

# Office Hours 1

1. **If you didn't finish Activity 1:** Consider the golfer as shown in Fig. 1. Analyze the motion of the ball while in flight.

- (a) Find  $\vec{a}(t)$  of the ball
- (b) Find  $\vec{v}(t)$  of the ball
- (c) Find  $\vec{r}(t)$  of the ball
- (d) Find the time of flight of the ball
- (e) How high above the ground does the ball go?
- (f) How far in the horizontal direction does the ball go?

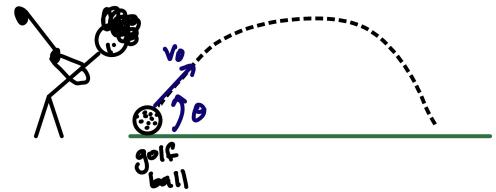


Figure 1: A golfer strikes a ball such that it has an initial speed  $v_0$  and its initial velocity vector  $\vec{v}_0$  makes an angle  $\theta$  with the horizontal.

2. Prove that if  $\vec{v}(t)$  is any vector that depends on time but has *constant magnitude*, then  $\dot{\vec{v}}$  is orthogonal to  $\vec{v}$ . Also prove the converse, that if  $\dot{\vec{v}}(t)$  is orthogonal to  $\vec{v}(t)$ , then  $\vec{v}(t)$  is constant.

3. **Horizontal Drag** . Let a particle experience a drag force given by:

$$\vec{F}_{\text{drag}} = -v \vec{v} \quad (1)$$

where  $\vec{v} = v_x \hat{x}$ . Assuming no other forces except drag act on a particle, find its  $v_x(t)$  and  $x(t)$ .

4. Let Object 1 have initial velocity  $\vec{v}$  and mass  $m_1$ . Let Object 2 start from rest with mass  $m_2$ . The two objects collide and stick together. Find the final velocity of the system.

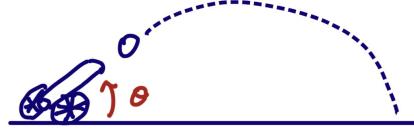


Figure 2: A cannon shoots a cannon ball such that it has an initial speed  $v_0$  and its initial velocity vector  $\vec{v}_0$  makes an angle  $\theta$  with the horizontal.

5. A cannon shoots a ball at an angle  $\theta$  above the horizontal, see Fig. 2.
  - (a) Find the ball's position  $\vec{r}(t)$  as a function of time.
  - (b) Let  $r(t)$  be the ball's distance from the cannon. What is the maximum  $\theta$  such that  $r(t)$  increases throughout the ball's flight?
  
  
  
6. Someone kicks a frictionless puck with initial speed  $v_0$  so that it slides straight up a plank that is inclined at an angle  $\theta$  above the horizontal.
  - (a) Write down Newton's 2nd law for the puck and solve to give its position as a function of time
  - (b) How long will it take for the puck to return to its starting point?
  
  
  
7. A ball is thrown with initial speed  $v_0$  up an inclined plane. The plane is at an angle  $\phi$  from the horizontal, and the ball is thrown at an angle  $\theta$  above the plane.
  - (a) Find the ball's position as a function of time
  - (b) Find the distance the ball travels from where it was launched