# Physics 541 Homework Assignment 4

---

## Three WKB Bound State Problems

---

1. A potential problem with two soft walls: Use the WKB method to calculate the bound state energies for an electron in the quartic oscillator potential

$$V(x) = Ax^4.$$

---

2. A potential problem with one hard wall and one soft wall: Use the WKB method to calculate the bound state energies for an electron in the "cut-in-half" quartic oscillator potential

$$V(x) = \infty \text{ for x} \leq 0$$

$$V(x) = Ax^4 \text{ for x} > 0.$$

---

3. A potential problem with two hard walls: Use the WKB method to calculate the bound state energies for an electron in the infinite square well with a potential shelf $V_0$ halfway across the well

$$V(x) = \infty \text{ for x} \leq 0$$

$$V(x) = V_0 \text{ for } 0 > \text{x} > \text{a}/2.$$

$$V(x) = 0 \text{ for a}/2 \geq \text{x} > \text{a}$$

$$V(x) = \infty \text{ for x} \geq \text{a}.$$

## And Two WKB Tunneling Problems

4. Use the WKB method to calculate the transmission coefficient for an electron to tunnel through the triangular potential which is given by

$$V(x) = 0 \text{ for x} < 0$$

$$V(x) = V_0 - kx \text{ for x} \geq 0.$$

where $V_0$ and $k$ are constants.

5. Use the WKB method to calculate the transmission coefficient for a proton to tunnel into a nucleus with charge Z. The potential here is given by the repulsive Coulomb barrier

$$V(r) = Ze^2/r.$$