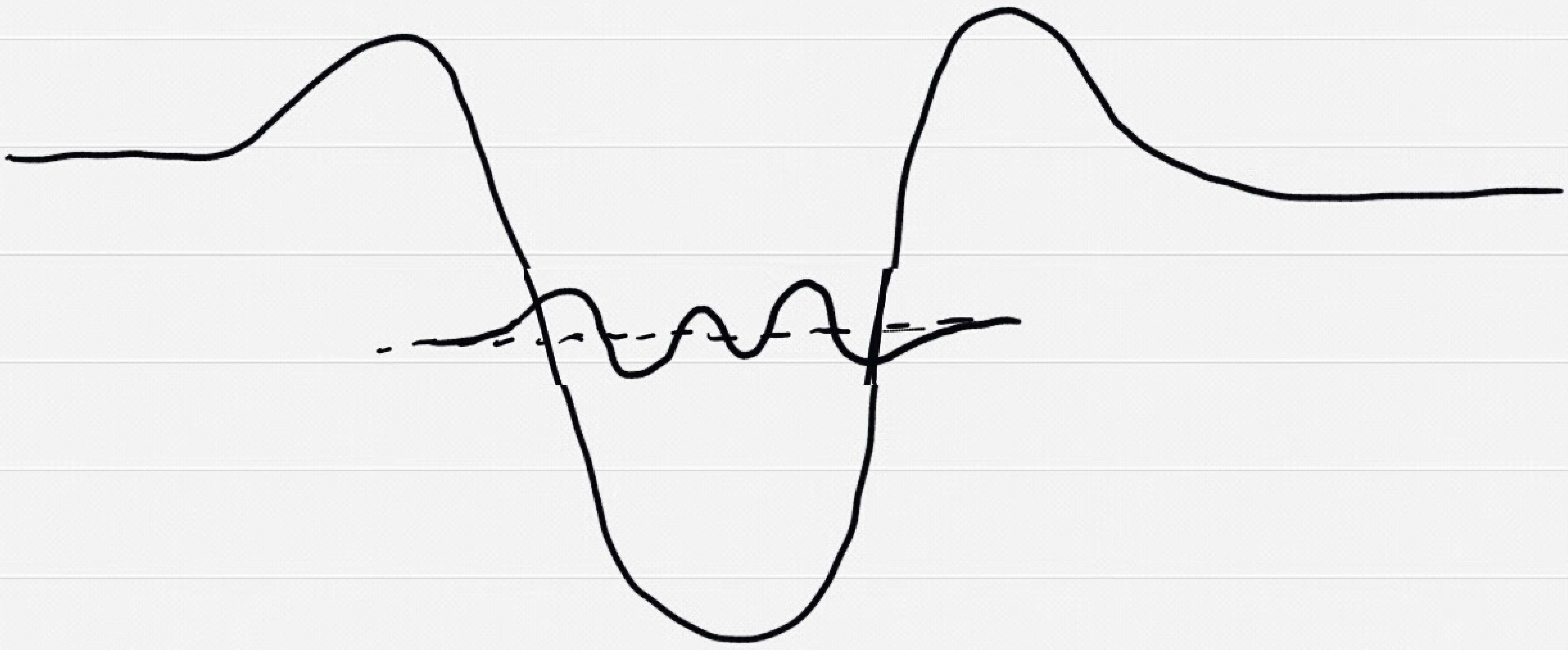
1. a.

b.



- shorter λ, lower amplitude where well is deeper

- exponential decay at edges

2. $$\partial\psi/\partial x = Ae^{-ax^2} + Ax\cdot -2ax\, e^{-ax^2}$$

$$\partial^2\psi/\partial x^2 = A\cdot -2ax\, e^{-ax^2} - 2Aa\cdot 2x\, e^{-ax^2}$$
$$- 2Aax^2\cdot -2ax\, e^{-ax^2}$$
$$= Axe^{-ax^2}(-2a - 4a + 4a^2x^2)$$
$$= \psi(-6a + 4a^2x^2)$$
$$= \frac{2m}{\hbar^2}\left(\tfrac{1}{2}kx^2 - E\right)\psi \quad //$$

$$\boxed{E = 3\frac{\hbar^2 a}{m} = \tfrac{3}{2}\hbar\sqrt{k/m}}$$

2b. $\int |\psi|^2 dx$

$$= \int_{-\infty}^{\infty} A^2 x^2 e^{-2ax^2} dx = 1$$

3. $E_n = -13.6 \cdot Z^2/n^2$

$$\Delta E_{12} = (1 - 1/2^2) \cdot 13.6 Z^2$$
$$= 3/4 \cdot 13.6 \; Z^2$$
$$= 10.2 \cdot Z^2 \Rightarrow \boxed{Z = 2}$$

4. a. $r^2 R^2 = A^2 r^4/a_0^2 \, e^{-r/a_0}$

$$d/dr \, (r^2 R^2) = \frac{A^2}{a_0^2} \left(4r^3 e^{-r/a_0} - r^4/a_0 \, e^{-r/a_0}\right)$$
$$= 0 \quad \text{if} \quad r/a_0 = 4$$
$$\text{or} \quad \boxed{r = 4 a_0}$$

6. (n, l, m_l, m_s)

$$= (2, 1, \pm 1, \pm 1/2)$$
$$\text{or } (2, 1, 0, \pm 1/2)$$

$\boxed{6 \text{ states}}$

5. Quantization condition comes from continuity of standing de Broglie waves. This doesn't account for ground state or the difference between L_z and L, but does explain the energy levels of Hydrogen