1. For any tank that is being filled or drained we have

$$\frac{dV}{dt} = A \cdot \frac{dh}{dt}, \quad \text{where } h \text{ is the depth of the liquid}$$

If the rate of evaporation is proportional to the surface area, then

$$\frac{dV}{dt} = -k \cdot A, \quad \text{where } k > 0 \text{ is a constant.}$$

Thus,

$$A \cdot \frac{dh}{dt} = -kA,$$

so

$$\frac{dA}{dt} = -k,$$

and the water level drops at a constant rate.

5. As in class, when $t=5$ the bug is at the point $P\left(\frac{\sqrt{10}}{\pi^{1/4}}, \frac{10}{\sqrt{\pi}}\right)$, and

$$\left.\frac{dy}{dt}\right|_{t=5} = \frac{1}{\sqrt{\pi}}.$$

The slope of the tangent line to $y = x^2$ at P is $2\left(\frac{\sqrt{10}}{\pi^{1/4}}\right)$, and the angle that the tangent line makes with the positive x-axis is

$$\theta = \tan^{-1}\left(\frac{2\sqrt{10}}{\pi^{1/4}}\right) \sim 78°.$$

So the speed of the bug at $t=5$ is

$$1/\sqrt{\pi} \cdot \frac{1}{\sin\theta} \sim .58 \text{ cm/s}$$