NB1140: Physics 1A - Classical mechanics and Thermodynamics
Quiz 1
23 November 2016
You have 10 minutes to finish this quiz

A bug (see the picture on the right) is initially at a distance R from the lamp. The bug always flies at a constant speed V while always maintaining an angle θ between its direction of flight and the lamp. This means that the velocity vector $\vec{V}$ is always at a constant angle θ with respect to the radial line that joins the bug and the lamp. (Note: $|\vec{V}| = V$). We can always decompose the velocity vector $\vec{V}$ into two component vectors that are perpendicular to each other: $\vec{V}_{||}$ and $\vec{V}_{\perp}$ (see picture). During the bug's entire flight. $\vec{V}_{||}$ is always parallel and aligned with the radial line that joins the lamp and the bug. The $\vec{V}_{\perp}$ is always perpendicular to this radial line.

Let's analyze how the bug spirals into the lamp. Suppose $0 < \theta < \frac{\pi}{2}$.

(a) What are the lengths of the vectors $\vec{V}_{\perp}$ and $\vec{V}_{||}$ in terms of V and θ?

(b) Calculate $r(t)$ in terms of V, θ, and R. When does the bug arrive at the lamp?
Answer: $r(t) = R - Vtcos(\theta)$.

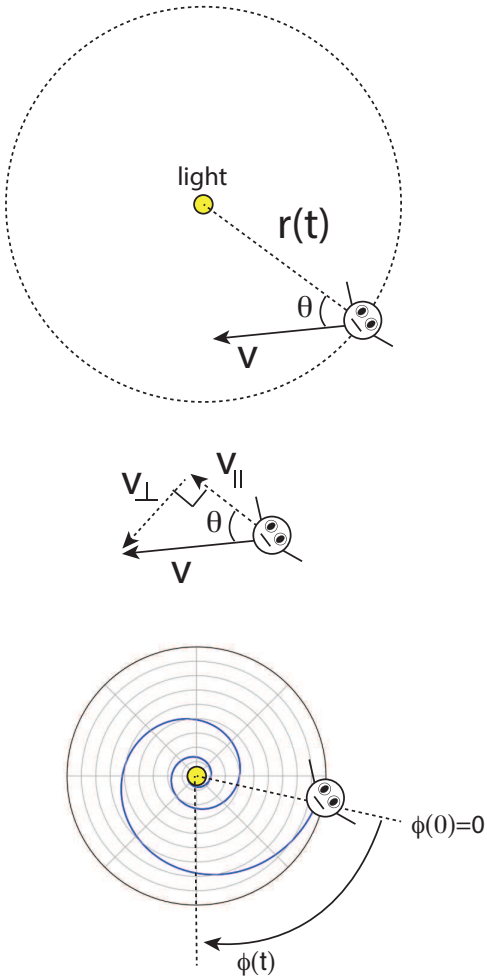

Figure 1: A bug spirals into a lamp.