_0 = P_1 V_1$

$10^5 \cdot A \cdot (1{,}5 - 1{,}05) = P_1 \cdot A(1{,}5 - 1{,}2)$

$\boxed{P_1 = 1{,}5 \cdot 10^5\ Pa}$

b) $\frac{P_2 V_2}{T_2} = \frac{P_3 V_3}{T_3}$

$$\frac{1 \cdot 10^5 \cdot A \cdot (0{,}75)}{300} = \frac{1{,}5 \cdot 10^5 \cdot A\,(0{,}9)}{T_F}$$

$\boxed{T_F = 540\,K}$

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**19** a) a cada min passam 3 l pelo aquecedor

$Q = mc\Delta T$

$Q = 3 \cdot 4000 \cdot (25-15)$

$\boxed{Q = 120\,000\ J}$

b,c) Depois do sistema atingir temperaturas estáveis, o tanque terá $\frac{100}{3}\,l$ a temp. $T_2$ e $\frac{200}{3}\,l$ a 15°C, sendo que essas quantidades atingem uma temp de equilíbrio $T_C$. Logo:

$Q_1 + Q_2 = 0$

$$\frac{100}{3} \cdot 4000 (T_C - T_2) + \frac{200}{3} \cdot 4000 (T_C - 15) = 0$$

$\therefore\ \boxed{3T_C - T_2 = 30}$ (I)

No aquecedor:

$\boxed{T_2 - T_C = 10}$ (II)

Resolvendo (I) e (II)

$\boxed{T_C = 20°C}$

$\boxed{T_2 = 30°C}$

QUADRO DESTINADO A RESPOSTA DA QUESTAO
TEXTOS ESCRITOS FORA DESTE QUADRO (OU A LAPIS) NAO SERAO CONSIDERADOS PELO CORRETOR

PROVA FUVEST

**Questão** 20

a) $P = \frac{E}{\Delta t}$ → $Q = mc\Delta T$

$1800 = \frac{1{,}5 . 4000 . (100-40)}{t_A}$

$\therefore t_A = 200s$

b)

| J | mol |
|---|---|
| 40 000 | 1 |
| E | 0,27 |

$\therefore E = 40000 . 0{,}27 J$

$P = \frac{E}{\Delta t}$

$1800 = \frac{40000 . 0{,}27}{t_B}$

$\therefore t_B = 6s$

c)

| mol | l |
|---|---|
| 1 | 30 |
| 0,27 | V |

$\therefore V = 30 . 0{,}27\ l$

$\tau = P . \Delta V$

$\tau = 1 . 10^5 . (30 . 10^{-3} . 0{,}27)$ → conversão de litro para $m^3$

$\therefore \tau = 810 J$

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PROVA FUVEST

**Questão** 21

a) $PV = nRT$

$100 . 60 = n . 8 . 10^{-2} . 300$

$\therefore n = 250$ mols

b)

| l | min |
|---|---|
| 5 | 1 |
| V | 30 |

$\therefore V = 150\ l$

Pressão de consumo: 3 atm

$PV = nRT$

$3 . 150 = n_{cons.} 8 . 10^{-2} . 300$

$n_{cons.} = 18{,}75$ mols

c) $PV = nRT$

$40 . 60 = n_{resta} . 8 . 10^{-2} . 300$

$\therefore n_{resta} = 100$ mols

Assim, foram consumidos:

$n_{cons} = n_{inicial} - n_{resta}$

$n_{cons} = 250 - 100$

$\therefore n_{cons} = 150$ mols

| mol | min |
|---|---|
| 18,75 | 30 |
| 150 | $\Delta t$ |

$\Delta t = 240$ min

$\therefore \Delta t = 4h$

QUADRO DESTINADO A RESPOSTA DA QUESTAO
TEXTOS ESCRITOS FORA DESTE QUADRO (OU A LAPIS) NAO SERAO CONSIDERADOS PELO CORRETOR

PROVA FUVEST

Questão 22

a) $P_0 = dgh + P_1$

$1.10^5 = 10^3.10.2 + P_1$

$\therefore P_1 = 8.10^4 N/m^2$

b) $\frac{P_0 V_0}{T_0} = \frac{P_1 . V_1}{T_1}$

$$\frac{1.10^5.A.(6-h_0)}{300} = \frac{8.10^4.A.(6-2)}{360}$$

$\therefore h_0 = \frac{10}{3} m$

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TEXTOS ESCRITOS FORA DESTE QUADRO (OU A LAPIS) NAO SERAO CONSIDERADOS PELO CORRETOR

PROVA FUVEST

Questão 23

a) $P_1 = P_0 + dgh$

$P_1 = 1.10^5 + 10^3.10.0,4$

$\therefore P_1 = 1,04.10^5 N/m^2$

b) $\frac{P_0.V_0}{T_0} = \frac{P_1.V_1}{T_1}$

$$\frac{1.10^5.A.0,8}{T_0} = 1,04.10^5.A.1$$

$\frac{T_1}{T_0} = \frac{1,04}{0,8}$

$\therefore R_2 = 1,3$

$R_1 = \frac{P_1}{P_0}$

$R_1 = \frac{1,04.10^5}{1.10^5}$

$\therefore R_1 = 1,04$

c) $P_0 V_0 = n_0 . R . T_0$

$1.10^5.A.0,8 = n_0 . R . T_0$ (I)

$P_1 V_1 = n_1 . R . T_1$

$1.10^5.A.0,6 = n_1 . R . T_1$ (II)

Dividindo-se (I) por (II) temos:

$$\frac{1.10^5.A.0,8}{1.10^5.A.0,6} = \frac{n_0 . R . T_0}{n_1 . R . T_1}$$ → $R_2$

$\frac{n_0}{n_1} = 1,73 \Rightarrow \frac{m_0/M}{m_1/M} = 1,73 \therefore R_3 \simeq 1,73$