HOMEWORK II

RECTANGULAR COORDINATES
The velocity of a particle moving in the x-y plane is given by $6.12\mathbf{i} + 3.24\mathbf{j}$ m/s at time $t = 3.65$ s. Its average acceleration during the next 0.02 s is $4\mathbf{i} + 6\mathbf{j}$ m/s$^2$. Determine the velocity $\mathbf{v}$ of the particle at $t = 3.67$ s and the angle $\theta$ between the average-acceleration vector and the velocity vector at $t = 3.67$ s.
The $y$-coordinate of a particle in curvilinear motion is given by $y = 4t^2 - 3t$, where $y$ is in meters and $t$ is in seconds. Also, the particle has an acceleration in the $x$-direction given by $a_x = 12t \text{ m/s}^2$. If the velocity of the particle in the $x$-direction is $4 \text{ m/s}$ when $t = 0$, calculate the magnitudes of the velocity $v$ and acceleration $a$ of the particle when $t = 1 \text{ s}$. Construct $v$ and $a$ in your solution.
A roofer tosses a small tool to the ground. What minimum magnitude $v_0$ of horizontal velocity is required to just miss the roof corner $B$? Also determine the distance $d$. 

Problem 2/67
The quarterback $Q$ throws the football when the receiver $R$ is in the position shown. The receiver’s velocity is constant at 10 m/s, and he catches passes when the ball is 2 m above the ground. If the quarterback desires the receiver to catch the ball 2.5 s after the launch instant shown, determine the initial speed $v_0$ and angle $\theta$ required.
The pilot of an airplane carrying a package of mail to a remote outpost wishes to release the package at the right moment to hit the recovery location \( A \). What angle \( \theta \) with the horizontal should the pilot’s line of sight to the target make at the instant of release? The airplane is flying horizontally at an altitude of 100 m with a velocity of 200 km/h.
A projectile is launched with an initial speed of 200 m/s at an angle of 60° with respect to the horizontal. Compute the range $R$ as measured up the incline.
The muzzle velocity of a long-range rifle at A is \( u = 400 \text{ m/s} \). Determine the two angles of elevation \( \theta \) which will permit the projectile to hit the mountain target B.
A projectile is launched from point A with the initial conditions shown in the figure. Determine the slant distance $s$ which locates the point $B$ of impact. Calculate the time of flight $t$.

$v_0 = 120 \text{ m/s}$

Problem 2/83
The pilot of an airplane pulls into a steep 45° climb at 300 km/h and releases a package at position A. Calculate the horizontal distance $s$ and the time $t$ from the point of release to the point at which the package strikes the ground.
A projectile is launched from point A and lands on the same level at D. Its maximum altitude is \( h \). Determine and plot the fraction \( f_2 \) of the total flight time that the projectile is above the level \( f_1 h \), where \( f_1 \) is a fraction which can vary from zero to 1. State the value of \( f_2 \) for \( f_1 = \frac{3}{4} \).