

## 17.2: Parametrized Curves and their Derivatives

### Calculus III

College of the Atlantic

1. The position of a bird is given by  $r(\vec{t}) = (3 \cos(2t), 3 \sin(2t))$ .

(a) Sketch the motion of the bird.

(b) Find the bird's velocity vector  $v(\vec{t})$ .

(c) Sketch  $v(\vec{0})$  and  $v(\vec{\pi}/2)$ .

(d) Find the bird's acceleration vector  $a(\vec{t})$ .

(e) Show that  $\|\vec{a}\| = \|\vec{v}\|^2/r$ .

2. A TAB mug is thrown from a rooftop at time  $t = 0$  seconds. Its position while in the air at time  $t$  is given by

$$r(\vec{t}) = 10t\hat{i} - 5t\hat{j} + (6.4 - 4.9t^2)\hat{k}. \quad (1)$$

The origin is the base of the building, which stands on flat ground. The vector  $\hat{i}$  points east,  $\hat{j}$  points north, and  $\hat{k}$  points up.

(a) How high is the rooftop above the ground?

(b) At what time does the mug hit the ground?

(c) How fast is the mug moving when it hits the ground?