

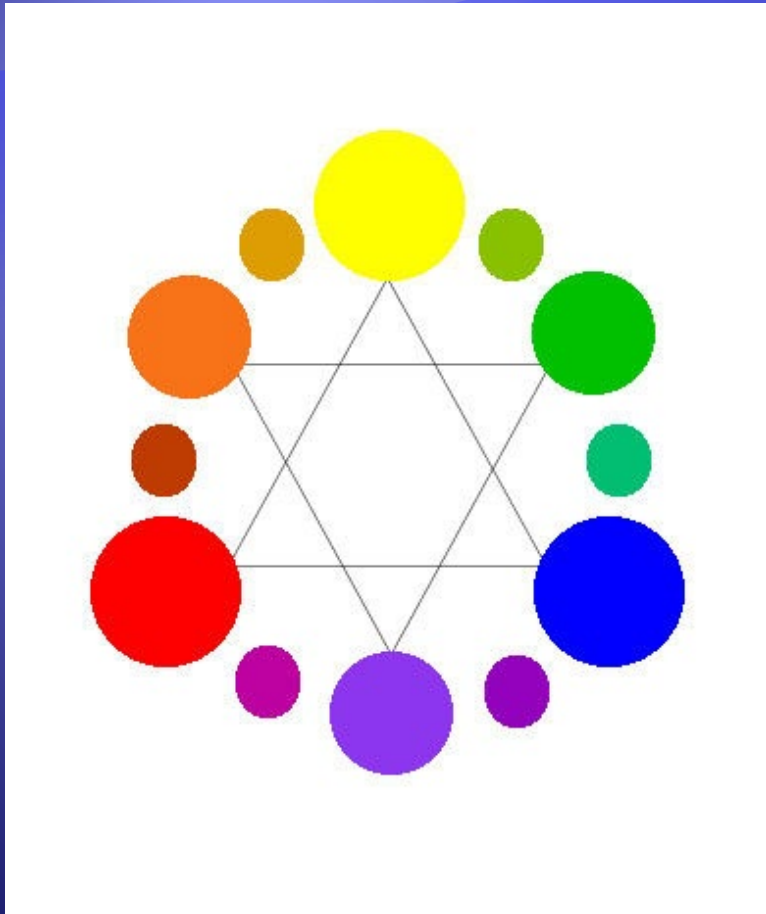
DESCRIBING UNIFORM MOTION

Question

- ◆ A car, starting at rest, experiences a constant acceleration (*or increase in velocity*) of 5 m/s^2 for 10 sec.
 - ◆ How far has the car traveled?

- ◆ We can NOT solve the previous problem using any of our current models or equations!
- ◆ BUT, we can make/derive some models that will!

An Example From Art



In Art, there are 3
Primary Colors

They can be combined to
form the 3 Secondary
Colors

Etc...

- ◆ The same sort of process can be done with our math models.
- ◆ Our simple models for speed, velocity and acceleration can be combined into 'Super'-models!

Limitation of our 'Super'-models

- ◆ These new models will **ONLY** work for objects that move at a constant acceleration!

WHY?

- ◆ Objects that experience a constant acceleration move in very predictable ways!

Kinematic Equations for Linear Motion

(For constant acceleration ONLY)

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Equation	Involved Quantities	Unneeded Quantity
1) $v_f = v_i + at$	v_i, v_f, a, t	Δx
2) $v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x, v_f, v_i, a$	t
3) $\Delta x = v_i t + \frac{1}{2}at^2$	$\Delta x, v_i, a, t$	v_f
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After Working a Problem...

- ◆ Are my units ok?
- ◆ Is my magnitude reasonable?
- ◆ Is my direction reasonable?

- ◆ Using our new kinematic (motion) models, we can answer our original question:
- ◆ A car, starting at rest, experiences a constant acceleration of 5 m/s^2 for 10 sec.
 - ◆ How far has the car traveled?

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Question

- ◆ A driver traveling at a constant 112.6 km/hr (70 mph) drops his cell phone on the floorboard. He takes his eyes off the road for 3 sec to retrieve it.
 - ◆ How far does he travel (in m) while not paying attention to the road?

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Question

- ◆ Spotting a state trooper on your way home for Spring break, you casually reduce your speed from 38 m/s (85 mph) to 31.3 m/s (70 mph) in 4 sec.
 - ◆ What is your acceleration?
 - ◆ How far did you travel while you were breaking?

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Question

- ◆ While rock climbing, you look down to monitor your progress when your favorite pair of sunglasses fall off. You observe (*in the midst of your sorrow*) that they are accelerating away from you at a constant rate of 9.8 m/s^2 as they plummet toward the ground.
 - ◆ If it takes 5 sec to reach the ground, how high are you on the cliff?
 - ◆ What is the speed of the sunglasses just before shattering on the ground below?

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Question

- ◆ Randy Johnson can throw a baseball at 100 mph (44.7 m/s). A brave catcher acting as a target must bring the ball to a complete stop in just a few inches using a well padded glove.
 - ◆ What is the acceleration of the ball as it comes to rest in the catcher's glove?

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Question

- ◆ Jules Verne (1865) suggested sending people to the moon by firing a space capsule from a 220 *m* long cannon w/ $v_f = 10.97 \text{ km/s}$.
 - ◆ What is the capsules acceleration? (put in terms of “g’s”)

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Question

- ◆ An object moving at a uniform acceleration has a velocity of $v = 12 \text{ cm/s}$ in the $+x$ direction when $x = 3 \text{ cm}$. 2 seconds later, its position is $x = -5 \text{ cm}$.
 - ◆ What is the objects acceleration?

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Question

- ◆ A car has $v_0 = 30 \text{ m/s}$. Its engine quits at the base of a hill and coasts up the incline at an acceleration of -2 m/s^2 .
 - ◆ Find expressions for $x(t)$ and $v(t)$
[assuming $x=0$ at the base of the hill]
 - ◆ What is the max distance the car coasts up the hill?

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Question

- ◆ A car is sitting at a traffic light. It turns green and the car accelerates at 3.2 m/s^2 . At the same time, a truck that never stopped for the red light zooms past at the very instant the light turns green with a constant velocity of 20 m/s .
 - ◆ How long does it take the car to overtake the truck?
 - ◆ What is the velocity of the car when it catches up?

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Question

Class Exercise

- ◆ A race car starting from rest accelerates at a constant rate of 5 m/s^2 .
 - ◆ What is its velocity after it has traveled 30.5 m ?
 - ◆ How much time has elapsed?
 - ◆ What was the cars average velocity?

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Class Exercise

A jetliner lands at a speed of 71.5 m/s and reduces its speed at a rate of -4.47 m/s^2 . If the plane travels at a constant speed of 71.5 m/s for 1 sec after landing before it applies its brakes.

- ◆ What is the total displacement of the plane between touchdown and the point where it comes to rest?

Kinematic Equations for Linear Motion

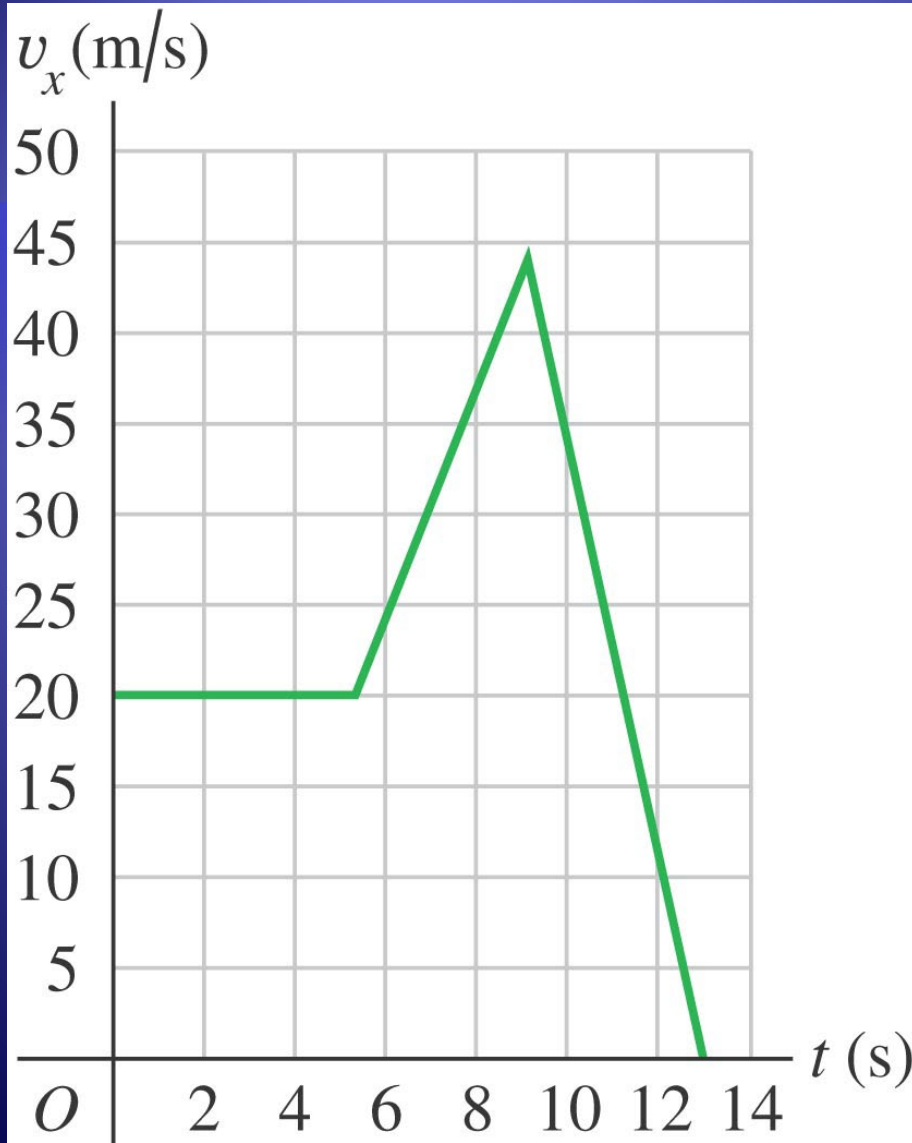
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Question



- ♦ Find the acceleration at $t = 3$ sec, 7 sec and 11 sec.
- ♦ How far has the bike traveled after 5 sec, 9 sec and 13 sec?

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