QMFa1199B

The three parts of this quantum mechanics problem are independent.

(a) Consider a one dimensional potential

$$V(x) = \begin{cases} m\omega^2 x^2/2 & \text{for } x > 0 \\ \infty & \text{for } x < 0 \end{cases}$$

Find the energy eigenvalues.

(b) An electron is contained inside a sphere of radius R (e.g. a bubble of He). What is the energy of the ground state and how does it change as the radius of the sphere is increased? What is the pressure exerted by the electron on the surface of the sphere when the electron is in its ground state? If the confining sphere has a surface tension (i.e. energy per unit surface area) γ independent of R, what is the equilibrium size of the sphere?

(c) Consider an electron, of charge e, confined to a circle of radius R. A uniform electric field, E, is applied in the circle's plane. What is the correction to the ground state energy up to terms of order E^2?