Physics 452: Homework #18

Due Thursday, Mar. 19, 5:00PM, 2009

11.10 HINT: The low-energy limit is the same as the limit $\kappa \to 0$.

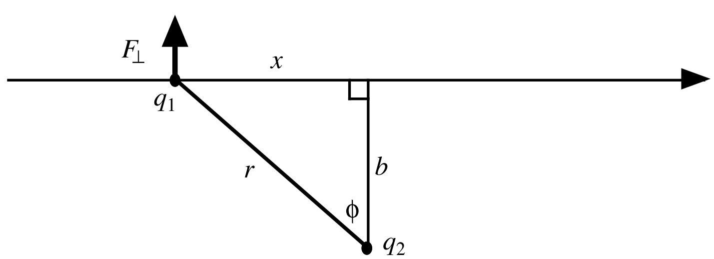
Note: $\lim_{\kappa\to 0}\frac{1}{\kappa^3}\left[\sin(\kappa a)-(\kappa a)\cos(\kappa a)\right]=\lim_{\kappa\to 0}\frac{1}{\kappa^3}\left[(\kappa a)-\frac{(\kappa a)^3}{3!}+...-(\kappa a)\left(1-\frac{(\kappa a)^2}{2!}+...\right)\right]$

11.12 HINT: When computing σ, write $\sin\theta = 2\sin\frac{\theta}{2}\cos\frac{\theta}{2}$ in the numerator of the θ integration. Make the following change of variables: $u = 4k^2\sin^2\frac{\theta}{2} \Rightarrow du = 2k^2\sin\frac{\theta}{2}\cos\frac{\theta}{2}d\theta$.

The integral and limits becomes $\int_0^{4k^2}\frac{du}{\left(\mu^2+u\right)^2} = -\frac{1}{\mu^2+u}\Big|_0^{4k^2}$.

11.13 HINT: In part (c), we must comparison in the 1st Born approximation, which assumes that the scattering is weak. In other words, $f/a \ll 1$, which is a measure of the strength of the scattered wave. This is the same as $\beta \ll 1$.

11.14 HINT: This is a classical trajectory problem again. To first approximation, you assume that the particle flies right on by along a straight path.



$\vec{F} = \frac{q_1q_2}{4\pi\varepsilon_o r^2}\hat{r} \Rightarrow F_\perp = \frac{q_1q_2}{4\pi\varepsilon_o r^2}\cos\phi$ Note: $\cos\phi = \frac{b}{r}$ and $r=\sqrt{b^2+x^2}$.

When computing the impulse momentum, you will want to write $dt = dx/v$.

The following integral formula is handy: $\int\frac{dx}{\left[b^2+x^2\right]^{3/2}} = \frac{x}{b^2\sqrt{b^2+x^2}}$

You pretend that the impulse happens all at a point in the interaction region. This only makes sense if θ is small. So looking from far away, we have $\theta \sim I_\perp/mv$.