Q- A baseball is hit into the air at an initial speed of 30 m/s and an angle of 60° above the horizontal. At the same time, the center fielder starts running towards the batter and catches the ball 1 m above the level at which it was hit. If the center fielder is initially 1.25 x 10^2 m from home plate, what must be his average speed?

Let the time of the flight be t.

Horizontal velocity (constant) of the ball

$v_x = 30*\cos(60^0) = 30*0.50 = 15$ m/s

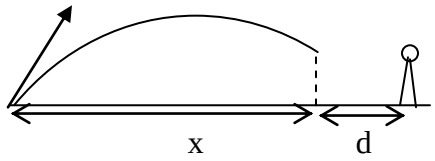
Initial vertical velocity of the ball

$v_y = 30*\sin(60^0) = 30*0.866 = 26$ m/s

Vertical displacement is given by the second equation of motion as

$[s = u*t + ½\ a*t^2]$

$1 = 26*t + 0.5*(-9.8)*t^2$



Or $4.9*t^2 - 26*t + 1 = 0$

Gives $t = \frac{26 \pm \sqrt{26^2 - 4*4.9*1}}{2.4.9} = t = \frac{26.38 \pm \sqrt{(26.38)^2 - 4*4.9*0.958}}{2*4.9}$

Or $t = \frac{26 \pm 25.6}{9.8}$ $t = \frac{26.38 \pm 26.02}{9.8}$

Gives t = 5.267s or 0.04s

Clearly the time of flight is the one for which the ball coming down and is 5.267s

Hence the horizontal distance covered by the ball in this time will be

$x = v_x*t = 15*5.267 = 79$ m

Thus the distance to be covered by the fielder will be d = 125 - 79 = 46 m

Hence the minimum speed of the catcher should be

$v = d/t = 46/5.267 =$ **8.73 m/s.**