

## PHY-852 QUANTUM MECHANICS II

**Homework 11**, 40 points

*April 17 - 26, 2002*

### **Time-dependent perturbations.**

Reading: *Merzbacher*, Chapter 19.

1. /8/ *Merzbacher*, Exercise 19.2 (for an arbitrary external force  $f(t)$ ).
2. a. /8/ *Merzbacher*, Exercise 19.5 (recall the dipole sum rule discussed in the first semester).  
b. /6/ *Merzbacher*, Problem 3, p. 516.
3. /8/ *Merzbacher*, Problem 2, p. 116.
4. ★ /10/ a. Calculate a transmission coefficient  $T(E)$  through a one-dimensional potential barrier

$$U(x) = \begin{cases} 0, & x < 0 \text{ and } x > a, \\ U_0 > 0, & 0 < x < a. \end{cases} \quad (1)$$

for energies  $E \geq U_0$ .

b. The same for  $0 \neq E \neq U_0$ .

c. Find the limiting behavior of  $T(E)$  for  $E \gg U_0$ .

d. Find the limiting behavior of  $T(E)$  for  $E \rightarrow 0$ .

e. Find  $T(E)$  in the semiclassical approximation and compare with the exact solution.

f. Find the conditions when the barrier can be substituted by the equivalent  $\delta$ -function barrier.