Name:_____ **Date:**_____

Mean Value Theorem

Mean Value Theorem:

1. A blue angels fighter jet takes off according to the function $f(t)=\frac{1}{3}(2.71^{t-4})$. Where t is in seconds.

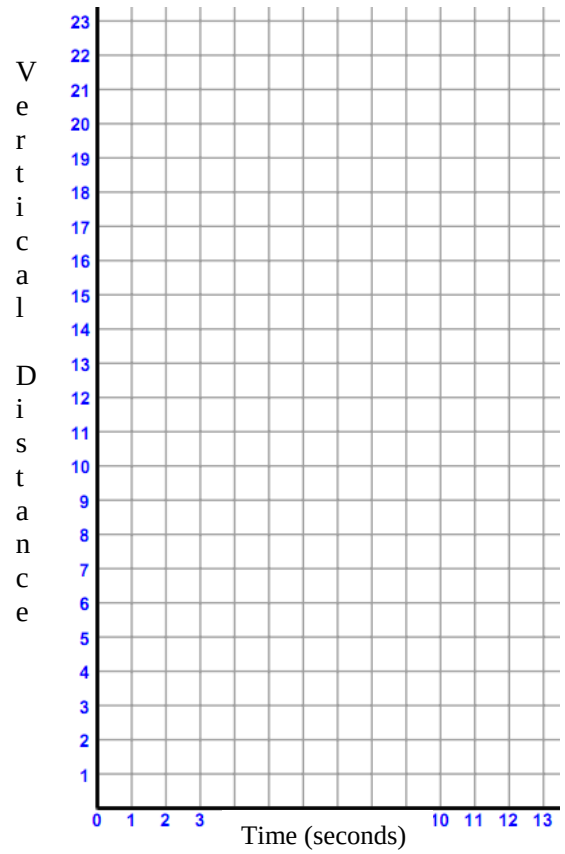
a. Sketch the graph of the function. Note: input x instead of t.

To Graph: i. From the start menu (m) select (W).

ii. Type the formula with the soft keyboard (k) then press E.

iii. Tap $ to graph the function.

iv. Select **O/View window** and set xmin = 0, xma = 13 ymin = 0 and ymax = 10.



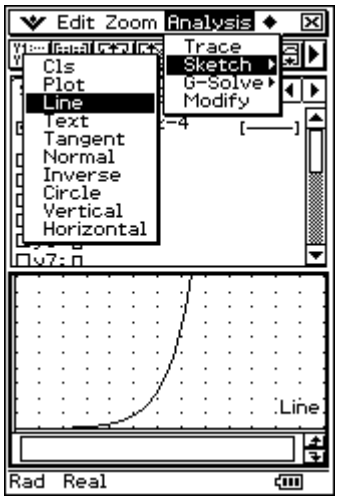
b. Draw a line through the points $f(3)$ and $f(7)$ on your graph to the right.

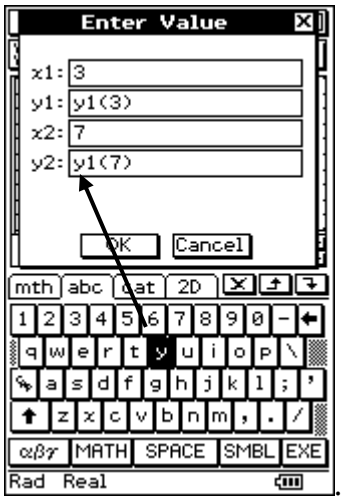
i. Select **Analysis/Sketch/Line**

ii. Press "3" to open dialog box.

iii. Use "y" from the O menu for y1 and y2 input

iv. Tap OK.





This is called a secant line. The slope of the secant line tells us the average rate of change on that interval.

c. For our model what physical quantity does the slope of the secant line tell us?

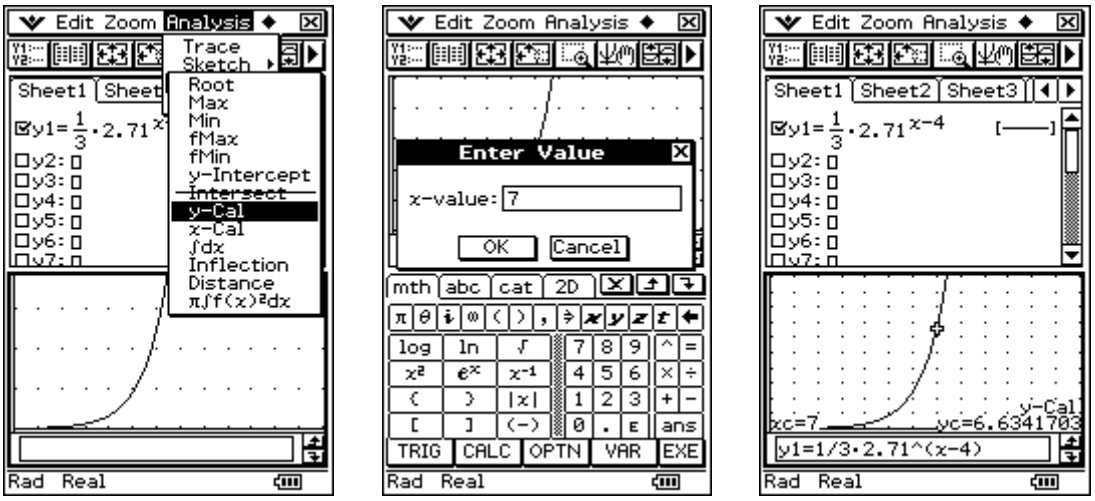
d. Calculate the average velocity $\bar{v}$ between $t_1=3$ and $t_2=7$? See next page for evaluating $f(t)=\frac{1}{3}(2.71^{t-4})$.

$$\bar{v}=\frac{f(t_2)-f(t_1)}{t_2-t_1}=$$

To evaluate $f(t)=\frac{1}{3}(2.71^{t-4})$ at certain t values:

i. Tap the graph to give it focus, then select **Analysis/G-Solve/y-Cal**

ii. Enter a t value in the x-value field. **Tap** OK. **(x-Cal** gives you the x values when you give the y values**.)**



2. What is the point in time in the above interval at which his average speed **equals** his instantaneous speed? Use the **mean value theorem**. (Note that you have already determined the right side of this equation for the interval $t_1 = 3$ to $t_2 = 7$

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

a. Find derivative of $f(t)$.

i. From the start menu (m) select (J).

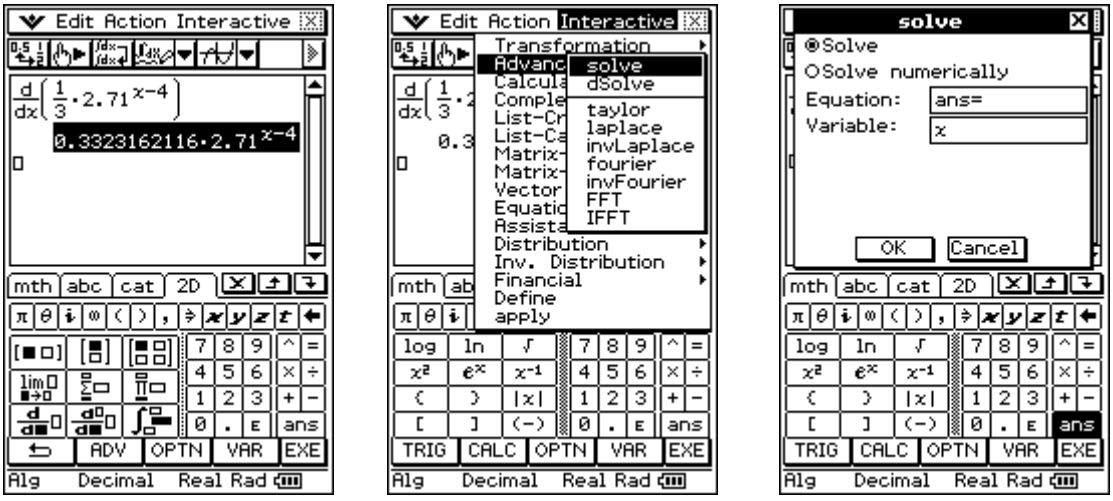
ii. In the soft keyboard (k) **tap**) tab, then - option and tap] . Then use 9 tab to type in the formula. After typing in the formula press E.

b. To solve for c in the mean value theorem:

i. Select **Interactive/Advanced/Solve.**

ii. Into the equation line enter "ans=".

iii. Set the expression equal to $\bar{v}$ that you found on previous page and tap OK to get the time.



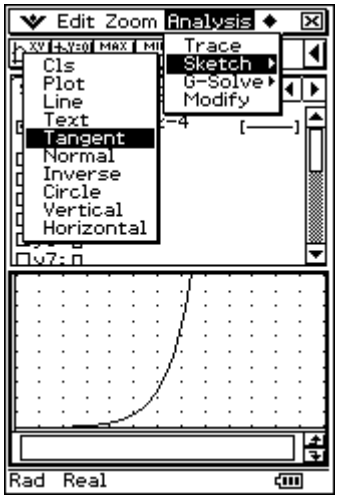
c. Draw the Tangent line at the point $f(c)$ for the c value that you found.

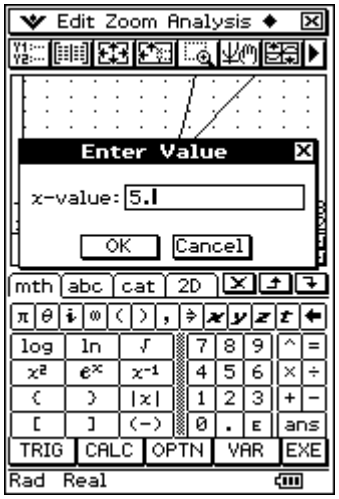
To sketch tangent line:

i. From the start menu (m) select (W).

ii. Tap $ to re-graph the function if needed.
iii. Select **Analysis/Sketch/Tangent.**
iv. **Press** the first number of your c value to open the interactive menu.
Check that you have entered the value correctly and tap OK.
v. Sketch the secant line again from part 1b. of this activity.

.





d. Answer the following questions:
What two objects on the graph does the Mean Value Theorem relate and what does it say about them?

Does the Mean Value Theorem apply to all functions? Why or why not? What criteria must a function have in order for the Mean Value Theorem to apply?

For this type of function (exponential function $f(t)=\frac{1}{3}(2.71^{t-4})$) and on the same interval ($t_1=3$ and $t_2=7$) is there another time t at which the instantaneous speed of the fighter jet is equal to the average speed on the interval? Why or why not?