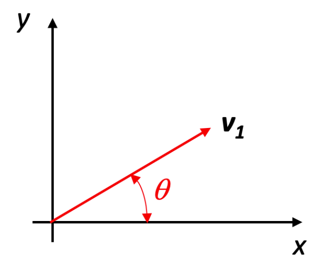
Chapter 3 Written Homework Problems
DUE: February 3 at the beginning of class
SHOW ALL WORK FOR FULL CREDIT
EXPRESS ALL ANSWERS IN *SI* UNITS



1. A velocity vector $\boldsymbol{v_1}$ has a magnitude of 1m/s and is oriented as shown in the Figure to the right. Assume $0 \le \theta \le \pi/2$. A velocity vector $\boldsymbol{v_2}$ has a magnitude of 2 m/s. *(a)* What is the $\boldsymbol{v_2}$, in terms of θ, if $\boldsymbol{v_1} + \boldsymbol{v_2}$ is to have only a positive *y*-component? *(b)* In what direction does $\boldsymbol{v_2}$ point if *(b)* $\theta = 0°$ and if *(c)* $\theta = 90°$ In (b) and (c) check that $\boldsymbol{v_1} + \boldsymbol{v_2}$ has only a positive *y*-component.

2. The Colts kick off the football to the Seahawks. Travis Homer stands at the Colts goal line, 65 yards from where the ball is kicked. The ball is kicked at a speed to 60 ft/s at an angle to 45° above the horizontal. The instant the ball is kicked Homer begins running to meet the ball. If he is going to catch the ball just before it hits the ground what is his speed (assumed constant)? Ignore air resistance.

3. *(a)* What is the centripetal acceleration required to keep an object on the Earth at its equator? *(b)* What would be the rotational speed of the Earth if a centripetal acceleration of 1 *g* was required to keep an object on the earth? In the later case *(c)* what time period would correspond to one day?

4. In a dog fight one fighter jet makes a vertical dive at 1100 km/h. If the pilot pulls out of the dive and ends up in a vertical climb on a flight path that is an arc of a circle, at what minimum altitude must he begin the turn if he is not to hit the ground and never experience an acceleration > 5*g*? A trained pilot can withstand a maximum acceleration of 5*g* (i.e., 5 times the gravitational acceleration of the Earth at its surface with the acceleration vector directed from the pilot's head toward their feet) before becoming unconscious. There is a time dependence to this tolerance for *g*-loading that will ignore. You may assume the speed of the plane remains constant.

5. Sandhill cranes are migrating along the Rio Grande River to the Bosque Del Apache. The cranes can fly at a speed of 11 m/s relative to the air and need to go due south. A wind is blowing from the east at 4.3 m/s. (a) In what direction should the cranes fly? (b) How long does it take the cranes to fly from Albuquerque to the Bosque Del Apache, which is 95 miles south of Albuquerque.

6. Although it is very dangerous to other hikers, it is always tempting to throw stones off of a cliff and see how far from the bottom of the cliff the stone will land, that is try to maximize your horizontal range. If the cliff is very high relative to the horizontal distance you can throw a stone can you show that a launch angle of 0° maximizes your range?

Hint: This is a little trickier problem than it may appear to be. Start by using your kinematic equations for $x(t)$ and $y(t)$ and the fact that $x(t^*) = R$ and $y(t^*)$, where t^* is the flight time and R is the range. Eliminate t^* in the equation for $y(t^*)$ by using $t^* = R / v_i \cos\theta$ to get an equation in terms of R and θ. Then find the maximum R in terms of θ by differentiating the equation with respect to θ noting that $dR/d\theta = 0$ for the maximum range.