your name(s)____

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Physics 851 Exercise #11 - Monday, Nov. 22nd

Consider a one-dimensional world where a particle of mass m experiences the attractive potential,

$$V_0(x) = -\frac{\hbar^2}{mb}\delta(x).$$

A particle in the bound state of the well then experiences a small external potential,

$$V_p(t) = v_0 \cos\omega t,$$
$$\hbar\omega > \frac{\hbar^2}{2mb^2}.$$

1. What is the bound-state energy B of the original well (ignore the external potential)? If you know, or can look up the answer, just write it down.

2. What is the energy, E, and wavenumber k of the liberated particles?

3. Again ignoring the small external potential, find the wave function where at large times (long after V_p is turned off) there is an outgoing plane wave $e^{ikx}/\sqrt{L}$ with $k > 0$, i.e. it moves in the positive x direction. For this boundary condition have an outgoing wave for $x > 0$ and incoming waves for both $x < 0$ and for $x > 0$. This wave function describes that of a created particle with asymptotic momentum k. At some large time ($vt >> L$), the incoming waves disappear and there is only an outgoing wave.

4. Calculate the overlap of the outgoing wave function

$$\alpha(k) \equiv \langle k|\psi_0\rangle,$$

where $|k\rangle$ is the state described above and $|\psi_0\rangle$ is the bound state. Give your answer in terms of k and b.

5. What is the rate at which one liberates the particle?