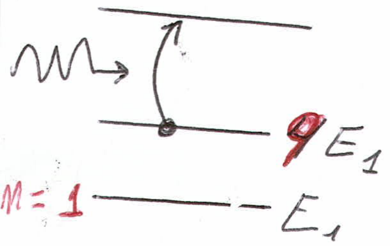
Gabarito P3

1- $\frac{p^2}{2m} = q \cdot V \Rightarrow p = \left(2 \cdot 9 \cdot 10^{-31} \cdot 2 \cdot 10^{-19} \cdot 1\right)^{1/2} = 6 \cdot 10^{-25}$

$$\Rightarrow \lambda = \frac{h}{p} = \frac{6 \cdot 10^{-34}}{6 \cdot 10^{-25}} = 10^{-9}\,m = \underline{\underline{10\,Å}}$$

2- "caixa" $E_n = \frac{\hbar^2 \pi^2 n^2}{2mL^2} = n^2 \cdot E_1$



a partícula vai para o nível:

$$E = 9E_1 + 16E_1 = 25E_1 \Rightarrow \underline{n = 5}$$

Ao decair emite fóton com energia:

$$25E_1 - E_1 = \underline{\underline{24 \cdot E_1}}$$

3- a) $1 = \int_{-\infty}^{0} |A|^2 e^{+2bx}\,dx + \int_{0}^{\infty} |A|^2 e^{-2bx}\,dx$

$$1 = |A|^2 \cdot \frac{e^{2bx}}{2b}\Big|_{-\infty}^{0} + |A|^2 \frac{e^{-2bx}}{-2b}\Big|_{0}^{\infty} = \frac{|A|^2}{2b} + \frac{|A|^2}{2b} = \frac{|A|^2}{b}$$

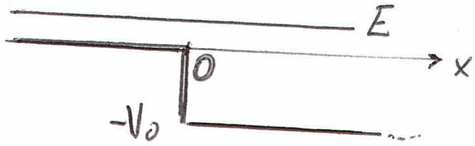
$$\Rightarrow |A| = \sqrt{b}$$

b) $P = \int_{-1/b}^{1/b} |\psi|^2 dx = b\int_{-1/b}^{0} e^{2bx}\,dx + b\int_{0}^{1/b} e^{-2bx}\,dx =$

$$= b\,\frac{1 - e^{-2}}{2b} + b\,\frac{e^{-2} - 1}{-2b} = 1 - e^{-2}$$

c) $j = \frac{\hbar}{2mi}\left(\psi^* \frac{\partial \psi}{\partial x} - \psi \frac{\partial \psi^*}{\partial x}\right) = 0$, já que ψ é função real.

4 -



onda plana $\Rightarrow$ $E > 0$

a) $x \leq 0$: $\phi_1 = A e^{ik_1 x} + B e^{-ik_1 x}$, c/ $E = \frac{\hbar^2 k_1^2}{2m}$

$x \geq 0$: $\phi_2 = C e^{ik_2 x} + D e^{-ik_2 x}$, $\frac{\hbar^2 k_2^2}{2m} = E - V_0$

$\nexists$ onda vindo de $+\infty$ $\Rightarrow$ $D = 0$.

$\phi_1(0) = \phi_2(0) \Rightarrow A + B = C$

$\phi_1'(0) = \phi_2'(0) \Rightarrow k_1(A-B) = C k_2$

$\Rightarrow$ $B = \frac{k_1 - k_2}{k_1 + k_2} A$

$C = \frac{2k_1}{k_1 + k_2} A$

b) $j_i = \frac{\hbar k_1}{m} |A|^2$; $j_r = \frac{\hbar k_1}{m} \left(\frac{k_1 - k_2}{k_1 + k_2}\right)^2 |A|^2$; $j_t = \frac{\hbar k_2}{m} \frac{4k_1^2}{(k_1 + k_2)^2} |A|^2$

c) $R = \frac{j_r}{j_i} = \left(\frac{k_1 - k_2}{k_1 + k_2}\right)^2$; $T = \frac{j_t}{j_i} = \frac{4k_1 k_2}{(k_1 + k_2)^2}$

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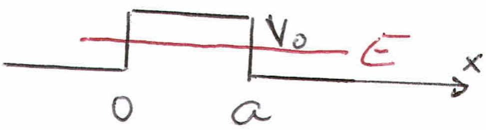
5)



$0 < E < V_0$

a) $x \leq 0$: $\phi_1 = A e^{ikx} + B e^{-ikx}$, c/ $E = \frac{\hbar^2 k^2}{2m}$

$0 \leq x \leq a$: $\phi_2 = C e^{qx} + D e^{-qx}$, c/ $E = -\frac{\hbar^2 q^2}{2m} + V_0$

$x \geq a$: $\phi_3 = F e^{ikx} + \underbrace{G}_{=0} e^{-ikx}$; $\nexists$ onda vindo de $-\infty$

b) em $x = 0$ $\begin{cases} A + B = C + D \\ ik(A - B) = q(C - D) \end{cases}$

em $x = a$ $\begin{cases} A e^{ika} + B e^{-ika} = C e^{qa} + D e^{-qa} \\ ik(A e^{ika} - B e^{-ika}) = q(C e^{qa} - D e^{-qa}) \end{cases}$