

**PHYS 452 Quantum Mechanics II (Fall 2018)**  
**Homework #4, due Tuesday November 1 in class**

WKB approximation

1. Problem 8.5 (part (a) only) and Problem 8.6 (parts (a) and (c) only) in Griffiths. In order to solve the latter problem you first need to do the former.
2. A particle of mass  $m$  moves freely in 1D between  $x = -a$  and  $x = a$ . Beyond this range it experiences a harmonic force. The corresponding potential is given by in the following form:

$$V(x) = \begin{cases} \frac{1}{2}m\omega^2(x+a)^2, & x < -a \\ 0, & -a < x < a \\ \frac{1}{2}m\omega^2(x-a)^2, & x \geq a \end{cases}$$

Find the approximate energy levels of the particle using the WKB approximation. Take the limits of your result for the case of very small and very large  $a$  and show that you get exactly what is expected.

3. Using the WKB approximation estimate the transmission and reflection coefficients for the potential barrier

$$V(x) = \begin{cases} V_0\left(1 - \frac{x^2}{a^2}\right) & , |x| < a \\ 0 & , |x| > a \end{cases} .$$