2.º

$\sigma = \pi (2r)^2$

~~[illegible]~~ $1{,}26 \times 10^{-16}$

1) Dados $\sigma = 3{,}52 \times 10^{-16}\ cm^2$

$T = 300K$ $m_N = 2{,}32 \times 10^{-23}\ g$?

Nitrogênio: 0,1 nm = 28 nucleons

$\rho_{ar} = 1{,}2\ Kg/m^3 = 0{,}0012\ g/cm^3$

$K = 1.38 \times 10^{-23}\ J/K$

$\ell = \frac{1}{n\sigma}$ $\rightarrow n = \frac{\rho}{m_N}$

$v_{rms} = \sqrt{\frac{3KT}{m_N}}$ $\rightarrow \boxed{t = \ell / v}$ //

$n = \frac{\rho}{28 \times m_H} = \frac{0{,}0012\ g/cm^3}{2{,}32 \times 10^{-23}\ g} = 5.17 \times 10^{19}\ cm^{-3}$ //

$\ell = \frac{1}{n\sigma} = \frac{1}{5.17 \times 10^{19}\ cm^{-3} \cdot 3{,}52 \times 10^{-16}\ cm^2} = \frac{1}{18057{,}6\ cm^{-1}} = 5{,}54 \times 10^{-5}\ cm$ //

cm^{-1}

$J = m^2 \cdot Kg / s^2 \cdot K$ 515

$v_{rms} = \sqrt{\frac{3KT}{m_N}} = \sqrt{\frac{3 \cdot 1{,}38 \times 10^{-23}\ J/K \cdot 300K}{2{,}32 \times 10^{-26}\ Kg}} = \sqrt{\frac{1{,}242 \times 10^{-20}}{2{,}32 \times 10^{-26}}} = 731{,}7\ m/s$ //

$= 73170\ cm/s$

Então $t = \frac{\ell}{v_{rms}} = \frac{5.54 \times 10^{-5}}{73170} = 7{,}57 \times 10^{-10}\ s$

6×10^{-10}

3º

2)

$T_{atm} = ?$ ω $\frac{T_e}{T_{atm}} = ?$

Temos $T^4 = \frac{3 T_e^4}{4}\left(\tau_v + \frac{2}{3}\right)$ → Para o topo da atmosfera $\tau_v = 0$

∴

$T^4 = \frac{3}{4}(5777)^4\left(0 + \frac{2}{3}\right) = \frac{(5777)^4}{2}$

$T = \sqrt[4]{\frac{(5777)^4}{2}} = 4858\ K$ → Topo

Agora a razão $\frac{T_e}{T} = 1{,}18$ ⇒ $\begin{cases} T_e = 1{,}18\, T_{\nabla 0} \\ T = 0{,}84\, T_{e\,\nabla 0} \end{cases}$

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8) $r_p = 10^{-15}\ m$ $e = 1,6\times10^{-19}$

3) $v_{nucleons} = 10\, v_{rms}$ Para 2 protons colidirem
↳ ultrapassar o poço duplo

a) $T_c\ Sol = 1,44\times10^7\ K$

$\frac{1}{2}\mu m \bar{v}^2 = \frac{3}{2}KT = \frac{Z_1 Z_2 e^2}{4\pi\varepsilon_0 r}$

① $\frac{1}{2}\mu m\bar{v}^2 = \frac{1}{2}\mu m(10 v_{rms})^2 = \frac{1}{2}\mu m\, 100\cdot\left(\frac{3KT}{m_p}\right)$

↳ $v_{rms} = \sqrt{\frac{3KT}{m_p}}$ e $\mu m = \frac{m_p}{2}$

② # $1/4\pi\varepsilon_0 = 8,99\times10^9\ N.m^2/C^2$

$\frac{\mu m\, 100}{2}\frac{3KT}{m_p} = \frac{e^2}{4\pi\varepsilon_0 r} \rightarrow \boxed{T = \frac{e^2}{4\pi\varepsilon_0 r}\cdot\frac{m_p}{3K}\cdot\frac{2}{\mu m\cdot 100}}$

③ Substituindo os valores

$T = \frac{8,99\times10^9\cdot(1,6\times10^{-19})^2}{2\times10^{-15}}\cdot\frac{\cancel{m_p}}{3(1,38\times10^{-23})}\frac{4}{\cancel{m_p}\cdot100} =$

$= \frac{8,99\times10^9\cdot(1,6\times10^{-19})^2\cdot4}{10^{-15}\cdot300\cdot(1,38\times10^{-23})} = \frac{9,2\times10^{-28}}{4,14\times10^{-36}} = 2,2\times10^8\ K$ //

1,1 ↓ Temperatura necessária

④ Comparando c/ Sol $T_c = 1,44\times10^7\ K$

$\frac{T}{T_{c\odot}} = 15,2 \rightarrow T = 15,2\, T_{c\odot}$ //

$T_{c\odot} = 0,06\, T$

$v_{rms} = \sqrt{\frac{3KT}{mp}}$

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b) $n_v dv = n \left(\frac{m}{2\pi KT}\right)^{3/2} e^{-mv^2/2KT} \cdot 4\pi v^2 dv$

1

Razão $n_{10}/n = ?$

$$\frac{n_{10}}{n} = \frac{e^{(-m(10v_{rms})^2/2KT)}}{e^{(-m v_{rms}^2/2KT)}} \cdot \frac{(10 v_{rms})^2}{(v_{rms})^2}$$

$$\frac{n_{10}}{n} = \left[\frac{10 \cancel{v_{rms}}}{\cancel{v_{rms}}}\right]^2 \exp\left[\frac{-mp\,100\, v_{rms}^2}{2KT} + \frac{mp\, v_{rms}^2}{2KT}\right]$$

$$= 100 \exp\left[\frac{-99\, mp\, v_{rms}^2}{2KT}\right]$$

2 Substituindo os valores

$$\frac{n_{10}}{n} = 100 \exp\left[\frac{-99 \cdot \cancel{mp}}{\cancel{2KT}} \cdot \frac{3\cancel{KT}}{2\cancel{mp}}\right] = 100\, e^{-297/2} = 100\, e^{-148,5}$$

$-74,3$

$\therefore \frac{n_{10}}{n} = 100 \cdot 3,22 \times 10^{-65} = 3,22 \times 10^{-63}$ // 5.7×10^{-31}

c) $M_\odot = 1{,}989 \times 10^{30}$ Kg

$m_H = 1{,}673 \times 10^{-27}$ Kg

①

$$\text{Numero de nucleons} = \frac{M_\odot}{m_H} = \frac{1{,}989 \times 10^{30}}{1{,}673 \times 10^{-27}} = 1{,}19 \times 10^{57}$$ //

② $n = 1.2 \times 10^{57} \times 5.67 \times 10^{-31} = 6{,}8 \times 10^{26}$ núcleon

c/ $v = 10$ vn

$t = E / L_\odot = 1{,}88 \times 10^{12}$ g

$\approx$ 110000l17

4) a) $(\Delta\lambda)_{1/2} = \frac{2\lambda}{c}\sqrt{\frac{2KT\ln 2}{m}}$ $v_{turb} = 0$

$6{,}563 \times 10^{-7}$ m

$H\alpha$: $\lambda = 6563$ Å $= 656{,}28$ nm //

$T = T_e = 5777$ K

$c = 3 \times 10^{8}$ m/s

$m \to m_H$

$m > M_\odot = 1{,}989 \times 10^{30}$ Kg

$K = 1{,}38 \times 10^{-23}$ J/K

$\therefore$

$$(\Delta\lambda)_{1/2} = \frac{2 \cdot 6{,}563 \times 10^{-7}}{3 \times 10^{8}} \sqrt{\frac{2 \cdot 1{,}38 \times 10^{-23} \cdot 5777 \cdot \ln 2}{1{,}989 \times 10^{30}}} \quad 1{,}67 \times 10^{-27}$$

$$= \frac{1{,}31 \times 10^{-6}}{3 \times 10^{8}} \sqrt{\frac{1{,}1 \times 10^{-19}}{1{,}989 \times 10^{30}}} = 4{,}37 \times 10^{-15} \cdot 2{,}35 \times 10^{-25}$$

$\rightarrow (\Delta\lambda)_{1/2} = 1{,}03 \times 10^{-39}$ m X $0{,}03559$ nm

D S T Q Q S S

tinha no livro

granulo

b) v_{turb} : 7 km/s = 7000 m/s $v_{turb} = 400$ m/s

$$(\Delta\lambda)_{1/2} = \frac{2\lambda}{c}\sqrt{\left(\frac{2kT}{m} + v_t^2\right)\ln 2}$$

$$= 4,37\times10^{-15} \cdot \sqrt{\left(\frac{1,1\times10^{-19}}{1,989\times10^{30}}\right) + 7000^2 \ln 2}$$

$$= 4,37\times10^{-15} \cdot \sqrt{5,53\times10^{-50} + 3,4\times10^{7}}$$

$$= 4,37\times10^{-15} \cdot 5830,9 = 2,6\times10^{-11}$$

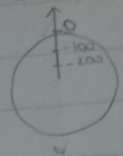
c)

$$\frac{(v_{turb})^2}{2kT/m} = \frac{(4000)^2 \cdot 1,989\times10^{30}}{2\cdot 1,38\times10^{-23}\cdot 5777} = \frac{9,246\times10^{37}}{1,59\times10^{-19}} = 6,12\times10^{56}$$ //

2,0

5) $\rho = 2{,}2\times10^{-4}\ Kg\ m^{-3}$ | $\lambda_1 \rightarrow K_{\lambda 1} = 0{,}026\ m^2\ Kg^{-1}$ $\tau = 2/3$

$T = 5777\ K$ | $\lambda_2 \rightarrow K_{\lambda 2} = 0{,}03\ m^2\ Kg^{-1}$ $\tau_\lambda = 0$ sup



$$\boxed{d\tau_\lambda = -K_\lambda\, \rho\, dS}$$

1) $\tau_\lambda = -0{,}026 \cdot 2{,}2\times10^{-4}\, \Delta S_1 = \frac{2}{3} \rightarrow \Delta S_1 = \frac{2}{3}\cdot\left(\frac{-1}{5{,}72\times10^{-6}}\right) = -116550\ m = \boxed{-116\ Km}$ abaixo da sup

2) $\tau_\lambda = -0{,}03\cdot 2{,}2\times10^{-4}\, \Delta S_2 = \frac{2}{3}$

$\Delta S_2 = \frac{2}{3}\cdot\left(\frac{-1}{6{,}6\times10^{-6}}\right) = -101010\ m = \boxed{-101\ Km}$

$\therefore\ \tau = 2/3$ vale para a profundidade de 116 Km e 101 Km