Helicopter Bungee Jump

Name ________________________

Class ________________________

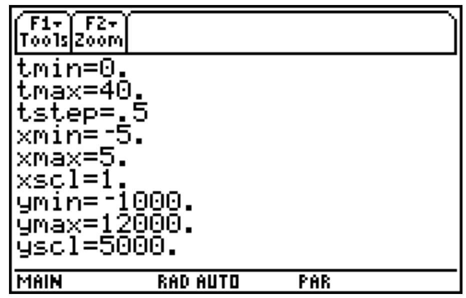
Part 1 – Bungee Jump

In June 2001, the record for the longest bungee jump was shattered when a stuntman jumped from a helicopter hovering over 10,000 feet. This "Mile Long Bungee Jump" is illustrated using the following parametric equations:

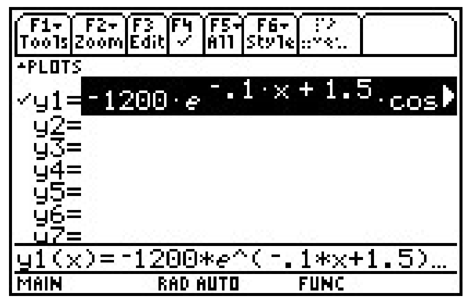
xt1(t) = 1

yt1(t) = $-1200e^{-0.1t+1.5}\cos(0.2(t-18)) + 5200$

Enter these equations in your calculator, then change the style for this set of parametric equations to **F6: Style > 6:Path**. Set your window settings to match those to the right. Press [◆] + [GRAPH] to watch the simulation.



For positive time t, the position of the bungee jumper can be modeled by the following function: $y(t) = -1200e^{-0.1t+1.5}\cos(0.2(t-18)) + 5200$, when $0 < t < 40$. Enter this function in **y1(x)**, using x in place of t. Take the derivative of the function twice to find the velocity and acceleration functions.



1. Enter the following command on the HOME screen: **solve(*d*(yt1(t),t)=0,t)|0<t<40**. What is the significance of this result? Notice the argument "**,t**" is needed twice and the "such that" symbol ("|") limits the domain.

2. What physical quantity is given by the second derivative of position?

3. Within the first 40 seconds, when do (does) the extrema for the velocity occur? Show your work.

4. The third derivative of position with respect to time is known as *jerk*. After the first time the velocity is zero, when does jerk have the largest magnitude?

5. When is the downward velocity at a maximum? What is the speed at that time?

Enter the velocity function in **y2**, the acceleration function in **y3**, and the jerk function in **y4**. Examine the position-time graph, the velocity-time graph, and the acceleration-time graph. Adjust the graphing window as necessary.

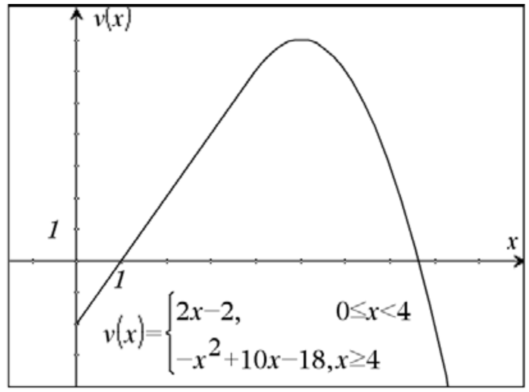
6. Write at least two complete sentences relating position-time, velocity-time, and acceleration-time graphs from the helicopter bungee jump situation.

On the acceleration-time graph, the mathematical model is not realistic for the first 4 seconds, but it is after that. Change the window settings so that you can no longer see the first 4 seconds of the acceleration-time graph.

7. After 4 seconds, what is the maximum number of g's. Use the graph to justify your answer. Remember that 1 g = 32 ft/s^2.

8. What is the point of inflection where the graph changes from concave up to concave down in the first 40 seconds? Use the **Inflection Point** tool (**F5:Math > 8:Inflection**).

Part 2 – Graphically examine another situation



Let *s* be the function $s(t) = \int_0^t v(x)dx$.

9. $s(1)$ =

10. $s'(1)$ =

11. $s''(1)$ =

12. Use calculus to find when *v* is a maximum. Show your work.

13. For $0 < x < 7$, when is the graph of *s* concave up? Explain your reasoning.

14. For $0 < x < 7$, when is the graph of *s* decreasing? Explain your reasoning.