Welcome to the MAA short course on **WeBWorK** .

Here is a synopsis of the tutorial examples presented in this set. They have been designed for learning the PG language, and are not necessarily the best questions to use for mathematics instruction.

1. Hello world example: Illustrates the basic structure of a PG problem.

2. Standard example: This covers what you need to know to ask the majority of the questions you would want to ask in a calculus course. Problems with text answers, numerical answers and answers involving expressions are covered.

3. Simple multiple choice example: Uses lists(arrays) to implement a multiple choice question.

4. Multiple choice example: Uses the multiple choice object to implement a multiple choice question.

5. Matching list example:

6. True/false example:

7. Pop-up true/false example: Answers are chosen from a pop-up list.

8. On-the-fly graphics example 1: The graphs are regenerated each time you press the submit button

9. On-the-fly-graphics example 2: – Adds some randomization to the first example.

10. Static graphics example: Presents graphs created on a separate application (e.g. Mathematica) and saved.

11. Hermite graph example: A particularly useful way of generating predictable graphs by specifying the value and first derivative of a function at each point. Piecewise linear graphs are also included in this example.

12. HTML links example: Shows how to link other web resources to your WeBWorK problem.

13. JavaScript example 1: An example which takes advantage of this interactive media! This one requires students to calculate the derivative of a function from the definition.

14. JavaScript example 2: A variant of the previous example that generates the example function as a cubic spline so that students can't read the javaScript code to find out the answer.

15. Vector field example Generates vector field graphs on-the-fly.

16. Conditional question example: Illustrates how you can create a problem which first asks an easy question, and once that has been answered correctly, follows up with a more involved question on the same material.

17 Java applet example: A preliminary example of how to include Java applets in WeBWorK problems.

The primary purpose of WeBWorK is to let you know if you are getting the right answer or to alert you if you get the wrong answer. Usually you can attempt a problem as many times as you want before the due date. However, if you are having trouble figuring out your error, you should consult the book, or ask a fellow student, one of the TA's or your professor for help. Don't spend a lot of time guessing – it's not very efficient or effective. The computer has NO CLUE about WHY your answer is wrong. Computers are good at checking, but for help go to a human.

Give 4 or 5 significant digits for (floating point) numerical answers. For most problems when entering numerical answers, you can if you wish enter elementary expressions such as $2 \wedge 3$ instead of 8, $sin(3*pi/2)$instead of -1, $e \wedge (ln(2))$ instead of 2, $(2+tan(3))*(4-sin(5)) \wedge 6-7/8$ instead of 27620.3413, etc. Here's the **list of the functions** which WeBWorK understands.

You can use the Feedback button on each problem page to send e-mail to the professors.

Complete the sentence:
_________ world!

Answer(s) submitted:

-

(incorrect)

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2. **(1 pt) setMAAtutorial/standardexample.pg**

Standard Example

Complete the sentence:
_________ world;

Enter the sum of these two numbers:
$3+5=$ _____

Enter the derivative of

$$f(x)=x^5$$

$f'(x)=$ ______________

Answer(s) submitted:

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-
-

(incorrect)

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3. **(1 pt) setMAAtutorial/simplemultiplechoiceexample.pg**

Multiple choice example

What is the derivative of tan(x)?

A. $-\cot(x)$
B. $\sec^2(x)$
C. $\tan(x)$
D. $\cosh(x)$
E. $\sin(x)$

Enter the letter corresponding to the correct answer: ____

Answer(s) submitted:

-

(incorrect)

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4. **(1 pt) setMAAtutorial/multiplechoiceexample.pg**

Multiple choice example

What is the derivative of tan(x)?

- A. $\cosh(x)$
- B. $-\cot(x)$
- C. $\sec^2(x)$
- D. $\cos^3(x)$
- E. $\sin(x)$
- F. $\tan(x)$
- G. $\text{sech}(x)$

Answer(s) submitted:

-

(incorrect)

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5. **(1 pt) setMAAtutorial/matchinglistexample.pg**

Matching list example

Place the letter of the derivative next to each function listed below:

___1. $\cos(x)$
___2. $\sin(3x)$
___3. $3x^5$
___4. $\sin(2x)$

A. $-\sin(x)$
B. $2\cos(2x)$
C. $9x^2$
D. $3\cos(3x)$

Let's print the questions again, but insist that the first two questions (about sin and cos) always be included. Here is a second way to format this question, using tables:

___1. $\sin(x)$ ___2. $2x^3$ ___3. $\cos(x)$	A. $-\sin(x)$ B. $\cos(x)$ C. $6x^2$

And below is yet another way to enter a table of questions and answers:

___1. $\sin(x)$ ___2. $2x^3$ ___3. $\cos(x)$	A. $-\sin(x)$ B. $\cos(x)$ C. $6x^2$ D. The derivative is not provid

Answer(s) submitted:

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(incorrect)

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6. **(1 pt) setMAAtutorial/truefalseexample.pg**

True False Example

Enter T or F depending on whether the statement is true or false. (You must enter T or F – True and False will not work.)

___1. All differentiable strictly increasing functions have non-negative derivatives at every point
___2. All differentiable functions are continuous.
___3. All increasing functions have positive deriviatives
___4. All functions with positive derivatives are increasing.

Answer(s) submitted:

-
-
-
-

(incorrect)

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7. **(1 pt) setMAAtutorial/popuplistexample.pg**

True False Pop-up Example

Indicate whether each statement is true or false.

[?] 1. All closed sets are compact
[?] 2. All polynomials are differentiable.
[?] 3. All increasing functions have positive deriviatives
[?] 4. All continuous functions are differentiable.

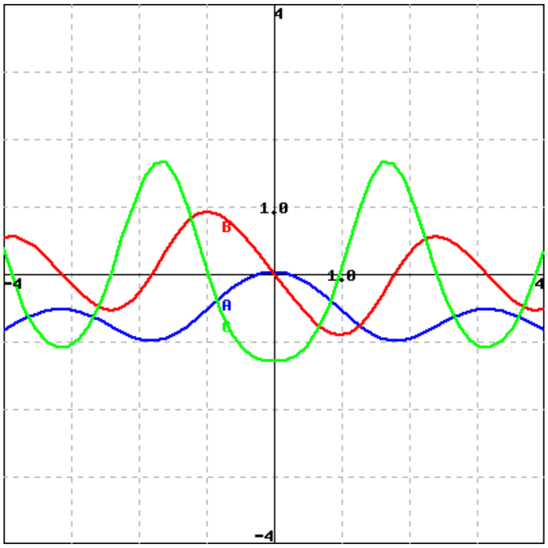
Answer(s) submitted:

-
-
-
-

(incorrect)

8. **(1 pt) setMAAtutorial/ontheflygraphicsexample1.pg**

On-the-fly Graphics Example1



Identify the graphs A (blue), B(red) and C (green) as the graphs of a function and its derivatives (click on the graph to see an enlarged image):

___ is the graph of the function
___ is the graph of the function's first derivative
___ is the graph of the function's second derivative

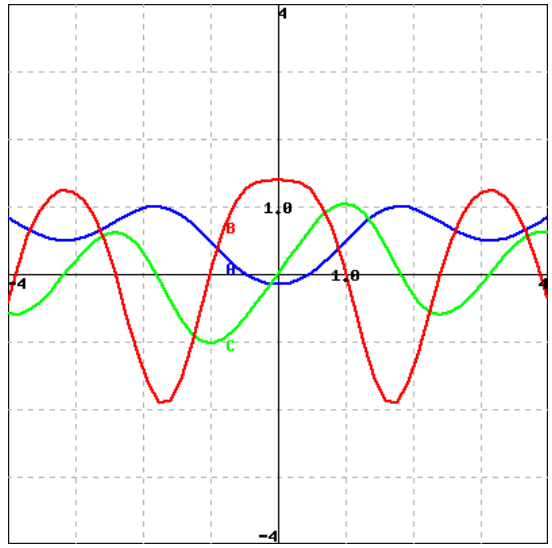
Answer(s) submitted:

-
-
-

(incorrect)

9. **(1 pt) setMAAtutorial/ontheflygraphicsexample2.pg**

On-the-fly Graphics Example2



Identify the graphs A (blue), B(red) and C (green) as the graphs of a function and its derivatives (click on the graph to see an enlarged image):

___ is the graph of the function
___ is the graph of the function's first derivative
___ is the graph of the function's second derivative

Answer(s) submitted:

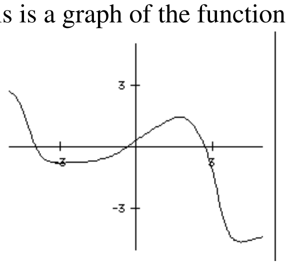
-
-
-

(incorrect)

10. **(1 pt) setMAAtutorial/staticgraphicsexample/staticgraphicsexample.pg**

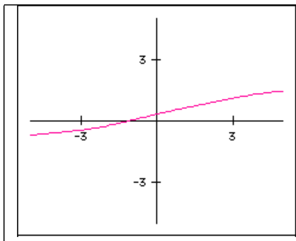
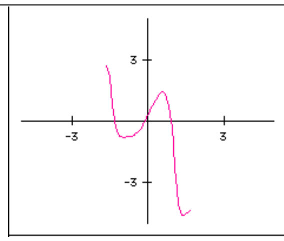
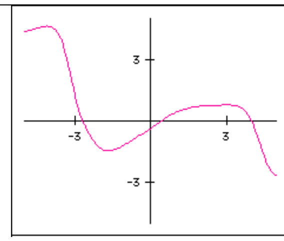
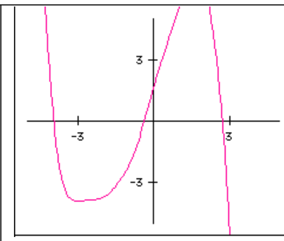
Static graphics Example

This is a graph of the function $F(x)$: (**Click on image for a larger view**)



Enter the letter of the graph below which corresponds to the transformation of the function.

___1. $F(x/3)$
___2. $-F(-x)$
___3. $F(3x)$
___4. $5F(x)$

			
A	B	C	D

Answer(s) submitted:

-
-

-
-

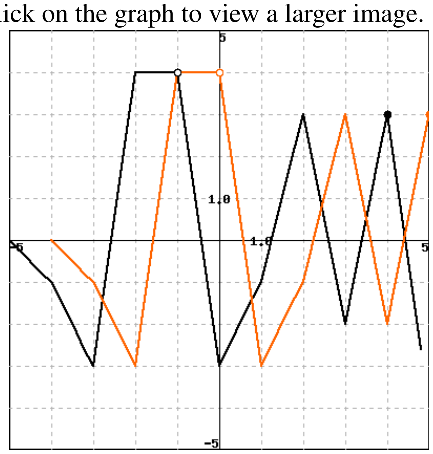
(incorrect)

11. **(1 pt) setMAAtutorial/hermitegraphexample.pg**

Hermite polynomial graph example

We have developed other ways to specify graphs which are to be created 'on the fly'. All of these new methods consist of adding macro packages to WeBWorK. Since they do not require the core of WeBWorK to be changed, these enhancements can be added by anyone using WeBWorK.

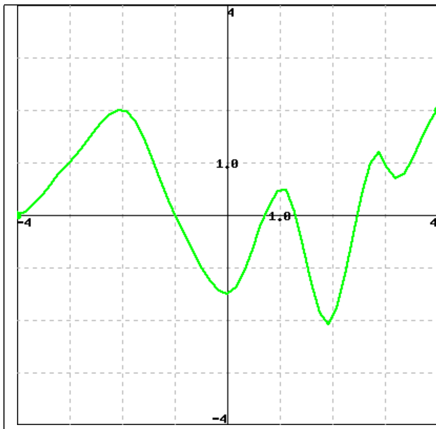
These two piecewise linear graphs were created by specifying the points at the nodes.
Click on the graph to view a larger image.



If the black function is written as $f(x)$, then the orange function would be written as $f($ __________ $)$.

This graph was created using a hermite spline by specifying points at

x	-4	-3	-2	-1	0	1	2	3	4
y	0	1	2	0	-1.5	0.5	-2	1	2
yp	0.1	1	0	-2	0	1	2	-3	1



List the internal local minimum points in increasing order:

_____ _____ _____

Answer(s) submitted:

-
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-

(incorrect)

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12. **(1 pt) setMAAtutorial/htmllinksexample/htmllinksexample.pg**

HTML links example

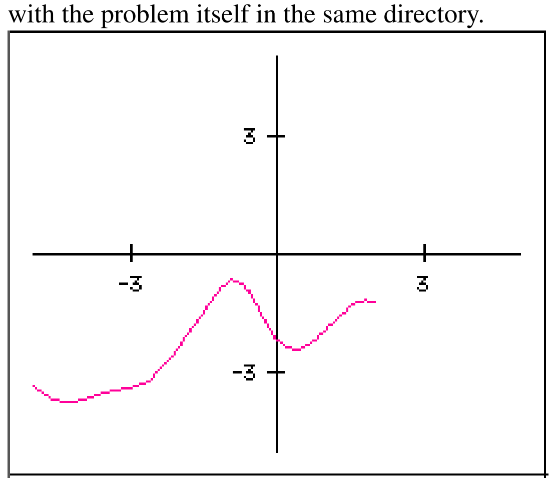
This example shows how to link to resources outside the problem itself.

Linking to other web pages over the internet is easy. For example, you can get more information about the buffon needle problem and how it is used by ants to find new nest sites by linking to **Ivars Peterson's column on the MAA site**.

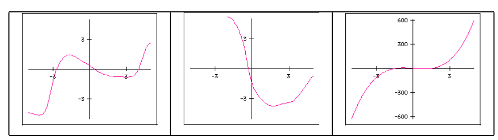
All of the files in the html directory of your WeBWorK course site can be read by anyone with a web browser and the URL (the address of the file). This is a good place to put files that are referenced by more than one problem in your WeBWorK course.

Here is the link to the **to the calculator page** stored in the top level of the html directory of the tutorialCourse.

Finally there are files, such as picture files, which are stored with the problem itself in the same directory.



And the table below has three more graphs which are stored in the directory containing the current problem.



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13. **(1 pt) setMAAtutorial/javascriptexample1.pg**

JavaScript Example 1

13. **(1 pt) setMAAtutorial/javascriptexample1.pg**
Find the derivative of the function f(x). The windows below will tell you the value of f for any input x. (I call this an "oracle function", since if you ask, it will tell.)

$f'(0) =$ ____________________

You may want to use a **calculator**

to find the result. You can also enter numerical expressions and have WeBWorK do the calculations for you.

The java Script calculator was displayed here

Answer(s) submitted:

-

(incorrect)

14. **(1 pt) setMAAtutorial/javascriptexample2.pg**

JavaScript Example 2

14. **(1 pt) setMAAtutorial/javascriptexample2.pg**

Find the derivative of the function f(x). The windows below will tell you the value of f for any input x. (I call this an "oracle function", since if you ask, it will tell.)

$f'(1) =$ ____________

You may want to use a **calculator**

to find the result. You can also enter numerical expressions and have WeBWorK do the calculations for you.

The java Script calculator was displayed here

Answer(s) submitted:

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(incorrect)

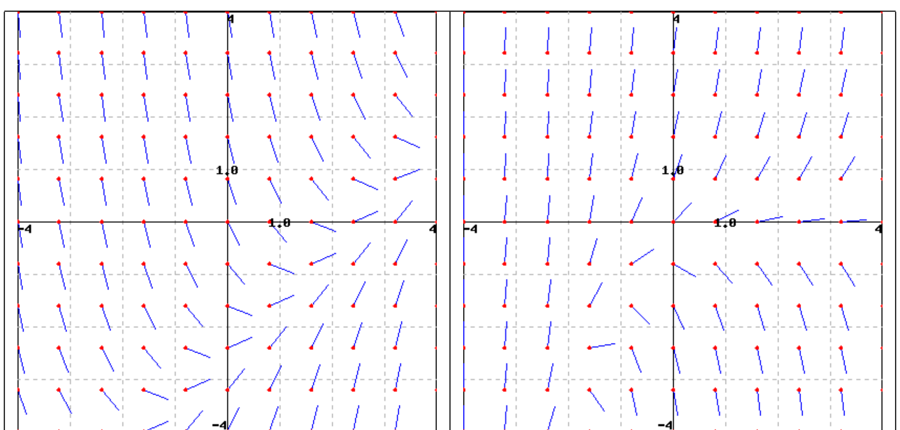
15. **(1 pt) setMAAtutorial/vectorfieldexample.pg**

Match the following equations with their direction field. Clicking on each picture will give you an enlarged view. While you can probably solve this problem by guessing, it is useful to try to predict characteristics of the direction field and then match them to the picture.

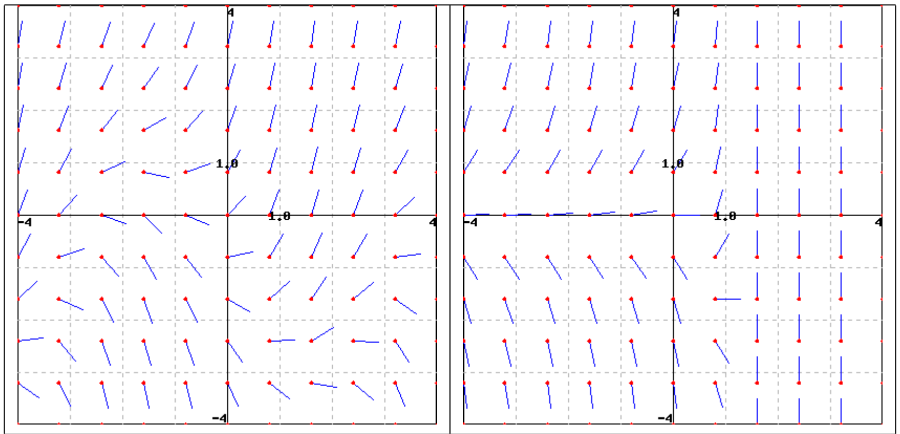
Here are some handy characteristics to start with – you will develop more as you practice.

A. Set y equal to zero and look at how the derivative behaves along the x axis.
B. Do the same for the y axis by setting x equal to 0
C. Consider the curve in the plane defined by setting y'=0 – this should correspond to the points in the picture where the slope is zero.
D. Setting y' equal to a constant other than zero gives the curve of points where the slope is that constant. These are called isoclines, and can be used to construct the direction field picture by hand.

____1. $y' = 2y + x^2 e^{2x}$
____2. $y' = e^{-x} + 2y$
____3. $y' = 2\sin(x) + 1 + y$
____4. $y' = -2 + x - y$



A	B



C D

Answer(s) submitted:

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(incorrect)

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16. **(1 pt) setMAAtutorial/conditionalquestionexample.pg**

Conditional questions example

If $f(x) = 8x + 14$, find $f'(6)$.

_____

Answer(s) submitted:

-

(incorrect)

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17. **(1 pt) setMAAtutorial/javaappletexample.pg**

Java applet example

This problem illustrates how you can embed Java applet code in a WeBWorK example to create an interactive homework problem that could never be provided by a text book.

WeBWorK can use existing **javaScript** and **Java** code to augment its capabilities.

The java applet was displayed here

The graph above represents the function

$$f(x) = x^2 + ax + b$$

where a and b are parameters.

For each value of a find the value of b which makes the graph just touch the x-axis.

if a= 1 then _____

if a= 1.5 then _____

if a= -1.5 then _____

Does this relationship between a and b specify b as a function of a? ___ (Yes or No)

Does this relationship between a and b specify a as a function of b? ___ (Yes or No)

Write a formula for calculating this value of b from a.

b = ____________________

Answer(s) submitted:

-
-
-
-
-
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(incorrect)