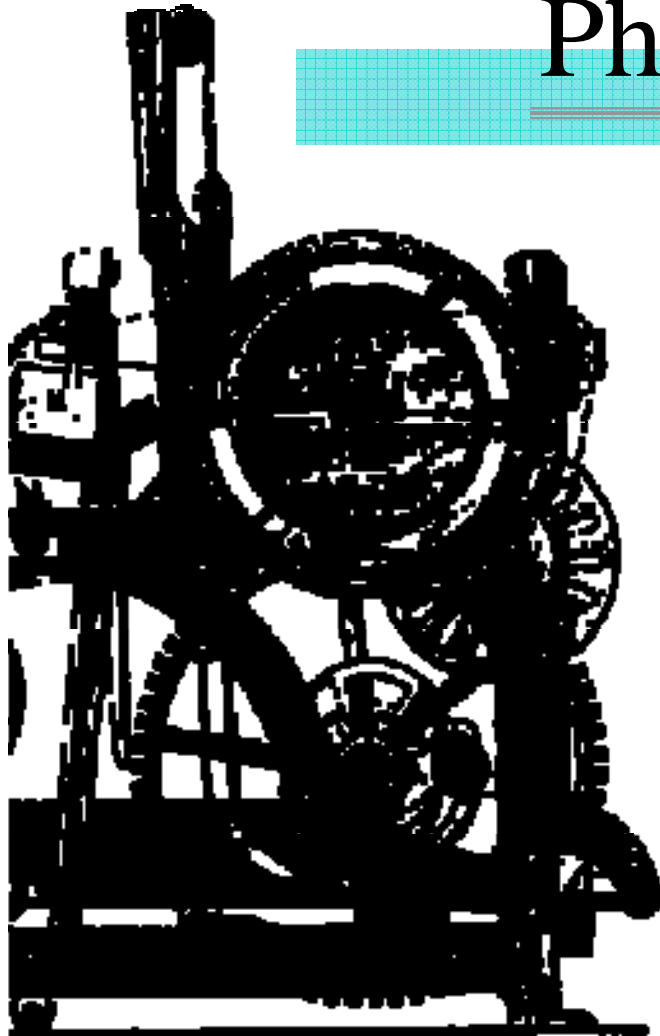


Physics Topics

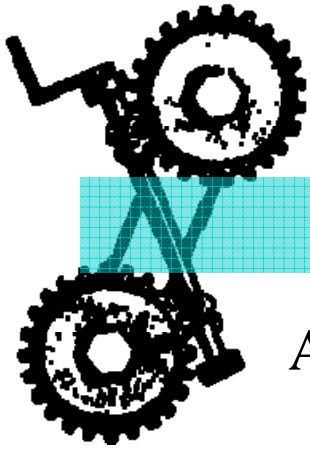
How Are Speed and Velocity Related?



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Phabulous Physics: Introduction

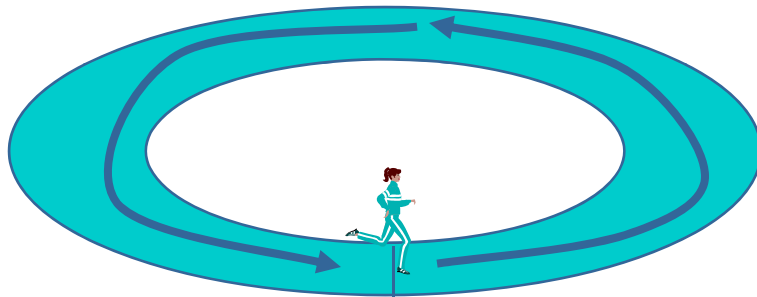


Speed and Velocity

$$\text{Average speed} = \frac{\text{total distance}}{\text{time}}$$

$$\text{Average velocity} = \frac{\text{total displacement}}{\text{time}}$$

$$v = \frac{\Delta s}{\Delta t}$$



$$\text{Time} = 1 \text{ min } 18 \text{ sec} \quad \frac{\text{Start}}{\text{Finish}} = 500 \text{ m}$$

$$\text{average speed} = \frac{500 \text{ m}}{78 \text{ s}} = 6.4 \frac{\text{m}}{\text{s}}$$

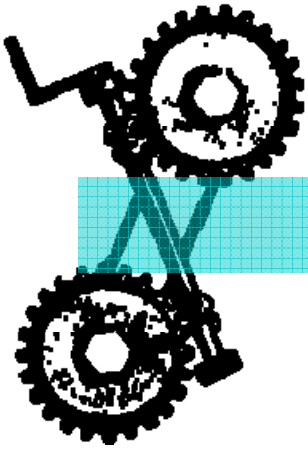
$$\text{average velocity} = \frac{0 \text{ m}}{78 \text{ s}} = 0 \frac{\text{m}}{\text{s}}$$

Is it possible to move with constant speed but not constant velocity?

Yes. (Cruising at 55 mph around a corner \Rightarrow changing direction = changing velocity)

Is it possible to move with constant velocity but not constant speed?

No. (A change in speed would cause a change in velocity.)



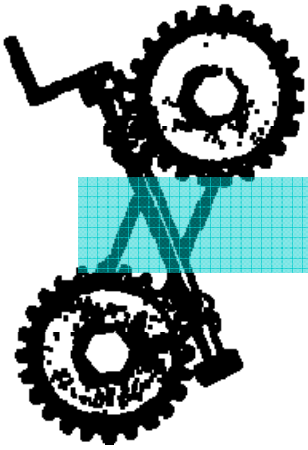
Acceleration

Average acceleration = $\frac{\text{change in velocity}}{\text{time}}$

$$a = \frac{\Delta v}{\Delta t}$$

- Positive acceleration means increasing velocity
- Negative acceleration means decreasing velocity

V_0	V_1	t	a
80 mph	80 mph	10 s	$0 \frac{m}{s^2}$
20 m/s	32 m/s	3 s	$4 \frac{m}{s^2}$
32 m/s	20 m/s	2 s	$-6 \frac{m}{s^2}$



Five Important Equations

Variable That's Missing

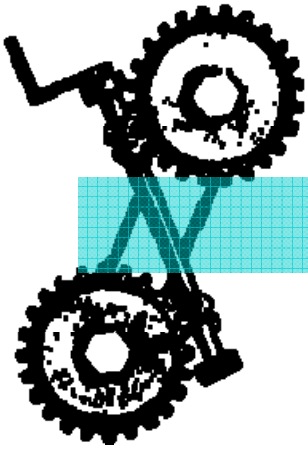
#1 $\Delta s = v_{avg} \Delta t$ \longrightarrow a

#2 $\Delta v = a \Delta t$ \longrightarrow Δs

#3 $\Delta s = v_0 \Delta t + \frac{1}{2} a (\Delta t)^2$ \longrightarrow v

#4 $\Delta s = v \Delta t - \frac{1}{2} a (\Delta t)^2$ \longrightarrow v_0

#5 $v^2 = v_0^2 + 2a \Delta s$ \longrightarrow Δt



Derivation of Equations 3 & 4

$$\Delta s = v_{avg} \Delta t = \frac{1}{2} (v_0 + v) \Delta t$$

$$\Delta s = \frac{1}{2} v_0 \Delta t + \frac{1}{2} v \Delta t$$



$$\Delta s = \frac{1}{2} v_0 \Delta t + \frac{1}{2} v \Delta t$$

$$(-) \quad \frac{1}{2} a (\Delta t)^2 = -\frac{1}{2} v_0 \Delta t + \frac{1}{2} v \Delta t$$

$$\Delta s - \frac{1}{2} a (\Delta t)^2 = v_0 \Delta t$$

$$\Delta s = v_0 \Delta t + \frac{1}{2} a (\Delta t)^2$$

$$a = \frac{\Delta v}{\Delta t} = \frac{v - v_0}{\Delta t}$$

$$a \Delta t = v - v_0 \quad \frac{a \Delta t}{2} = \frac{v - v_0}{2}$$

$$\frac{1}{2} a \Delta t = \frac{1}{2} v - \frac{1}{2} v_0$$

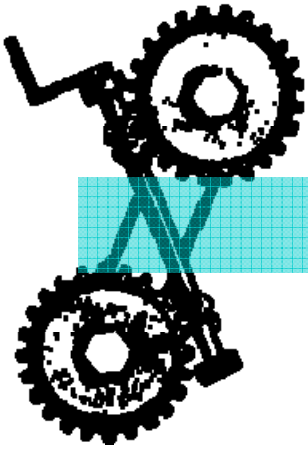
$$\Delta s = \frac{1}{2} v_0 \Delta t + \frac{1}{2} v \Delta t$$

$$(+)$$

$$\frac{1}{2} a (\Delta t)^2 = -\frac{1}{2} v_0 \Delta t + \frac{1}{2} v \Delta t$$

$$\Delta s + \frac{1}{2} a (\Delta t)^2 = v \Delta t$$

$$\Delta s = v \Delta t - \frac{1}{2} a (\Delta t)^2$$



Derivation of Equation 5

$$\Delta s = v_{avg} \Delta t = \frac{v + v_0}{2} \Delta t$$

$$a \Delta t = \Delta v = v - v_0$$

$$\frac{2\Delta s}{v + v_0} = \Delta t$$

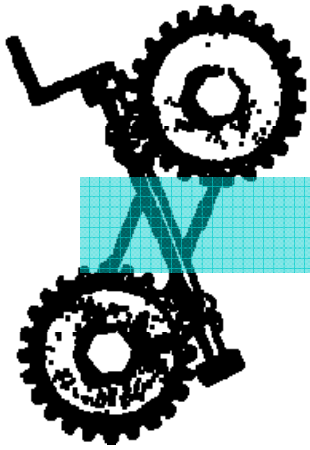
$$\Delta t = \frac{v - v_0}{a}$$

$$\frac{2\Delta s}{v + v_0} = \frac{v - v_0}{a}$$

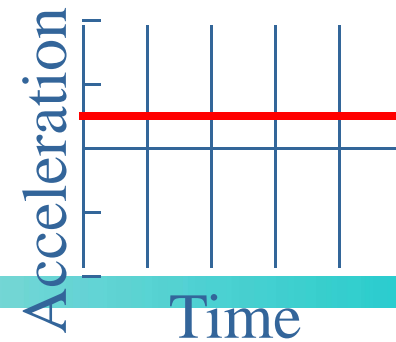
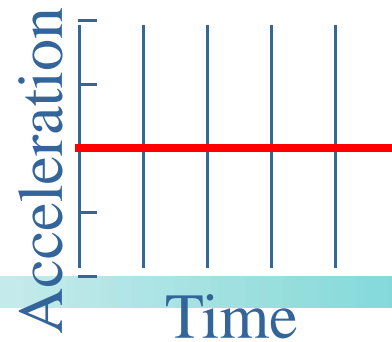
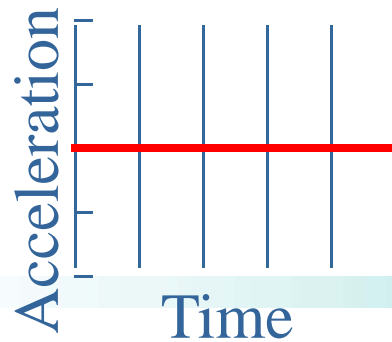
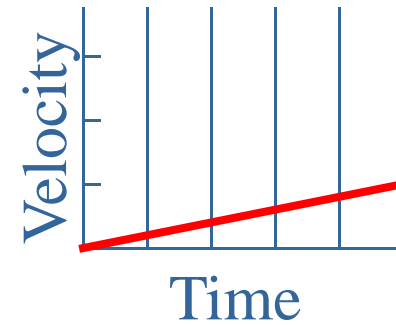
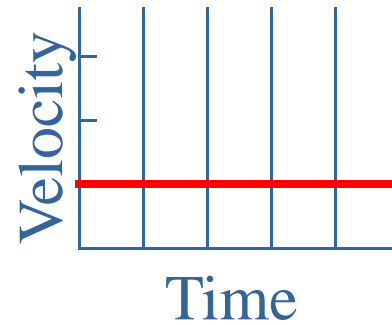
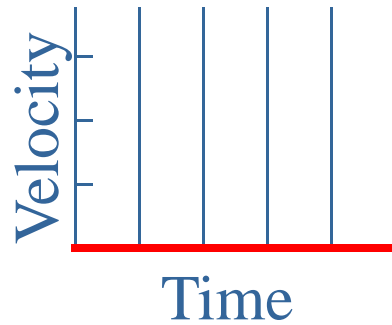
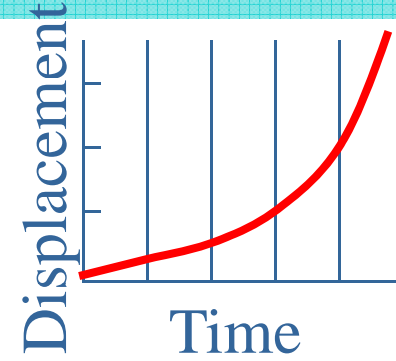
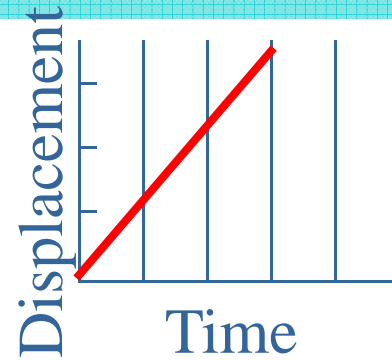
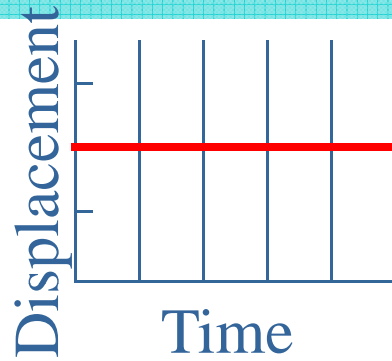
$$2a\Delta s = v^2 - v_0^2$$

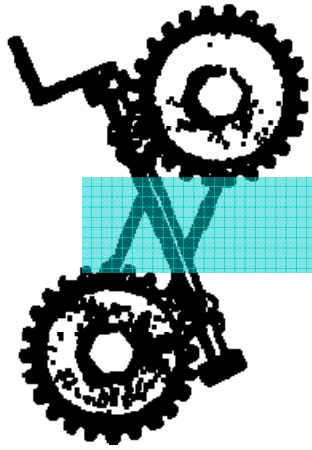
$$v^2 = v_0^2 + 2a\Delta s$$

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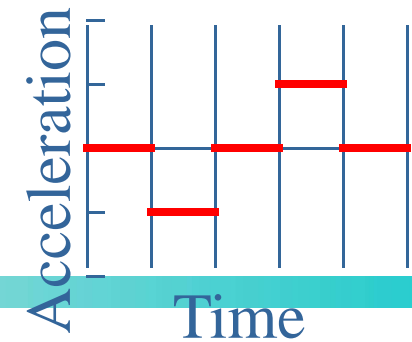
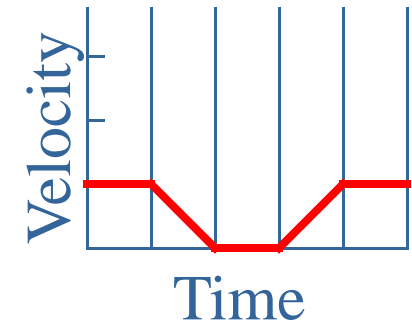
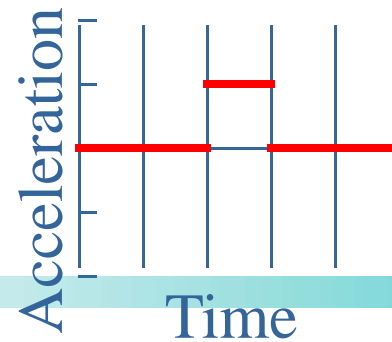
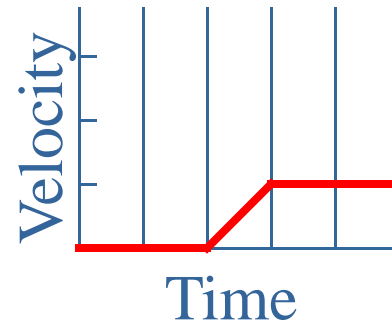
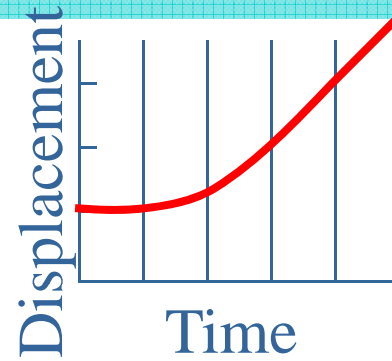
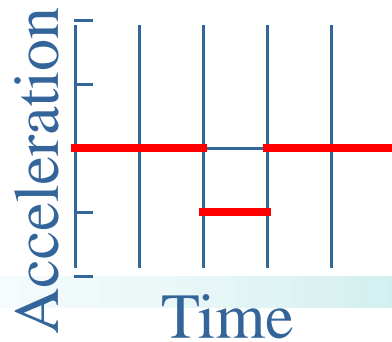
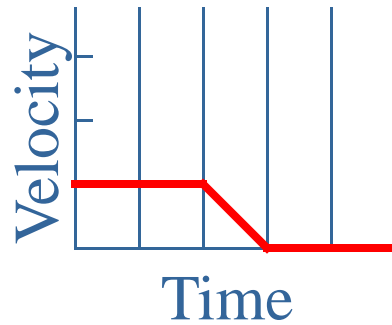
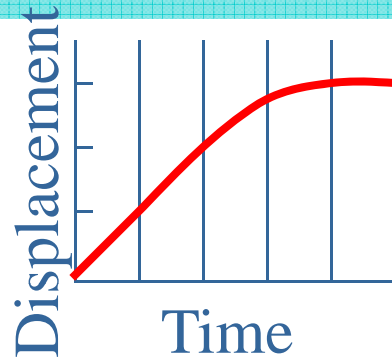
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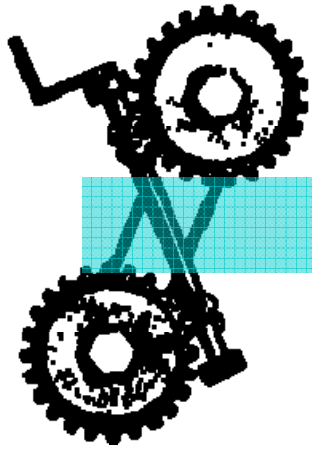




Graphs

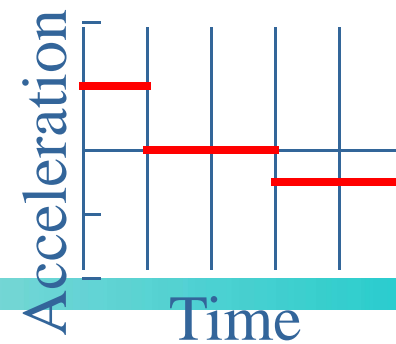
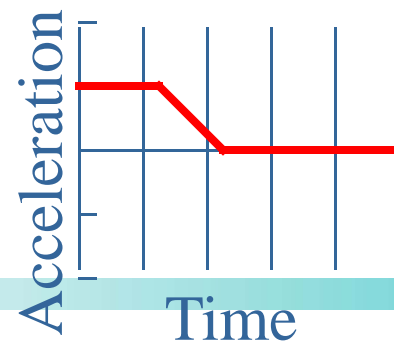
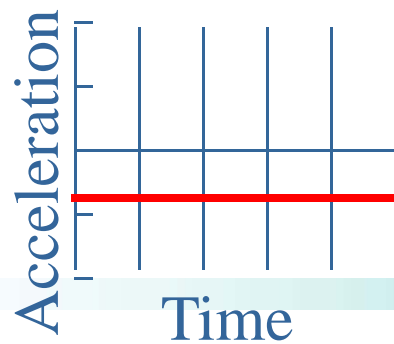
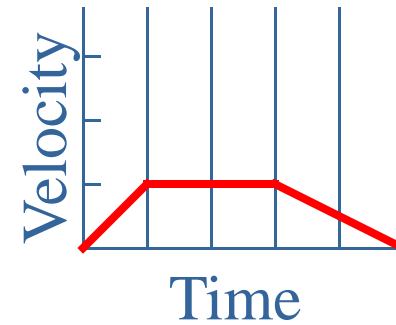
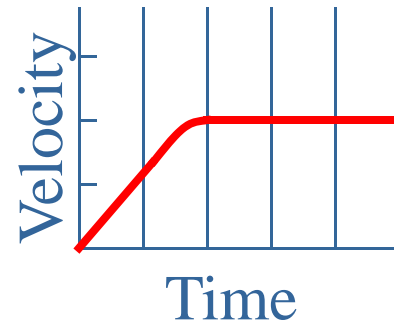
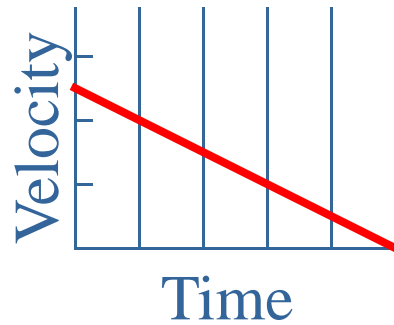
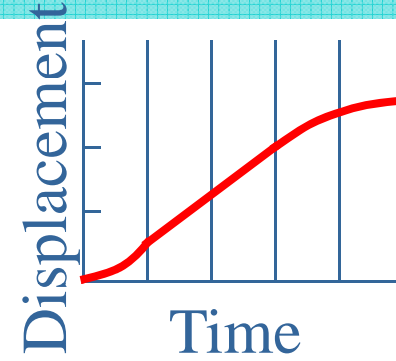
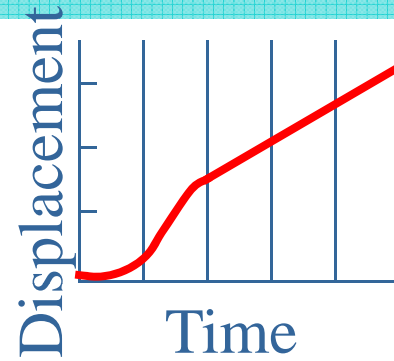
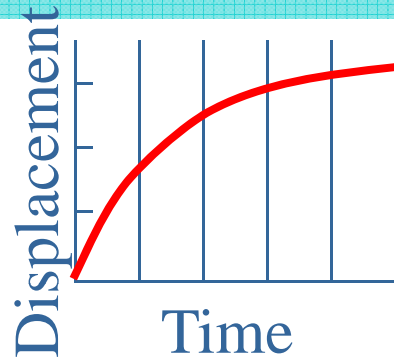
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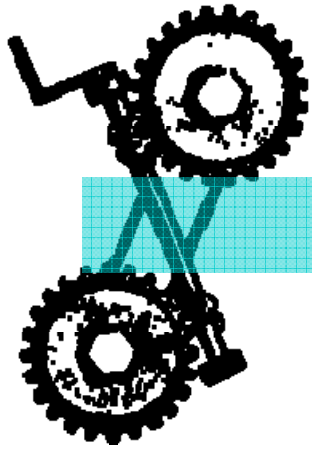




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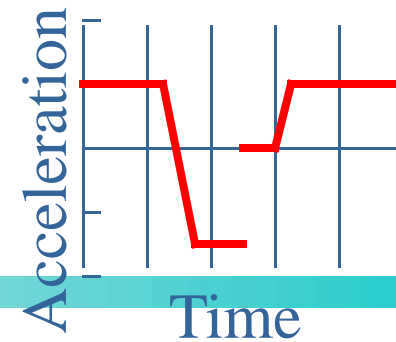
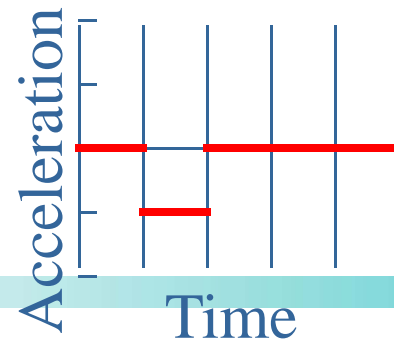
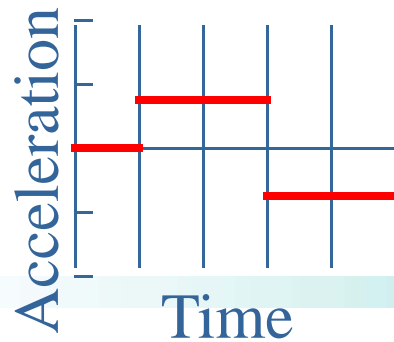
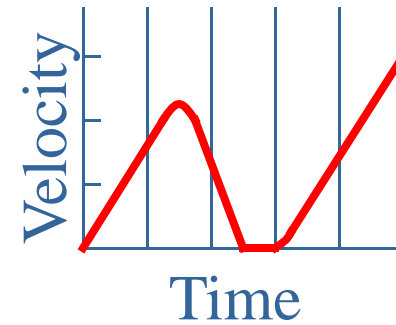
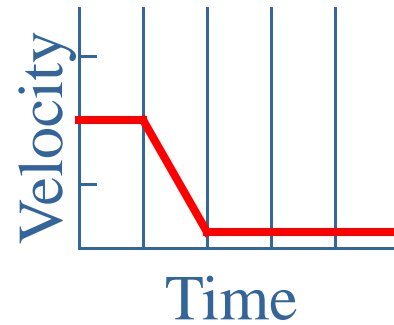
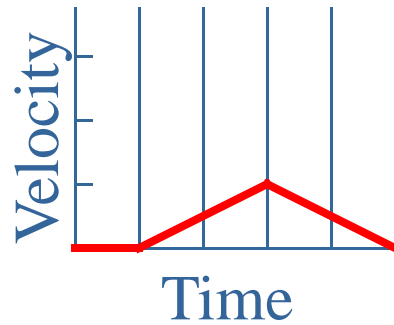
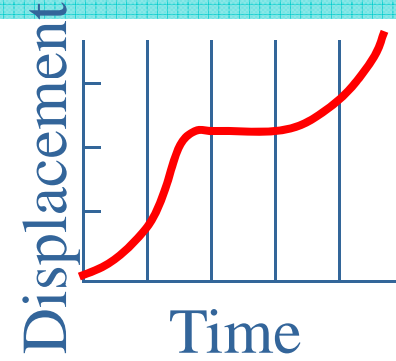
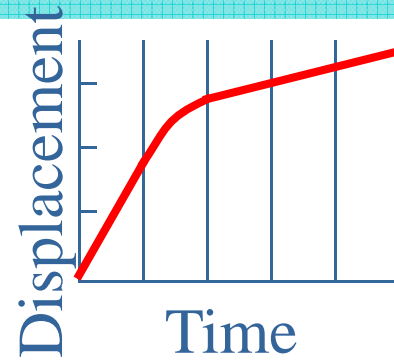
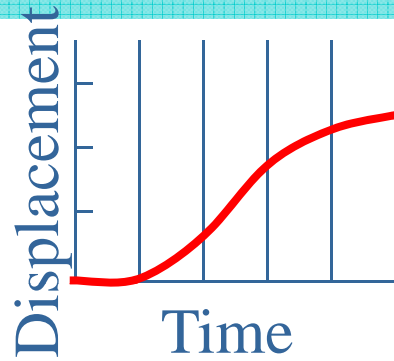
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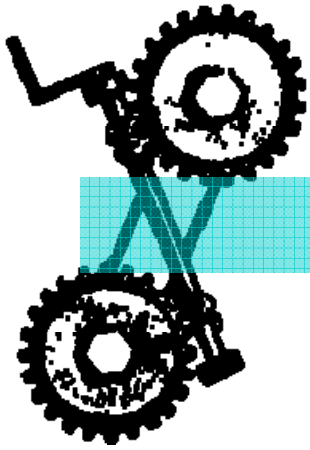




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