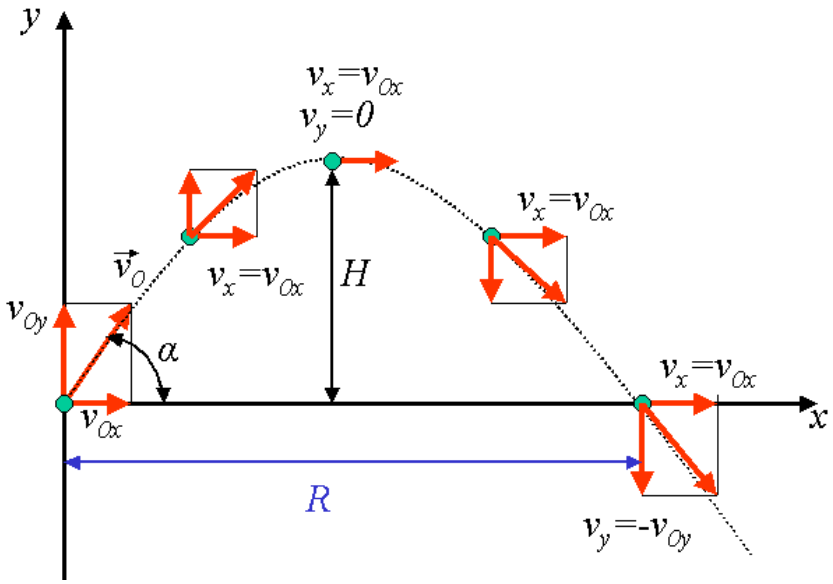
Task:

Superman (m = 90 kg) jumps over a 50 m tall building by first accelerating from rest to his maximum velocity in 0.001 s. Subsequent to this time, Superman follows normal projectile motion. What is the average force acting on Superman that gives his upward acceleration?

Solution:



Suppose R is insignificant. Then $v_{0_y} = v_0, v_{0_x} = 0, H = 50\ m, t = 0.001s$

$$H = \frac{v_0^2}{2g}$$

$$v_0^2 = 2gH$$

$v_0 = \sqrt{2gH}$ – the minimal velocity required to jump over a building

Newton's second law:

$$\frac{dp}{dt} = \Sigma F$$

$$m\frac{dv}{dt} = \Sigma F$$

$$\frac{dv}{dt} = \frac{v_0 - 0}{t} = \frac{\sqrt{2gH}}{t}$$

Answer:

$$\Sigma F = m\frac{dv}{dt} = m\frac{\sqrt{2gH}}{t} = 90\ kg \cdot \frac{\sqrt{2 \cdot 9.81\frac{m}{s^2} \cdot 50m}}{0.001\ s} \approx 2.819\ MN$$