

## Section A. Quantum Mechanics

1. Consider the scattering of a nonrelativistic quantum-mechanical particle of mass  $m$  from the finite spherical square well in three dimensions given by the radial potential:  $V(r) = -V_0 < 0$  for  $r < a$ , while  $V(r) = 0$  for  $r \geq a$ . Take the limit of zero incident energy, where the de Broglie wavelength  $\lambda$  of the incident particle satisfies  $\lambda/a \rightarrow \infty$ .
  - (a) In this limit obtain the differential cross section  $\frac{d\sigma}{d\Omega}$  and the total cross section  $\sigma$ .
  - (b) This limiting zero-energy cross section diverges to  $\infty$  at certain values of  $V_0$ . What are those values of  $V_0$ ? What is the physical significance of such divergences of  $\sigma$ ?