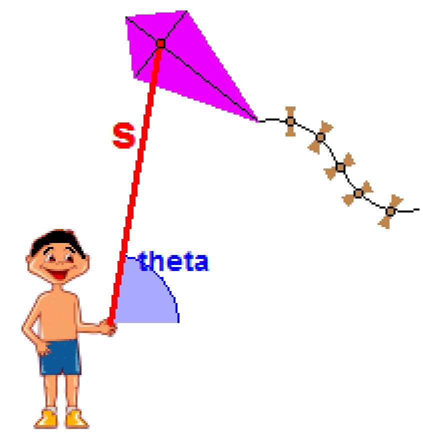
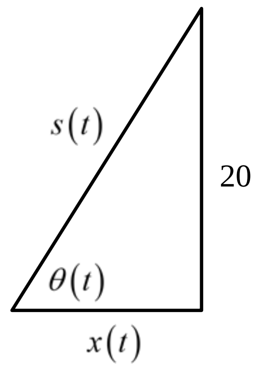
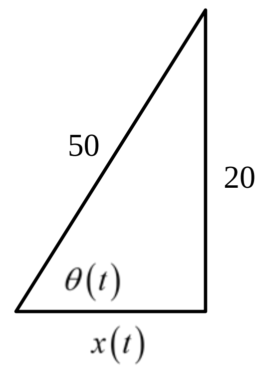
At t = 0, a child is flying a kite at an angle of elevation of 80º & height 20m above his hand's height. If the string pays out due to a 10 m/sec horizontal wind (from child towards kite), how fast is the string being paid out when its length is 50m; how fast is the angle of elevation changing? (string always taut)

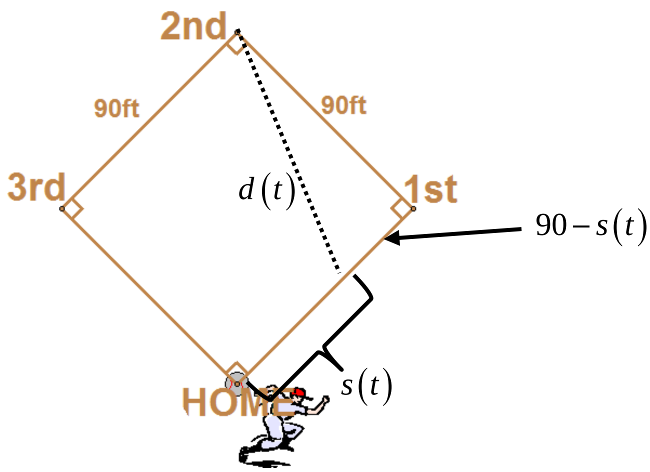






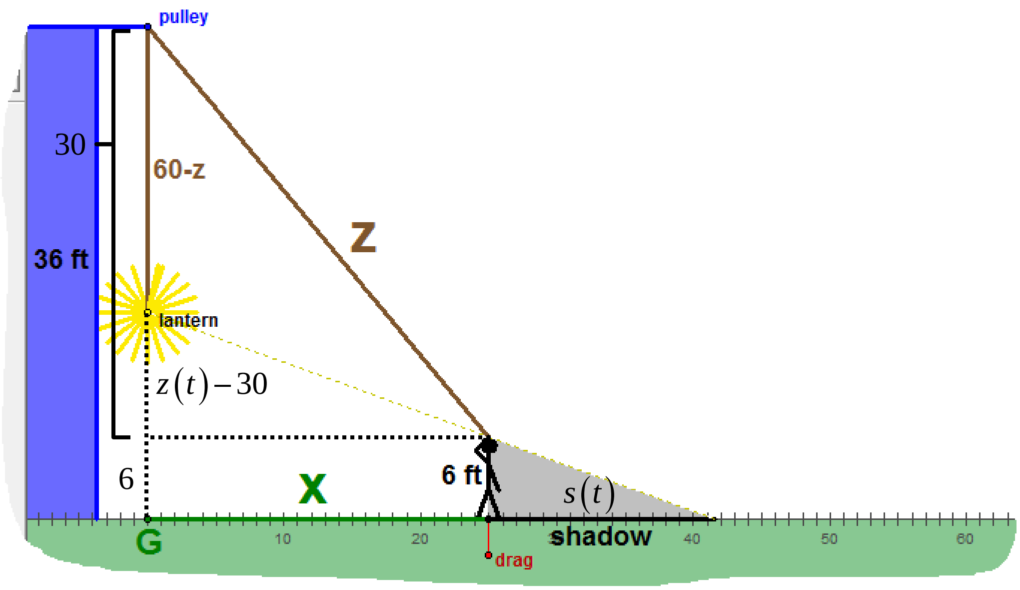
To find $s'(t)$	To find $\theta'(t)$	When $s(t)=50$
$20^2+\left[x(t)\right]^2=s(t)^2$ $\downarrow$ $2x(t)x'(t)=2s(t)s'(t)$ $x(t)x'(t)=s(t)s'(t)$ $\left(10\sqrt{21}\right)(\cdot 10)=50\cdot s'(t)$ $s'(t)=2\sqrt{21}$ $\approx 9.1651...$	$\tan\left(\theta(t)\right)=\dfrac{20}{x(t)}$ $\downarrow$ $\sec^2\left(\theta(t)\right)\cdot\theta'(t)=\dfrac{0\cdot x(t)-20x'(t)}{\left[x(t)\right]^2}$ $\sec^2(0.4115...)\cdot\theta'(t)=\dfrac{-(20)(10)}{\left[10\sqrt{21}\right]^2}$ $\theta'(t)=-0.08\ \dfrac{\text{rad}}{\text{sec}}$ $\downarrow$ $=\text{-}4.5836...\dfrac{\text{deg}}{\text{sec}}$	$20^2+\left[x(t)\right]^2=50^2$ $400+\left[x(t)\right]^2=2500$ $\left[x(t)\right]^2=2100$ $x(t)=10\sqrt{21}$ $\sin\left(\theta(t)\right)=\dfrac{20}{50}$ $\theta(t)=\arcsin\left(\dfrac{20}{50}\right)$ $\approx 0.4115...$

A runner runs down the first base line at 20 ft/sec. How fast is his distance from *2nd* base changing when he is 10 feet from home plate? 45 ft? 100 ft?



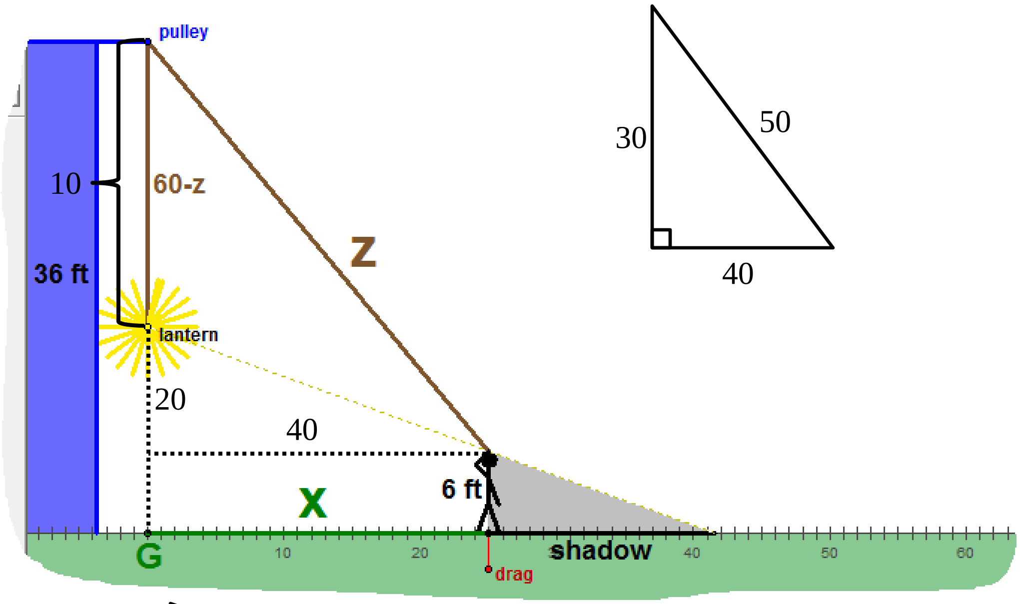
$$\left[90-s(t)\right]^2+90^2=\left[d(t)\right]^2$$
$$\downarrow$$
$$2\left[90-s(t)\right]\cdot\left[-s'(t)\right]=2d(t)d'(t)$$
$$\left[90-s(t)\right]\cdot\left[-s'(t)\right]=d(t)d'(t)$$
$$\left[90-10\right](-20)=\sqrt{90^2+80^2}\,d'(t)$$
$$d'(t)\approx-13.2872\ldots\frac{\text{ft}}{\text{sec}}$$

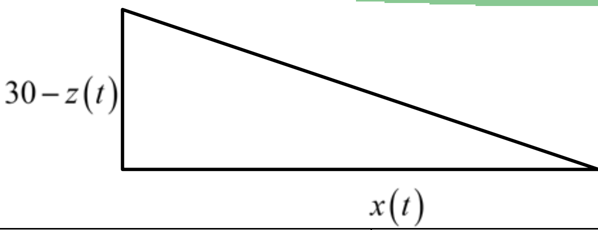
A 60-ft rope is looped through a pulley 36 feet above point G (G is on the ground).
A lantern is attached to the end of the rope hanging above G.
A 6-ft man holds the rope's other end at the top of his head as he walks away from G at 5 ft/sec.
What is the rate of change of the distance between the pulley and the man's head?
What is the rate of change of the man's shadow's length when he is 40 ft from G?
When is the tip of the shadow, P, closest to G?

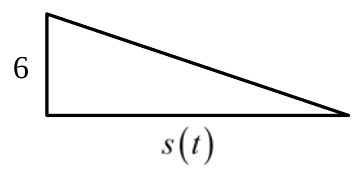


$$[x(t)]^2+30^2=[z(t)]^2$$
$$\downarrow$$
$$z(t)=\sqrt{30^2+[x(t)]^2}$$

$$[x(t)]^2+30^2=[z(t)]^2$$
$$\downarrow$$
$$2x(t)x'(t)=2z(t)z'(t)$$
$$x(t)x'(t)=z(t)z'(t)$$
$$x(t)\cdot(5)=\sqrt{30^2+[x(t)]^2}\,z'(t)$$
$$z'(t)=\frac{5x(t)}{\sqrt{30^2+[x(t)]^2}}$$







	$\begin{aligned} \frac{z(t)-30}{6} &= \frac{x(t)}{s(t)} \\ s(t)\left[z(t)-30\right] &= 6x(t) \\ s(t) &= \frac{6x(t)}{z(t)-30} \\ &\downarrow \\ s'(t) &= \frac{6x'(t)\left[z(t)-30\right]-6x(t)z'(t)}{\left[z(t)-30\right]^2} \\ &= \frac{6x'(t)\left[z(t)-30\right]-6x(t)\left[\frac{5x(t)}{\sqrt{30^2+\left[x(t)\right]^2}}\right]}{\left[z(t)-30\right]^2} \\ &= \frac{6(5)[50-30]-6(40)\left[\frac{5(40)}{\sqrt{30^2+40^2}}\right]}{[50-30]^2} \\ &= -\frac{9}{10} \end{aligned}$