

The Assessment Continuum

Before, in, and after lecture

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Michigan State University
April 16, 2012

Slides borrowed from:
Gerd Kortemeyer

What makes a good use of technology in education?

Must be integrated into the educational experience!

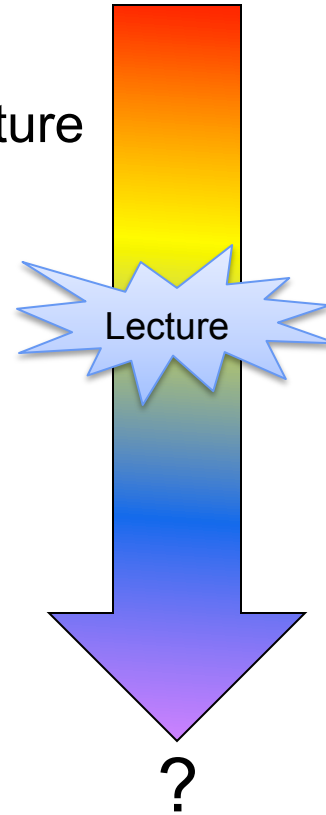
- supporting the goals
 - not technology for technology sake
- not scattered "technology highlights"
 - consistently applied
 - students know what to expect and what is expected
- moving into the background
 - not wizz-bang or gimmicky
- increasing effective time on task
 - make the students interact with the materials
 - do not waste student time
- Giving effective and timely feedback to learners and instructors: **assessment**

Assessment

- Assessment: Feedback to learners and instructors
- Formative assessment:
 - Students can keep track of their own learning
 - Students do not fall behind
 - Instructors keep track of their students' learning
 - can adapt the teaching to the learning
- Summative assessment: exams
 - Technology allows for frequent exams

Assessment

- Pre-Class Questions
 - Students being prepared for lecture
 - Just-In-Time Teaching
- In-Class Questions
 - Clickers
- Post-Class Questions
 - Homework
 - Online Discussions, Helprooms
 - Exams
- Does this even work?
- ***How is this realistically possible?***
 - *That's where course and learning content management come in!*




Pre-Class Questions

Students being prepared for
lecture

Just-In-Time Teaching

Pre-Class Questions

Gerd Kortemeyer (No Role, Cumulative Privileges)

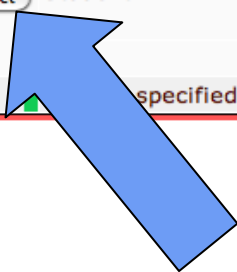
 Messages Roles Help Logout

Main Menu |

Menu » **User Roles**

Show all roles

	User Role	Extent	Start	End
Construction Space				
<input type="button" value="Select"/>	Author	Domain: nds Server: vita.sonia.de	Tue May 11 12:13:40 am 2010 (CEST)	
Course				
<input type="button" value="Select"/>	Course Coordinator	Your Test Course Syllabus Domain:nds		
<input type="button" value="Select"/>	Student	LB271, Fall 2008 - Intro Calculus-Based Physics I Syllabus Section: guest	Sun Aug 24 06:00:00 am 2008 (CEST)	Tue Dec 14 05:59:59 am 2010 (CET)
		specified		Currently selected.



Pre-Class Questions

- Easy questions embedded into content
- Due before lecture

▼ Time-Varying Currents Materials			
• Introduction			
• RC Circuit			
• RC Circuit Example			
• Applet: RC Circuit with Battery			
• RL Circuit with Battery			
• RL Circuit with Battery Example			
• LC Circuit			
• LC Circuit with Battery Example	💬		
• LC Circuit Time Evolution			
• LC Time Evolution Example			
• DC RCL Circuit			
? DC Circuit Basics	💬	✗	Answer available
• Alternating Currents and Voltages			
• Applet: Oscilloscope			
• AC Power Dissipation in a Resistor			
• AC Power Dissipation Example			
? RMS Current, Voltage, and Power	💬	✗	Answer available
• Inductance in an AC Circuit			
• Inductance in AC Circuit Example			
? RL-Circuits		✗	Answer available
• Capacitor in an AC Circuit			

Pre-Class Questions

- Make sure students read materials
- Questions can be answered just based on the readings
- Students come prepared

Which of the following statements are true?

False: In a circuit consisting of an AC voltage source and a resistor, the dissipated power is proportional to the current.

True: In a circuit consisting of an AC voltage source and a resistor, the voltage drop across the resistor and the voltage source are in phase.

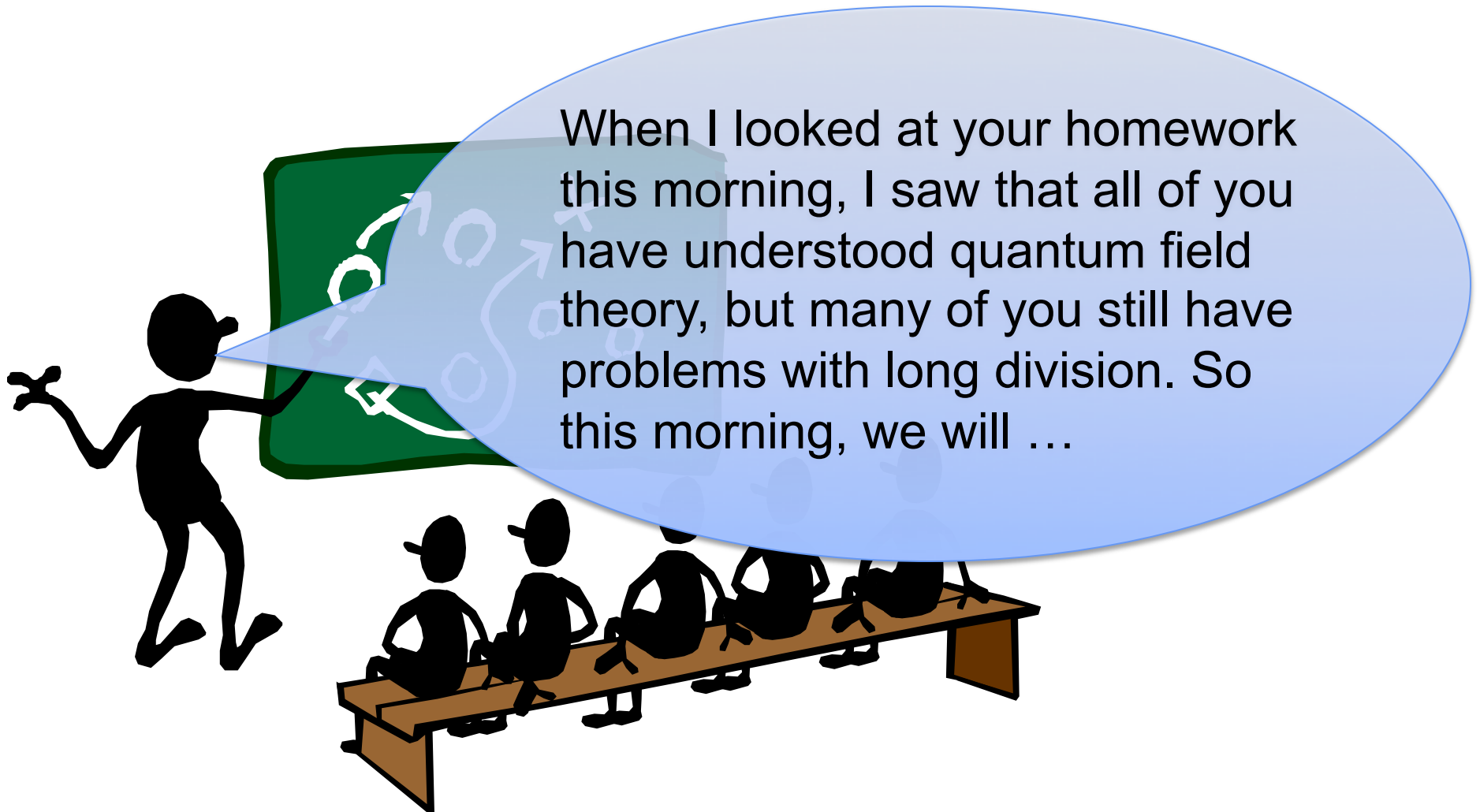
True: The rms-voltage is proportional to the maximum AC-voltage.

True: In a circuit with a capacitor and inductance in series (no resistance), if the capacitor is initially charged, an un-damped harmonic oscillation takes place.

Computer's answer now shown above. Tries 0/6

Just-In-Time

- Adapt lecture to student difficulties



Just-In-Time

Course Action Items

Gerd Kortemeyer
Course Coordinator
LBS 272 - Spring 2006

LBS 272 - Spring 2006 > Display Action Items

What's New?

[Go to first resource](#)

Page set to be displayed after you have viewed the [What's New? page \(user preference\)](#) **Change** for just [this course](#) or for all your courses.

[Hide all](#) [Show all](#)

Problems requiring handgrading [Hide](#)

Problem Name	Number ungraded
Electric Field	4

Problems with [Hide](#)

No problems with

Problems with av. attempts ≥ 3 or deg. difficulty ≥ 0.8 and total number of students with submissions ≥ 4 [Hide](#)

Change thresholds?						
Resource	Part Num.	students	Av. Attempts	Deg. Diff	Last Reset	Reset Count?
Field Lines	single part	24	2.12	0.84		<input type="checkbox"/>
Net Force	single part	53	2.49	0.80		<input type="checkbox"/>
Pith Balls	single part	52	4.12	0.90		<input type="checkbox"/>

[Reset counters to 0](#)

Resources in course with version changes since last week [Hide](#)

Change interval?			
Resource	Last revised	New version	Version used
Applet: Electron Orbit	Fri Jan 13 10:18:52 2006 (EST)	10	10
Capacitance of a Sphere	Mon Jan 16 12:03:13 2006	8	8

Discussions

Difficult problems

Unread course discussion posts [Hide](#)

Change options?			
Location	Type	Time of last post	Number of new posts
Coulomb	Resource	last Monday, Jan 16 at 04:55 pm (EST)	1
Distance Change	Resource	last Monday, Jan 16 at 07:00 pm (EST)	1
Field Lines	Resource	last Monday, Jan 16 at 07:49 pm (EST)	1
Force	Resource	on Wednesday, Jan 11 at 07:01 pm (EST)	3
Net Force	Resource	23 hours, 19 minutes ago	5
Pith Balls	Resource	last Monday, Jan 16 at 09:21 pm (EST)	6
Point P	Resource	last Friday, Jan 13 at 02:34 pm (EST)	5
Potential	Resource	last Sunday, Jan 15 at 03:15 pm (EST)	1
Two Charges	Resource	last Sunday, Jan 15 at 03:26 pm (EST)	1
Vector	Resource	last Saturday, Jan 14 at 01:32 am (EST)	1
Vectors	Resource	last Saturday, Jan 14 at 12:09 pm (EST)	2

New course messages [Hide](#)

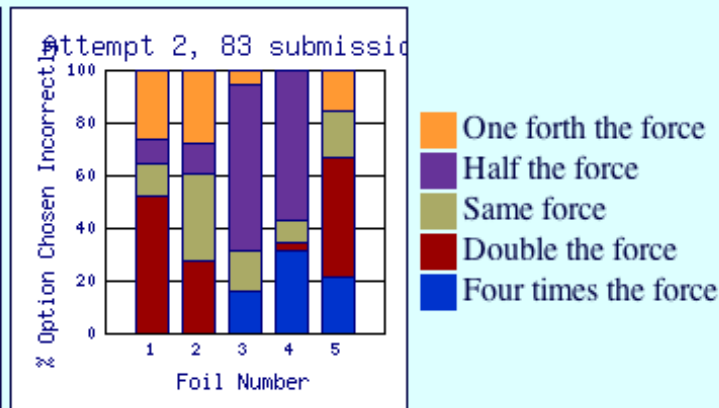
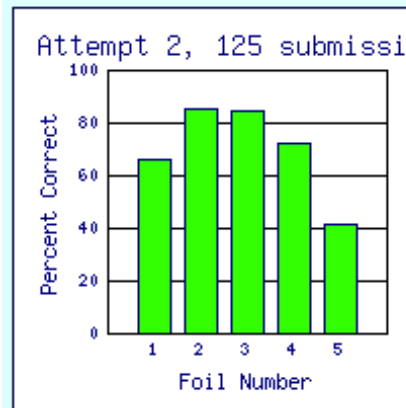
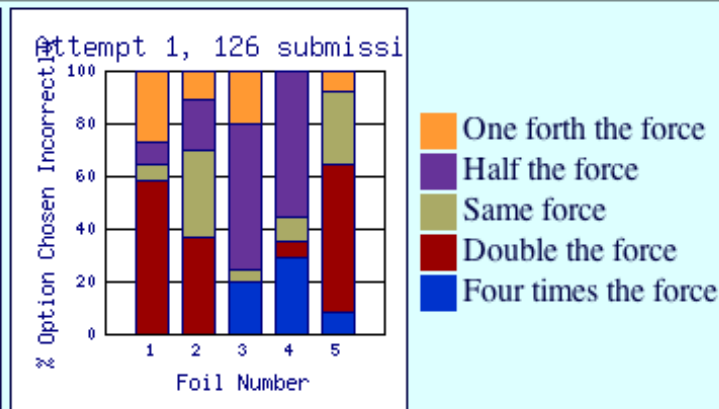
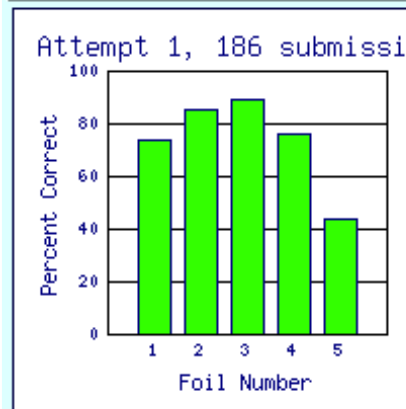
Number	Subject	Sender	Date/Time
1.	Feedback [msu/mmp/kap18/problems/cd460.problem]	@msu	Sat Jan 14 10:45:02 2006 (EST)

New critical messages in course [Hide](#)

No unread critical messages in course

Just-In-Time

Foil Number	Foil Name	Foil Text	Correct Value
1	1_6_1_1_2	The distance between the two charges is cut in half.	Four times the force
2	1_6_1_2_2	The magnitude of both charges is doubled.	Four times the force
3	1_6_1_3_2	The magnitude of one of the two charges is doubled.	Double the force
4	1_6_1_4_2	The distance between the charges is doubled.	One fourth the force
5	1_6_1_5_2	The charges are placed in a medium with a factor two higher permittivity.	Half the force



In-Class Questions

Clickers

Clickers

Doesn't he get that we don't get it?

Yawn!

That's clear
– no, wait ...

Looks like everybody but me understands this!

I wonder what's for lunch

Sadly, too often:
Anonymous crowd
in our lecture hall
We don't know
what's going on in
their heads



Clickers

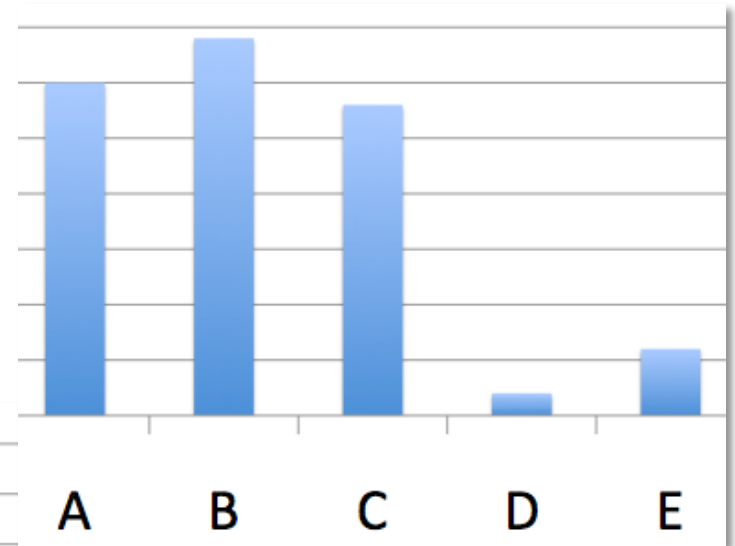
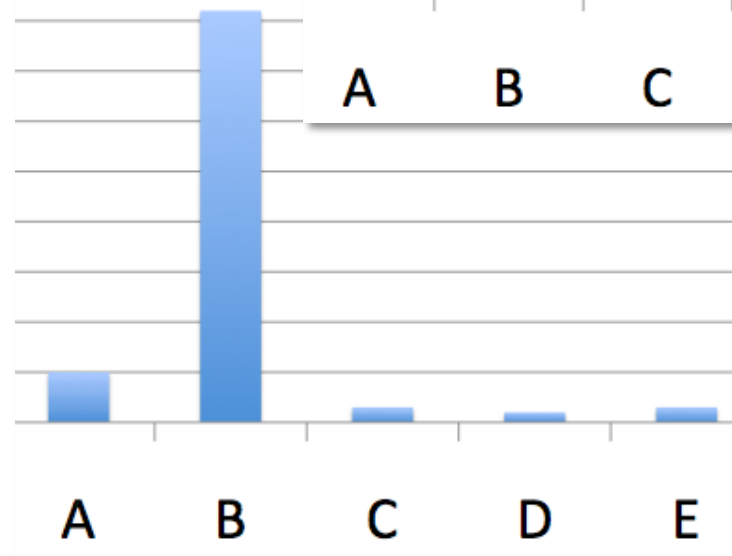
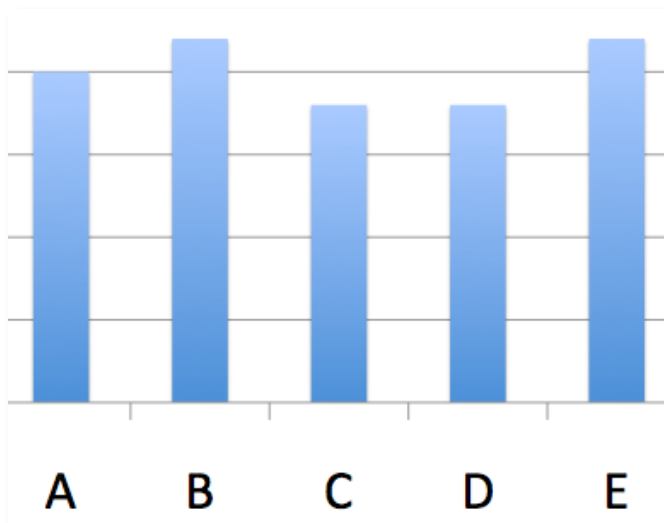
- RF devices
- One per student
- Students can answer questions during lecture



Clicker

Lecture progress depends on voting outcome

- Explain again
- Go on
- Let students discuss and vote again



Clicker

Peer-Instruction

- Students can sometimes explain concepts better than us to their peers
 - We have forgotten what we initially struggled with
- Students learn while explaining

Clicker

- Students register in LON-CAPA

LON-CAPA Change Preferences

http://phy1.lbs.msu.edu/adm/p

Getting Started Latest Headlines

LON-CAPA Course Statistics an... LON-CAPA Change Preferences

[Main Menu](#) [Launch Remote Control](#) [Roles](#) [Help](#) [Exit](#)

Change Preferences

[Menu->Set User Preferences->Register Clicker](#)

Enter response device ("clicker") numbers

005BC59E

Register

Gerd The Kortemeyer
No Role, Cumulative Privileges

Change Preferences

Clicker

- Give credit for correct and for incorrect answers


 [Main Menu](#) [Return to Last Location](#) [Navigate Contents](#)

Grading (msu_8p96131ebae7b47b8msul1 ss08lbs272)

Current Resource: Mon, Mar 10th

Part: 0 **score** **Type:** numerical

Specify a file containing the clicker information for this resource.

 MonMar10thA.csv

Type:

Award points just for participation

Correctness determined from response by course personnel

Correctness determined from response with clicker ID(s)

Percentage points for correct solution:

Percentage points for incorrect solution:

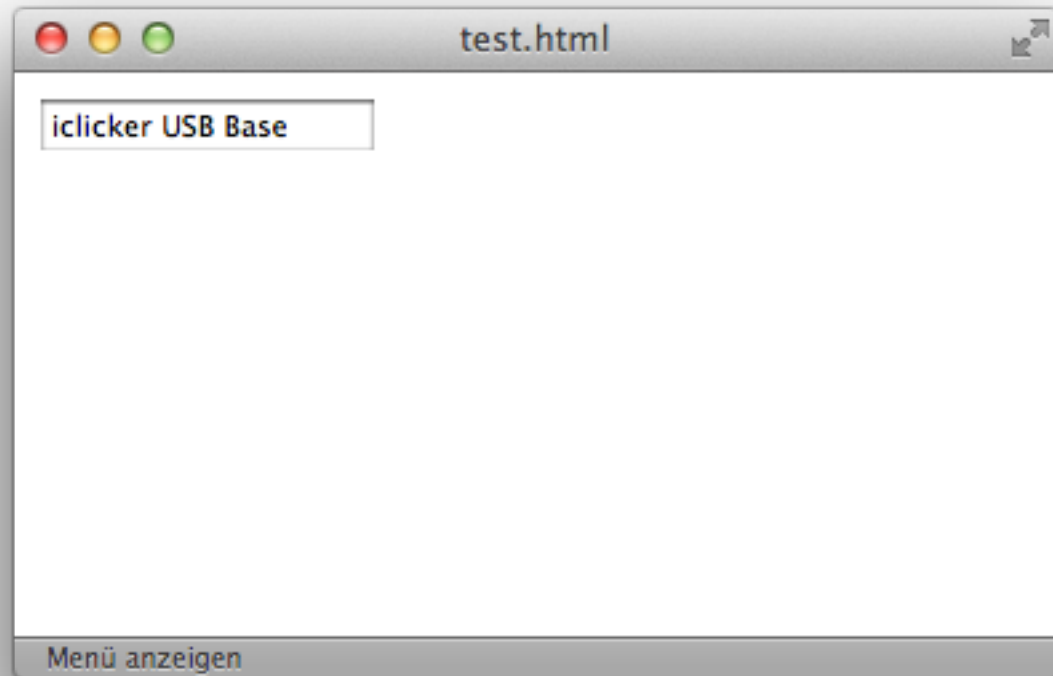
Clicker

- Embedded in course, alongside slides

▶	Homework		
▶	Recitation Grades		
▼	Clicker Slides and Grades		
✖	Mathematical Pre-Course, Part 1		
?	Mathematical Pre-Course, Part 1	→	Open, no due date
✖	Mathematical Pre-Course, Part 2		
?	Mathematical Pre-Course, Part 2	→	Open, no due date
✖	Units and Dimensions, Part 1		
?	Units and Dimensions, Part 1	→	Open, no due date
✖	Units and Dimensions, Part 2, and Kinematics, Part 1		
?	Units and Dimensions, Part 2, and Kinematics, Part 1	→	Open, no due date
✖	Kinematics, Part 2		
?	Kinematics, Part 2	→	Open, no due date
✖	Kinematics, Part 3		

Currently under Development

- Currently: uploading of session data
- Work-in-progress: running session out of LON-CAPA
- Questions from shared content library (more later)
- Item statistics



Post-Class Questions

Homework

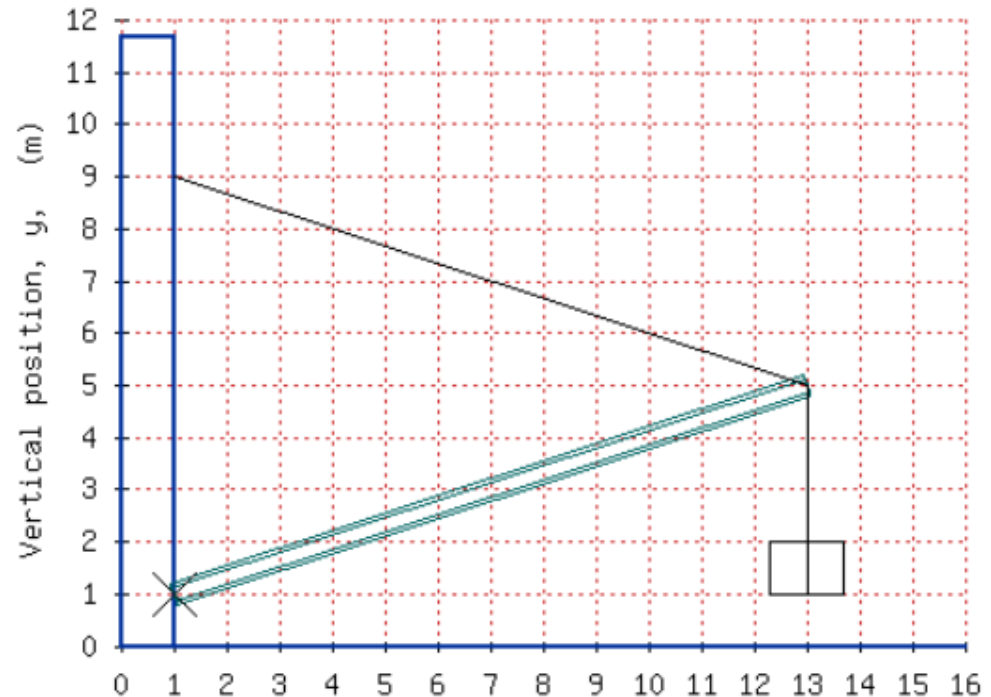
Helprooms

Exams

Homework

More sophisticated
highly
randomizing
problems

A crate with a mass of 155.5 kg is suspended from the end of a uniform boom with mass of 89.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



Homework

- ...special emphasis on math
 - including support of
 - LaTeX
 - Maxima
 - R

Give an example of a function

1. which is orthogonal to $6\cos(7x) - 2\sin(2x)$ with respect to the scalar product

$$\langle g | h \rangle = \frac{1}{\pi} \int_{-\pi}^{\pi} dx g(x) \cdot h(x)$$

2. whose norm is 1.

cos(2x)+sin(7x)

The function you have provided does not have a norm of one.

Submit Answer Incorrect. Tries 1

What is the derivative of

$$\begin{pmatrix} 4t^3 \\ 8t^8 \end{pmatrix}$$

with respect to t ?

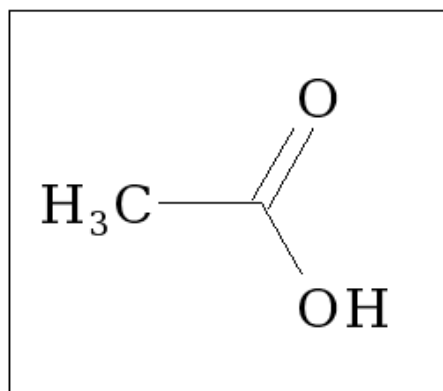
You need to multiply with the original exponent.

Submit Answer Incorrect. Tries 1

Homework

- ... chemistry ...

The image below is $C_2H_4O_2$



Draw acetic acid.

Draw Molecule

Submit Answer Tries 0/99

 [Post Discussion](#)

The screenshot shows the JME Editor interface. At the top, the window title is "Untitled". Below the title bar is a "Select substituent" dropdown menu. The main drawing area contains a skeletal structure of acetic acid. The left sidebar lists elements: C, N, O, S, F, Cl, Br, I, P, X. The top toolbar includes icons for CLR, DEL, D-R, +/-, UDO, and JME. At the bottom of the editor, there are buttons for "Insert Answer", "Close", and "Help". A credit line at the bottom reads "JME Editor courtesy of Peter Ertl, Novartis".

Homework

- ... physical units ...

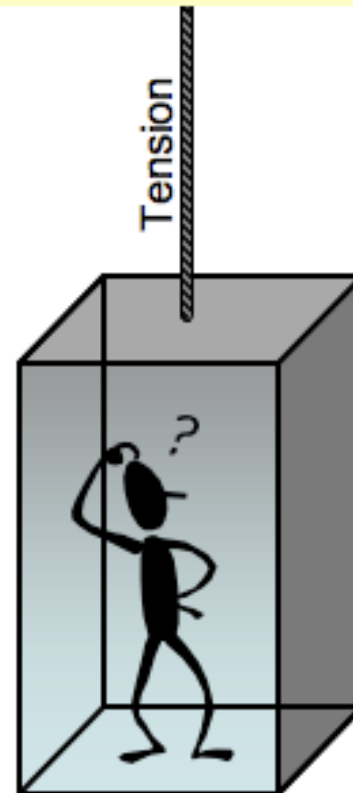
Elevator Problem

Due never

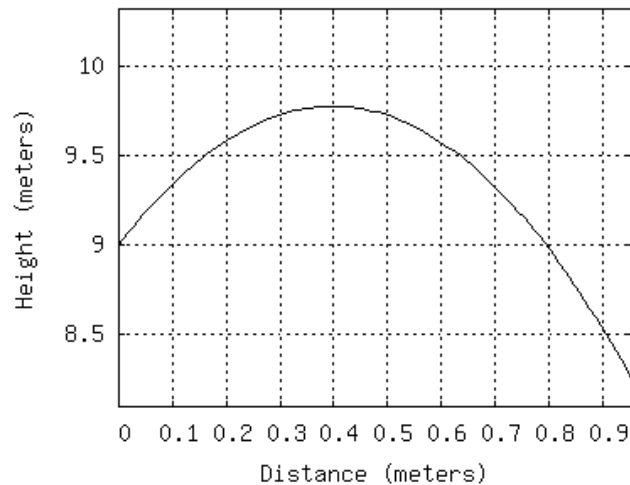
An elevator (cabin mass 500 kg) is designed for a maximum load of 2600 kg, and to reach a velocity of 3 m/s in 5 s. For this scenario, what is the tension the elevator rope has to withstand?

Submit Answer

Tries 0/99



Online Discussions



The plot shows the trajectory (height versus distance) of an object launched at an angle of 75.6 degrees. What was the initial speed of the object? **4.0 m/s**
Computer's answer now shown above. Tries 0/12

[Threaded View](#) [Chronological View](#) [Sorting/Filtering options](#) [Export?](#)

Anonymous 1 (Fri Sep 22 01:26:29 2006 (EDT))

any hints to start?

Re: *Anonymous 2* (Fri Sep 22 01:56:48 2006 (EDT))

You need to find the Y component of velocity... you can do this by finding the height traveled (notice it does not start on the ground) and combining that with acceleration in a kinematics equation. From there use trig to get the original velocity.

Re: Re: *Anonymous 1* (Fri Sep 22 12:10:37 2006 (EDT))

how can we find the height traveled and how can we get the acceleration if we don't have the time?

Anonymous 3 (Fri Sep 22 16:41:27 2006 (EDT))

i'm lost on this one... can anyone help?

Re: *Anonymous 4* (Fri Sep 22 20:02:45 2006 (EDT))

Use the squared kinematics equation - so $V_f^2 = V_i^2 + 2a(X_f - X_i)$.

Discussions

Encouraged, since all students have different versions.
Again: Peer-Instruction.

Helprooms

- Staffed with Learning Assistants in the evenings

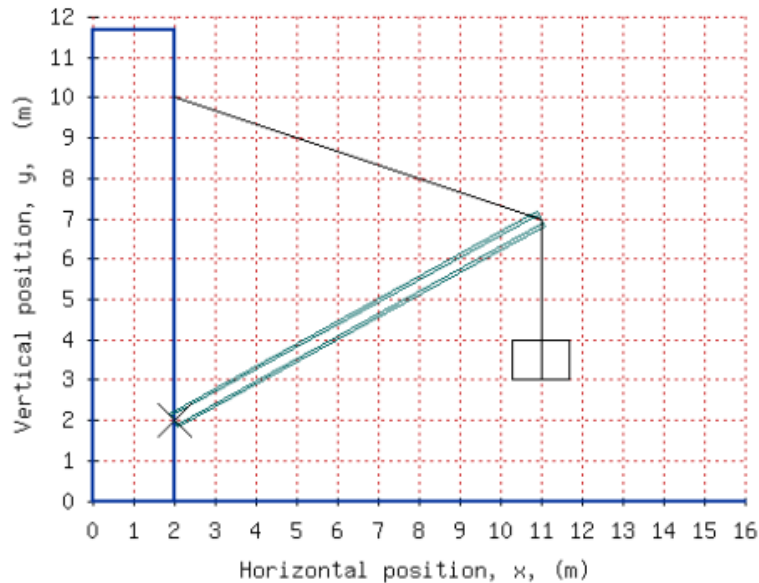


- Collaborative learning space, peer instruction

Exams

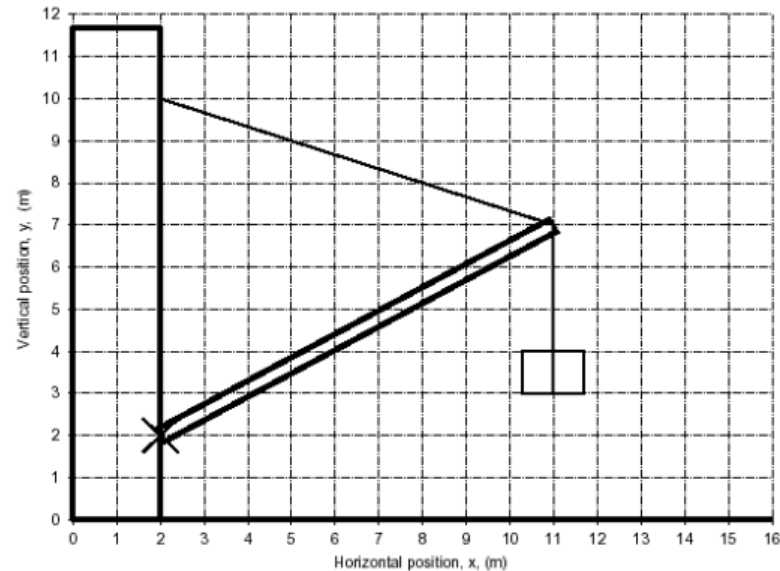
- Problems can also be rendered for bubble sheets
- Each student has a different exam

A crate with a mass of 177.5 kg is suspended from the end of a uniform boom with mass of 88.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



Submit Answer

1 pt A crate with a mass of 177.5 kg is suspended from the end of a uniform boom with mass of 88.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



(in N)

22. A 2.58×10^3 B 2.92×10^3 C 3.29×10^3
 D 3.72×10^3 E 4.21×10^3 F 4.75×10^3
 G 5.37×10^3 H 6.07×10^3

Exams

CODE - AACHDA
LB 271 - Introductory Physics Lecture
Version A

Name:

LB271 Fall 2009 Final Exam Version A

Gravitational Acceleration on Earth	$g = 9.81 \text{ m/s}^2$
Gravitational Constant	$G = 6.67 \cdot 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2)$
Absolute Zero	-273.15°C
Gas Constant	$R = 8.31 \text{ J}/(\text{K} \cdot \text{mol})$
Boltzmann Constant	$k = 1.38 \cdot 10^{-23} \text{ J/K}$
Avogadro's number	$N_A = 6.02 \cdot 10^{23} \text{ particles/mol}$
Specific heat of water vapor	$c_{\text{vapor}} = 0.48 \text{ kcal}/(\text{kg} \cdot \text{K})$
Specific heat of liquid water	$c_{\text{water}} = 1 \text{ kcal}/(\text{kg} \cdot \text{K})$ $= 4186 \text{ J}/(\text{kg} \cdot \text{K})$
Specific heat of water ice	$c_{\text{ice}} = 0.5 \text{ kcal}/(\text{kg} \cdot \text{K})$
Latent heat of fusion for water	$L_f = 80 \text{ kcal/kg}$
Latent heat of vaporization for water	$L_v = 540 \text{ kcal/kg}$



A block is being held in place on an incline. The magnitude of the force applied by the hand on the block is the same in the left and the right scenarios.

1 pt In which scenario does the incline exert a lower normal force on the block?

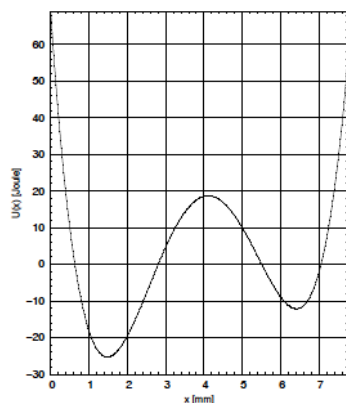
1. A The left scenario.
 B The right scenario.
 C Same in both scenarios.

1 pt In which scenario does the incline exert a lower frictional force on the block?

2. A The left scenario.
 B The right scenario.
 C Same in both scenarios.

1 pt By how many decibels does the sound intensity from a point source decrease if you increase the distance to it by a factor 6?

3. A 12.2 B 13.8 C 15.6 D 17.6
 E 19.9 F 22.5 G 25.4 H 28.7



1 pt

A particle is located at $x=2.0$ mm and has a kinetic energy of 29.5 Joule. What is the maximum x-coordinate the particle could reach? (in mm)

4. A 0.1 B 0.7 C 1.6 D 2.6
 E 3.2 F 4.7 G 5.3 H 7.6



Deep Space Nine sees Enterprise and a shuttle approach from exactly opposite directions with $0.8c$ and $0.5c$, respectively.

1 pt At what fraction of the speed of light (β) does Enterprise see the shuttle approach?

5. A 0.00 B 0.50 C 0.83 D 0.91
 E 0.93 F 1.00 G 1.25 H 1.30

1 pt The shuttle has a length of 9 meters when at rest. How long is it in the system of Deep Space 9? (in m)

6. A 1.8 B 2.6 C 3.7 D 5.4
 E 7.8 F 11.3 G 16.4 H 23.8

1 pt Captain Picard on the Enterprise takes a 49 minute tea break. How long is this break in the system of Deep Space 9? (in min)

7. A 27 B 33 C 42 D 52
 E 65 F 82 G 102 H 128

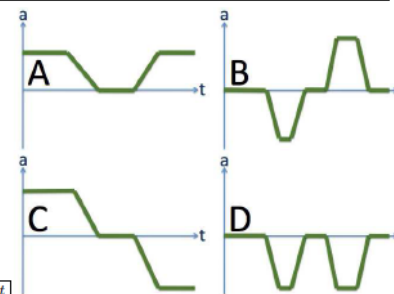
CODE - AACHDA
LB 271 - Introductory Physics Lecture
Version A

1 pt You have two organ pipes of the same length, one closed at both ends, one half open. Which one has a lower fundamental frequency?

8. A The closed pipe.
 B Same.
 C The half-open pipe.

1 pt In a very simple model of the lower atmosphere, air has a constant density of 1.26 kg/m^3 . How much would the air pressure change over a height difference of 130 m? (in Pa)

9. A 986 B 1110 C 1260 D 1420
 E 1610 F 1820 G 2050 H 2320



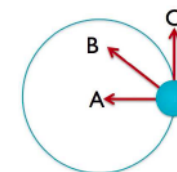
1 pt

A car drives in the forward (positive) direction. It first has a constant speed, then drives into a parking spot, waits for a few moments, and then drives out again backwards. Which one of the acceleration graphs could describe this scenario?

10. A Scenario A
 B Scenario B
 C Scenario C
 D Scenario D
 E None of the above.

1 pt A box is sliding uphill as shown. What is the direction of the frictional force on the box?

11. A Downhill.
 B Perpendicular to the surface.
 C Uphill.
 D None of the above.



An object is rotating on a circular trajectory as shown. The indicated direction A is toward the center of the trajectory, C is tangential to the trajectory. The object is **rotating clockwise and slowing down**.

1 pt What could be the direction of the (linear) acceleration?

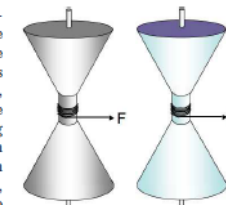
12. A Direction A.
 B Direction B.
 C Direction C.
 D Into the paper.
 E Out of the paper.

1 pt What could be the direction of the angular acceleration?

13. A Direction A.
 B Direction B.
 C Direction C.
 D Into the paper.
 E Out of the paper.

1 pt

You have two identical looking spools (same mass, same shape, same size). However, one is hollow, made from iron, the other is solid, made from aluminum. A string is wound around each spool. If you pull on both strings with equal forces, which spool is going to have the larger angular acceleration?



14. A Same
 B The solid spool
 C The hollow spool

Exams

CODE - AAFIHH
LB 271 - Introductory Physics Lecture
Version A

Name:

LB271 Fall 2009 Final Exam Version A

Gravitational Acceleration on Earth	$g = 9.81 \text{ m/s}^2$
Gravitational Constant	$G = 6.67 \cdot 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2)$
Absolute Zero	-273.15°C
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A block is being held in place on an incline. The magnitude of the force applied by the hand on the block is the same in the left and the right scenarios.

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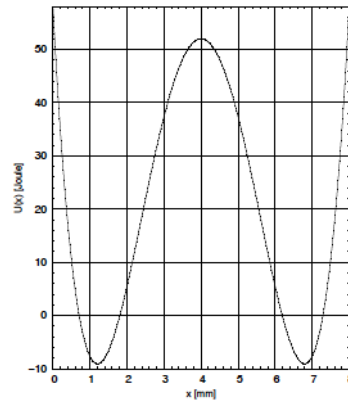
- A The left scenario.
- B The right scenario.
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1 pt In which scenario does the incline exert a higher normal force on the block?

- A The left scenario.
- B The right scenario.
- C Same in both scenarios.

1 pt By how many decibels does the sound intensity from a point source decrease if you increase the distance to it by a factor 6?

- A 7.10
- B 8.31
- C 9.72
- D 11.4
- E 13.3
- F 15.6
- G 18.2
- H 21.3



1 pt

A particle is located at $x = 5.5 \text{ mm}$ and has a kinetic energy of 9.8 Joule. What is the minimum x-coordinate the particle could reach? (in mm)

- A 1.6
- B 2.6
- C 2.7
- D 2.9
- E 3.0
- F 3.8
- G 5.2
- H 6.9



Deep Space Nine sees Enterprise and a shuttle approach from exactly opposite directions with $0.8c$ and $0.4c$, respectively.

1 pt At what fraction of the speed of light (β) does Enterprise see the shuttle approach?

- A 0.00
- B 0.47
- C 0.50
- D 0.59
- E 0.78
- F 0.91
- G 1.00
- H 1.20

1 pt The shuttle has a length of 12 meters when at rest. How long is it in the system of Deep Space 9? (in m)

- A 3.6
- B 4.5
- C 5.6
- D 7.0
- E 8.8
- F 11.0
- G 13.7
- H 17.2

1 pt Captain Picard on the Enterprise takes a 35 minute tea break. How long is this break in the system of Deep Space 9? (in min)

- A 19
- B 28
- C 40
- D 58
- E 85
- F 123
- G 178
- H 258

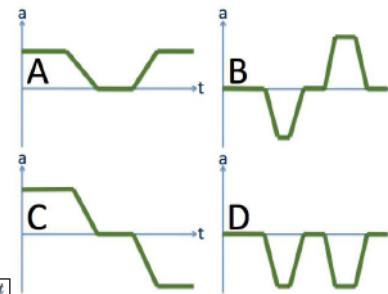
CODE - AAFIHH
LB 271 - Introductory Physics Lecture
Version A

1 pt You have two organ pipes of the same length, one closed at both ends, one half open. Which one has a lower fundamental frequency?

- A Same.
- B The closed pipe.
- C The half-open pipe.

1 pt In a very simple model of the lower atmosphere, air has a constant density of 1.22 kg/m^3 . How much would the air pressure change over a height difference of 110 m? (in Pa)

- A 1320
- B 1490
- C 1680
- D 1900
- E 2150
- F 2430
- G 2740
- H 3100



1 pt

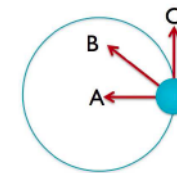
A car drives in the forward (positive) direction. It first has a constant speed, then drives into a parking spot, waits for a few moments, and then drives out again backwards. Which one of the acceleration graphs could describe this scenario?

- A Scenario A
- B Scenario B
- C Scenario C
- D Scenario D
- E None of the above.

1 pt

A box is sliding uphill as shown. What is the direction of the frictional force on the box?

- A Perpendicular to the surface.
- B Downhill.
- C Uphill.
- D None of the above.



An object is rotating on a circular trajectory as shown. The indicated direction A is toward the center of the trajectory, C is tangential to the trajectory. The object is **rotating clockwise** and **slowing down**.

1 pt What could be the direction of the (linear) acceleration?

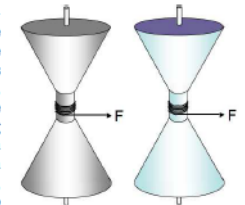
- A Direction A.
- B Direction B.
- C Direction C.
- D Into the paper.
- E Out of the paper.

1 pt What could be the direction of the angular acceleration?

- A Direction A.
- B Direction B.
- C Direction C.
- D Into the paper.
- E Out of the paper.

1 pt

You have two identical looking spools (same mass, same shape, same size). However, one is hollow, made from iron, the other is solid, made from aluminum. A string is wound around each spool. If you pull on both strings with equal forces, which spool is going to have the larger angular acceleration?



- A The solid spool
- B The hollow spool
- C Same

Exams

CODE - AACHDA

LB 271 - Introductory Physics Lecture

Version A

Name:

LB271 Fa

PRINT AND MARK YOUR NAME										PID																				T F																							
YOUR LAST NAME										F.I.	A																																										
A	A	A	A	A	A	A	A	A	A	A	A	0	0	0	0	0	0	0	0	0											1	2	3	4	5	6	7	8	9	10	15	1	2	3	4	5	6	7	8	9	10		
B	B	B	B	B	B	B	B	B	B	B	B	1	1	1	1	1	1	1	1	1											2	1	2	3	4	5	6	7	8	9	10	16	1	2	3	4	5	6	7	8	9	10	
C	C	C	C	C	C	C	C	C	C	C	C	2	2	2	2	2	2	2	2	2											3	1	2	3	4	5	6	7	8	9	10	17	1	2	3	4	5	6	7	8	9	10	
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P	P	P	P	P	P	P	P	P	P	P	P	4	4	4	E	E	E	E	E	E											16	1	2	3	4	5	6	7	8	9	10	30	1	2	3	4	5	6	7	8	9	10	
Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	5	5	5	F	F	F	F	F	F											17	1	2	3	4	5	6	7	8	9	10	31	1	2	3	4	5	6	7	8	9	10	
R	R	R	R	R	R	R	R	R	R	R	R	6	6	6	G	G	G	G	G	G											18	1	2	3	4	5	6	7	8	9	10	32	1	2	3	4	5	6	7	8	9	10	
S	S	S	S	S	S	S	S	S	S	S	S	7	7	7	H	H	H	H	H	H											19	1	2	3	4	5	6	7	8	9	10	33	1	2	3	4	5	6	7	8	9	10	
T	T	T	T	T	T	T	T	T	T	T	T	8	8	8	I	I	I	I	I	I											20	1	2	3	4	5	6	7	8	9	10	34	1	2	3	4	5	6	7	8	9	10	
U	U	U	U	U	U	U	U	U	U	U	U	9	9	9	J	J	J	J	J	J											21	1	2	3	4	5	6	7	8	9	10	35	1	2	3	4	5	6	7	8	9	10	
V	V	V	V	V	V	V	V	V	V	V	V	FORM																				22	1	2	3	4	5	6	7	8	9	10	36	1	2	3	4	5	6	7	8	9	10
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X	X	X	X	X	X	X	X	X	X	X	X	2	B																			24	1	2	3	4	5	6	7	8	9	10	38	1	2	3	4	5	6	7	8	9	10
Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	3	C																			25	1	2	3	4	5	6	7	8	9	10	39	1	2	3	4	5	6	7	8	9	10
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PLEASE WRITE YOUR SIGNATURE WITHIN THIS BOX

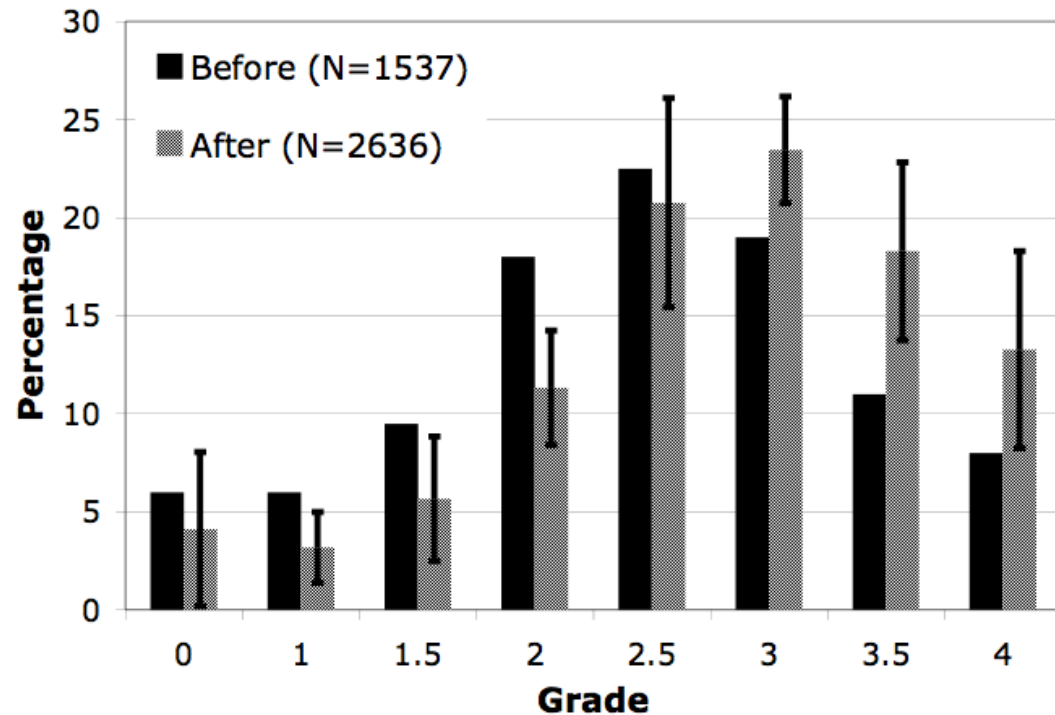
O-21677

Before we go on ...

... does this even work?

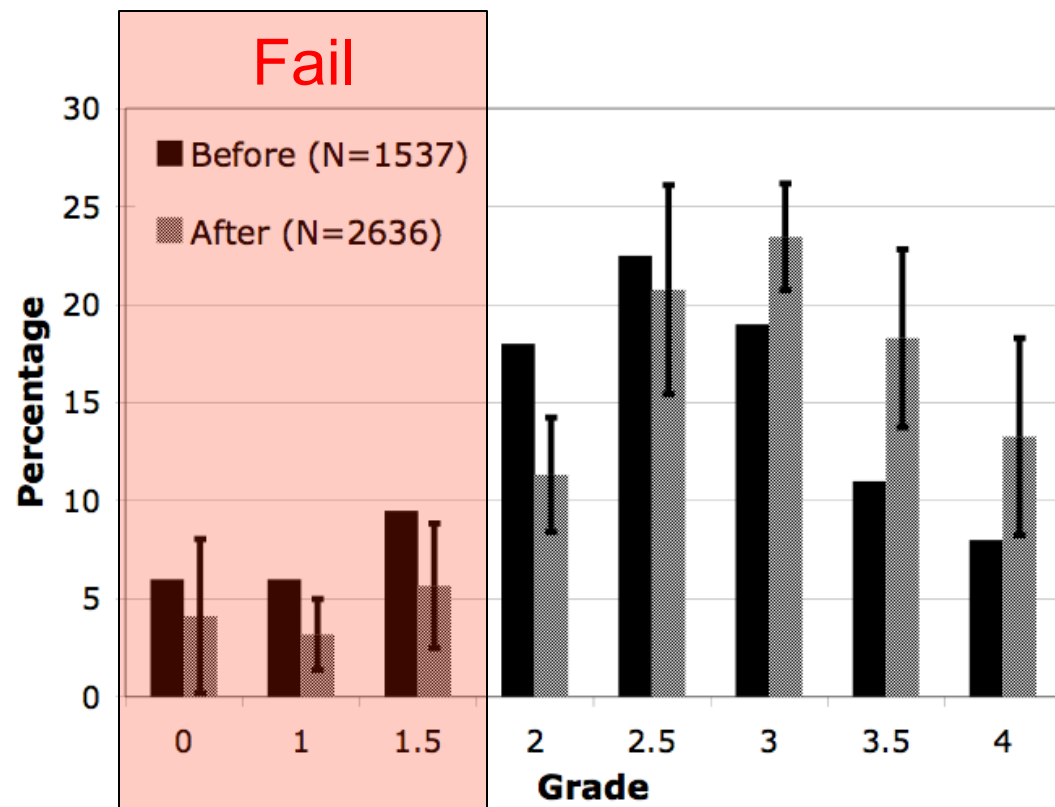
Learning Success

- Intro Physics for Scientists and Engineers
- Grades in years before and after online homework



Learning Success

Mostly helps students who are on the brink of failing the course.



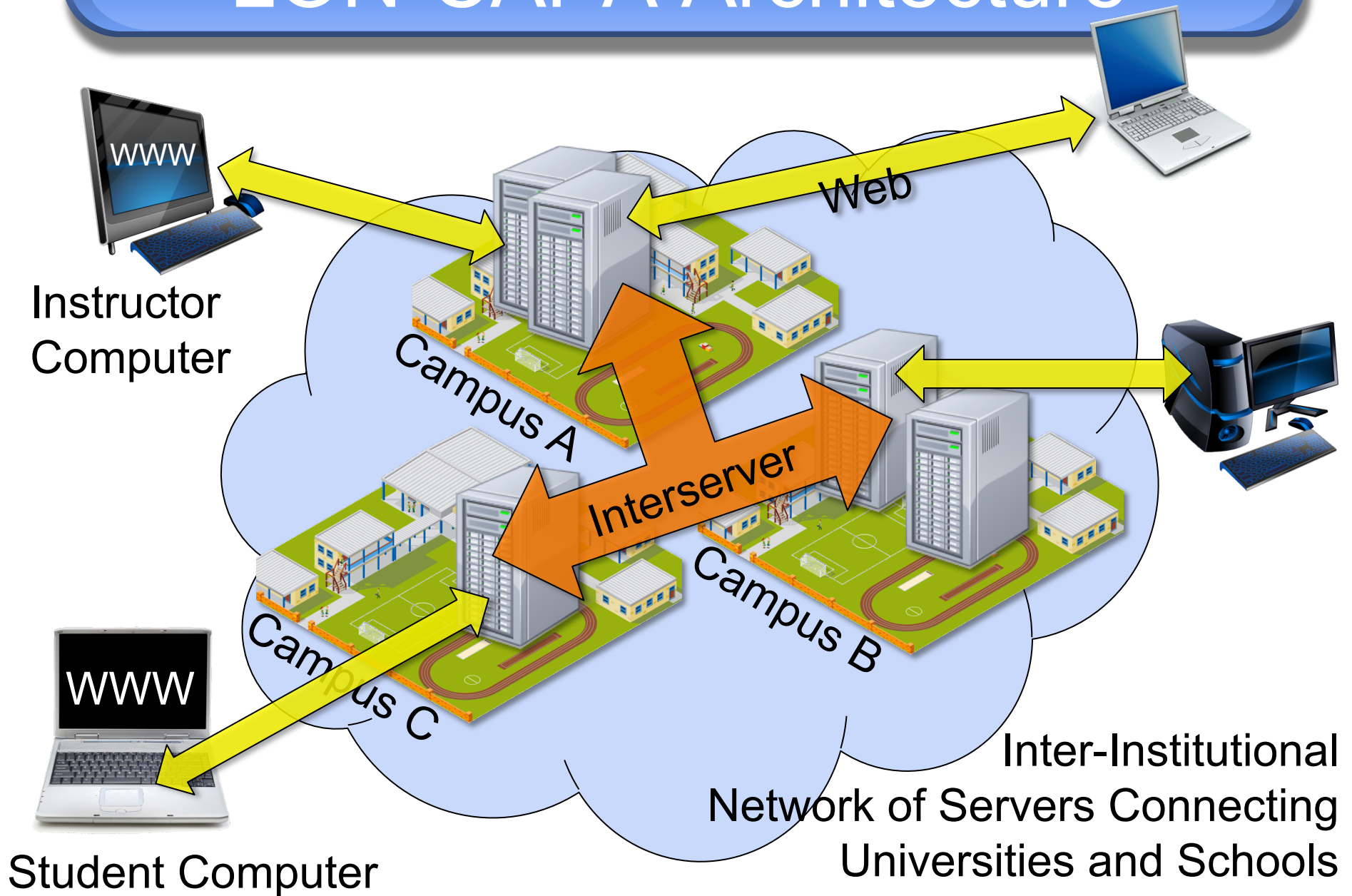
How is this realistically possible?

Sharing of Resources

- Creating online resources is a lot of work
- Doing so for use in just one course is a waste of time and effort
- Many resources could be used among a number of courses and across institutions



LON-CAPA Architecture



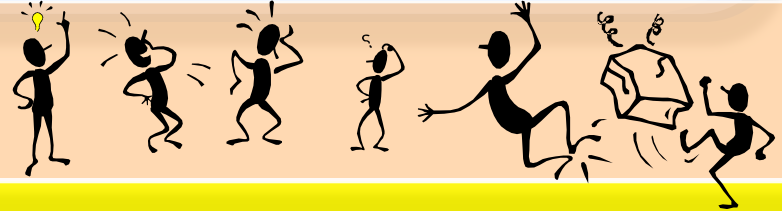
LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



Course Management

Campus B

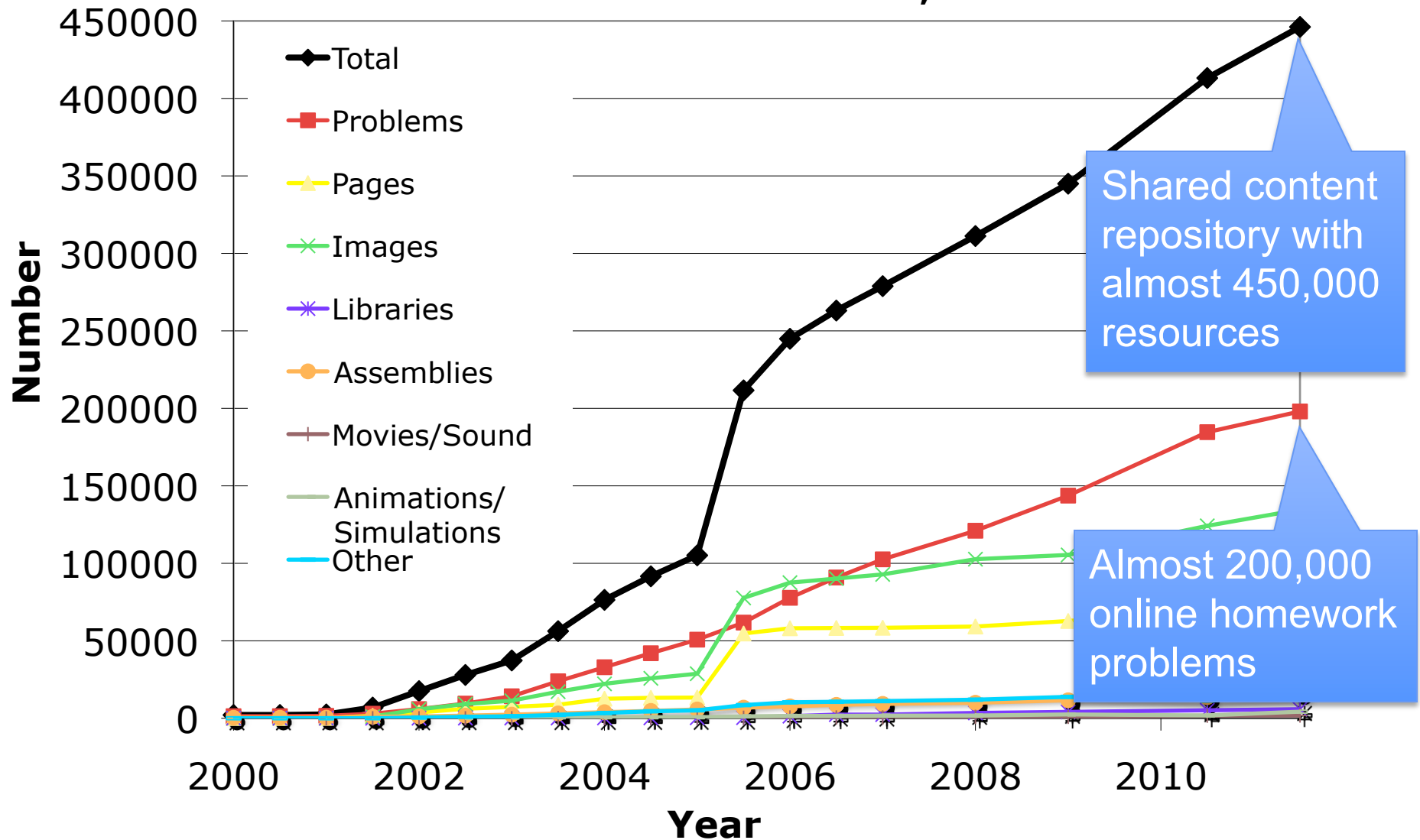
Resource Assembly

Shared Cross-Institutional Resource Library

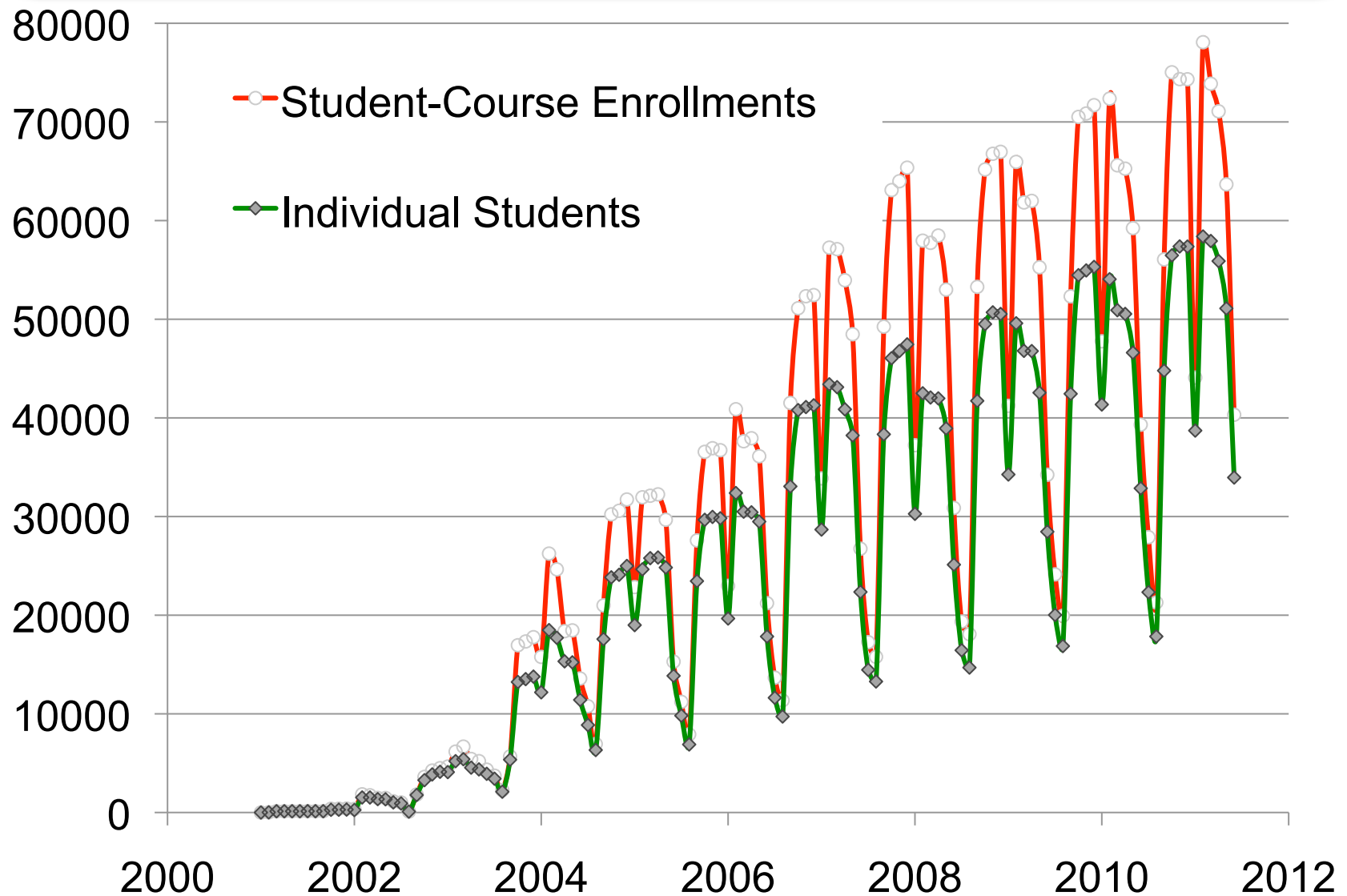


The LON-CAPA Community

LON-CAPA Shared Resource Pool, Summer 2011



LON-CAPA Enrollment



WIP: Recommender

Initializing ... Resource data ... Associations ... Basket Associations ... Taxonomies ...

[accounting](#):(639) [advertising](#):(2043) [astronomy](#):(5981) [biochemistry](#):(2194) [biology](#):(49872) [botany](#):(88751)
[chemistry](#):(35725) [computerscience](#):(1199) [design](#):(450) [ecology](#):(1708) [engineering](#):(2180) [finance](#):(1568)
[geology](#):(2388) [geometry](#):(546) [history](#):(263) [languages](#):(13) [mathematics](#):(11868) [medicine](#):(5067) [nursing](#):(8)
[nutrition](#):(594) [philosophy](#):(10) [physics](#):(112158) [psychology](#):(527) [statistics](#):(3084) [zoology](#):(218)

Search:

Current Basket

[/res/msu/plough/physlibrary/momentum/elhs-prob11.problem](#) Remove
[/res/bsu/physicstir3/Conceptual Questions/001 Ball Path when Dropped by Horizontally Moving Cyclist.problem](#) Remove
[/res/msu/kortemey/physicslib/momentum/soyuziss.problem](#) Remove
[/res/msu/physicslib/msuphysicslib/16_Momentum/msu-prob11.problem](#) Remove
[/res/msu/kortemey/physicslib/momentum/superman.problem](#) Remove
[/res/msu/physicslib/msuphysicslib/17_Impulse/msu-prob12.problem](#) Remove
[/res/msu/kortemey/physicslib/momentum/businelastic.problem](#) Remove
[/res/msu/plough/physlibrary/momentum/elhs-prob06.problem](#) Remove
[/res/fsu/GeneralChemLib/Lab/Density/Metals.problem](#) Remove
[/res/ohiou/0Up200lib/sfChpt6/sf0615a.problem](#) Remove

Basket taxonomies: [chemistry:introduction](#):(2708) [physics:mechanics:linearmomentum](#):(1362)

Basket Recommendations

[/res/msu/plough/physlibrary/momentum/elhs-prob07.problem](#) Add
[/res/msu/plough/physlibrary/momentum/elhs-prob09.problem](#) Add
[/res/ohiou/cutnell/Chap07/cj-prob0712.problem](#) Add

Languages

LON-CAPA Content Display Settings +

msu.edu https://s3.lite.msu.edu/adm/preferences?action=changelanguages

James Thomas Laverty (No Role, Cumulative Privileges)

Main Menu |

Menu » Set User Preferences » **Change Language**

Preferred language: No language preference ▼

Save

- No language preference
- Arabic - UTF
- German - UTF
- English - UTF
- Spanish (Castellan) - UTF
- Persian - UTF
- French - UTF
- Hebrew - UTF
- Japanese - UTF
- Portuguese - UTF
- Russian - UTF
- Turkish - UTF
- Swedish Chef - UTF
- Chinese Simplified - UTF

Mathematical Output

- Typesetting:
LaTeX can be embedded anywhere in the material

Text Block Delete? Edit Math

[Rich formatting »](#)

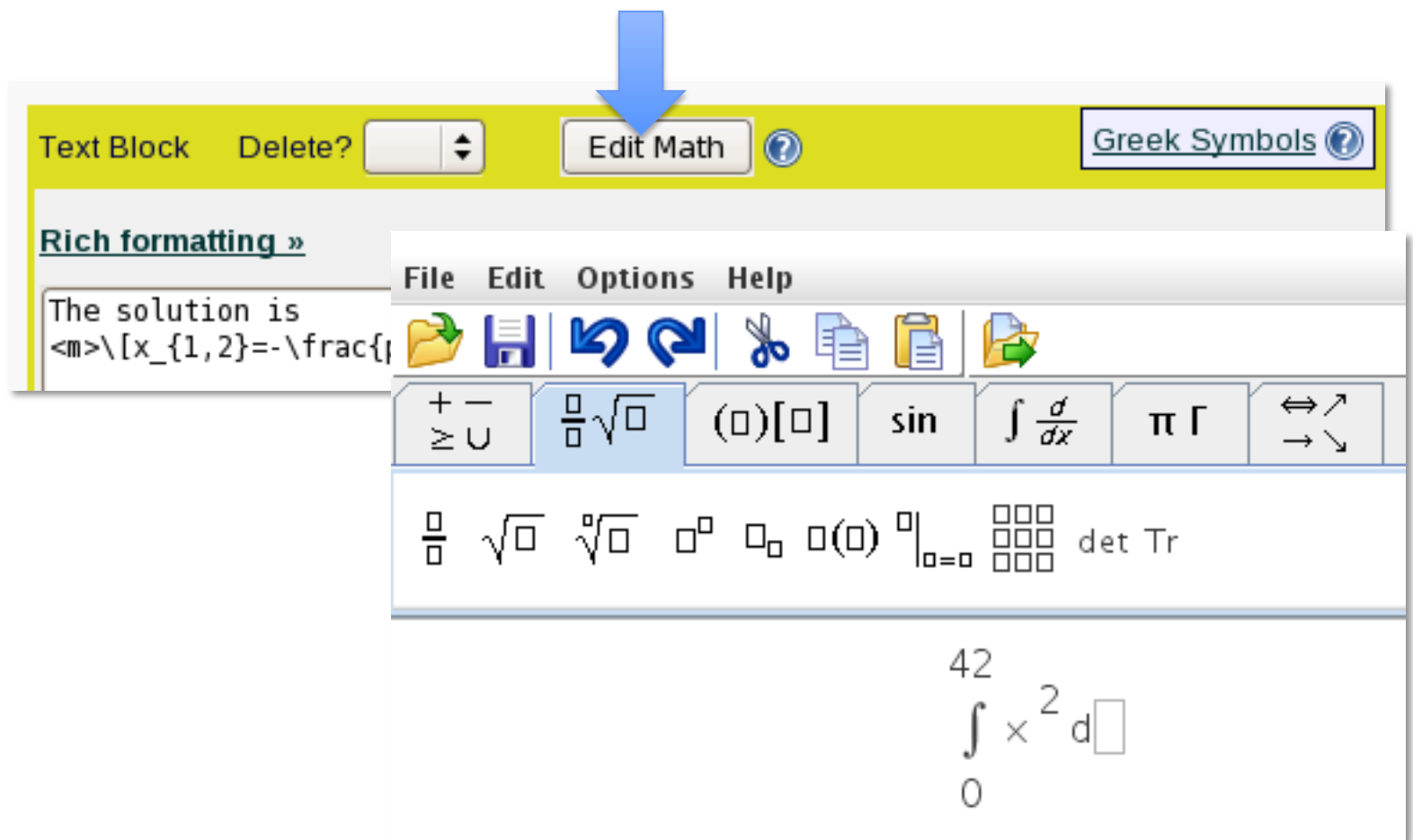
```
The solution is  
<m>\[x_{1,2}=-\frac{p}{2}\pm\sqrt{\left(\frac{p}{2}\right)^2-q}\]
```

The solution is

$$x_{1,2} = -\frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 - q}$$

Mathematical Output

- Editor for non-native LaTeX speakers



The screenshot displays a software interface for editing mathematical content. At the top, a yellow header bar contains the text "Text Block", a "Delete?" button, an "Edit Math" button (highlighted by a blue arrow), and a "Greek Symbols" button. Below this, a "Rich formatting »" section is visible. The main editing area shows the text "The solution is" followed by a LaTeX code snippet: $\langle m \rangle \backslash [x_{1,2}] = - \backslash \text{frac}\{$. A floating toolbar is positioned over the code, featuring a menu bar with "File", "Edit", "Options", and "Help". The toolbar includes icons for file operations (save, open, copy, paste) and mathematical symbols such as $\frac{\square}{\square}$, $\sqrt{\square}$, $(\square)[\square]$, \sin , $\int \frac{d}{dx}$, π , Γ , and \leftrightarrow . Below the toolbar, a row of mathematical symbols is displayed: $\frac{\square}{\square}$, $\sqrt{\square}$, $\sqrt[\square]{\square}$, \square^\square , \square_\square , $\square(\square)$, $\square|_{\square=\square}$, a 3x3 grid of squares, and the text "det Tr". At the bottom of the interface, a preview window shows the rendered mathematical expression:
$$\int_0^{42} x^2 dx$$

Mathematical Output

- Generated on-the-fly, can vary from student to student.

The screenshot shows a software interface for generating mathematical questions. It features a 'Script' area with a 'Delete?' button and a dropdown arrow, containing the code `$k=&random(2,5,1)`. Below this is an 'Insert:' dropdown menu. A 'Text Block' section is highlighted in yellow, containing a 'Delete?' button, an 'Edit Math' button with a question mark icon, and a link for 'Rich formatting >>'. The main text area contains the question: 'What is the derivative of $\frac{1}{k}x^k$ with respect to x ?' where k is a variable.

What is the derivative of

$$\frac{1}{3}x^3$$

with respect to x ?


What is the derivative of

$$\frac{1}{5}x^5$$

with respect to x ?

Mathematical Output

- `<algebra>`-tag to pretty-print the output from computer algebra systems
- Example: `$formula="a*x^5"`

Text Block Delete? Edit Math 

[Rich formatting »](#)

What is the derivative of `<algebra>$formula</algebra>` with respect to x?

What is the derivative of $a \cdot x^5$ with respect to x?

Tries 0

Mathematical Output

- One-source, multiple target
- Looks good in print
 - Online:

The solution is

$$x_{1,2} = -\frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 - q}$$

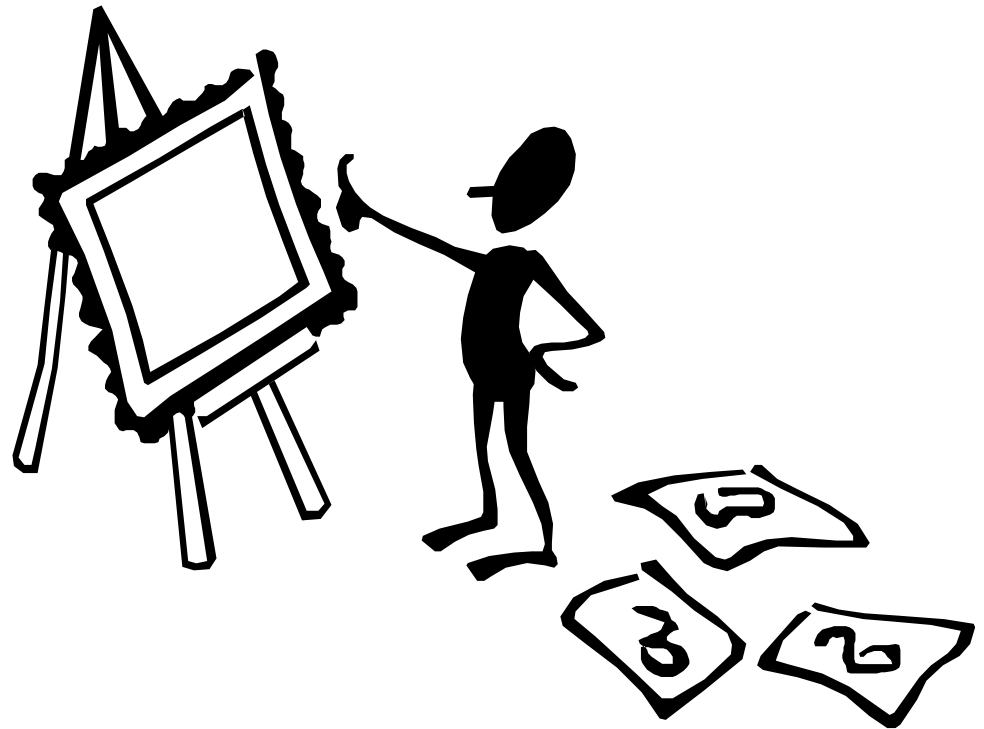
- Print (dynamically generated PDF):

The solution is

$$x_{1,2} = -\frac{p}{2} \pm \sqrt{\left(\frac{p}{2}\right)^2 - q}$$

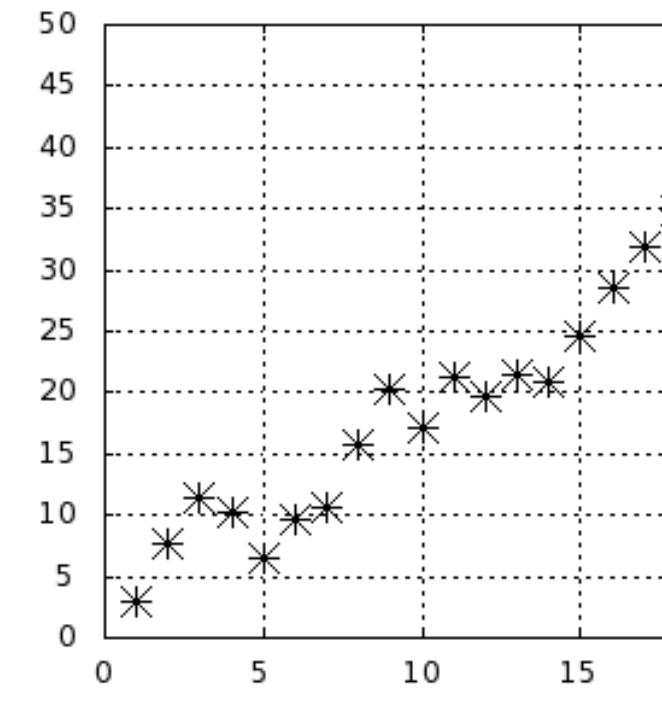
Mathematical Output

- Dynamic Graphing
 - Data-Points
 - Functions
 - Line-Graphics
- Internally uses GNUplot



Mathematical Output

- Data points



Curve Delete?

Color of curve (x000000)

Name of curve to appear in key

Plot with:

Line width (may not apply to all plot styles)

Line type (may not apply to all plot styles)

Point type (may not apply to all plot styles)

Point size (may not apply to all plot styles)

Point to fill -- for filledcurves

Comma or space delimited curve data

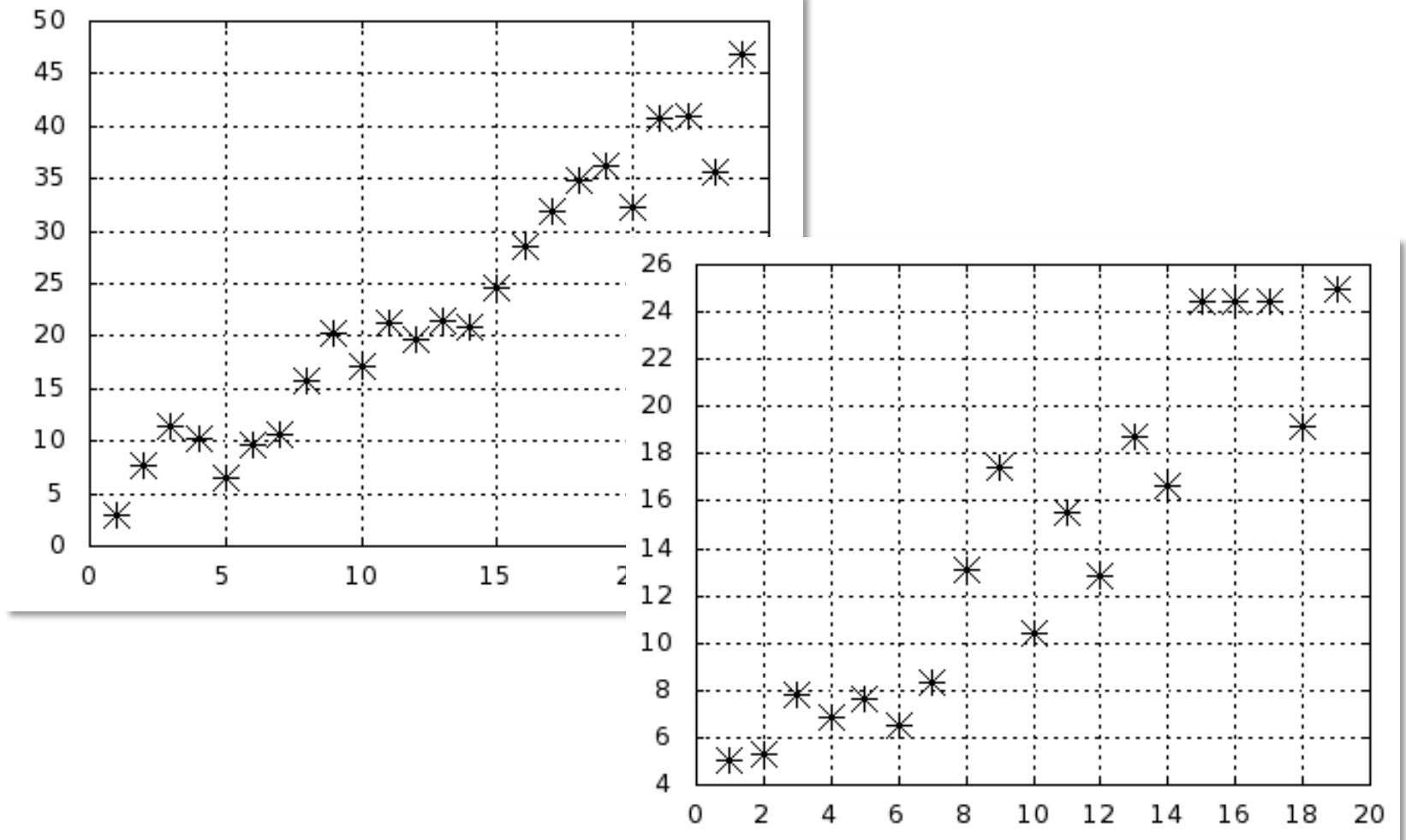
Insert:

Comma or space delimited curve data

Insert:

Mathematical Output

- Data points



Mathematical Output

- Functions

Match the function indicated in black.

$f(x) =$

[Submit Answer](#) Tries 0/99

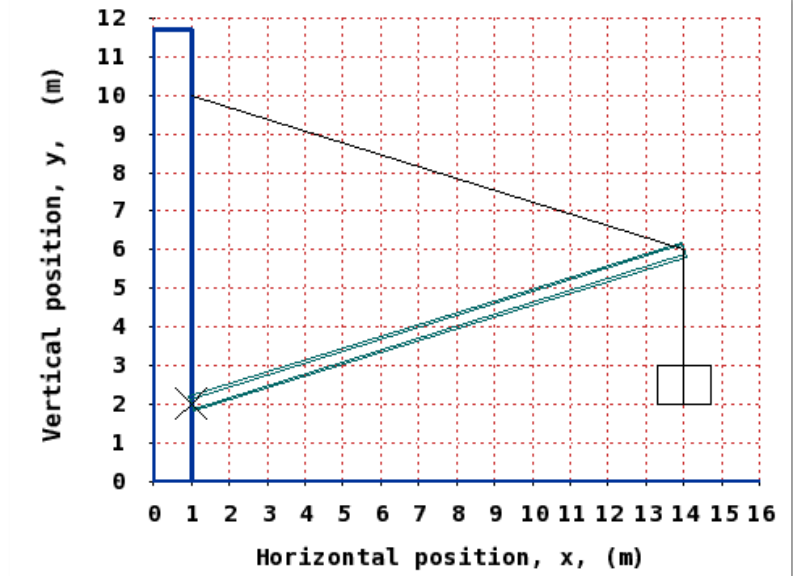
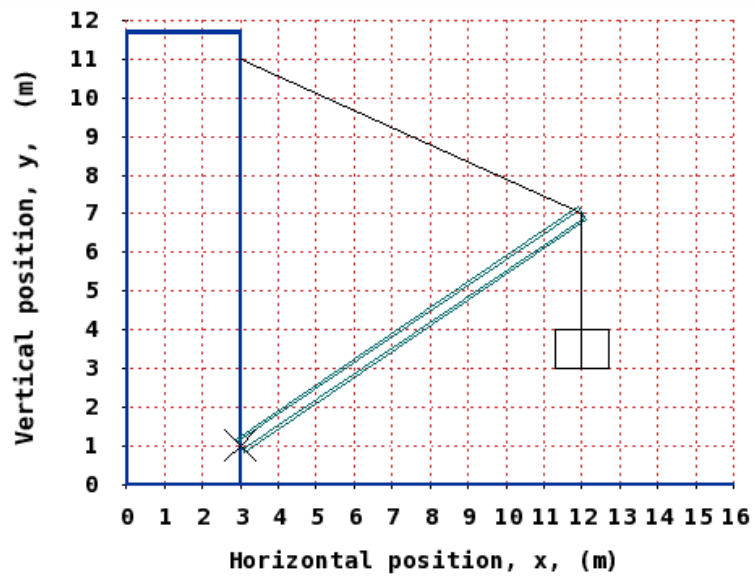
Match the function indicated in black.

$f(x) =$

[Submit Answer](#) Tries 0/99

Mathematical Output

- Line graphics



Generating Mathematics Problems

- LON-CAPA problems include
 - Perl Scripting Environment
 - MAXIMA Computer Algebra System
 - R Statistics Package
- Problems not just randomized, but randomly generated with desired properties



Generating Mathematics Problems

- Direct calls to MAXIMA:
`$result=&cas('maxima',$expression);`
- Simple example: use computer algebra system to calculate a reduced

Script Delete?

```
# Construct an Egyptian Fraction that can be represented by three terms with denominators between 3 and 12
@denominators=(&random_permutation(&random(1,1000,1),(3..12)))[0..2];
$egyptian='1/' . (join('+1/',sort{$a<=>$b}(@denominators)));
$possible="A possible solution is $egyptian";

# Let the CAS figure out the value
$solution=&cas('maxima',$egyptian);
```

Write 103/165 as an Egyptian Fraction

Tries 0

Answer for Part: 0 **A possible solution is 1/3+1/5+1/11**

Generating Mathematics Problems

- Direct calls to R:
\$result=&cas('R',\$expression);
\$results=&cas_hashref('R',\$expression);
- Example: generate a distribution with certain properties:

```
Script Delete?    
$seed=&random(1,500,1);  
$n=&random(15,25,1);  
$offset=&random(2,5,0.1);  
$slope=&random(0.6,2.5,0.1);  
# construct a data set using R  
# dump is for debugging, print to screen to see data structure  
($data,$dump)=&cas_hashref('R',"set.seed($seed);x<-1:$n;w<-1+sqrt(x)/2;data.frame(x=x,y=$offset+$slope*x+rnorm(x)*w);");  
@x=&cas_hashref_array($data,'x');  
@y=&cas_hashref_array($data,'y');
```

Mathematics Input

Script Delete?

```
$vx=&random(3,6,0.1);
$vy=&random(2,8,0.1);
$vz=&random(4,10,0.1);
$t=&random(4,9,1);
@solution=($vx*$t,$vy*$t,$vz*$t);
```

Insert:

Text Block Delete? Edi

Rich formatting »

An object starts at the origin with a constant velocity of

```
<m eval="on">
\[\vec{v}=\left(\begin{array}{c}$vx\\ $vy\\ $vz\end{array}\right)\right)
\frac{\mbox{m}}{\mbox{s}}\]
</m>
```

Where is it \$t seconds later?

[Check Spelling](#)

Insert:

Response: Numerical Delete? Insert:

Answer: Incorrect Answers: Unit: m

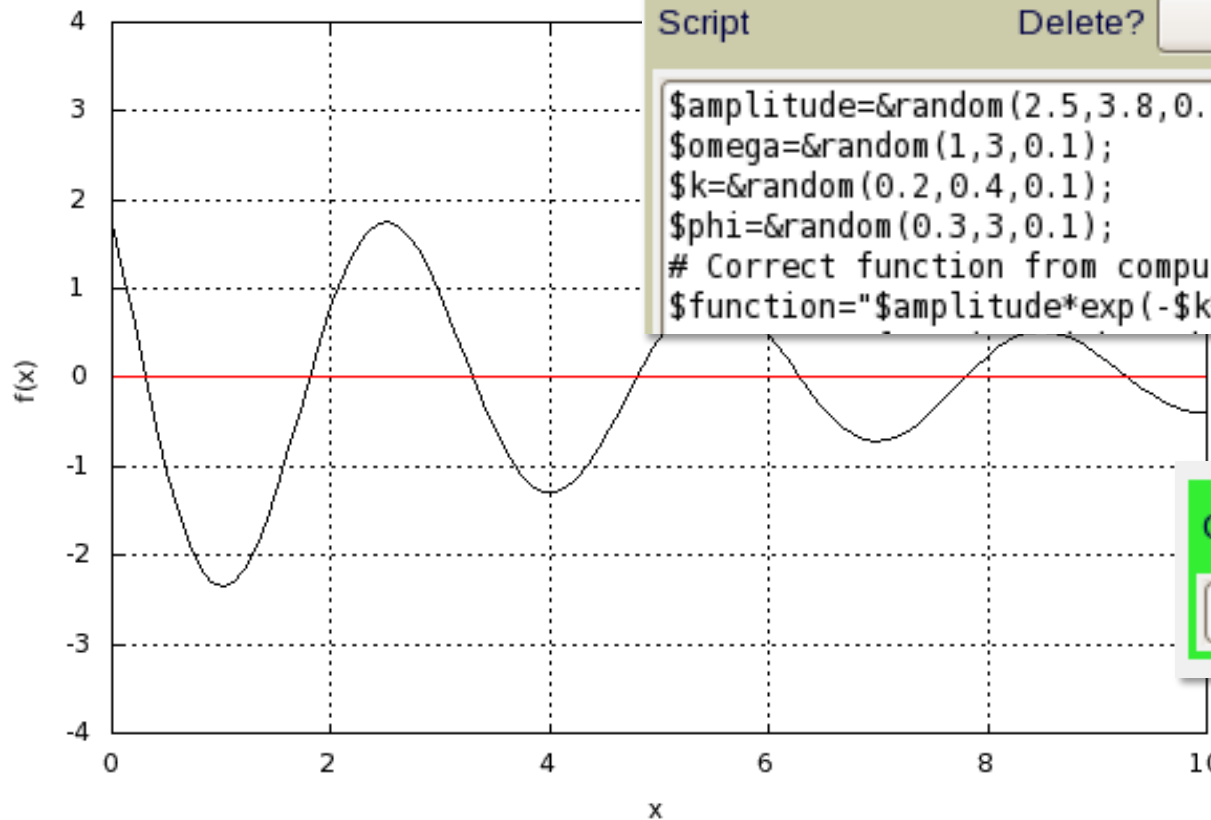
An object starts at the origin with a constant velocity of

$$\vec{v} = \begin{pmatrix} 4.4 \\ 2.5 \\ 7.2 \end{pmatrix} \begin{matrix} \text{m} \\ \text{s} \end{matrix}$$

Where is it 4 seconds later?

- Simplest input: numerical

Mathematics Input



Gnuplot compatible curve function

- Sampling – approximate function

Match the function indicated in black.

f(x)=

Response: Formula

Delete?

Insert:


Answer:

Sample Points:

Mathematics Input

Script Delete?

```
$k=&random(3,6,1);  
$formula="a*x^$k";  
$m=$k-1;  
$derivative="$k*a*x^$m";
```

What is the derivative of $a \cdot x^4$ with respect to x ? 

Tries 0

Answer for Part: 0

What is the derivative of $\langle \text{algebra} \rangle \$formula \langle / \text{algebra} \rangle$ with respect to x ?

[Check Spelling](#)

rt:

Response: Formula Delete? Insert:

Answer: Sample Points:

- Symbolically: exactly one exact answer (but equivalent forms)

Mathematical Input

- Checking properties
 - Using R:

Provide a list of 3 numbers (separated by commas) that has a mean value of 6.2.

Response: Math Delete?

String to display for answer: Algebra System:

Libraries:

Answer algorithm Delete?

```
x<-c(RESPONSE[1],RESPONSE[2],RESPONSE[3]);  
abs(mean(x)-LONCAPALIST[1])<0.001
```

Mathematical Input

- Checking properties
 - Using MAXIMA:

Give an example of a function

1. which is orthogonal to

$$-2 \cdot \cos(5 \cdot x) + 2 \cdot \sin(4 \cdot x)$$

with respect to the scalar product

$$\langle g | h \rangle = \frac{1}{\pi} \int_{-\pi}^{\pi} dx g(x) \cdot h(x)$$

2. whose norm is 1.

Submit Answer

Try

Answer algorithm

```
overlap:integrate((RESPONSE[1])*(LONCAPALIST[1]),x,-%pi,%pi)/%pi;
norm:integrate((RESPONSE[1])*(RESPONSE[1]),x,-%pi,%pi)/%pi;
is(overlap=0 and norm=1);
```

Mathematical Input

- Checking properties
 - Using Perl and MAXIMA

Write 9/20 as an Egyptian Fraction

```
# Subroutine that checks if the provided term is indeed an Egyptian Fraction
sub analyze {
    my ($expression)=@_;
    $expression=~s/\s//gs;
    $expression=~s/\+?1\//\,/gs;
    if ($expression=~/^(\,[0-9]+)+$/ ) {
# Format is indeed 1/n+1/m+...
        $last=-1;
        foreach $number (sort { $a<=>$b } split(/\,/,$expression)) {
# Is a number used twice?
            if ($last==$number) { return(0,1); }
            $last=$number;
        }
        return(0,0);
    }
    return(1,0);
}
```

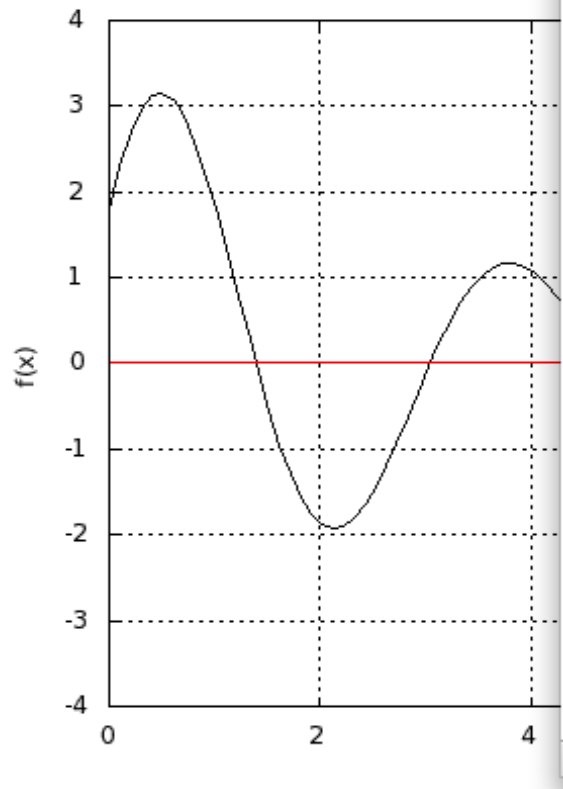
Answer algorithm

Delete?

```
# Analyze the format
($formaterror,$doubleerror)=&analyze($submission);
if ($formaterror || $doubleerror) { return 'WRONG_FORMAT'; }
# It is an Egyptian Fraction, is the value correct?
if (&cas('maxima',$submission.'-('$egyptian.')) eq '0') {
    return 'EXACT_ANS';
}
return 'INCORRECT';
```

Mathematical Input

New Randomization Change Random Seed To
Edit EditXML



Mozilla Firefox
msu.edu https://s10.lite.msu.edu/adm/dragmath/applet/MaximaPopup.html

File Edit Options Help

sin cos tan Inverse Hyperbolic log In e^{\square}

$e^{-(0.3) \cdot x}$

Save & Close

Applet DragMath started

Match the function indicated in black.

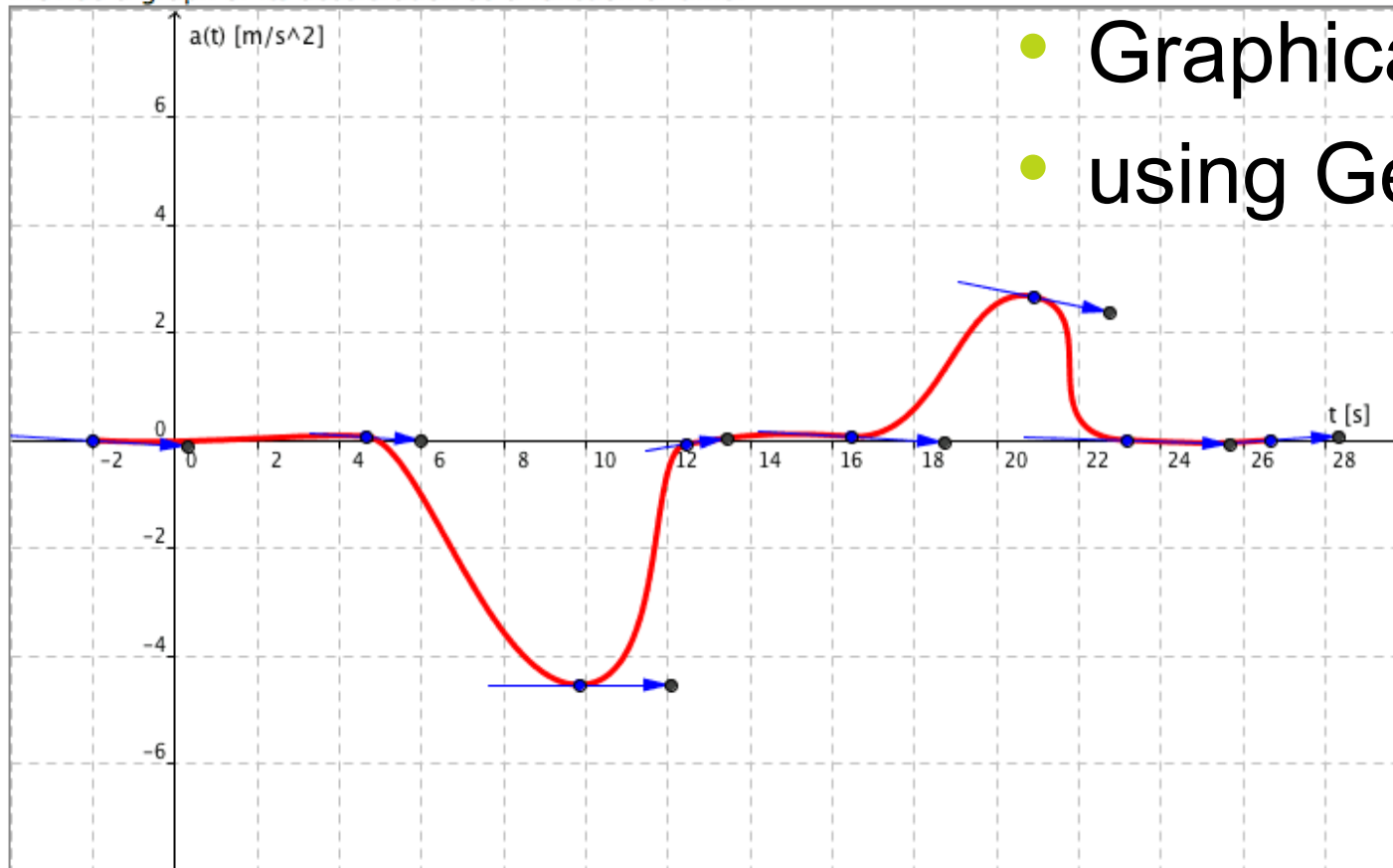
$f(x) =$

Submit Answer Tries 0/99

Math editor for students

Mathematical Input

At $t=0$ s, a car cruises at a constant positive velocity. Suddenly, a light switches to red. At $t=10$ s, the driver is maximum on the brake. The car then stops in front of the red light for over 2 seconds. Eventually, it drives off, and then again cruises at a constant velocity. The car cannot accelerate with more than 3 m/s^2 . Provide a graph of its acceleration as a function of time.



- Graphical input
- using GeoGebra

You are correct. Computer's answer now shown above. [Previous Tries](#)

Mathematical Input

- Rulesets

Function

First Derivative
Second Derivative
Integral

Function Plot Evaluation Rule Delete? Evaluatio

Index/Name: Function:

Initial x-value: Initial x-value label:

Final x-value (optional): Final x-value label (optional):

Minimum length for range (optional): Maximum length for range (optional):

Relationship:

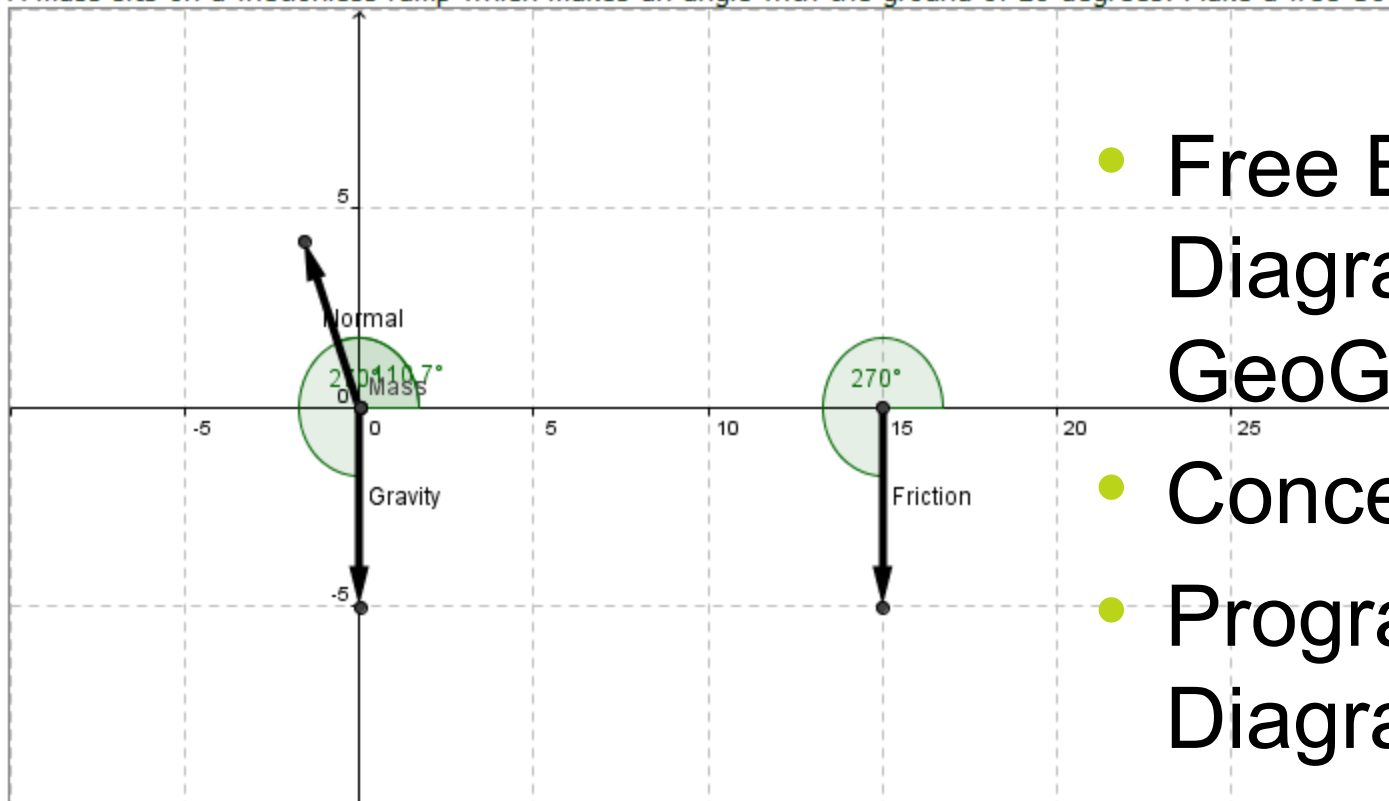
Percent error:

Symbolic,
computed, or
hard-coded
ranges

Mathematical Input

- (This will be in the next version of LON-CAPA)

A mass sits on a frictionless ramp which makes an angle with the ground of 20 degrees. Make a free-body diagram for this mass.



You are correct. [Previous Tries](#)

- Free Body Diagrams using GeoGebra
- Concept Maps
- Programming Diagrams
- Etc.

Mathematical Input

- Rules

Function Plot Rule Set Delete? Insert: [Function Plot Rules](#)

Function Plot Vector Rule Delete? [Vector Rule](#)

Index/Name: Vector:

Attached to object: Not attached to object:

Tail attached to object: Tip attached to object: Tail not attached to object: Tip not attached to object:

Length: Absolute error length:

Angle: Absolute error angle:

Insert:

Specify Length
and Direction of
a Vector

What the object
is (or is not)
attached to.

Thank You

- Now it's time to play with it!
- <http://relate.mit.edu/physicscourse>