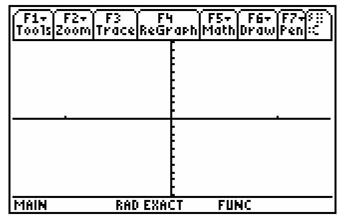
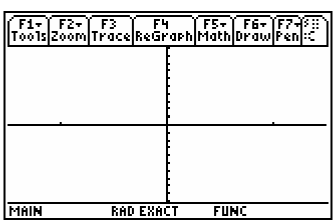
Assignment 8: Derivatives of Explicit Functions (2.1-9) Name___________________
Please provide a handwritten response.

1a. The TI calculators will graph both a function and its derivative. Graph $f(x) = 3x^3 + 2x - 1$ by entering the function as $y1$ and graph the derivative as $y2$. The derivative is entered as **2nd 8 (*d*)**. The syntax is ***d*(*expression*,*variable*(,*order*))**.
Graph $f(x) = 3x^3 + 2x - 1$ and its derivative as $y2 = d(3x \wedge 3 + 2x - 1, x)$ or as $y2 = d(y1(x), x)$ and record the result below. Use different line styles for the function and its derivative.



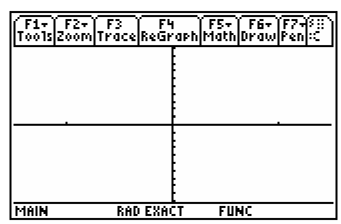
$-1.5 \le x \le 1.5, -10 \le y \le 10$

1b. The slope m_{tan} line tangent to the graph of f at, say, $x = 1$ is given by ***y*2(1).** Execute ***y*2 (1)** to see that m_{tan}**= 11** in this case. Also execute ***y*1(1)** to see that $y = 4$ when $x = 1$. The equation of the tangent line at $x = 1$ is $y = 11(x-1) + 4 = 11x - 7$. Now, graph both $y_1 = 3x^3 + 2x - 1$ and $y_3 = 11x - 7$ together on the same set of axes (select y_1 and y_3 using **F4**). You can also draw the tangent line using the **Math** menu from the graph of $y_1 = 3x^3 + 2x - 1$. Select **F5 (Math) A (Tangent).** Once you have pressed **ENTER** type **1**, at the **tangent at ?** prompt. When you press **ENTER** again calculator will graph the tangent line and give its equation. Does the tangent line really look as though its slope is **11**? Why?



$-1.5 \le x \le 1.5, -10 \le y \le 10$

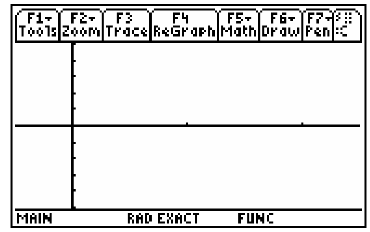
Graph y_1 and y_3



$-1.5 \le x \le 1.5, -10 \le y \le 10$

Use **DRAW** Menu

2. Graph $y = sin\frac{2x}{x+1}$ and its first and second derivatives on the axes provided. To graph the second derivative f'' of $y1 = sin\frac{2x}{x+1}$ use $y3 = d(sin(2x/(x+1)), x, 2)$.
(The first derivative is $y2 = d(sin(2x/(x+1)), x)$). Label which is which.

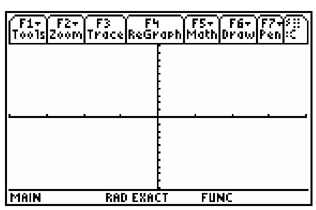


$\mathbf{-.5 \le x \le 2.5, -5 \le y \le 5}$

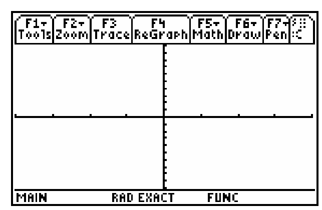
3a. Differentiate $f(x) = x^2 e^{\sin x}$ by entering $d\left(x \wedge 2 * e \wedge (\sin(x)), x\right)$. Record your results below.

3b. Plot the <u>first</u> <u>derivative</u> of $f(x) = x^2 e^{\sin x}$ on the axes (on the left) provided below (Enter $y_1 = f(x), y_2 = f'(x)$. Use the select option to turn y_1 off.)

3c. According to the definition of derivative, if h is a small fixed number, then the difference quotient $\dfrac{f(x+h) - f(x)}{h}$ should be close to $f'(x)$, and so their graphs should lie close together. For the moment let's choose $h = 0.5$. Now plot $f'(x)$ and the difference quotient on the same set of axes (on the right) below. Enter $y_1 = x^2 e^{\sin x}$, $y_2 =$ derivative of y_1, and $y_3 = (y_1(x+0.5) - y_1(x)) / (0.5)$. Do not plot y_1. Use different line styles for y_2 and y_3.



$\mathbf{-4 \le x \le 4, -10 \le y \le 10}$



$\mathbf{-4 \le x \le 4, -10 \le y \le 10}$

3d. Change the **0.5** to **0.4** in the difference quotient in part **c.** Repeat parts **b** and **c** again. Are the two graphs closer? Can you still tell them apart?

3e. Experiment with smaller and smaller values of h until the graphs of $f'(x)$ and the difference quotient over $-4 \le x \le 4$ become indistinguishable on your calculator screen. How small does h have to be for this to happen?