2.2. Stimulating Newton's Apple

$$\vec{F} = -mg\,\hat{n}_y = -1.3916\,N\ \hat{n}_y$$

$$\vec{r} = y\,\hat{n}_y \qquad \vec{v} = \dot{y}\,\hat{n}_y \qquad \vec{a} = \ddot{y}\,\hat{n}_y$$

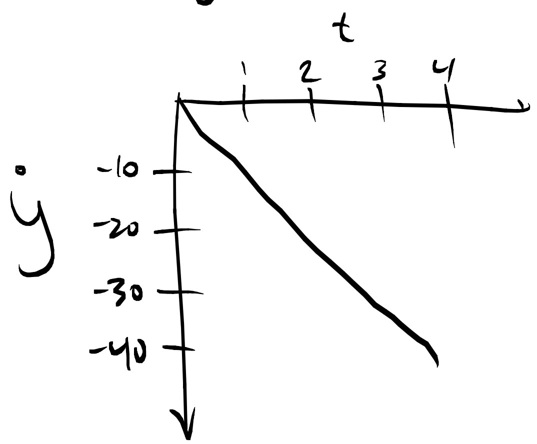
$$\vec{F} = m\vec{a}$$

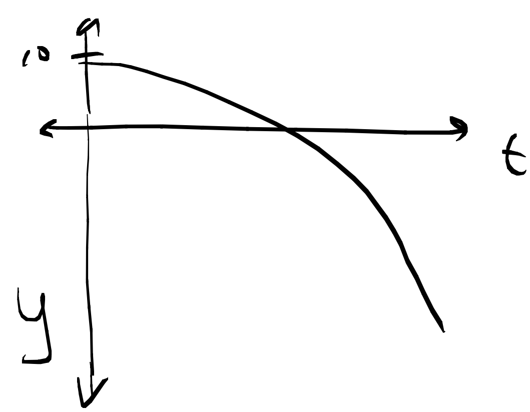
$$-mg = m\ddot{y}$$

$$\ddot{y} = -g$$

$$\dot{y} = \dot{y}(0) - gt$$

$$y = y(0) + \dot{y}(0)\,t - \frac{1}{2}gt^2$$





See plotAnalyticApple.pdf

At 4.2 s, # of accurate digits = 16 High accuracy

2.3 Simulating Projectile Motion

$F_x = 0 \qquad F_y = -mg$

$$\vec{F} = m\vec{a}$$

$\ddot{x} = 0 \qquad\qquad \ddot{y} = -g$

$\dot{x} = \dot{x}(0) \qquad\qquad \dot{y} = \dot{y}(0) - gt$

$x = \dot{x}(0)t + x(0) \qquad\qquad y = y(0) + \dot{y}(0)t - \frac{1}{2}gt^2$

$$\vec{v}(0) = 44.7\cos(35^\circ)\,\hat{x} + 44.7\sin(35^\circ)\,\hat{y}$$

$$\vec{r}(0) = (0,0)$$

$x(t) = 44.7\cos(35^\circ)\,t$

$y(t) = 44.7\sin(35^\circ)t - 4.9t^2$

$$= \tan(35^\circ)\,x - \frac{4.9}{(44.7\cos(35^\circ))^2}x^2$$

$$\approx 0.7002075x - 0.003654702x^2$$

$0 = 44.7\sin(35)\,t - 4.9t^2$

$44.7\sin(35) - 4.9t = 0$

$t = \dfrac{44.7\sin(35)}{4.9}$

$t \approx 5.232422\ s$

$x = 44.7\cos(35)\,t$

$= 191.5909\ m$

See plotAnalyticBaseball.pdf

At 5.2 s

\# of accurate digits = 11

High accuracy