Mecânica Quântica

Sobreposição de estados

1-

$P\uparrow = |0,5|^2 = 0,25$

$P\downarrow = |0,866|^2 = 0,75$

2-

$a^2 = 1 - |0,1|^2 - |0,3i|^2 - |0,5|^2 - |-0,4|^2 =$

$= 1 - 0,01 - 0,09 - 0,25 - 0,16 = 0,49$

3-

a) $\left|\frac{1}{2}\right|^2 \times 4 = 1$ Normalizado

b) $\left|\frac{1}{\sqrt{2}}\right|^2 \times 2 = 1$ Normalizado

c) $\left|\frac{1}{2}\right|^2 + \left|\frac{\sqrt{3}}{2}\right|^2 \times 2 = \frac{7}{4}$ Não normalizado

d) $|\cos\alpha|^2 + |\sin\alpha|^2 = 1$ Normalizado

4-

$|A\uparrow\rangle, |A\downarrow\rangle, |A\leftarrow\rangle, |A\rightarrow\rangle, |B\uparrow\rangle, |B\downarrow\rangle, |B\leftarrow\rangle, |B\rightarrow\rangle$

5-

a) $|0,55|^2 = 0,3025 \rightarrow |111\rangle$ Calcular todas e ver qual é maior

b) $P_{010} = |0,2|^2 = 0,04 \rightarrow$ $\boxed{\text{Quando é x medidas em x sistemas idênticos}}$

$200 \times 0,04 = 8$

c) 20 ou 0 $\rightarrow$ $\boxed{\text{Quando é x medidas no mesmo sistema, ou calha x vezes ou 0}}$

d) $|0,1|^2 + 0,25 + |0,2|^2 + |0,5|^2 = 0,55$

e) Sim $|110\rangle$

6-

$a_H b_H = \frac{1}{\sqrt{2}}$ $a_H b_V = 0$ $a_H = \frac{1}{\sqrt{2}}$ $b_H = 1$ $b_V = 0$

É entrelaçado

$a_V b_H = 0$ $a_V b_V = \frac{1}{\sqrt{2}}$ $a_V = 0$ $a_V b_V \neq \frac{1}{\sqrt{2}}$

8-

Estados de spin possíveis : $|+z\rangle$ e $|-z\rangle$ logo $P = 0,5$

7-

a) $a_H b_H = \frac{1}{2}$ $a_V b_H = \frac{1}{2}$ $a_H = b_H = \frac{1}{\sqrt{2}} = b_V = a_V$ logo não é entrelaçado

$a_H b_V = \frac{1}{2}$ $a_V b_V = \frac{1}{2}$

b) $a_H b_H = \frac{1}{2}$ $a_V b_H = \frac{1}{2}$ $a_H = b_H = \frac{1}{\sqrt{2}} = b_V = b_H$

$a_H b_V = \frac{1}{2}$ $a_V b_V = -\frac{1}{2}$ $\rightarrow$ mas $\frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} \neq -\frac{1}{2}$ É entrelaçado

c) $a_H b_H = \frac{1}{2}$ $a_H b_V = 0$ $a_H = \frac{1}{\sqrt{2}} = b_H$ $b_V = 0$

É entrelaçado

$a_V b_H = \sqrt{\frac{3}{8}}$ $a_V b_V = \sqrt{\frac{3}{8}}$ $a_V = \frac{\sqrt{3}}{\sqrt{4}}$ $a_V b_V \neq \sqrt{\frac{3}{8}}$

d) $a_H b_H = \cos\alpha$ $a_V b_H = 0$

É entrelaçado porque não existe a_V, a_H, b_H, b_V que satisfaça todas as condições

$a_H b_V = 0$ $a_V b_V = \sin\alpha$

e) $a_H b_H = 0$ $a_V b_H = -\frac{1}{\sqrt{2}}$ Para que $a_H b_H = 0$, a_H ou b_H tem de ser 0

logo $a_H b_V = 0$ ou $a_V b_H = 0$

É entrelaçado

$a_H b_V = \frac{1}{\sqrt{2}}$ $a_V b_V = 0$

9-

a) $|S_z\rangle = \sqrt{\frac{2}{3}}\,|+_z\rangle - \sqrt{\frac{1}{3}}\,|-_z\rangle$

$|+_z\rangle = \frac{1}{\sqrt{2}}\left(|+_x\rangle + |-_x\rangle\right)$

$|-_z\rangle = \frac{1}{\sqrt{2}}\left(|+_x\rangle - |-_x\rangle\right)$

$|S_z\rangle = \sqrt{\frac{2}{3}} \times \frac{1}{\sqrt{2}}\left(|+_x\rangle + |-_x\rangle\right) - \sqrt{\frac{1}{3}} \times \frac{1}{\sqrt{2}}\left(|+_x\rangle - |-_x\rangle\right)$ $P_{+_x} = 0,029$

$= \sqrt{\frac{2}{6}}\left(|+_x\rangle + |-_x\rangle\right) - \frac{1}{\sqrt{6}}\left(|+_x\rangle - |-_x\rangle\right)$

$= \sqrt{\frac{2}{6}}\,|+_x\rangle + \sqrt{\frac{2}{6}}\,|-_x\rangle - \frac{1}{\sqrt{6}}\,|+_x\rangle + \frac{1}{\sqrt{6}}\,|-_x\rangle$

$= \left(\sqrt{\frac{2}{6}} - \frac{1}{\sqrt{6}}\right)|+_x\rangle + \left(\sqrt{\frac{2}{6}} + \frac{1}{\sqrt{6}}\right)|-_x\rangle$

b) $|S_z\rangle = \sqrt{\frac{2}{3}}\,|+_z\rangle - \sqrt{\frac{1}{3}}\,|-_z\rangle$

$$|S_z\rangle = \sqrt{\frac{2}{3}} \times \frac{1}{\sqrt{2}} \left(|+_y\rangle + |-_y\rangle\right) - \sqrt{\frac{1}{3}} \times \frac{1}{i\sqrt{2}} \left(|+_y\rangle - |-_y\rangle\right)$$

$$= \sqrt{\frac{2}{6}}\,|+y\rangle + \sqrt{\frac{2}{6}}\,|-y\rangle - \frac{1}{i\sqrt{6}}\,|+y\rangle + \frac{1}{i\sqrt{6}}\,|-y\rangle =$$

$$= \left(\sqrt{\frac{2}{6}} - \frac{1}{i\sqrt{6}}\right)|+y\rangle + \left(\sqrt{\frac{2}{6}} + \frac{1}{i\sqrt{6}}\right)|-y\rangle$$

$$P_{+y} = \left|\sqrt{\frac{2}{6}} - \frac{1}{i\sqrt{6}}\right|^2 = \frac{2}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$$

Relações de De Broglie

13-

a) $p^2 = 2mEc$

$$p = \frac{h}{\lambda} \Leftrightarrow \lambda = \frac{h}{p} = \frac{h}{\sqrt{2m \times \frac{1}{2} m v^2}} = \frac{h}{\sqrt{m^2 v^2}} = \frac{6,63 \times 10^{-34}}{\sqrt{(9,11 \times 10^{-31})^2 \times 277,78^2}}$$

$$\simeq 2,62 \times 10^{-6}\ m$$

$$1000\ km/h = \frac{1000}{3,6} \simeq 277,78\ m/s$$

b) $Ec = 10\,keV = 10 \times 1000 \times 1,6 \times 10^{-19} = 1,6 \times 10^{-15}\ J$ $\qquad p^2 = 2m\,Ec + \frac{Ec^2}{c^2}$

$$\lambda = \frac{6,63 \times 10^{-34}}{\sqrt{2 \times 9,11 \times 10^{-31} \times 1,6 \times 10^{-15} + \frac{(1,6 \times 10^{-15})^2}{(3 \times 10^8)^2}}} = 1,22 \times 10^{-11}\ m$$

c) $Ec = 30\ keV = 30 \times 10^3 \times 1,6 \times 10^{-19} = 4,8 \times 10^{-15}\ J$

$$\lambda = \frac{6,63 \times 10^{-34}}{\sqrt{2 \times 9,11 \times 10^{-31} \times 4,8 \times 10^{-15} + \frac{(4,8 \times 10^{-15})^2}{(3 \times 10^8)^2}}} \simeq 6,99 \times 10^{-12}$$

d) $Ec = 15\ GeV = 15 \times 10^9 \times 1,6 \times 10^{-19} =$

⋮

14-

$\lambda = 5890\ \mathring{A} = 5890 \times 10^{-10}\ m$

$\lambda = \dfrac{h}{p} \Leftrightarrow p = \dfrac{6{,}63 \times 10^{-34}}{5890 \times 10^{-10}} = 1{,}13 \times 10^{-27}$

$p^2 = 2m\,Ec \Leftrightarrow Ec = \dfrac{p^2}{2m} = \dfrac{(1{,}13 \times 10^{-27})^2}{2 \times 9{,}11 \times 10^{-31}} = 7{,}01 \times 10^{-25}\ J = 4{,}38 \times 10^{-6}\ eV$

15-

$\lambda = 2{,}0\ \mathring{A} = 2 \times 10^{-10}\ m$ Eletrão NÃO tem velocidade relativística

a) $p = \dfrac{h}{\lambda} = \dfrac{6{,}63 \times 10^{-34}}{2 \times 10^{-10}} = 3{,}315 \times 10^{-24}\ kgm/s$

b) Ec total ?

Eletrão $Ec_e = \dfrac{p^2}{2m} = \dfrac{(3{,}315 \times 10^{-24})^2}{2\,(9{,}11 \times 10^{-31})} = 6{,}03 \times 10^{-18}\ J$

Fotão

$p^2 = \cancel{2m\,Ec}^{\,m=0} + \dfrac{Ec^2}{c^2} \Leftrightarrow Ec = \sqrt{p^2c^2} \Leftrightarrow Ec = pc \quad , pc > 0$

$\Leftrightarrow Ec = 3{,}315 \times 10^{-24} \times 3 \times 10^{8} = 9{,}945 \times 10^{-16}\ J$

$Ec\ total = 9{,}945 \times 10^{-16} + 6{,}03 \times 10^{-18} = 1 \times 10^{-15}\ J$

c) $Ec_f > Ec_e$

16-

v(Partícula NÃO relativística) $= 3\,v_e$

$\dfrac{\lambda_p}{\lambda_e} = 1{,}813 \times 10^{-4}$

$\dfrac{\lambda_p}{\lambda_e} = \dfrac{\frac{h}{p_p}}{\frac{h}{p_e}} = \dfrac{p_e}{p_p} = \dfrac{m_e v_e}{m_p v_p} = \dfrac{9{,}11 \times 10^{-31} \times 1}{m_p \times 3} = 1{,}813 \times 10^{-4}$

$\Leftrightarrow m_p = \dfrac{9{,}11 \times 10^{-31}}{3 \times 1{,}813 \times 10^{-4}} = 1{,}67 \times 10^{-27}\ kg$

Neutrão

17-

$Ec_m = \frac{3}{2} K_B T$ $\quad T = 300\,K \quad k_B = 1,38 \times 10^{-23}\ J/K$

Estão em equilíbrio térmico

a) $Ec = \frac{3}{2} \times 1,38 \times 10^{-23} \times 300 = 6,21 \times 10^{-21}\ J = \frac{6,21 \times 10^{-21}}{1,6 \times 10^{-19}}\ eV \doteq 0,0388\ eV$

b) $\lambda = \frac{h}{p} = \frac{6,63 \times 10^{-34}}{\sqrt{2,07414 \times 10^{-47}}} = 1,46 \times 10^{-10}\ m$

$p^2 = 2m\,Ec = 2 \times 1,67 \times 10^{-27} \times 6,21 \times 10^{-21} = 2,07414 \times 10^{-47}$

18-

$Ec_p = m$

$\lambda = 1,7898 \times 10^{-6}\ \mathring{A} = 1,7898 \times 10^{-16}\ m$

Se $2Ec$, λ ?

$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2m\,Ec}} = \frac{h}{\sqrt{2\,Ec^2}} = \frac{h}{Ec\sqrt{2}}, \quad Ec > 0$

$\lambda_2 = \frac{h}{2Ec\sqrt{2}} = \frac{1}{2} \times \lambda = \frac{1}{2} \times 1,7898 \times 10^{-16} = 8,949 \times 10^{-17}\ m$

19- Relativístico acelerador fornece eletrão

$Ec = 50\ GeV = 50 \times 10^{9} \times 1,6 \times 10^{-19} = 8 \times 10^{-9}\ J$

$p^2 = 2m\,Ec + \frac{Ec^2}{c^2} \Leftrightarrow$

$\Leftrightarrow p = \sqrt{2m\,Ec + \frac{Ec^2}{c^2}}, \ p > 0 = \sqrt{2 \times 9,11 \times 10^{-31} \times 8 \times 10^{-9} + \frac{(8 \times 10^{-9})^2}{(3 \times 10^{8})^2}} = 2,67 \times 10^{-17}$

$\lambda = \frac{h}{p} = \frac{6,63 \times 10^{-34}}{2,67 \times 10^{-17}} = 2,48 \times 10^{-17}\ m$

Função de onda

20- $\psi(x) = \frac{1}{\pi} \frac{\sin(x)}{x}$

a)

$$|\psi(0)|^2 = \left|\frac{1}{\pi} \times \frac{\sin 0}{0}\right|^2 =$$

b) $$|\psi(5)|^2 = \left|\frac{1}{\pi} \times \frac{\sin 5}{5}\right|^2 = 3{,}72 \times 10^{-3}$$

21-

$$\psi(x) = A \sin\left(\frac{m\pi}{a} x\right)$$

a) $$\int |\psi(x)|^2 \, dx = 1$$

$$\int_0^a |\psi(x)|^2 \, dx = \int_0^a A^2 \sin^2\left(\frac{m\pi}{a} x\right) dx$$

$$= A^2 \int_0^2 \sin^2\left(\frac{m\pi}{a} x\right) dx = A^2 \left[\frac{x}{2} - \frac{1}{\frac{4m\pi}{a}} \sin\left(\frac{2m\pi}{a} x\right)\right]_0^a$$

$$= A^2 \left(\frac{a}{2} - \frac{a}{4m\pi} \sin\left(\frac{2m\pi}{\cancel{a}} \cancel{a}\right)\right) = A^2 \left(\frac{a}{2} - \frac{a}{4m\pi} \overbrace{\sin(2m\pi)}^{0}\right) =$$

$$A^2 \left(\frac{a}{2}\right) = 1 \Leftrightarrow A^2 = \frac{2}{a} \Leftrightarrow A = \sqrt{\frac{2}{a}}, \quad A > 0$$

b) $$\psi(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{m\pi}{a} x\right)$$

$$P_m\left(\frac{a}{2}\right) = \left|\psi\left(\frac{a}{2}\right)\right|^2 = \frac{2}{a} \sin^2\left(\frac{m\pi}{\cancel{a}} \times \frac{\cancel{a}}{2}\right) = \frac{2}{a} \sin^2\left(\frac{m\pi}{2}\right)$$

c) $$p^2 = 2m E_c \Leftrightarrow E_c = \frac{p^2}{2m}$$

$$E_c = \frac{(\hbar k)^2}{2m} = \frac{\hbar \left(\frac{m\pi}{a}\right)^2}{2m} = \frac{\hbar^2 m^2 \pi^2}{2m a^2}$$

22-

$P = e^{-2\alpha L}$ $L \rightarrow$ comprimento da barreira $\alpha = \sqrt{\dfrac{2m(U-E)}{\hbar^2}}$

P? $E_e = 0{,}5\ eV = 8 \times 10^{-20}\ J$

$U = 3\ eV = 4{,}8 \times 10^{-19}\ J$ $L = 1\ nm = 1 \times 10^{-9}\ m$

$$\alpha = \sqrt{\dfrac{2 \times 9{,}11 \times 10^{-31}\,(4{,}8 \times 10^{-19} - 8 \times 10^{-20})}{\dfrac{(6{,}63 \times 10^{-34})^2}{4\pi^2}}} = 8090409831$$

$$P = e^{-2\alpha \times 10^{-9}} = 9{,}39203 \times 10^{-8}$$

11-

$$\hat{H}\,|0\rangle = \frac{1}{\sqrt{2}}\,(|0\rangle + |1\rangle)$$

$$\hat{H}\,|1\rangle = \frac{1}{\sqrt{2}}\,(|0\rangle - |1\rangle)$$

$$|\psi\rangle = \frac{1}{\sqrt{2}}\,(|101\rangle + |010\rangle)$$

Só aplica no 2° Qubit e mantém os outros

$$\hat{H}\left(\frac{1}{\sqrt{2}}\,(|101\rangle + |010\rangle)\right) = \frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\,(|101\rangle + |111\rangle) + \frac{1}{\sqrt{2}}\,(|000\rangle - |010\rangle)\right)$$

$$= \frac{1}{2}\,(|101\rangle + |111\rangle + |000\rangle - |010\rangle)$$

10-

$\psi = a|0\rangle + b|1\rangle$ com $|a^2 + b^2| = 1$

$$\psi_1 = \hat{H}(\psi) = a\left(\frac{1}{\sqrt{2}}\,(|0\rangle + |1\rangle)\right) + b\left(\frac{1}{\sqrt{2}}\,(|0\rangle - |1\rangle)\right)$$

$$\hat{H}(\psi_1) = a\left(\frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\,(|0\rangle + |1\rangle) + \frac{1}{\sqrt{2}}\,(|0\rangle - |1\rangle)\right)\right) + b\left(\frac{1}{\sqrt{2}}\left(\frac{1}{\sqrt{2}}\,(|0\rangle + |1\rangle) + \frac{1}{\sqrt{2}}\,(|0\rangle - |1\rangle)\right)\right)$$

faz as contas $= a\,|0\rangle + b\,|1\rangle = \psi$ logo é unário

$\hat{X}\ |0\rangle = |1\rangle$

$\hat{X}\ |1\rangle = |0\rangle$

$\psi 1 = \hat{H}(\psi) = a|1\rangle + b|0\rangle$

$\hat{H}(\psi 1) = a|0\rangle + b|1\rangle = \psi$ logo é unitário deu diferente mas vasques diz q tá certo

p 23-

$$\Delta x \, \Delta p \geq \frac{\hbar}{2}$$

$5\,nm = 5 \times 10^{-9}\,m$

$x = (2,5 \pm 2,5)\,nm$

A incerteza toma sempre o valor maior então para que ela seja mínima tem que estar a metade

$\therefore 5 \times 10^{-9} \cdot \Delta p \geq \frac{\hbar}{2}$

$\therefore \Delta p \geq 1,055 \times 10^{-26}$

$\therefore m \, \Delta v \geq 1,055 \times 10^{-26}$

$\therefore \Delta v \geq 11582,84602\,m/s$

$\delta = \frac{\Delta v}{v} = \frac{0,1}{100} \therefore v = 1000\,\Delta v$

$\therefore v = 1,16 \times 10^{7}$

24-

$$\frac{\Delta\lambda}{\lambda} = 10^{-7}$$

$$\Delta\lambda \, \Delta x = \frac{\lambda^2}{4\pi} \therefore \Delta x = \frac{\lambda^2}{\Delta\lambda \, 4\pi} = \frac{\lambda}{\Delta\lambda} \times \frac{\lambda}{4\pi}$$

a) $10^{-7} \times \frac{5 \times 10^{-4}}{4\pi} = 3,98 \times 10^{-12}\,Å$

b) $10^{-7} \times \frac{5}{4\pi} = 3,98 \times 10^{-8}\,Å$

c) $10^{-7} \times \frac{5000}{4\pi} = 3,98 \times 10^{-5}\,Å$

25-

$\lambda = 800 \pm 5\,nm$ $\quad \Delta\lambda = 10 \times 10^{-9}\,m$ $\quad \lambda = 800 \times 10^{-9}\,m$

$$\Delta\lambda \, \Delta t = \frac{\lambda^2}{4\pi c}$$

$$\Delta t = \frac{\lambda^2}{4\pi c \, \Delta\lambda} = \frac{(800 \times 10^{-9})^2}{4\pi \times 3 \times 10^{8} \times 10 \times 10^{-9}} = 1,6977 \times 10^{-14}$$

$1\,s = 1 \times 10^{15}\,fs \longrightarrow 1,697 \times 10^{-14} \times 10^{15} = 16,98\,fs$

26-

$$\boxed{\Delta E \, \Delta t \geq \frac{\hbar}{2}} \qquad \Delta E \geq \frac{\frac{\hbar}{2}}{\frac{\Delta t}{1}} \Leftrightarrow \Delta E \geq \frac{\frac{6{,}67 \times 10^{-34}}{2\pi}}{2 \times 10^{-12}} \Leftrightarrow \Delta E \geq 5{,}30 \times 10^{-23}\,J$$

27-

$\Delta t_1 = 1{,}2 \times 10^{-8}\,s$

$\Delta t_2 = 2{,}3 \times 10^{-8}\,s$

$$\Delta E_1 \, \Delta t_1 \geq \frac{\hbar}{2} \Leftrightarrow \Delta E_1 \geq \frac{\frac{6{,}67 \times 10^{-34}}{2\pi}}{2 \times 1{,}2 \times 10^{-8}} \Leftrightarrow \Delta E_1 \geq 4{,}42 \times 10^{-27}\,J$$

$$\Delta E_2 \, \Delta t_2 \geq \frac{\hbar}{2} \Leftrightarrow \Delta E_2 \geq \frac{\frac{6{,}67 \times 10^{-34}}{2\pi}}{2 \times 2{,}3 \times 10^{-8}} \Leftrightarrow \Delta E_2 \geq 2{,}31 \times 10^{-27}\,J$$

$$\therefore \Delta E = \Delta E_2 + \Delta E_1 = 6{,}73 \times 10^{-27}\,J = \frac{6{,}73 \times 10^{-27}}{1{,}6 \times 10^{-19}}\,eV = 4{,}21 \times 10^{-8}\,eV$$

Transições

29-

$m = 2 \rightarrow E_2 = (-13{,}6\,eV)\,\frac{1}{2^2} = -3{,}4\,eV$ $\qquad$ $m = 1 \rightarrow -13{,}6\,eV$

$m = 3 \rightarrow E_3 = (-13{,}6\,eV)\,\frac{1}{3^2} = -1{,}51\,eV$ $\qquad$ $m = 4 \rightarrow E_4 = (-13{,}6\,eV)\,\frac{1}{4^2} = -0{,}85\,eV$

De $m=1$ para $m=2$ $\rightarrow |E_2 - E_1| = -3{,}4 + 13{,}6 = 10{,}2\,eV$

De $m=1$ para $m=3$ $\rightarrow |E_3 - E_1| = -1{,}51 + 13{,}6 = 12{,}09\,eV$

De $m=1$ para $m=4$ $\rightarrow |E_4 - E_1| = -0{,}85 + 13{,}6 = 12{,}75\,eV$

30-

$a \rightarrow$ largura do poço $= 1\,nm = 1 \times 10^{-9}\,m$ $\qquad$ $\boxed{E = hf}$

m é um inteiro

$$E_m = m^2 \frac{\pi^2 \hbar^2}{2ma^2}$$

$m=4 \rightarrow E_4 = \dfrac{4^2 \pi^2 \hbar^2}{2 \times 9{,}11 \times 10^{-31} \times (1 \times 10^{-9})^2} = 9{,}65 \times 10^{-19}$ J

$m=3 \rightarrow E_3 = 5{,}428 \times 10^{-19}$ J

$m=2 \rightarrow E_2 = 2{,}41 \times 10^{-19}$ J

ΔE entre $m=4$ e $m=3$ $= |E_3 - E_4| = 4{,}222 \times 10^{-19}$ J

$f = \dfrac{E}{h} = 6{,}37 \times 10^{14}$ Hz

ΔE entre $m=4$ e $m=2$ $= |E_2 - E_4| = 7{,}24 \times 10^{-19}$

$f = \dfrac{E}{h} = 1{,}09 \times 10^{15}$ Hz

31 -

$\omega_c = \sqrt{\dfrac{K}{m}}$ $\quad E_m = \left(m + \dfrac{1}{2}\right) \hbar \omega_c$

$\omega_c = \sqrt{\dfrac{K}{2m}}$ $\quad \omega_c' = \sqrt{\dfrac{K}{2m}} = \dfrac{1}{\sqrt{2}} \times \dfrac{\sqrt{K}}{\sqrt{m}} = \dfrac{1}{\sqrt{2}} W_c = \dfrac{W_c}{\sqrt{2}}$

Corpo negro

32-

$T = 10^6$ K

b → constante

$\lambda_{máx} T = b \rightarrow 2{,}898 \times 10^{-3}$

$\boxed{\lambda_{máx} T = b}$

$\lambda_{máx} = \dfrac{b}{T} = \dfrac{2{,}898 \times 10^{-3}}{10^6} = 2{,}898 \times 10^{-9}$ m $= 2{,}898$ nm

33-

$\lambda_{máx} = 100$ Å

$\lambda_{máx} = \dfrac{b}{T} \Leftrightarrow T = \dfrac{b}{\lambda_{max}} = \dfrac{2{,}898 \times 10^{-3}}{100 \times 10^{-10}} = 289800$ K

35-

$T = 2500\ K$

$\lambda_{max.} = ?$

$$\lambda_{max.} = \frac{b}{T} = \frac{2,898 \times 10^{-3}}{2500} = 1,16 \times 10^{-6}\ m$$

→ Não está na parte visível, está na parte do infravermelho