



LON-CAPA

Mathematical Functionality

Gerd Kortemeyer

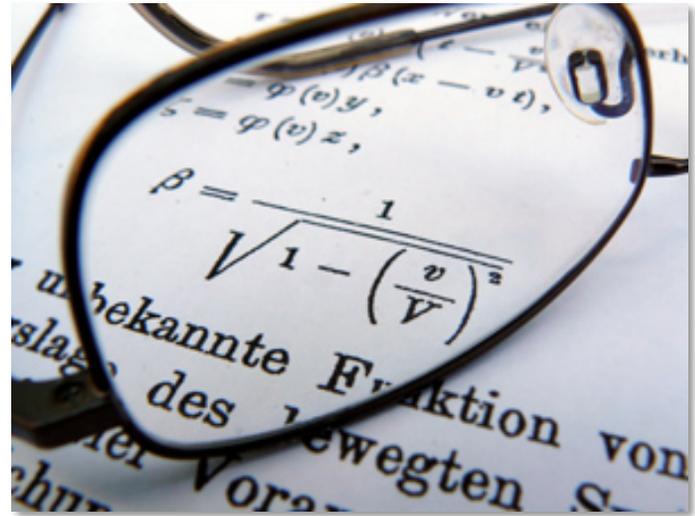
Explorations in Instructional Technology

Brownbag Seminar

February 2011

LON-CAPA Math Functionality

- Today's Session: somewhat specialized topic
- Goal: demonstrate how mathematical assessment is integrated into the LON-CAPA course management functionality



LON-CAPA Course Management

Page set to be displayed after you have selected a role in this course. Currently: *What's New Page (user preference)*. **Change** for just **Full featured course management system**

Hide all Show all

Problems requiring handgrading Hide

Problems require handgrading

Drop boxes

Unread course discussion posts Hide

Change options?

Location	Type	Time of last post	Number of new posts
Magnetic Field	Resource	11 hours, 13 minutes ago	1

Discussions

New course messages Hide

No new course messages

Statistics

Messaging

(Problems with av. attempts ≥ 2 or deg. difficulty ≥ 0.5) and total number of students with submissions ≥ 2 Hide

Change thresholds?

Resource	Part	Num. students	Av. Attempts	Deg. Diff	Last Reset	Reset Count?
Capacitor Properties	single part	111	2.06	0.58		<input type="checkbox"/>
Capacitors in Parallel and Series	single part	105	2.40	0.66		<input type="checkbox"/>
Classic Model of the Atom	single part	105	2.9			
Cost	single part	41	2.7			
Currents and Magnetic Fields	single part	26	2.00	0.63		<input type="checkbox"/>
Decoration	part - 14	45	1.36	0.56		<input type="checkbox"/>

MSU integration

Roles for which access to course has become available since last week Hide

Change interval?

Time of change	User	Role	Section Status
Thu Feb 3 07:13:24 pm 2011 (EST)	Walter Benenson	Student adm	active

Roles for which access to course has expired since last week Hide

Change interval?

Time of change	User	Role	Section Status
Sat Feb 5 07:19:02 am 2011 (EST)		Student002	previous

LON-CAPA Course Management

Gerd Kortemeyer (Course Coordinator) LB274, Spring 2011 - Intro Calc-Based PH

[Main Menu](#) | [Return to Last Location](#) | [Course Contents](#) | [Course Editor](#) | [Groups](#) |

LB274, Spring 2011 - Intro Calc-Based Physics II » [Course Contents](#)

Tools: Sort by:

- Syllabus
- Calendar Overview
- ▶ Electrostatics
- ▶ Electric Field
- ▶ Capacitors
- ▼ Current
 - Current
 - ▶ Current Materials
 - ▶ Current Homework
- ▼ Magnetism
 - Magnetism
 - ▼ Magnetism Materials
 - Introduction
 - Magnetic Field
 - Cross Product
 - Example: Force
 - Applet: Lorentz Force
 - Magnetic Field → Due this Friday, Feb 11 at 11:59 am (EST)
 - Magnetic Field of the Earth
 - Force on a Current

Structured Content (points to 'Current' folder)

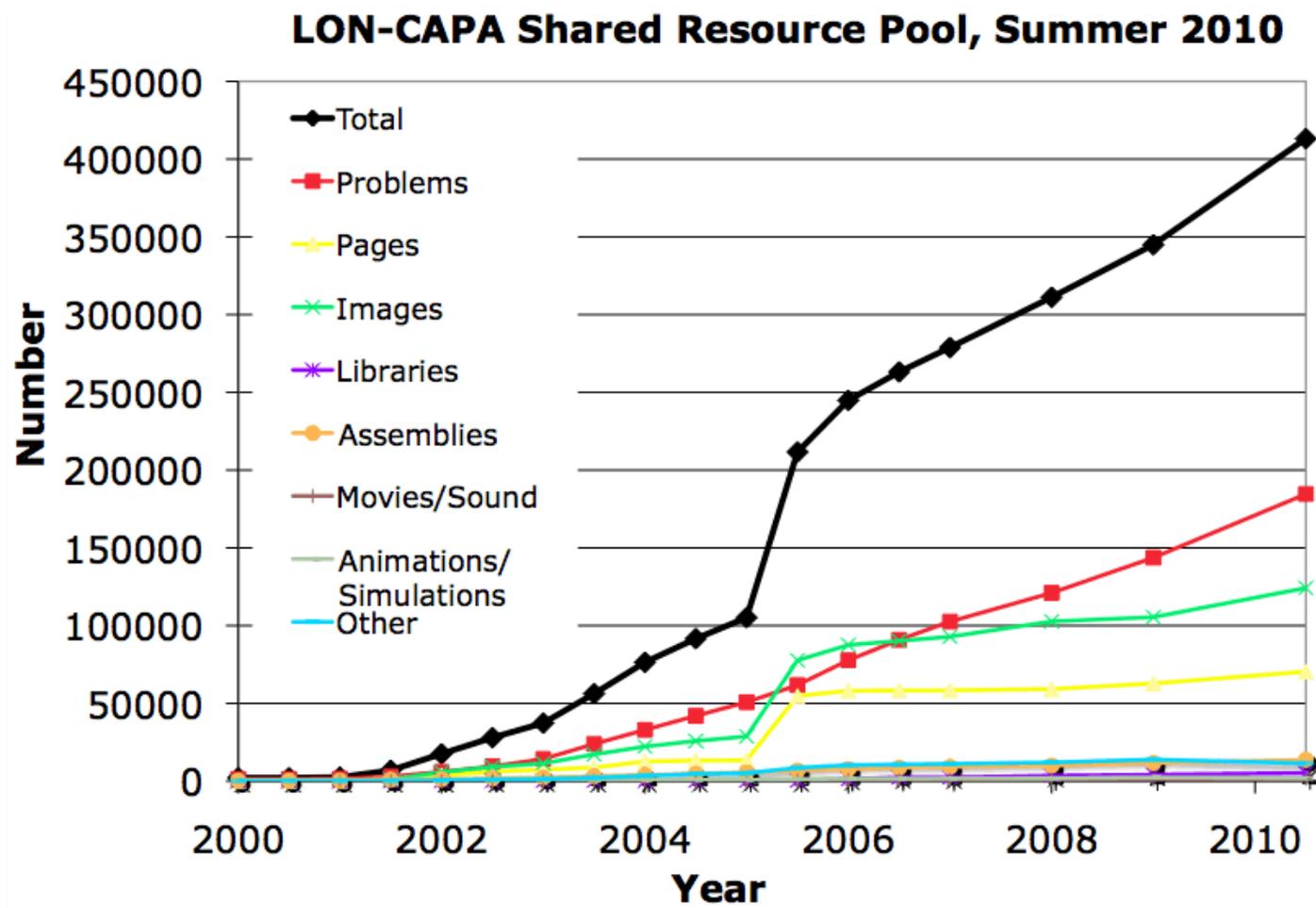
Embedded Assessment (points to 'Magnetic Field' item)

Contextual Discussions (points to 'Magnetic Field' item)

Time Management (points to 'Due this Friday, Feb 11 at 11:59 am (EST)')

LON-CAPA Course Management

- Shared Learning Content Management



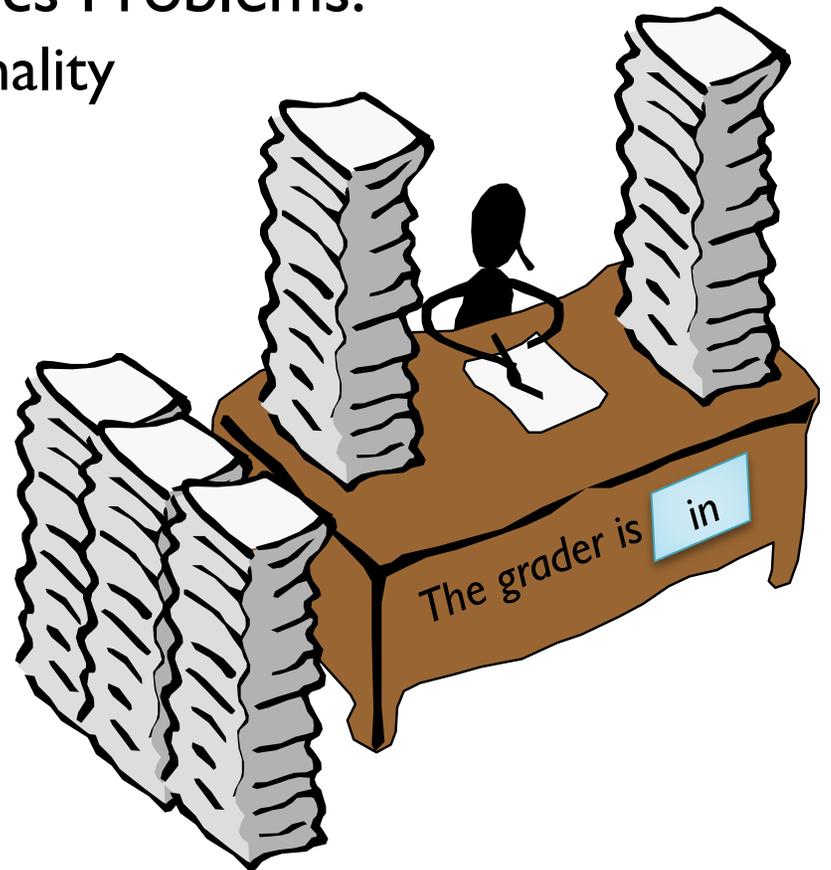


Particular Strength: Assessment

- Randomized problems: different
 - numbers
 - formulas
 - graphs
 - images
 - options
 - ...for each student.
- Student can collaborate without “cheating”
- Randomized exams

LON-CAPA Mathematics

- Mathematics Output:
 - typesetting
 - graphing
- Generating Mathematics Problems:
 - symbolic math functionality
 - statistics packages
- Mathematics Input:
 - numerical
 - formula evaluation
 - sampling
 - symbolically
 - checking for properties
 - graphical input
 - bubble sheets
 - clickers



WARNING

Today's presentation is going to show some very specialized functionality. Because you can does not mean you have to.



Mathematical Output

- **Typesetting:**
LaTeX can be embedded anywhere in the material

Text Block Delete? Edit Math  [Greek Symbols !\[\]\(3b1700cbc304ccaa610d7a6a96d906f3_img.jpg\)](#)

[Rich formatting »](#)

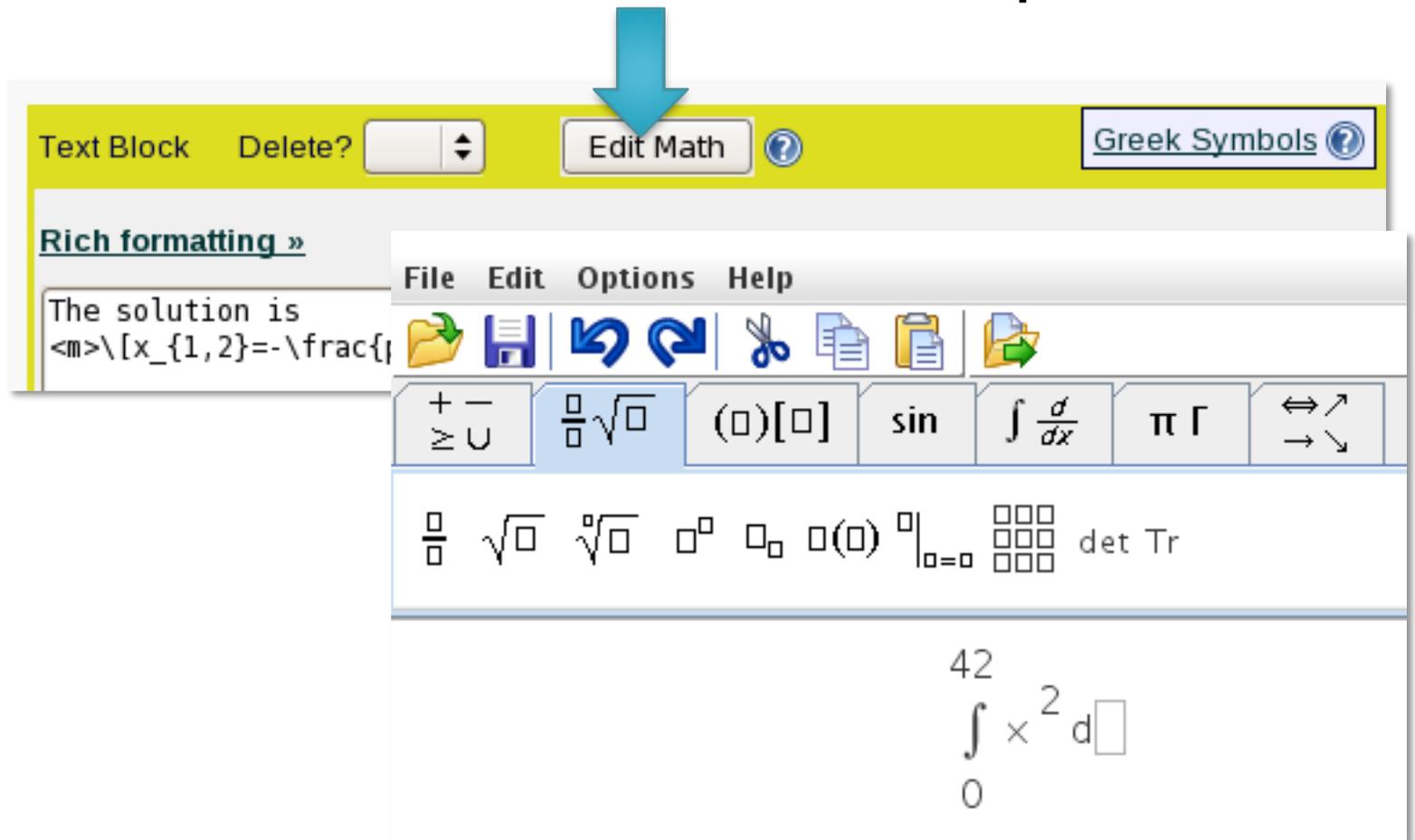
The solution is
<m>\[x_{1,2}=-\frac{p}{2}\pm\sqrt{\left(\frac{p}{2}\right)^2-q}\]</m>

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 a dropdown menu set to "Text Block", a "Delete?" button, an "Edit Math" button (highlighted by a blue arrow), and a "Greek Symbols" button. Below this is a "Rich formatting »" section. 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 arrows. Below the toolbar, a row of mathematical symbols is shown: $\frac{\square}{\square}$, $\sqrt{\square}$, $\sqrt[\square]{\square}$, \square^\square , \square_\square , $\square(\square)$, $\square|_{\square=\square}$, a 3x3 grid of squares, and "det Tr". At the bottom, a preview window displays the rendered mathematical expression:
$$\int_0^{42} x^2 dx$$

Mathematical Output

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

Script Delete?

```
$k=&random(2,5,1)
```

Insert:

Text Block Delete? Edit Math

Rich formatting »

```
What is the derivative of  
<m eval="on">\[\frac{1}{$k}x^{k}\]</m>  
with respect to <m>$x$</m>?
```

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

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

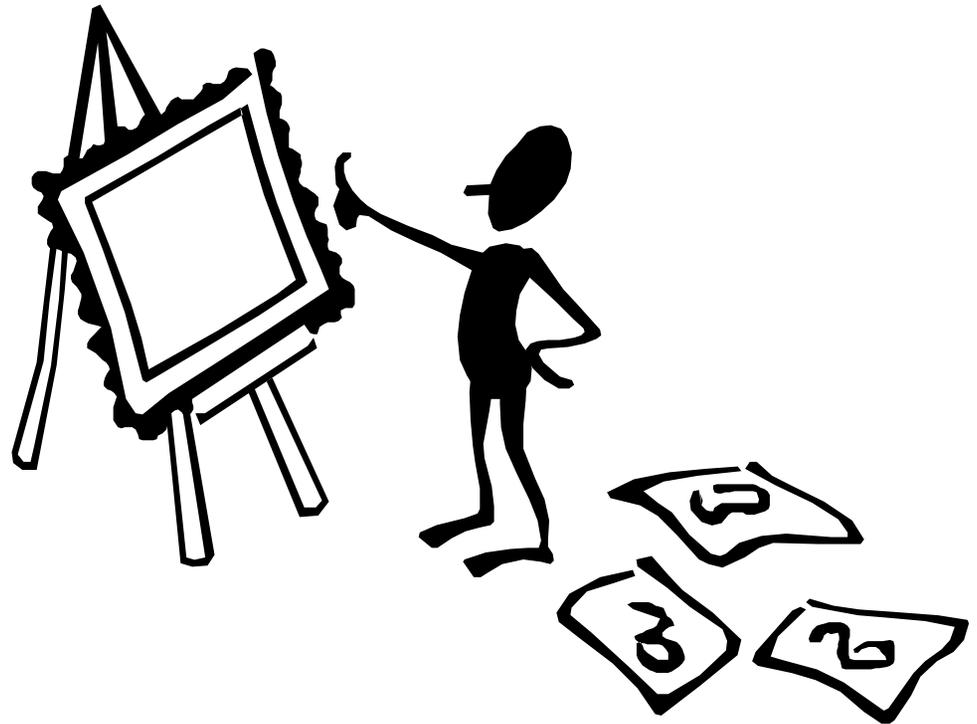
- Print (dynamically generated PDF):

The solution is

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

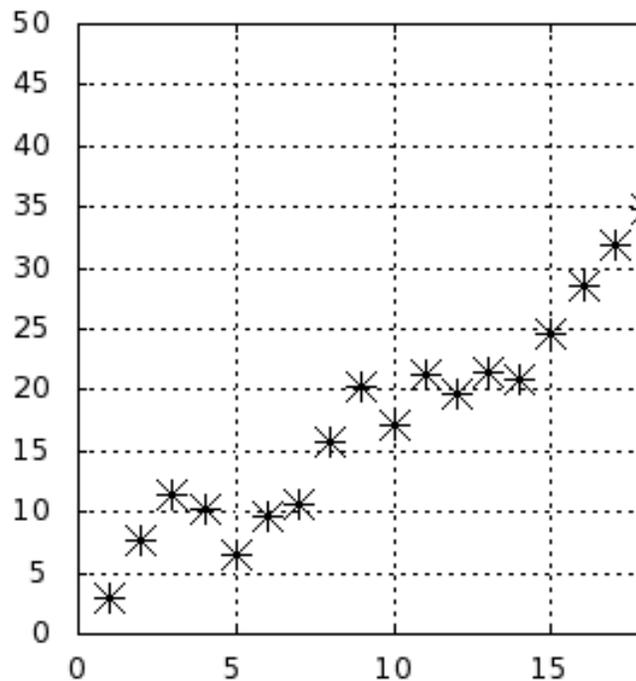
Mathematical Output

- 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

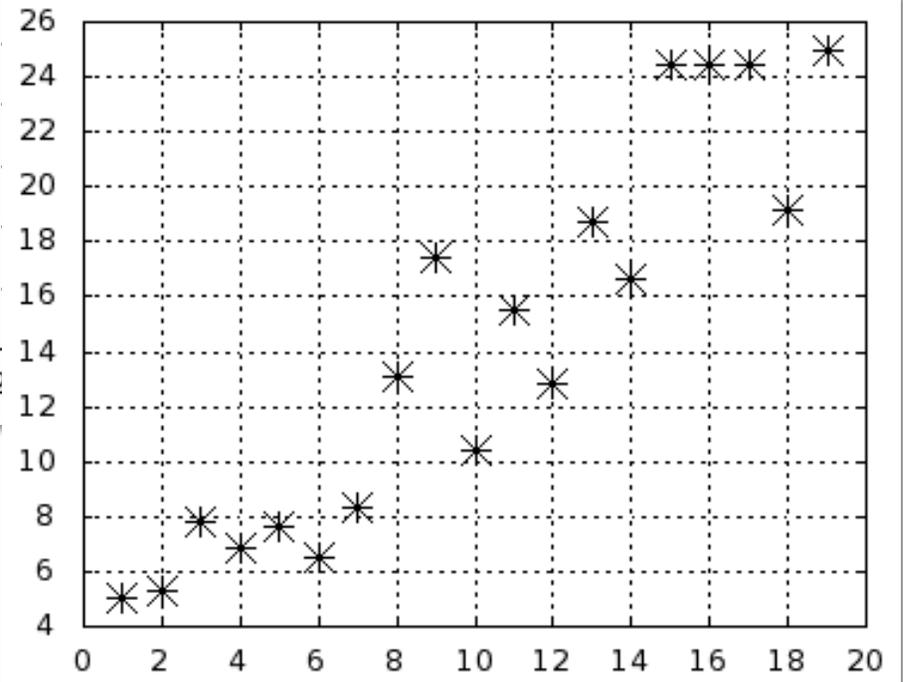
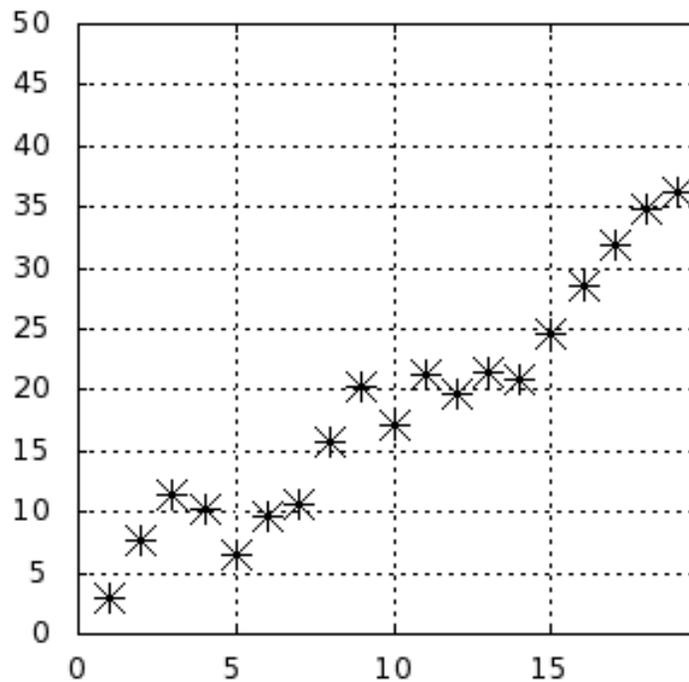
Insert:

Comma or space delimited curve data

Insert:

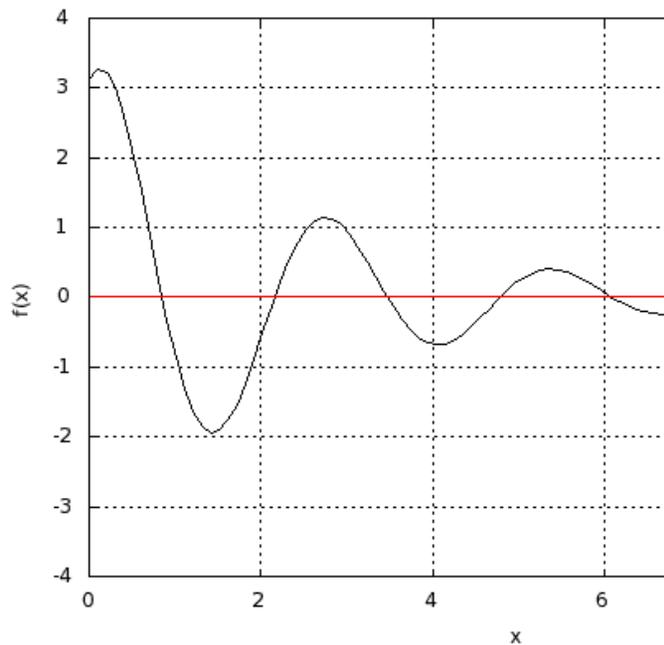
Mathematical Output

- Data points



Mathematical Output

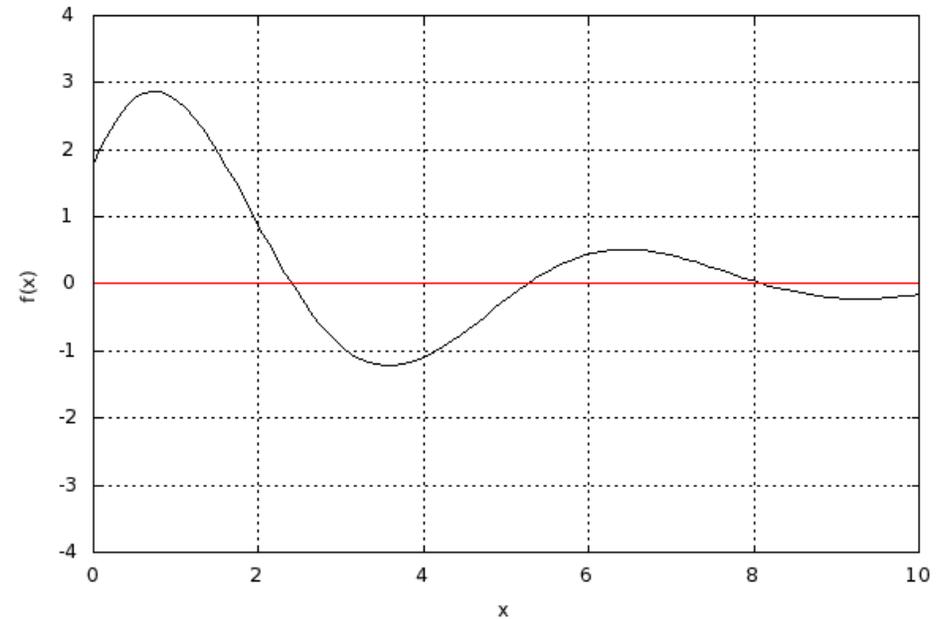
- Functions



Match the function indicated in black.

$f(x) =$

Tries 0/99



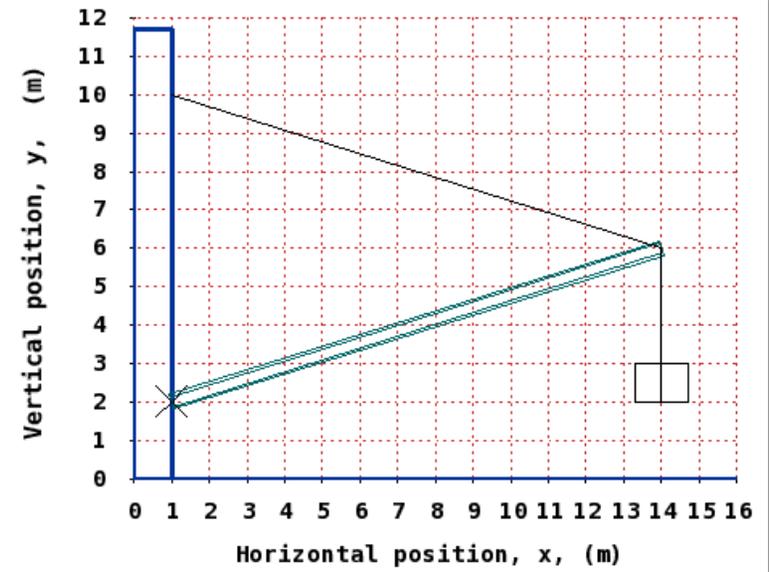
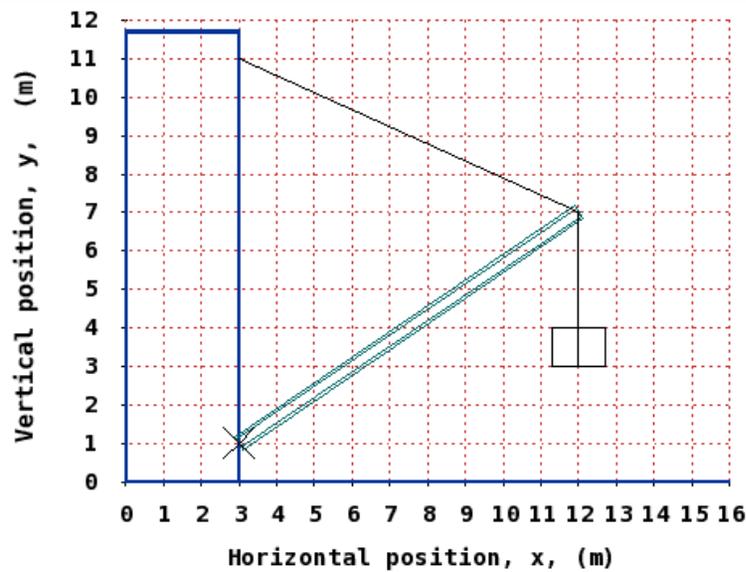
Match the function indicated in black.

$f(x) =$

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 fraction

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

Submit Answer

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

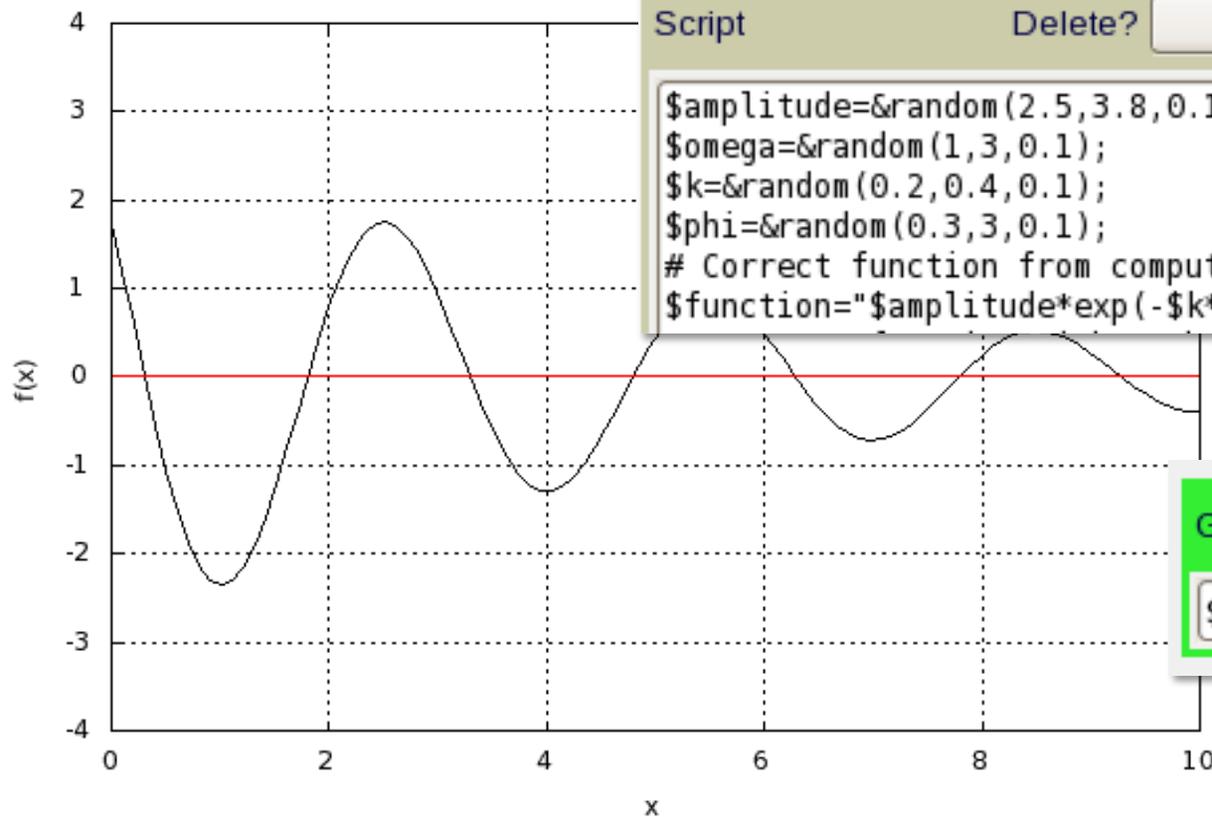
An object starts at the origin with a constant velocity of

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

Where is it 4 seconds later?

- Simplest input: numerical

Mathematics Input



Script

Delete?

```
$amplitude=&random(2.5,3.8,0.1);  
$omega=&random(1,3,0.1);  
$k=&random(0.2,0.4,0.1);  
$phi=&random(0.3,3,0.1);  
# Correct function from computer  
$function="$amplitude*exp(-$k*x)*sin($omega*x+$phi)";
```

Gnuplot compatible curve function

`$function`

Match the function indicated in black.

f(x)=

Response: Formula

Delete?

Insert:

Answer: `$function`

Sample Points: `x@0;1;2;3;4;5;6;7;8;9`

- Sampling – approximate function

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);
}
```

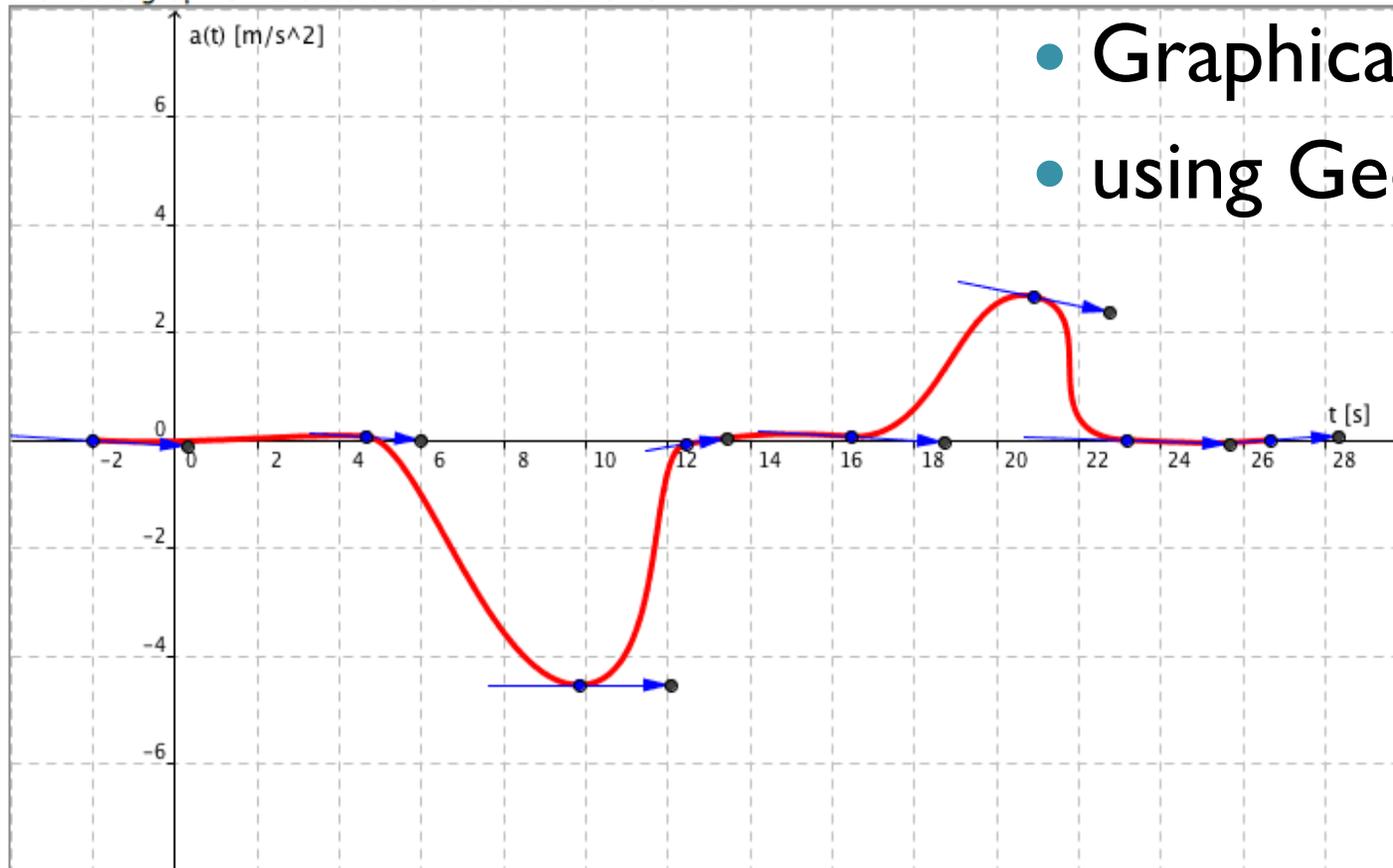
Answer algorithm

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

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](#)

[Script Vars](#)
[Rules Log](#)

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:

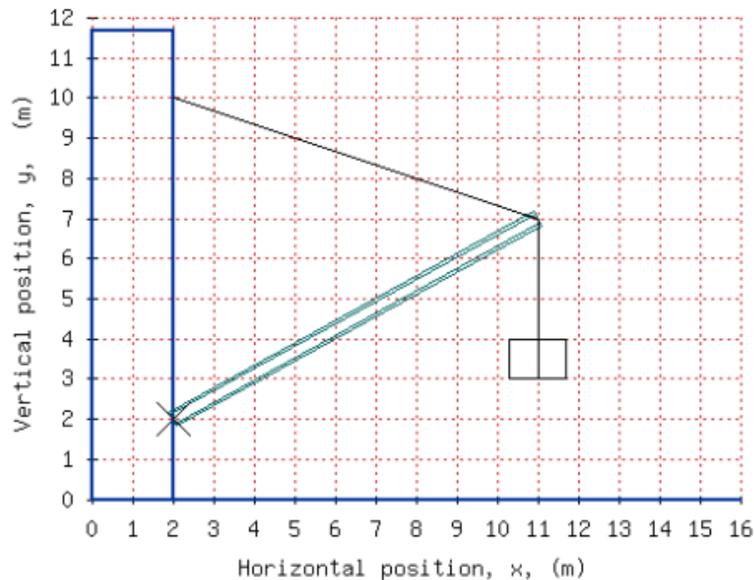
Percent error:

Symbolic, computed, or
hard-coded ranges

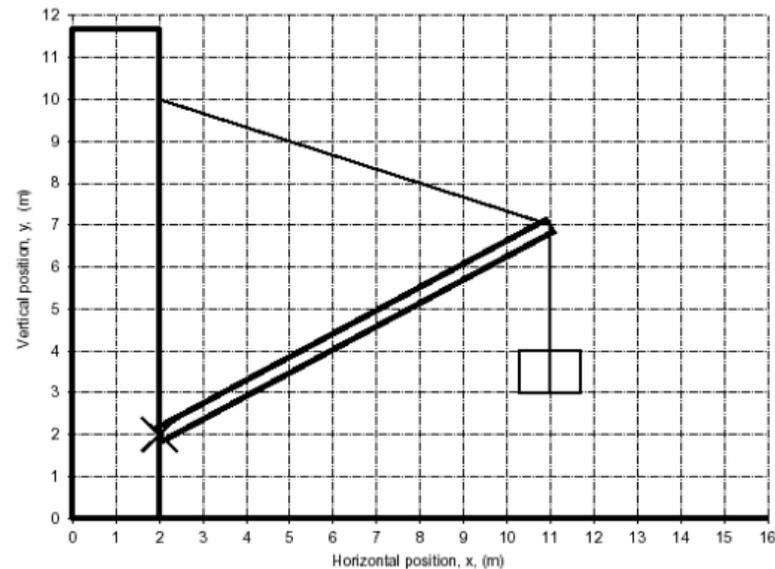
Mathematical Input

- Problems can also be rendered for bubble sheets

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.



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

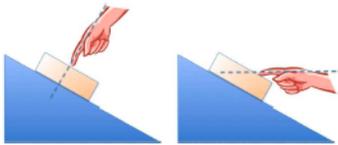
Mathematical Input

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?

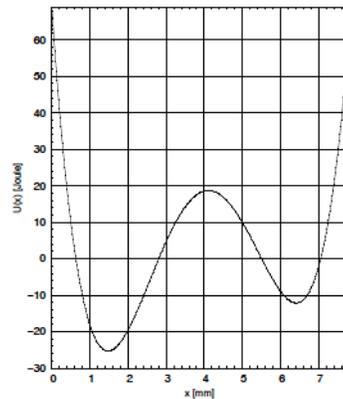
1. A The left scenario.
 B The right scenario.
 C Same in both scenarios.

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

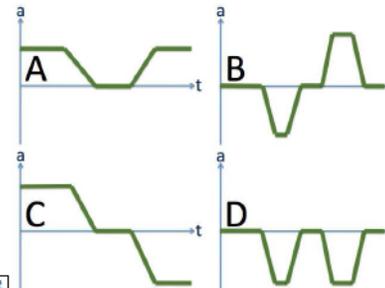
CODE - AACHDA
LB 271 - Introductory Physics Lecture
Version A

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

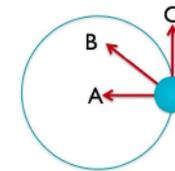


1 pt A car drives in the forward (positive) direction. It first has a constant speed, then drives into a parking spot, waits for a few moments, and then drives out again backwards. Which one of the acceleration graphs could describe this scenario?

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?

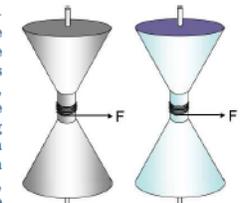
12. A Direction A.
 B Direction B.
 C Direction C.
 D Into the paper.
 E Out of the paper.

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

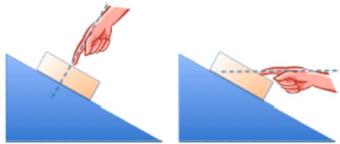
Mathematical Input

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	$G = 6.67 \cdot 10^{-11} \text{ m}^3/(\text{kg s}^2)$
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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 higher frictional force on the block?

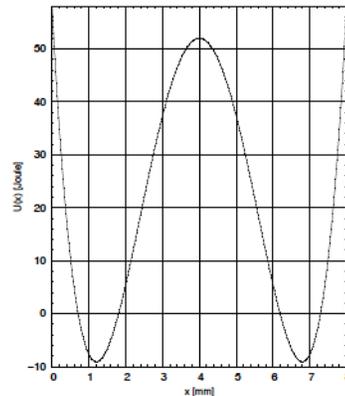
- A The left scenario.
- B The right scenario.
- C Same in both scenarios.

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 0.710
- B 0.831
- C 0.972
- 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

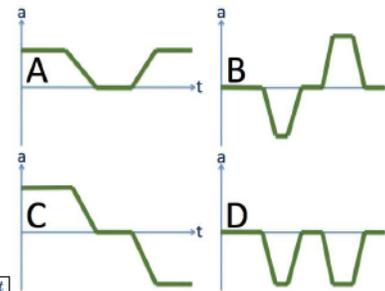
CODE - AAFIHH
LB 271 - Introductory Physics Lecture
Version A

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

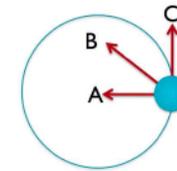
A car drives in the forward (positive) direction. It first has a constant speed, then drives into a parking spot, waits for a few moments, and then drives out again backwards. Which one of the acceleration graphs could describe this scenario?

- 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?

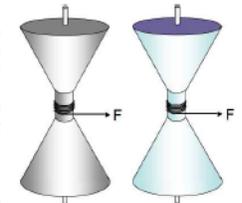
- A Direction A.
- B Direction B.
- C Direction C.
- D Into the paper.
- E Out of the paper.

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

Mathematical Input

CODE - AACHDA

LB 271 - Introductory Physics Lecture

Version A

Name:

LB271 Fa

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YOUR LAST NAME										F.I.	A									
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PLEASE WRITE YOUR SIGNATURE WITHIN THIS BOX

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14	1	2	3	4	5	6	7	8	9	10		28	1	2	3	4	5	6	7	8	9	10		

Mathematical Input



Resistance

Numerical Clicker
in Lecture

Current through a resistor



What is the current in milliamperes?

Mathematical Input

LON-CAPA can evaluate clicker data after lecture

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

Gerd The Kortemeyer
No Role, Cumulative Privileges

Menu->Set User Preferences->Register Clicker

Change Preferences

Enter response device ("clicker") numbers

005BC59E

Register

Mathematical Input

[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:

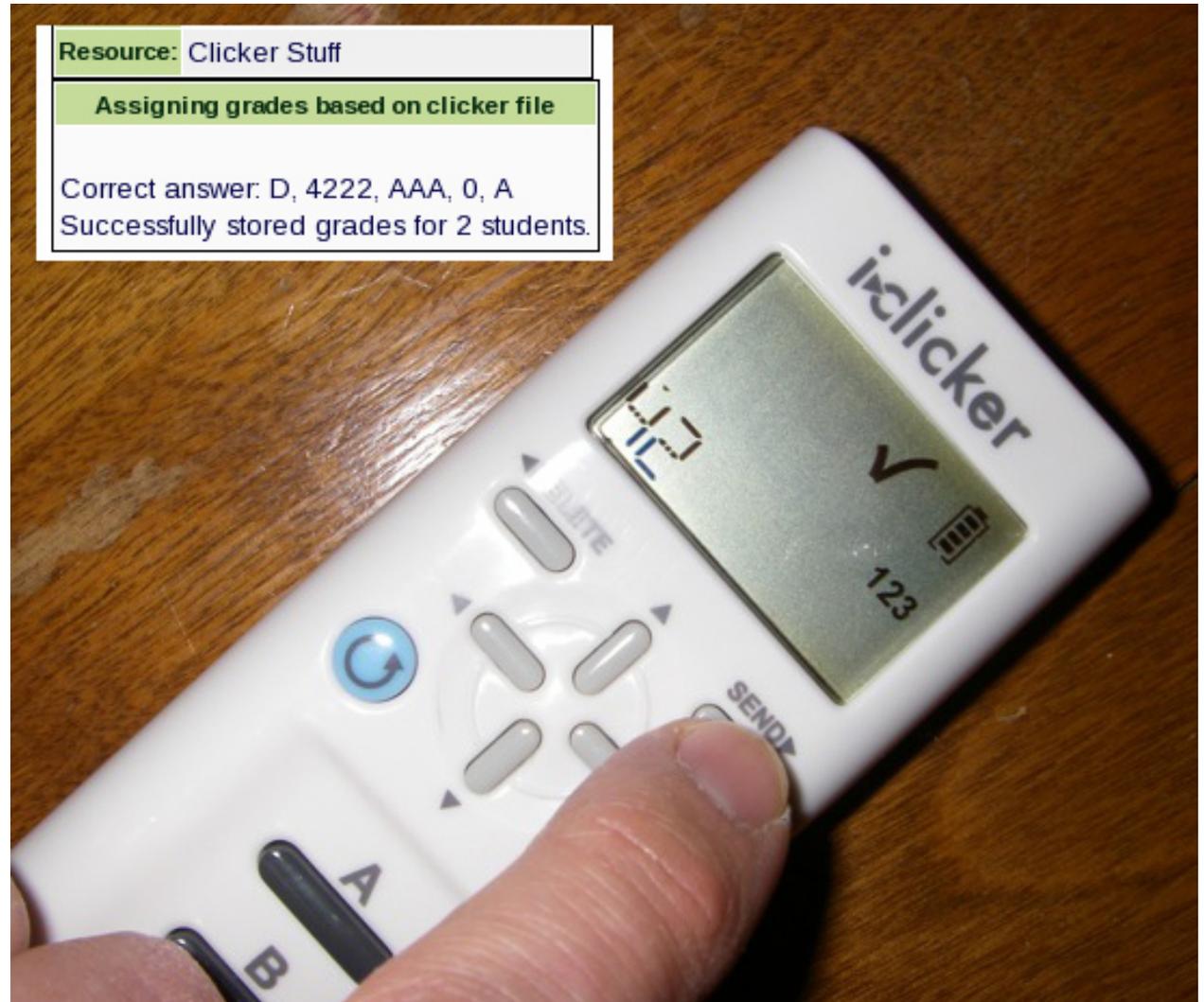
- Award points just for participation
- Correctness determined from response by course personnel
- Correctness determined from response with clicker ID(s)

Percentage points for correct solution:

Percentage points for incorrect solution:

Mathematical Input

- i>clicker2 integrated in LON-CAPA





Interested?

- Faculty Seminars
May 10-11, 2011
- Can give departmental colloquia
- Work one-on-one
- LON-CAPA Conference
Virginia Commonwealth University
May 19-21, 2011
- LON-CAPA Workshop
MSU, late June



Thank You

Gerd Kortemeyer
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and

Division of Science and Mathematics Education

korte@lite.msu.edu

<http://www.lon-capa.org/>