

Honors Precalculus

Summer Homework

Summer homework is due the first day of class. You need to check out a TI-89 Titanium graphing calculator from the library. This assignment was made to help you become familiar with your calculator and review some Algebra. Please review the TI-89 Calculator Uses for Calculus starting on page 3. The manual for your calculator will be helpful as well. The grade for this work will be worth 5% of your overall grade. Show all work on a separate piece of paper.

Please visit <http://www.mrandmmeb.com/honors-precalculus-blog.html> at least once every two weeks to post and answer questions, get help with summer homework and/or find useful information for the class. The password for this page is calculators.

Directions: Graph the mother function for each numbered problem below (1-8) using your calculator. On separate axes, sketch the functions. They do not need to be 100% accurate, just plot key points and sketch. Check your sketches with the graphing calculator. For each problem set, compare and contrast each function to either the mother function or a function in that set. Describe what the change in the function does to the graphs of the functions.

1) Mother Function: $y = x^2$

- a) $y = x^2 - 5$ b) $y = x^2 + 4$
c) $y = (x - 2)^2$ d) $y = (x + 4)^2 + 5$
e) $y = -x^2$ f) $y = (x - 2)^2 - 6$

2) Mother Function: $y = \sqrt{x}$

- a) $y = \sqrt{x}$ b) $y = \sqrt{x} + 4$
c) $y = \sqrt{x-3}$ d) $y = -\sqrt{x}$
e) $y = 3 - \sqrt{x}$ f) $y = -\sqrt{x-2} + 1$

3) Mother Function: $y = x^3$

- a) $y = x^3 + 4$ b) $y = -x^3$
b) $y = x^3 - 6$ c) $y = (x - 2)^3 - 5$

4) Mother Function: $y = \frac{1}{x}$

- a) $y = \frac{1}{x+3}$ b) $y = \frac{1}{x} + 3$
c) $y = -\frac{1}{x}$ d) $y = \frac{3}{4-x}$

5) Mother Function: $y = \ln(x)$

- a) $y = \ln(x) + 2$ b) $y = \ln(x+2)$
c) $y = -\ln(x)$ d) $y = \ln(-x)$

6) Mother Function: $y = e^x$

- a) $y = e^{x+1}$ b) $y = e^{2x}$
c) $y = e^{1-x}$ d) $y = e^x + 1$
e) $y = e^{-x}$ f) $y = -e^x$

7) Mother Function: $y = \sin(x)$ (set mode to RADIANS)

- a) $y = 4\sin(x)$ b) $y = \sin(x) - 1$
c) $y = \sin(x/2)$ d) $y = 2\sin(x) + 2$

8) Mother Function: $y = \cos(x)$

- a) $y = 4\cos(x)$ b) $y = \cos(2x)$
c) $y = 4\cos(x) - 4$ d) $y = -\cos(x) + 1$

9) Resize your viewing window to $[0,1] \times [0,1]$ (In other words, $x_{\min} = 0$, $x_{\max} = 1$, $y_{\min} = 0$, $y_{\max} = 1$) Graph all of the following functions in the same window. In other words, let $y_1 =$ graph a), let $y_2 =$ graph b), etc. List the functions from the highest graph to the lowest graph. How do they compare for values of $x > 1$?

a) $y = x^2$ b) $y = x^3$ c) $y = \sqrt{x}$ d) $y = x^{2/3}$ e) $y = |x|$ f) $y = x^4$

For problems 10 – 13, use the Finding Roots section below to help solve for the roots of each function to the nearest 0.001 both graphically and algebraically. You may need to change your viewing window.

10) $f(x) = x^4 - 3x^3 + 2x^2 - 7x - 11$

11) $f(x) = x^4 - 8x^2 + 5$

12) $f(x) = 2\sin(2x) - 1$ from $[-2\pi, 2\pi]$

Note: All trig functions need to be done in radian mode.

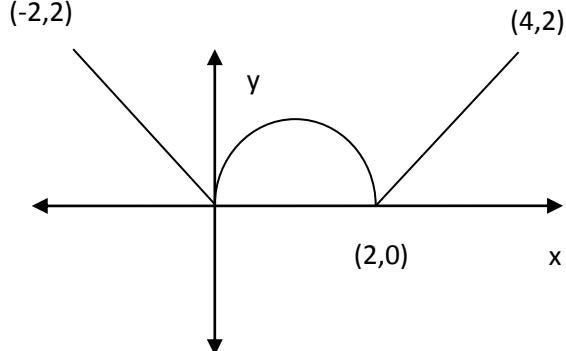
Find the intersection point(s) of the two graphs for problems 14 and 15.

14) $y_1 = \sin(x)$, $y_2 = x^2$

15) $y_1 = \ln(x)$, $y_2 = \cos(x)$

Solve the following inequality by graphing the function and by using the solve feature of your calculator.

16) $x^3 - 4x < -5$



The graph of $f(x)$ to the right consists of two line segments and a semicircle. Use it to answer questions 17-22.

17) Find the slope of each of the line segments.

18) Find the equation of each of the line segments.

19) Find the equation of the semi-circle.

20) Write the equation $f(x)$ as a piecewise function.

21) State the intervals on which the function is a) increasing and b) decreasing.

22) Find the area bounded by $f(x)$, the line $x = -2$, the line $x = 2$, and the x -axis.

TI-89 Calculator Uses for A.P. Calculus

I. Graphing

Press **Y=** to get to the equation screen. Type the desired function(s) in any location (Y_1 is the most common). Press the diamond key (green), then **F3 GRAPH**. This will graph most functions. Occasionally, it will be necessary to resize the graphing window to show the function. This can be done manually or automatically.

Manually. Press **WINDOW**. Type the smallest x-value for your window in **Xmin**. Enter the largest x-value for your window in **Xmax**. **Xscl** is used to indicate how often you want a tic mark along the x-axis. **Ymin** is the smallest y-value for your window. **Ymax** is the largest y-value for your window. **Yscl** is used to indicate how often you want a tic mark along the y-axis.

Automatically. Press **ZOOM**. The following explains each ZOOM feature.

1: ZoomBox allows the user to set a window of any desired size that is smaller than the current window. After pressing **ZBOX**, use the directional arrows to move the cursor to a corner of your new window. Press **ENTER** to anchor that corner. Use directional arrows to expand the rectangle to the other corner of a diagonal. Press **ENTER** again. The rectangle will be resized to fill the entire screen.

2: Zoom In causes the window to zoom in by a fixed factor in both the x and y directions. The default factor is 4. Each time you press **ENTER** while in this mode, the screen will zoom in by the current factor. After pressing **Zoom In**, use directional arrows to move the cursor to the center of the desired screen. Press **ENTER**. The screen will zoom in by the specified factor. You may move the cursor and press **ENTER** as many times as you want to zoom in as close as you want. It is possible to change the default value.

3: Zoom Out causes the window to zoom out by a fixed factor in both the x and y directions. The default factor is 4. Each time you press **ENTER** while in this mode, the screen will zoom out by the current factor. After pressing **Zoom In**, use directional arrows to move the cursor to the center of the desired screen. Press **ENTER**. The screen will zoom out by the specified factor. You may move the cursor and press **ENTER** as many times as you want to zoom out as far as you want. It is possible to change the default value.

4: ZoomDec resizes the window so that each horizontal pixel represents a change of 0.1 in the x-coordinate. This gives a convenient window when using the **TRACE** button. The domain is from -4.7 to 4.7. The range is from -3.1 to 3.1.

5: ZoomSqr resizes the window so that each pixel represents the same number in both the x- and y- directions. The domain defaults to -15 to 15. The range goes from -10 to 10. This window is useful in seeing the true aspect ratio of the graph.

6: ZoomStd defaults the domain from -10 to 10 and the range from -10 to 10.

This window is usually large enough to show a representative portion of the graph. However, the graph will be distorted because the x and y units are not equal.

7: ZoomTrig. In **Radian** mode the domain is -10.341 to 10.341. In **Degree** mode the domain is -360° to 360° . In both cases the range is -4 to 4.

8: ZoomInt This mode is similar to **ZDecimal** except that each pixel represents one unit along the horizontal and vertical axes. The default domain is -47 to 47 and -31 to 31 for the range. This window is useful when looking at a large scale view of the graph.

9: ZoomStat Automatically sizes the window to show all data points in an active plot as shown in **STATPLOT**.

0: ZoomFit Automatically adjusts the range so the function enters the window at a corner on the left side. If the function is odd, the range is adjusted so the function leaves the window at the other corner of the diagonal. If the function is even, the range is adjusted to cover the extreme y-value in the other direction of the entry point.

A common error message when graphing is **ERR: DIM MISMATCH**. This usually occurs when the **StatPlot** window is on and the referenced lists do not contain the same number of elements. To correct this error, press **2_{nd} Y= [STAT PLOT]**. Press **4: PlotsOff**. This transfers the command to the home screen. Press **ENTER** and the command will be executed. The command should be used whenever you wish to graph an equation without plotting any data points.

II. Finding Roots

Graphically:

To find the roots (zeros, or x-intercepts) of a function by graphing, type the function in the y= page (usually **Y₁**). Graph the function in an appropriate window. Press **F5 (Math)**. Choose **2: zero**. Type in any x-value that is clearly to the left of the root (zero) and press **ENTER**. Next, type in an x-value that is clearly to the right of the root (zero) and press **ENTER**.

The cursor will flash on the root and the coordinates will be displayed at the bottom of the screen. Often, the y-coordinate will not be zero but is so close to zero that the x-coordinate is correct to 13 decimal places. If the function has additional roots, repeat the process making sure to select x-coordinates clearly to the left and right of the desired root. Note: If you have several functions entered into the equation page, use the down arrow to select the proper function *after* pressing **F5, 2: zero** but *before* choosing an x-coordinate to the left of the root.

Algebraically:

To find the roots of a function algebraically, go to the home screen by pressing **HOME**. Press the **F2** key, which according to the drop down menu at the top of the screen gives you *Algebra* options. Choose **1: SOLVE** and press enter. Enter the equation, insert a comma (above the 9) and insert the variable you are solving for. Close the parenthesis and press **ENTER**. You can also press the diamond key then ENTER if you want an approximate value. (Trig functions).

III. Finding Points of Intersection

Graphically:

To find the intersection of two functions, enter both functions into the equation page. Press the diamond button (green and F3 (graph)). Press **F5 (Math)** and choose **5: intersection**. The cursor will flash on one of the graphs. To accept this function as one of the two, press **ENTER**. The cursor will then move to the next function. If this is one of the two functions, press **ENTER**. If not, press the down arrow to highlight the desired function, then press **ENTER**. (Note: you will only need to do this if you have more than 2 functions graphed.) Use the arrow keys to give a lower bound, to the left of where the two graphs intersect and press **ENTER**. Then use the arrow keys to give an upper bound by moving the cursor to the right of the intersection and press **ENTER**. The coordinates of the point will be displayed at the bottom of the screen. If there are additional points of intersection, repeat the steps.

Algebraically:

The intersection of two functions is the point where they meet and the x-coordinate is found also occurs when the two functions are set equal to each other. Press the HOME key and press the **F2** key, which according to the drop down menu at the top of the screen gives you *Algebra* options. Choose **1: SOLVE** and press enter. Enter the equation, ($f(x) = g(x)$) insert a comma (above the 9) and insert the variable you are solving for. Close the parenthesis and press **ENTER**. You can also press the diamond key then **ENTER** if you want an approximate value. (Trig functions). This will give you the x value of the intersection point which for the most part is the most valuable. To find the y-value, replace the x-value that you got above into either function and compute.

Other Important Features that You Will Use Frequently:

- 1) The diamond key let you get all the things in green. The **2nd** key lets you get all the things in blue.
- 2) Diamond Key then = gives you an approximate instead of exact.
- 3) **2nd MATH** (Press **2nd** then Press 5 (math is in blue))key will give you lots of functions and operations that you will need in certain calculations. Check them out. To get a < or > sign for example, **2nd MATH 8:Test** will give you all of these inequality signs.
- 4) Use the MODE right now to change Display Digits to float 6, Angle to radians, Graph to Function.
- 5) Diamond COPY, Diamond Paste are useful so you don't have to input a complicated function more than once.

EXAMPLE:

Graph the two equations $y = x^4 - 3x^2 - 1$ and $y = e^x$. Find the zeros (if any) of each function. find the intersection point(s).

Enter $y_1 = x^4 - 3x^2 - 1$ and $y_2 = e^x$. For e^x , press the diamond key (green), then the **X** button below **HOME**.

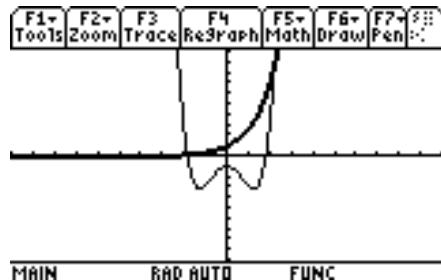
F1=	F2=	F3=	F4=	F5=	F6=	F7=	F8=
Tools	Zoom	Edit	✓	All	Style	...	

+PLOTS

$\checkmark y_1=x^4-3\cdot x^2-1$
 $\checkmark y_2=e^x$
 $y_3=$
 $y_4=$
 $y_5=$
 $y_6=$

$y_1(x)=x^4-3\cdot x^2-1$

MAIN RAD AUTO FUNC



Select the $y_2 = e^x$ function in the **y=** screen, press **2nd F1** to get **F6 style** from the menu at the top of the screen, and choose **4: thick** to make your graphs look like the ones above. This feature is useful to be able to tell which function is which.

Find the zeros on the graph screen. Press F5, Zero for the y_1 function, choose lower and upper bounds using the arrow keys, and find the first zero. (To get a lower bound, move the cursor to the left of the zero, to find an upper bound, move the cursor to the right of the zero.) Then find the 2nd zero. $y_2 = e^x$ has no zeros since the x-axis is a horizontal asymptote.

F1=	F2=	F3=	F4=	F5=	F6=	F7=	F8=
Tools	Zoom	Trace	Regraph	Math	Draw	Pen	...

$y_1(x)=x^4-3\cdot x^2-1$

Zero
xc:-1.817354 yc:7.e-13

MAIN RAD AUTO FUNC

F1=	F2=	F3=	F4=	F5=	F6=	F7=	F8=
Tools	Zoom	Trace	Regraph	Math	Draw	Pen	...

$y_1(x)=x^4-3\cdot x^2-1$

Zero
xc:1.817354 yc:7.e-13

MAIN RAD AUTO FUNC

Now find the zeros Algebraically: Go to the home screen, press F2 Algebra, select SOLVE. Go to the Y= screen by pressing the diamond key, then F1. Use the up down arrow keys to highlight y1, then press the diamond key then the COPY key (to the right and above the diamond key). Press HOME, then press diamond key and PASTE. Press the = key and 0. Insert a comma and an x and close the parenthesis. Then press the diamond key and ENTER to get an approximate value.

F1 Tools F2 Algebra F3 Calc F4 Other F5 Prgrm F6 Clean Up

```
■ solve(x^4 - 3*x^2 - 1 = 0, x)
x = -1.81735402102 or x = ►
solve(x^4-3*x^2-1=0,x)
MAIN RAD AUTO FUNC 1/30
```

Now replace each x into the function to solve for the y-coordinates of the intersection points.

EXAMPLE:

Find the x-coordinates of the intersection points if $y = x^4 - 3x^2 - 1$ and $y = e^x$

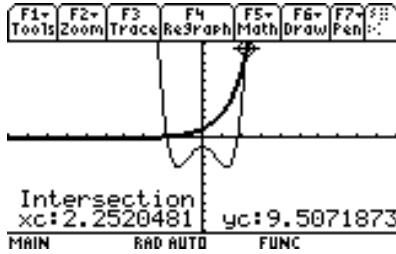
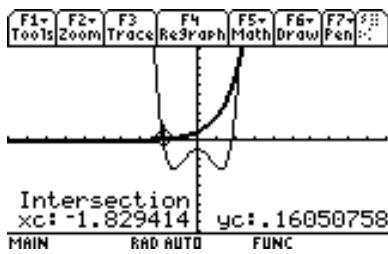
To solve for the intersection algebraically, **SOLVE** $y_1 = y_2, x$.

F1 Tools F2 Algebra F3 Calc F4 Other F5 Prgrm F6 Clean Up

```
■ solve(x^4 - 3*x^2 - 1 = e^x, x)
x = -1.82941410332 or x = ►
solve(x^4-3*x^2-1=e^x,x)
Warning: More solutions may exist
```

Solve for the intersection graphically.

Graph, F5 Math, 5: Intersection. Choose the function, press enter. (Since there are only 2 functions, just press enter twice.) Find the left intersection point first by giving appropriate lower and upper bounds. Then find the right intersection point.



For the things we will be doing in calculus, the x coordinates of the intersection points are the most important.

One more Example, solving an inequality.

EXAMPLE:

Solve for x in the following inequality:

$$x^4 - 4x^2 - 1 < -2$$

Solve Algebraically in a calculator. SOLVE $(x^4 - 4x^2 - 1 < -2, x)$. To get the $<$ sign, press 2nd then MATH, go down to 8: TEST, 2: <.

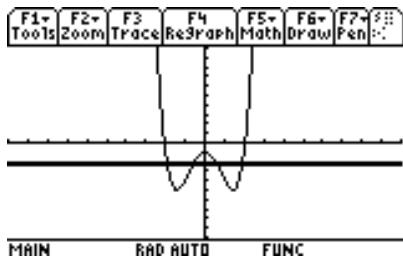
F1- Tools F2- Zoom F3- Trace F4- Regraph F5- Math F6- Draw F7- Pen

■ solve($x^4 - 4 \cdot x^2 - 1 < -2, x$)
-1.93185165258 < x < -.5177
solve($x^4 - 4 \cdot x^2 - 1 < -2, x$)
MAIN RAD AUTO FUNC 1/30

Solve by Graphing in the Calculator: In order to solve by graphing, you must understand this very important concept that we will use all year long. A function $f(x)$ is less than a function $g(x)$ ($f(x) < g(x)$) if $f(x)$ is below $g(x)$. You have two functions in the inequality:

$$f(x) = x^4 - 4x^2 - 1 \text{ and } g(x) = -2$$

Go to the Y= screen, $y_1 = x^4 - 4x^2 - 1$ $y_2 = -2$. Press the diamond key then F3 to graph. There are 4 intersection points for the graphs.



Find all four intersection points by using F5, 5: Intersection, selecting the functions, inputting the upper and lower bounds. The answers should match the numbers in the inequality you got doing the problem algebraically. Notice that $f(x)$ is below $g(x)$ from the first intersection point to the second intersection point and from the 3rd intersection point to the 4th. So the intervals are the solutions to the inequalities.