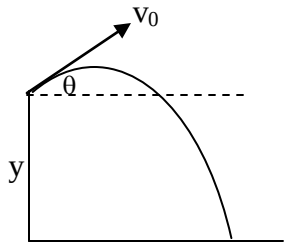
Q- An airplane with a speed of 75 m/s is climbing upward at an angle of 37.0 ° with respect to the horizontal. When the plane's altitude is 600 m, the pilot releases a package. **(a)** Calculate the distance along the ground, measured from a point directly beneath the point of release, to where the package hits the earth. **(b)** Relative to the ground determines the angle of the velocity vector of the package just before impact.



At the time of release the velocity of the package v_0 will be same as that of the plane means 75 m/s at 37 degree above horizontal.

Horizontal component of its velocity will be

$v_x = 75*\cos(37.0^0) = 75*0.8 = 60.0$ m/s

Initial vertical velocity

$v_y = 75*\sin(37.0^0) = 75*0.6 = 45$ m/s

Vertical displacement is given by the second equation of motion as

$[s = u*t + ½\ a*t^2]$

(Upward positive, hence y is negative from the point of release)

$-600 = 45*t + 0.5*(-10)*t^2$

Or $5t^2 - 45*t - 600 = 0$
Or $t^2 - 9*t - 120 = 0$

Gives $t = \frac{9 \pm \sqrt{9^2 - 4*1*(-120)}}{2*1}$
Or $t = \frac{9 \pm 23.7}{2}$
Gives t = 16.3 s (cannot have negative value)

Hence the horizontal distance covered by the package will be

$x = v_x*t = 60*16.3 =$ **978 m**

And the vertical velocity of the package will be given by

$v_y' = v_y + g*t$

or $v_y' = 45 + (-10)*16.3 = -118$ m/s

(Negative means downwards)

Hence the velocity vector makes and angle with the horizontal given by

$\text{Tan}\theta = v_y'/v_x = -118/60 = -1.967$

Gives $\theta = -$ **63^0**.