Problems 02

(for tutorial that will take place on 20 November 2014)

1) For the evaluation of the scattering cross section we have discussed separately the incident (plane-wave) and scattered waves. This usually works well for large scattering angles but may fail for the forward scattering. Estimate the "critical" angle θ_0 so that for $\theta < \theta_0$ one can not separate the plane- and scattering components of the beam.

   Hint: Estimate conditions under which the interference between the incident and scattered currents can be neglected.

2) Write down the general expression for the scattering amplitude of the third order $f^{(3)}(k', k)$

3) Calculate the differential cross section (in the 1st Born approximation) for the scattering on the rectangular potential:

$$V(r) = \begin{cases} V_0, r \leq d \\ 0, r > d \end{cases}$$

2) Calculate the differential cross section (1st Born) for the elastic scattering of electrons with energy 100 eV (k = 2.71 a.u) on hydrogen atom in its ground state. For your calculations use atomic units ($\hbar = \mu = e = 1$) and the potential:

$$V(r) = -2\left(1 + \frac{1}{r}\right)e^{-2r}$$