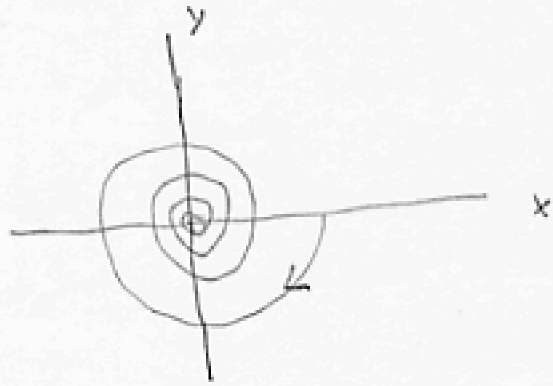
and $r(t) = 0$ when $t - t_c = R/\sqrt{2E/m}$.

In this case we see that $\theta(t) \to \pm\infty$

as t approaches $t_{collision} = t_c + R/\sqrt{2E/m}$.

So the orbit is a spiral into the origin with the spiral becoming ever tighter as time progresses.



It is also interesting to study this problem using the variational equation methods of problem 61.

a) The Lagrangian is $L = \frac{1}{2}m\left[\dot{r}^2 + (r\dot{\phi})^2\right] - \frac{\lambda}{r^2}$.

aa) The equations of motion are

$$\frac{\partial L}{\partial \dot{r}} = m\dot{r}, \quad \frac{\partial L}{\partial r} = m r\dot{\phi}^2 + \frac{2\lambda}{r^3} \Rightarrow$$

$$\boxed{m\ddot{r} = \frac{2\lambda}{r^3} + r\dot{\phi}^2}$$