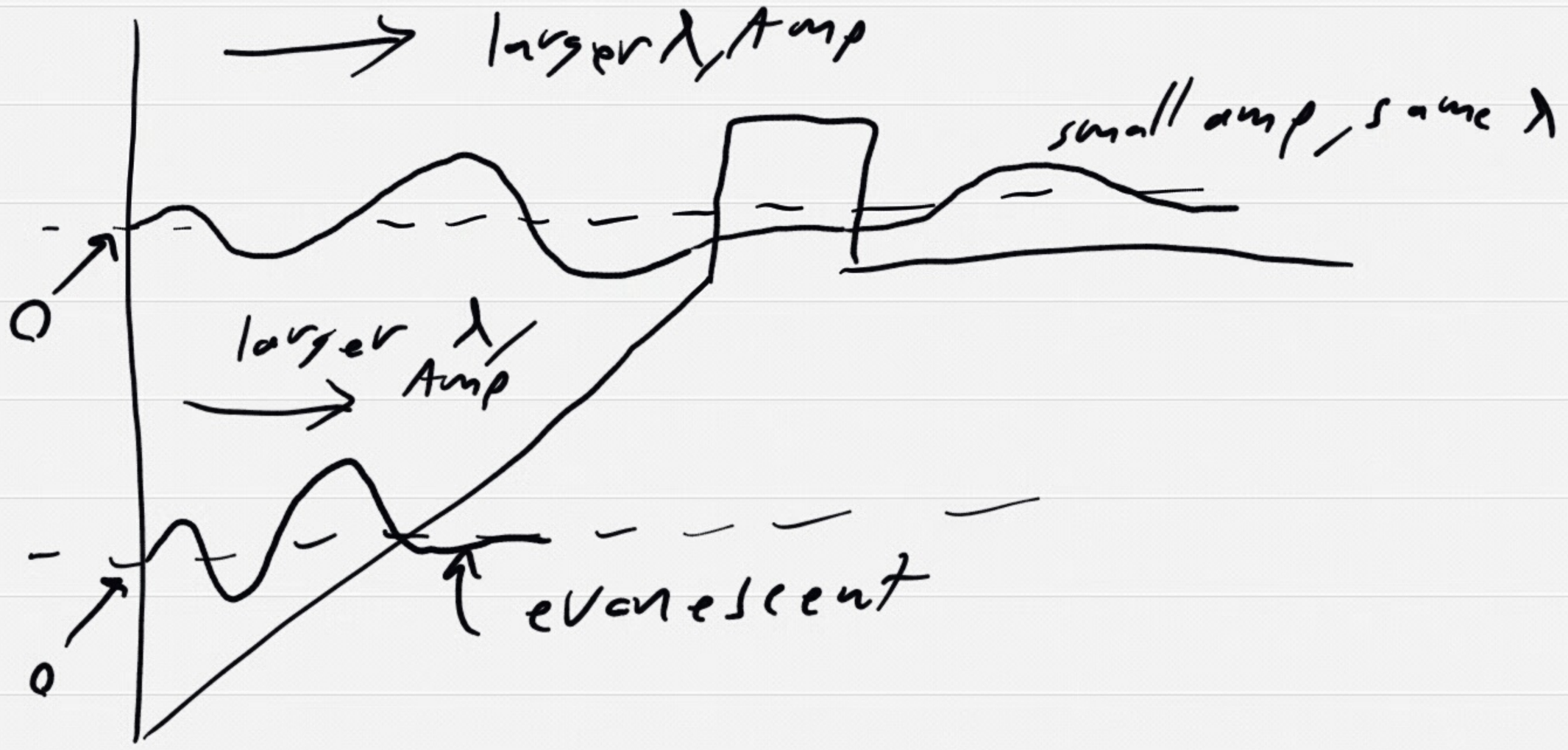
1.



2. a. $d\psi/dx = Ae^{-bx} - Abxe^{-bx}$

$d^2\psi/dx^2 = -Abe^{-bx} - Abe^{-bx} + Ab^2xe^{-bx}$

$-\hbar^2/2m\left[-2Abe^{-bx} + Ab^2xe^{-bx}\right]$

$-a/x\ Axe^{-bx} = EAxe^{-bx}$

$-\hbar^2/2m - -2Ab - aA = 0$

$\Rightarrow \quad a = \hbar^2 b/m \Rightarrow \boxed{b = \frac{ma}{\hbar^2}}$

$-\hbar^2/2m\ Ab^2 = EA$

$\Rightarrow E = -\hbar^2 b^2/2m$

$= -\frac{\hbar^2 m^2 a^2}{2m\hbar^4} = \boxed{\frac{-ma^2}{2\hbar^2}}$

b. $\int_0^\infty |\psi|^2\,dx = 1$

$\Rightarrow A^2 \int_0^\infty x^2 e^{-2bx}\,dx = 1$

3. $E_n = -\frac{me^4}{32\pi^2\varepsilon_0^2\hbar^2}\cdot\frac{2S}{n^2}$

$\Delta E_{12} = -\frac{me^4}{32\pi^2\varepsilon_0^2\hbar^2}\cdot 2S\left(1-\frac{1}{4}\right)$

$= hc/\lambda$

$\Rightarrow \lambda = \frac{hc\cdot 32\pi^2\varepsilon_0^2\hbar^2}{me^4}\cdot\frac{4}{3S}$

$= \boxed{\frac{64\pi^3\varepsilon_0^2\hbar^3 c}{me^4}\cdot\frac{4}{3S}}$

4. $n \rightarrow$ Energy

$l \rightarrow$ Orbital Angular Momentum L

$m_l \rightarrow$ orientation of L

$m_s \rightarrow$ electron spin

5. $\langle r\rangle = \int_0^\infty r\cdot r^2\cdot\frac{4}{a_0^3}e^{-2r/a_0}\,dr$

$= 4/a_0^3\int_0^\infty r^3 e^{-2r/a_0}\,dr$

$= 4/a_0^3\cdot 3!/(2/a_0)^4$

$= \frac{4\cdot 6\cdot a_0}{16} = \boxed{\frac{3a_0}{2}}$

6.