Welcome to Kinematics!

Classical Mechanics

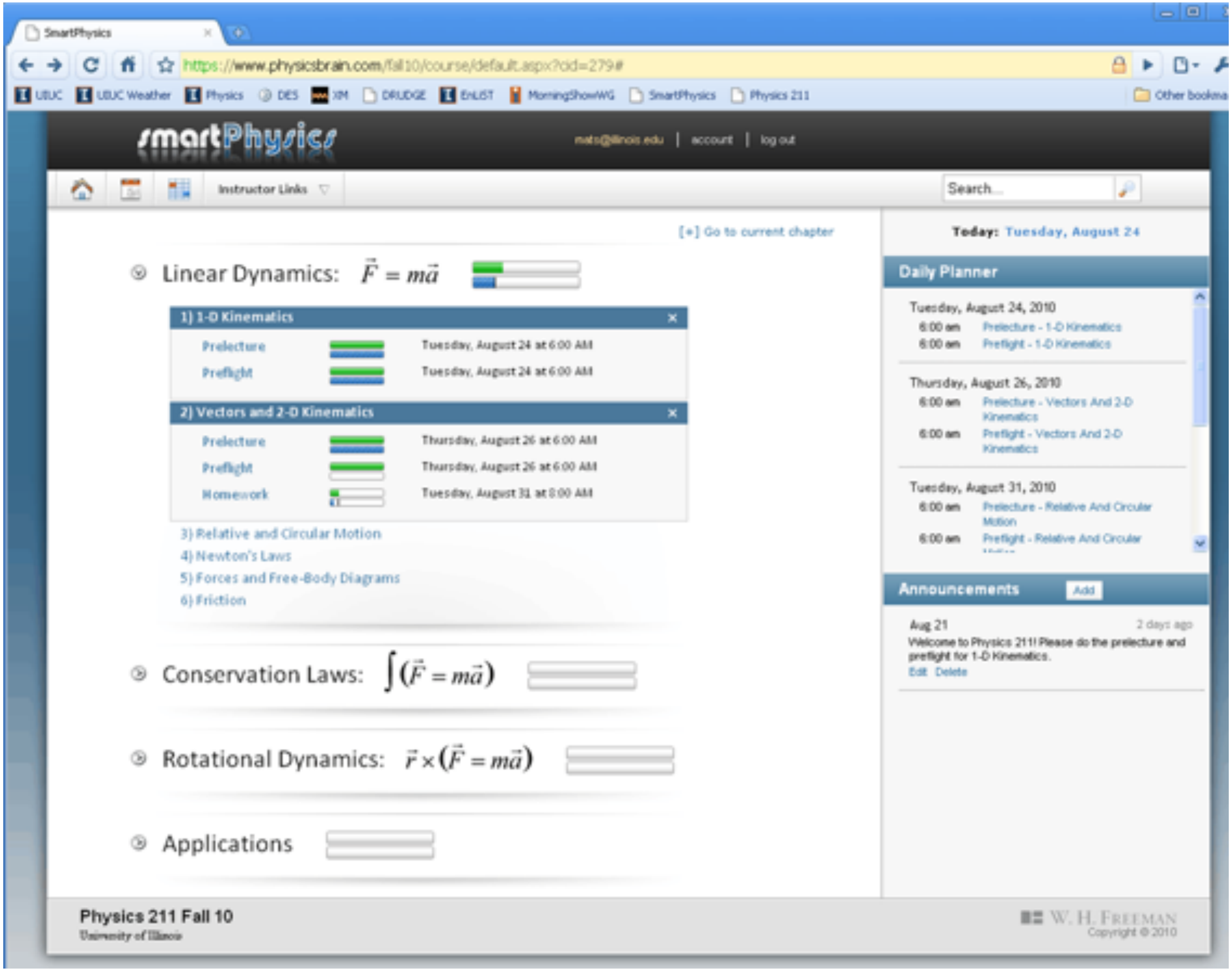
Modus Operandi

iClicker

- Register your i>Clicker in class during the "roll call."
- You may register it after you use it and still get the marks.
- If you want to use iClicker GO (eg., smartphone app) let me know.

SmartPhysics Protocol

- Online Prelectures (animated textbook, *before lecture*)
- Online Checkpoints (check knowledge, *before lecture*)
- Lectures (very interactive)
- Online Homework (first deadline Sunday, 80% credit for late online homework up to about one week from Sunday)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Linear Dynamics: $\vec{F} = m\vec{a}$
1) 1-D Kinematics
Prelecture
Tuesday, August 24 at 6:00 AM
Preflight
Tuesday, August 24 at 6:00 AM
2) Vectors and 2-D Kinematics
Prelecture
Thursday, August 26 at 6:00 AM
Preflight
Thursday, August 26 at 6:00 AM
Homework
Tuesday, August 31 at 8:00 AM
3) Relative and Circular Motion
4) Newton's Laws
5) Forces and Free-Body Diagrams
6) Friction
Conservation Laws: $\int(\vec{F} = m\vec{a})$
Rotational Dynamics: $\vec{r} \times (\vec{F} = m\vec{a})$
Applications
Today: Tuesday, August 24
Daily Planner
Tuesday, August 24, 2010
6:00 am
Prelecture - 1-D Kinematics
6:00 am
Preflight - 1-D Kinematics
Thursday, August 26, 2010
6:00 am
Prelecture - Vectors And 2-D Kinematics
6:00 am
Preflight - Vectors And 2-D Kinematics
Tuesday, August 31, 2010
6:00 am
Prelecture - Relative And Circular Motion
6:00 am
Preflight - Relative And Circular
Announcements
Add
Aug 21
2 days ago
Welcome to Physics 211! Please do the prelecture and preflight for 1-D Kinematics.
Edit
Delete
Physics 211 Fall 10
University of Illinois
W. H. Freeman
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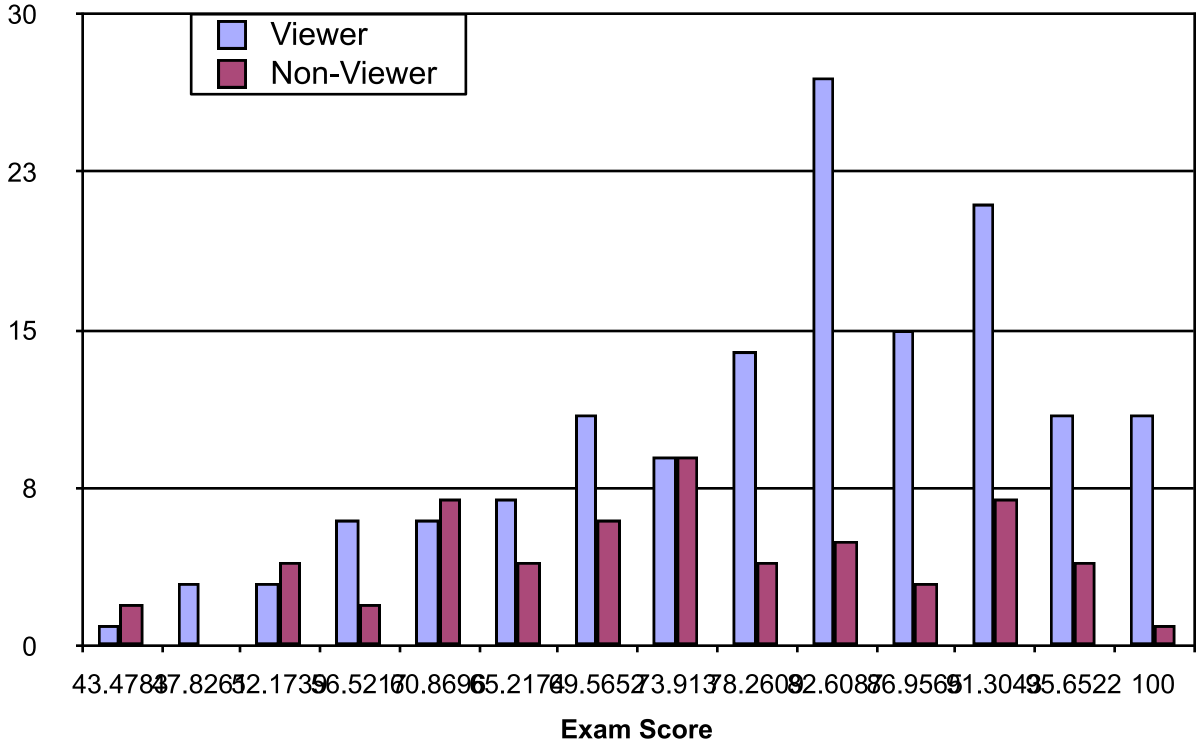
Q: What are the benefits of participating ?

A: You learn more



Students who…	Exam 1 average
Viewed pre-lectures	80%
Blew through pre-lectures	73%

Clicker Question 1

Do you have your i>clicker with you today?

A) Yes

B) No

C) Maybe

D) I like pudding

Clicker Question 2

Which of the following best describes your high-school physics class?

A) Awesome

B) Pretty good

C) So-so

D) Not so good

E) Awful

Classical Mechanics
Lecture 1

Today's Concepts:

a) Displacement, Velocity, Acceleration

b) 1-D Kinematics with constant acceleration

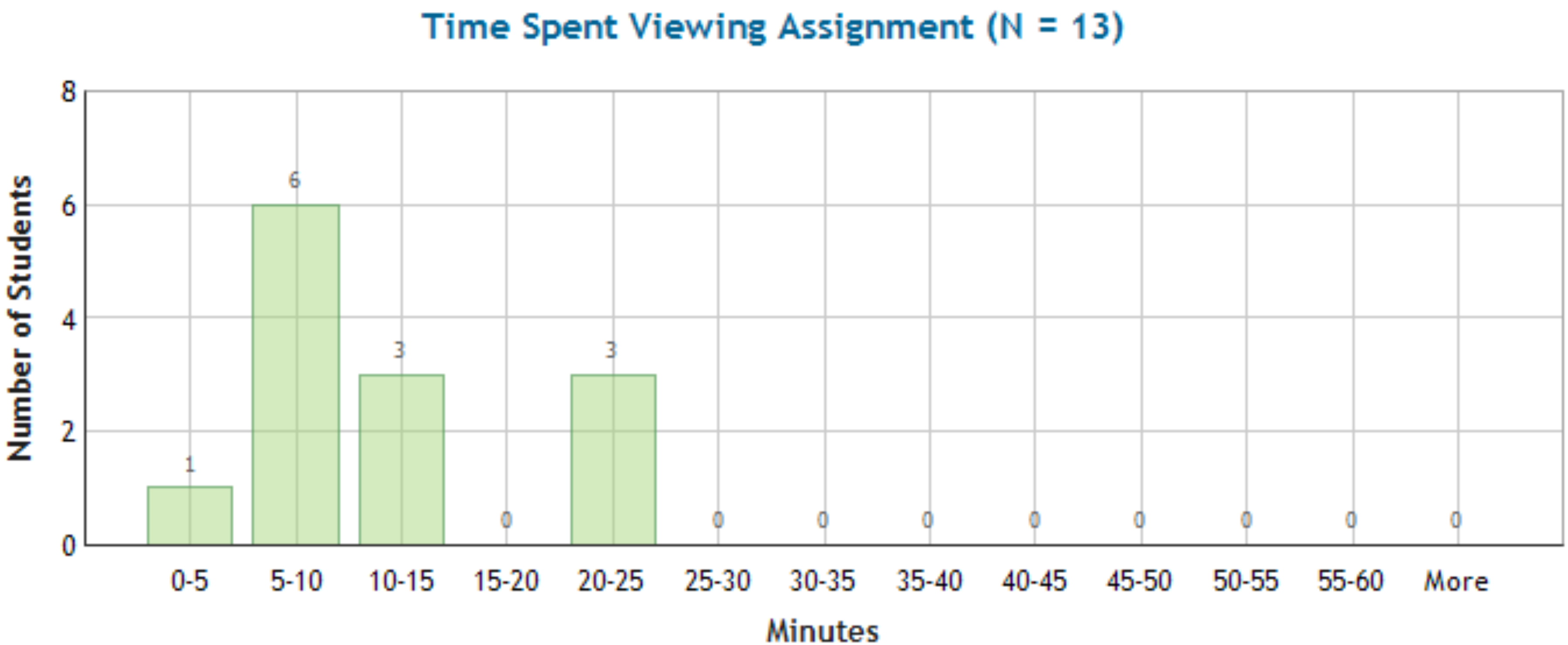
Your Comments

"The connection between acceleration and displacement"

"does the velocity actually goes to zero as the cart turns from right to left? how is the cart still moving if the velocity is zero?"

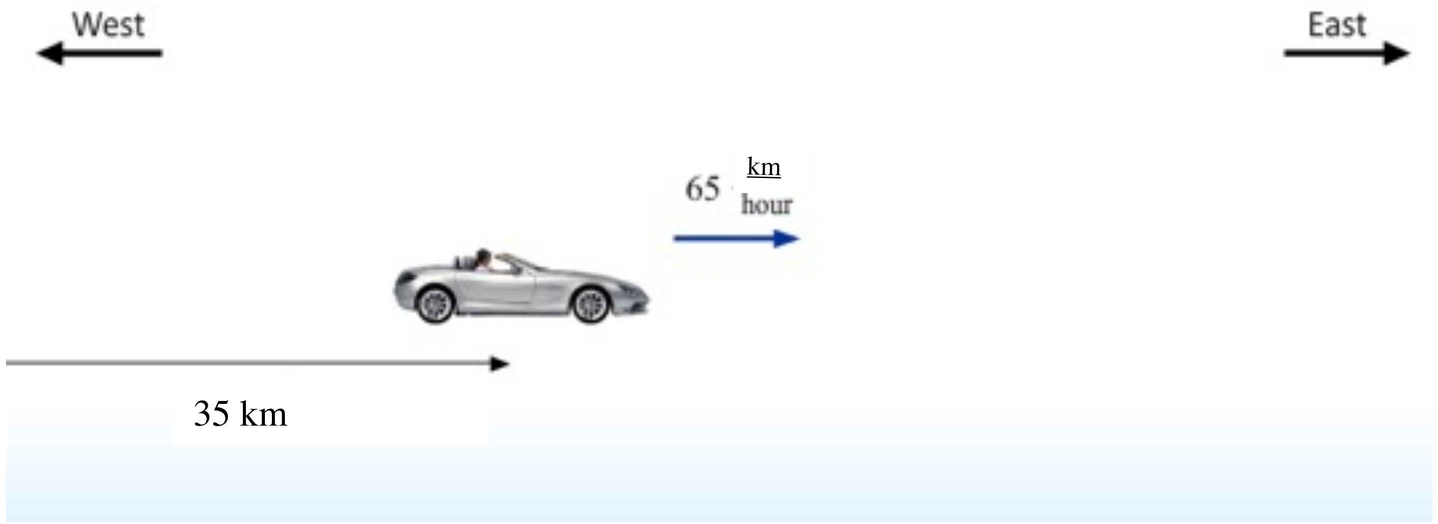
"Perhaps the introduction of the calculus concept is setting us up for later in the course?"

That's right



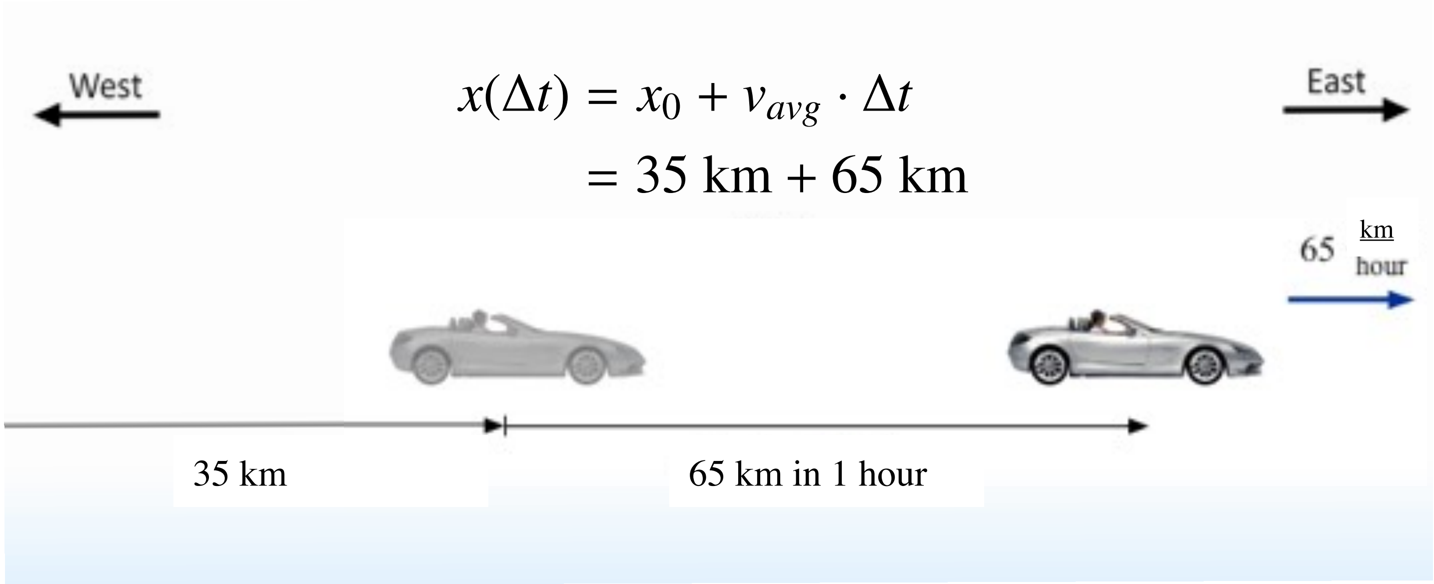
smartPhysics

Prelecture Example



Prelecture Example

$$x(\Delta t) = x_0 + v_{avg} \cdot \Delta t$$
$$= 35\text{ km} + 65\text{ km}$$



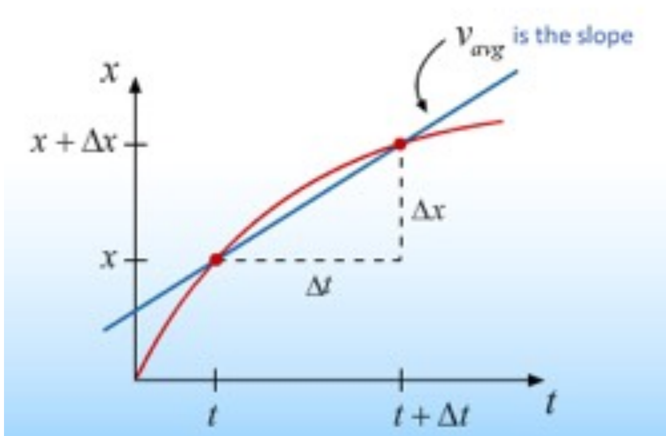
Displacement and Velocity in One Dimension

Average Velocity

$$v_{avg} \equiv \frac{\Delta x}{\Delta t}$$

Displacement (Δx)

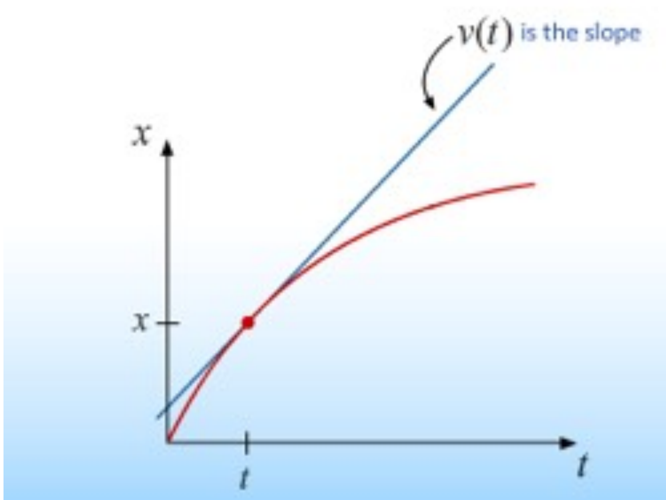
Time taken (Δt)



Displacement and Velocity in One Dimension

Instantaneous Velocity

$$v(t) \equiv \frac{dx(t)}{dt}$$

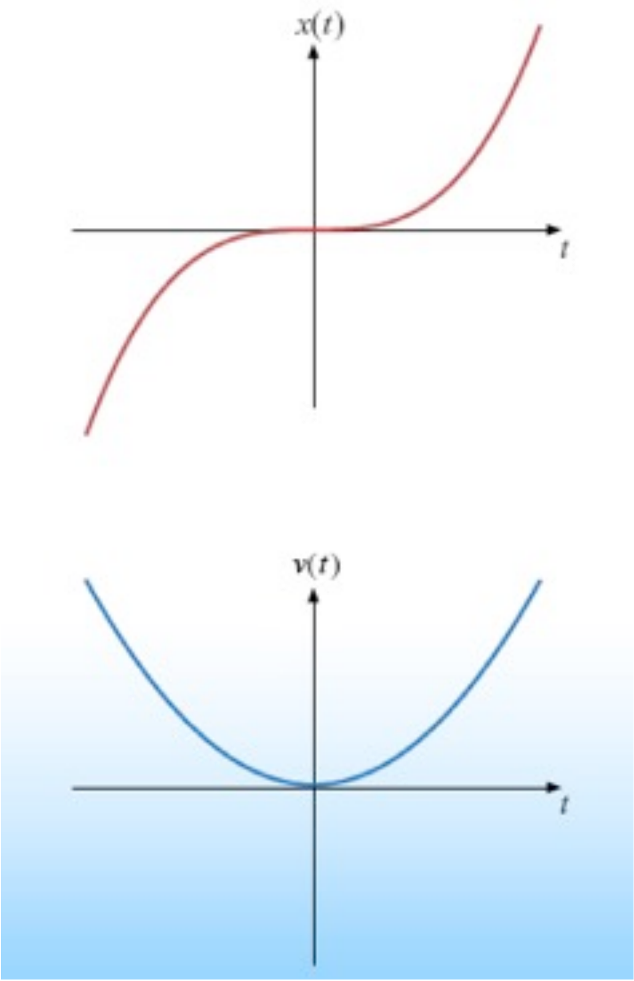


The $v(t)$ vs. t plot is just the <u>slope</u> of the $x(t)$ vs. t plot

Definition:

$$Speed = |v(t)|$$

Displacement and Velocity in One Dimension



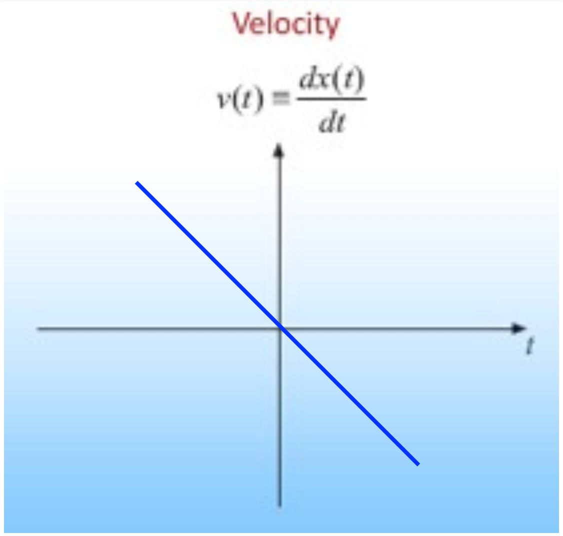
Are the plots shown at the left correctly related

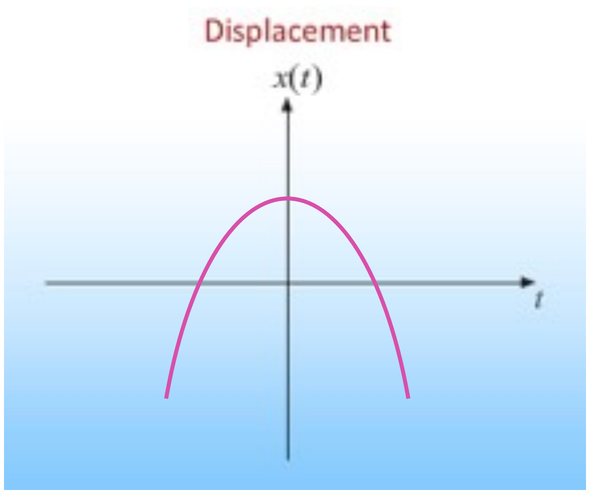
A) YES
B) NO

Clicker Question

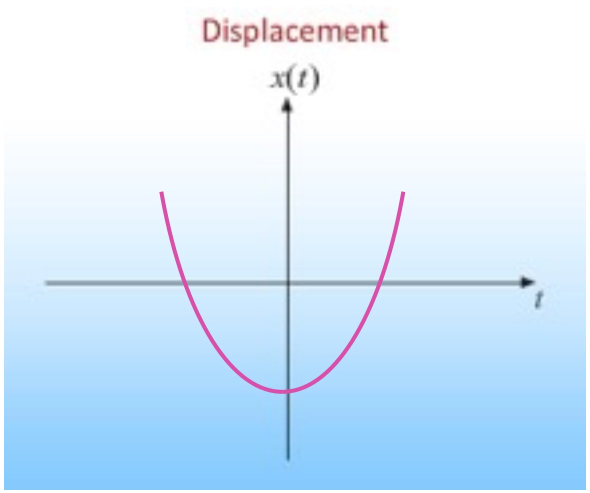
The velocity vs. time plot of some object is shown to the right.

Which diagram below could be the Displacement vs. time plot for the same object?

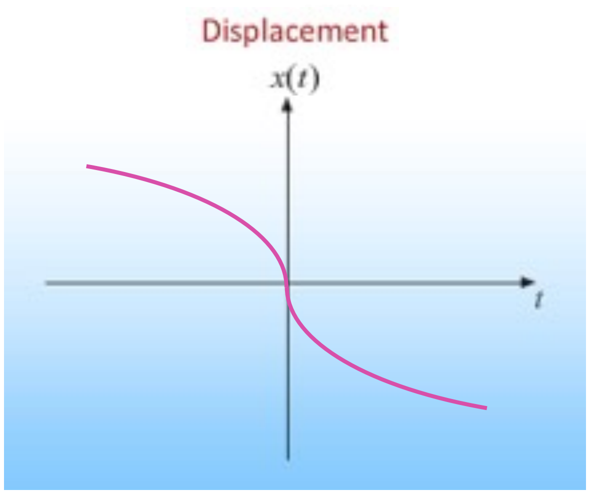




A



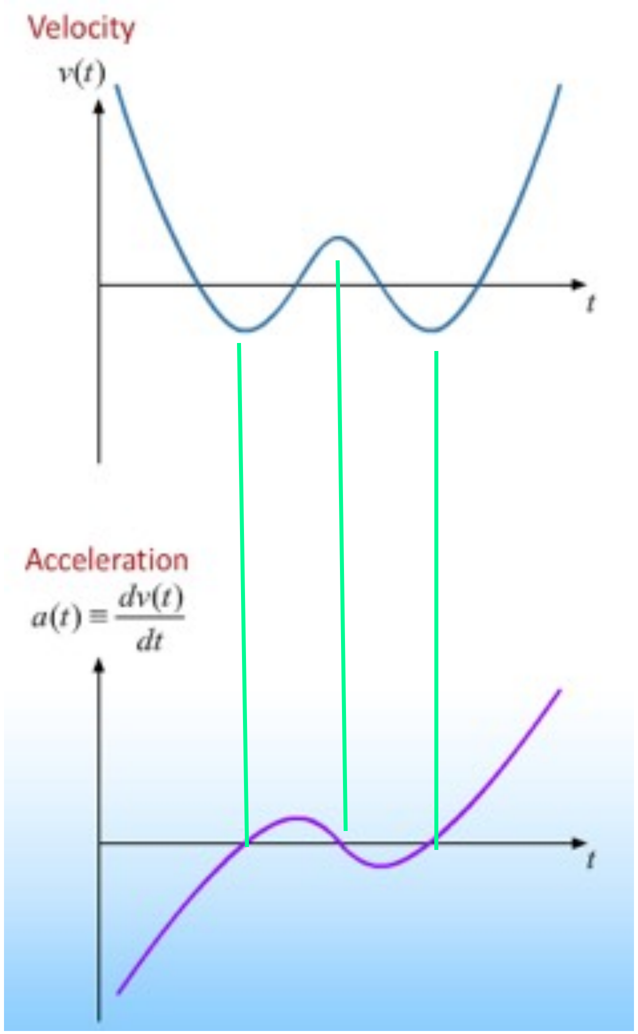
B



C

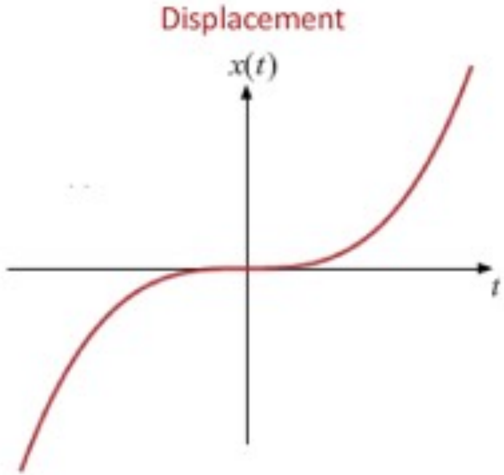
Acceleration

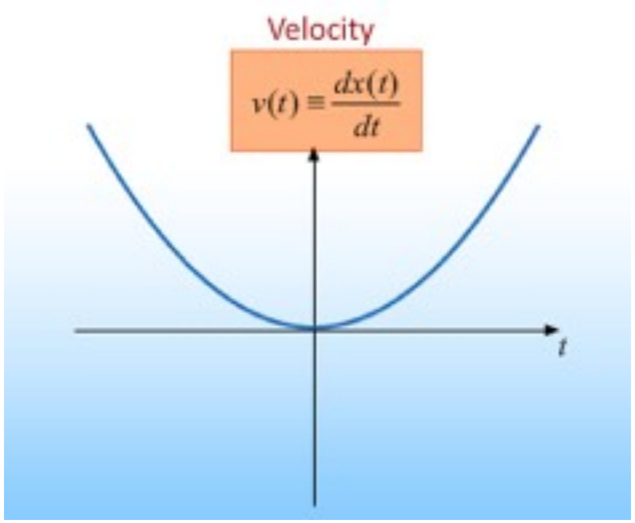
Displacement	$x(t)$
Velocity	$v(t) \equiv \dfrac{dx(t)}{dt}$
Acceleration	$a(t) \equiv \dfrac{dv(t)}{dt}$



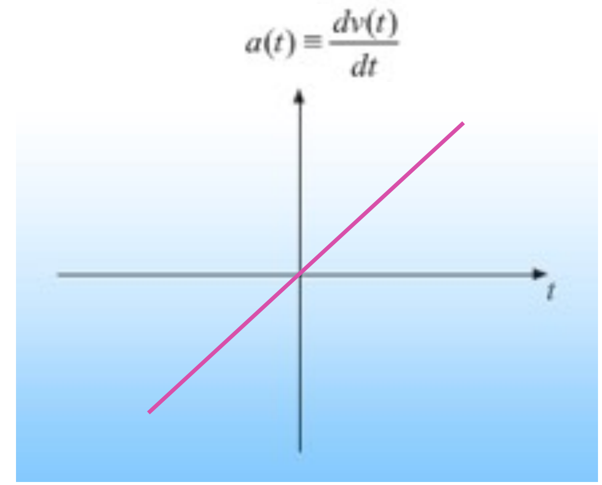
Checkpoint 1

For the Displacement and Velocity curves shown on the left. which is the correct plot of acceleration vs. time?





A



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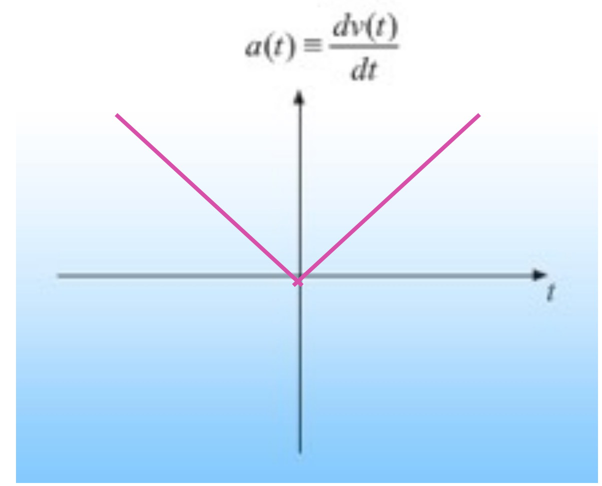
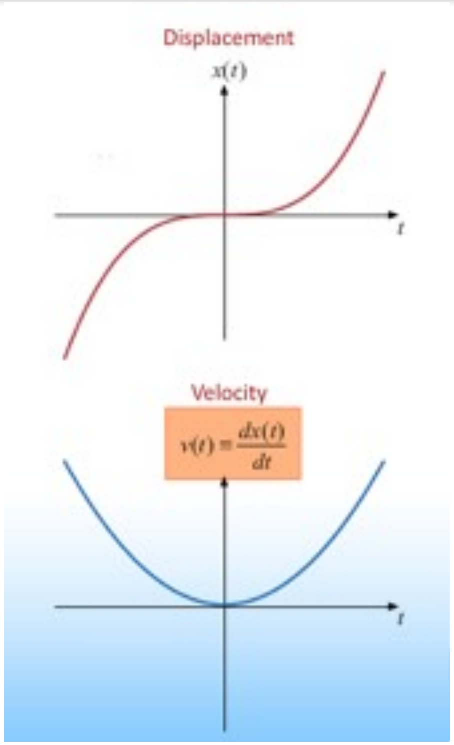
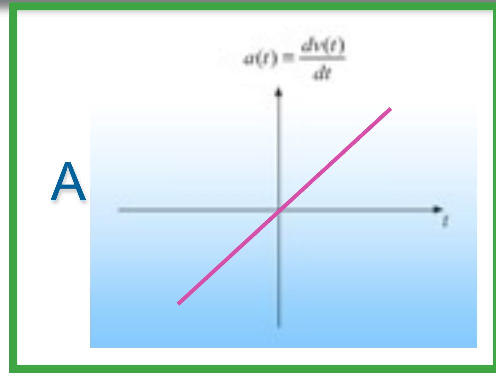
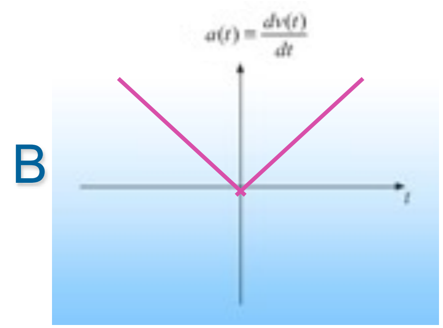
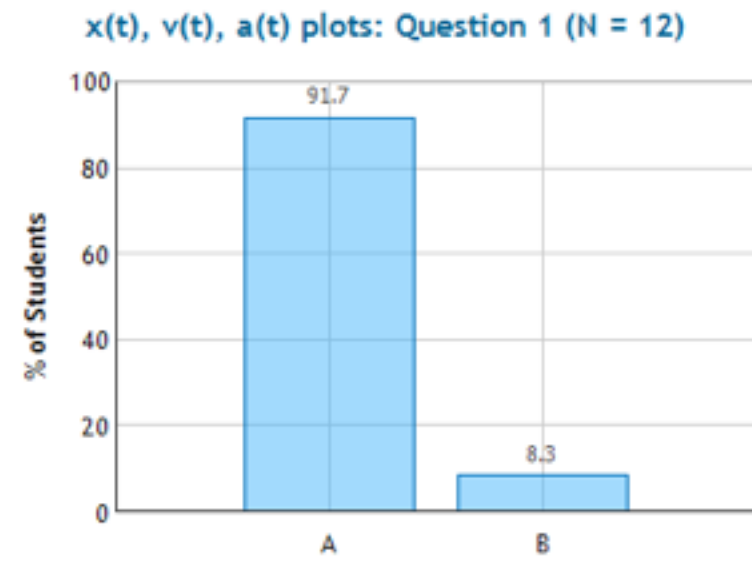


Clicker Question 4









Typical A answer

The velocity curve has a negative slope when t<0 and a positive slope when t>0. Therefore, the acceleration's value is negative when t<0 and positive when t>0.

Typical B answer

Since the velocity slowed down then increased I chose that graph because it showed a deceleration then acceleration.

Constant Acceleration

$$v(t_f) - v(t_i) = \int_{t_i}^{t_f} a(t)dt$$

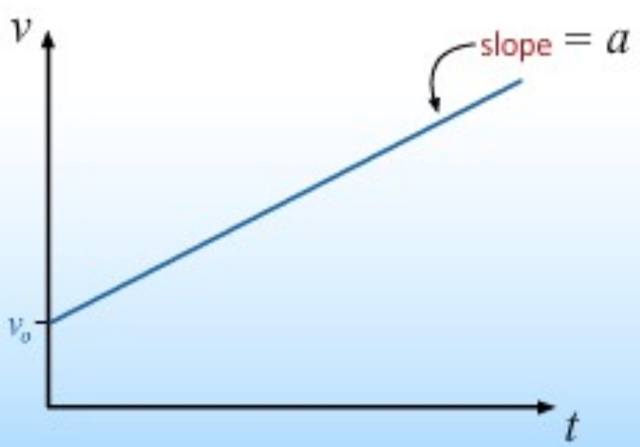
$$x(t_f) - x(t_i) = \int_{t_i}^{t_f} v(t)dt$$

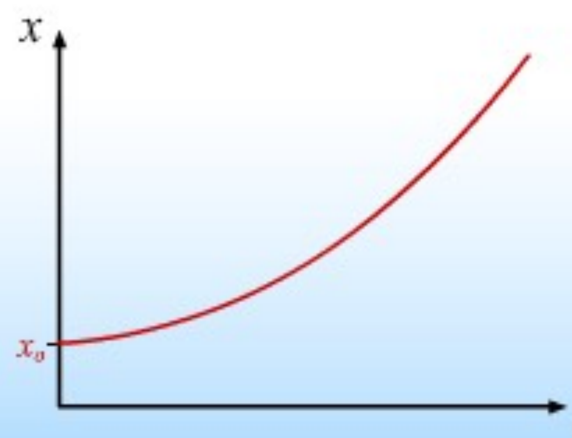
constant $a(t) = a$

$$x = x_o + v_o t + \frac{1}{2}at^2$$

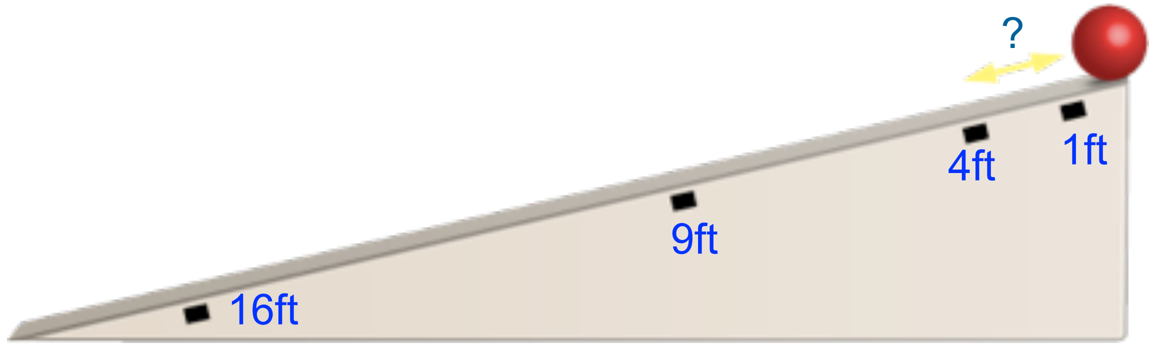
$$v = v_o + at$$

$$v^2 - v_o^2 = 2a(x - x_o)$$





Clicker Question 5

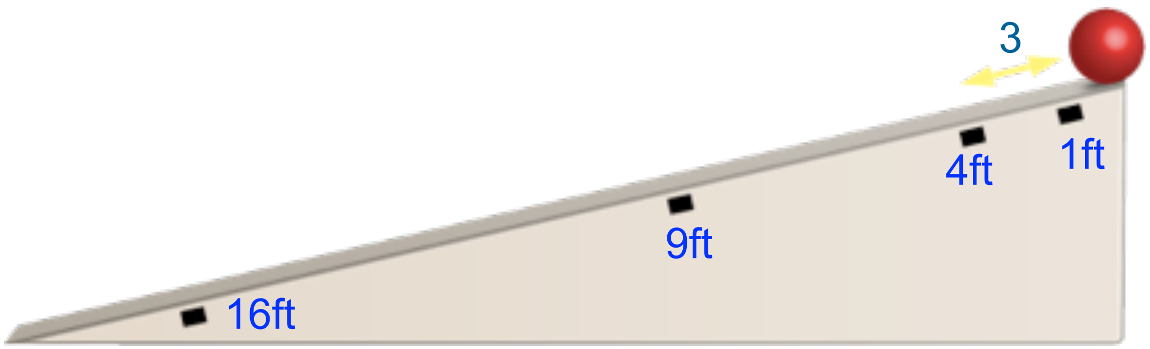


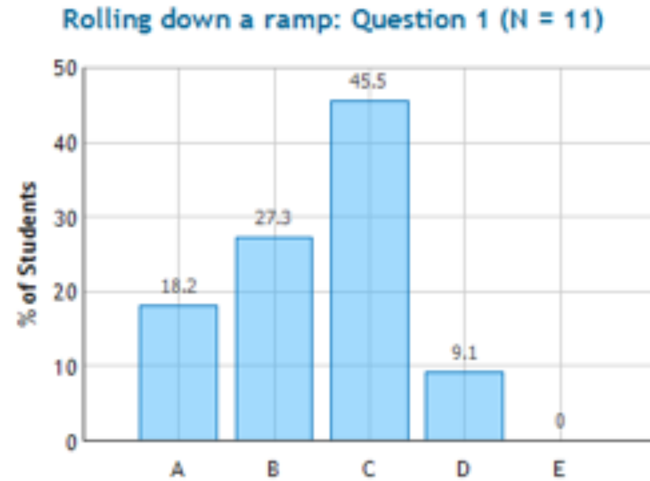
At $t = 0$ a ball, initially at rest, starts to roll down a ramp with constant acceleration. Suppose it moves 1 ft between $t = 0\text{ sec}$ and $t = 1\text{ sec}$.

How far does it move between $t = 1\text{ sec}$ and $t = 2\text{ sec}$?

A) 1 ft B) 2 ft C) 3 ft D) 4 ft E) 6 ft

Checkpoint 2 Responses





Typical A answer

Constant acceleration means, the velocity of the ball is increasing at a constant rate thus, the ball will cover the same distance as it covered in the first second after release. from V = at

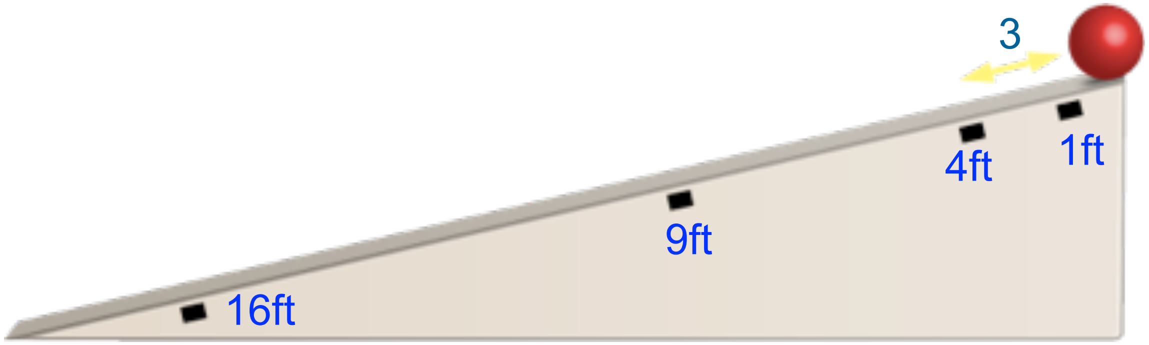
Typical B answer

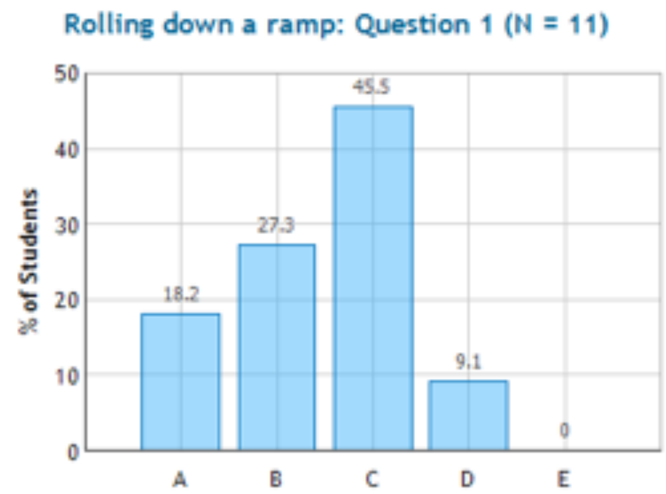
If the acceleration is constant, then the velocity is always increasing at the same rate. At t=0 the velocity was 0, at t=1 the velocity was 1 feet/s, so the velocity at t=2 must be 2 feet/s. Which means that between t=1 and t=2 it moved 2 feet.

Typical C answer

Acceleration is 1 ft/s^2 and the velocity at the end of the first interval is 2ft/s so at the second interval the distance is 3 ft from the equation d= v + 1/2 at^2

Checkpoint 2 Responses





Typical D answer

x(t) = a*t^2 x(1) =a*(1)^2 = 1 --> a = 1 x(2) = (1)*(2)^2 = 4

Question asks for distance from t=1 s to t=2.

Typical E answer (last year)

The equation $v_f = v_o + at$ will give us the final velocity and with that the final displacement. Given that v_o = 1 foot/second, a = 4.9 (this is true due to the gravitational pull from the ramp assuming a 30° ramp) and t to be 1s. This calculates to the final an swer being approximately 5.9 m.

$g \neq 9.8$ ft/s^2 — angle not necessarily 30°

If there's time

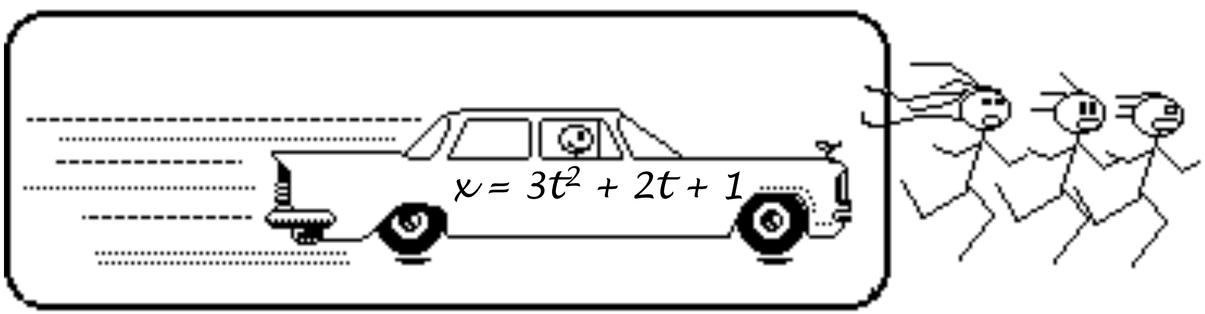
"Not relating to the prelecture, but in the checkpoint it uses feet instead of metre. Are we going to have to know the conversions for the imperial system as well in this course??

NO

Name ________________________ Date (YY/MM/DD) ______/_________/_______

SFU e-mail________@sfu.ca Section__________ Group______

UNIT 4: ONE-DIMENSIONAL MOTION II
A Mathematical Description



At the point where a speeding driver is caught by a cop, the cop comes up to the speeder and says, "You were going 60 miles an hour!" The driver says, "That's impossible, I was

Numerical analysis of motion from a picture.

is possible to view the position of the cart on each frame as shown in Figure 4-2 below.

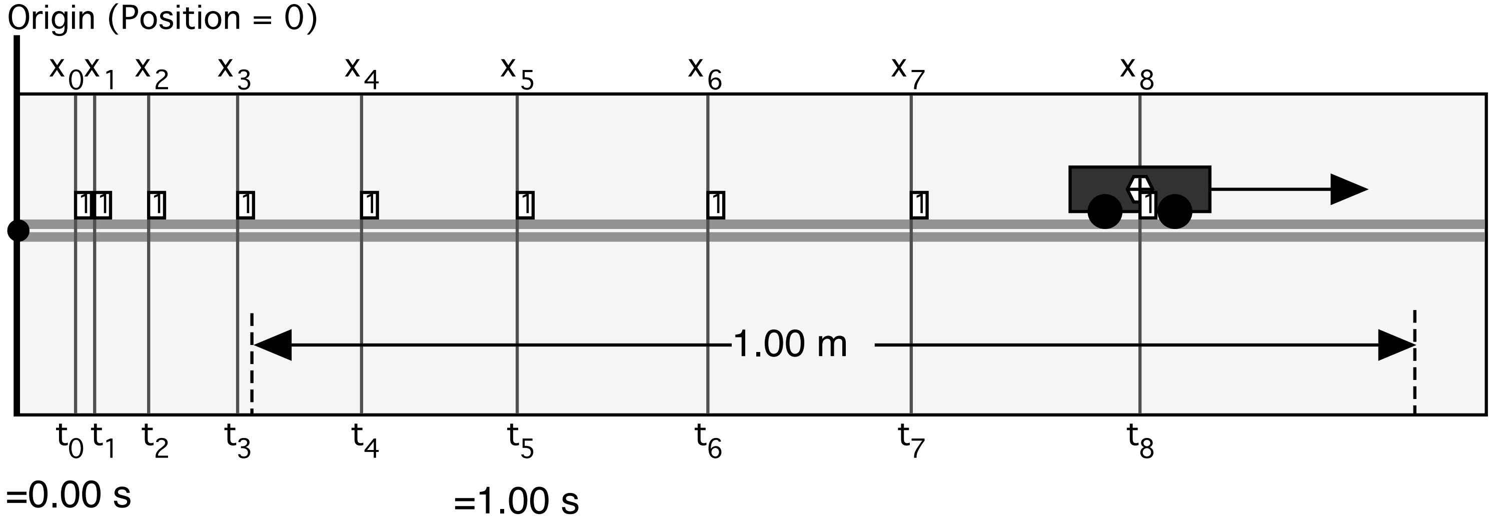


Figure 4-2: A scale diagram of the position of an accelerating cart at 8 equally spaced time intervals. The cart actually moved a distance of just less than 1 metre. Every 6th frame was displayed in the cart movie, so that 5 frames were recorded each second. *At each time the centre of the cart is located in the upper left corner of the rectangle with a number 1 in it.*

Measure the picture

Fill in the table.

- d is the distance on the picture
- x is the distance in reality
- measure to the nearest 0.1 mm
  - guess the tenths of mm

the cart's distance from the origin in pixels (1 pixel = 1 picture element).

TABLE 4-1

Frame #	Position	cm (or pixels) from origin in diagram **1** **d( )**	Elapsed Time (s) **2** **t(s)**	Actual distance from origin (m) **3** **x(m)**
0	x_0		0.000	
			0.100	
1	x_1		0.200	
			0.300	
2	x_2		0.400	
			0.500	
3	x_3		0.600	
			0.700	
4	x_4		0.800	
			0.900	
5	x_5		1.000	
			1.100	
6	x_6		1.200	
			1.300	
7	x_7		1.400	
			1.500	
8	x_8		1.600	

Put the average velocity at the midpoint of the position interval.

Put the average acceleration at the midpoint of the velocity interval.

Don’t write in the shaded boxes.

TABLE 4-2

Elapsed Time (s) 2	Actual distance from origin (m) 3	Average velocity (m/s) 4	Average acceleration (m/s) 5
***t*(s)**	***x*(m)**	**<*v*>(m/s)**	**<*a*>(m/s/s)**
0.000			
0.100			
0.200			
0.300			
0.400			
0.500			
0.600			
0.700			
0.800			
0.900			