Group Exam 2

Name: ____________________

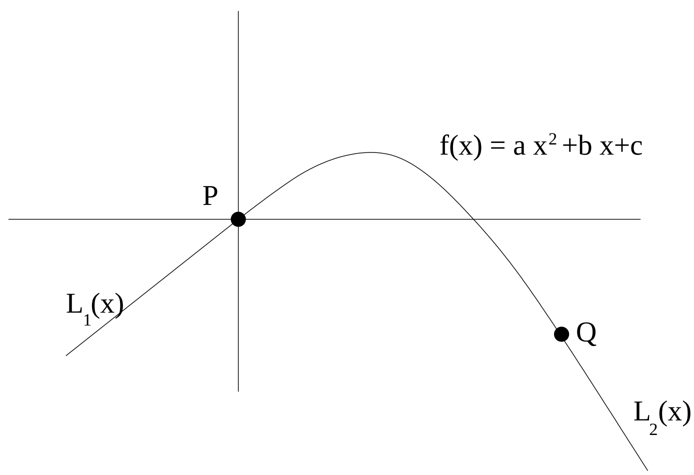
Math 141, 1:50PM

Name of group member: ____________________

Professor Johnson

Name of group member: ____________________

Problem 1: Designing a Roller Coaster.
Suppose you are asked to design the first ascent and drop for a new roller coaster. By studying photos of your favorite coasters, you decide to make the slope of the ascent 0.8 and the slope of the drop -1.6. You decide to connect these two straight stretches $y = L_1(x)$ and $y = L_2(x)$ with part of a parabola $y = f(x) = ax^2 + bx + c$, where x and $f(x)$ are measured in feet. For the track to be smooth the transitions there can't be abrupt changes in direction, so you want the linear segments to be tangent to the parabola at the transition points P and Q. (See the figure.) To simplify the equations, you decide to place the origin at P.



Hint: Start by writing equations for the values $f(0)$, $f'(0)$ and $f'(100)$.

(a) Suppose that the horizontal distance between P and Q is 100 ft. Write equations in a, b and c that will ensure that the track is smooth at the transition points.

(b) Solve the equations found in part (a) for a, b and c to find a formula for $f(x)$.

(c) Find the difference in elevation between P and Q.

(d) Write the equations for the functions $L_1(x)$, $f(x)$ and $L_2(x)$.

Problem 1, part 2.

Calculate the derivative $\frac{d}{dx}\left(\frac{\tan(x)}{\cos(x)}\right)$

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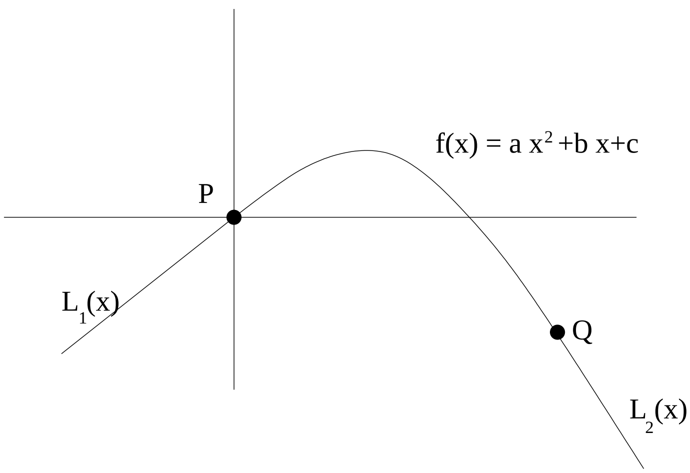
Problem 2: Designing a Roller Coaster.
Suppose you are asked to design the first ascent and drop for a new roller coaster. By studying photos of your favorite coasters, you decide to make the slope of the ascent 0.8 and the slope of the drop -1.6. You decide to connect these two straight stretches $y = L_1(x)$ and $y = L_2(x)$ with part of a parabola $y = f(x) = ax^2 + bx + c$, where x and $f(x)$ are measured in feet. For the track to be smooth the transitions there can't be abrupt changes in direction, so you want the linear segments to be tangent to the parabola at the transition points P and Q. (See the figure.) To simplify the equations, you decide to place the origin at P.



Hint: Start by writing equations for the values $f(0)$, $f'(0)$ and $f'(100)$.

(a) Suppose that the horizontal distance between P and Q is 100 ft. Write equations in a, b and c that will ensure that the track is smooth at the transition points.

(b) Solve the equations found in part (a) for a, b and c to find a formula for $f(x)$.

(c) Find the difference in elevation between P and Q.

(d) Write the equations for the functions $L_1(x)$, $f(x)$ and $L_2(x)$.

Problem 2, part 2.
This problem refers to the graph of the function $k(x)$ is given in Problem 3, Part 2.

List the x-values where the function k is not continuous. ____________________________

List the x-values where the function k is not differentiable. ________________________

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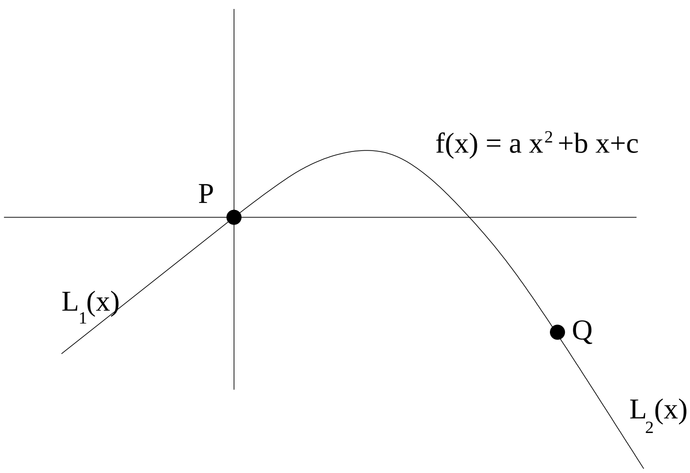
Problem 3: Designing a Roller Coaster.
Suppose you are asked to design the first ascent and drop for a new roller coaster. By studying photos of your favorite coasters, you decide to make the slope of the ascent 0.8 and the slope of the drop -1.6. You decide to connect these two straight stretches $y = L_1(x)$ and $y = L_2(x)$ with part of a parabola $y = f(x) = ax^2 + bx + c$, where x and $f(x)$ are measured in feet. For the track to be smooth the transitions there can't be abrupt changes in direction, so you want the linear segments to be tangent to the parabola at the transition points P and Q. (See the figure.) To simplify the equations, you decide to place the origin at P.



Hint: Start by writing equations for the values $f(0)$, $f'(0)$ and $f'(100)$.

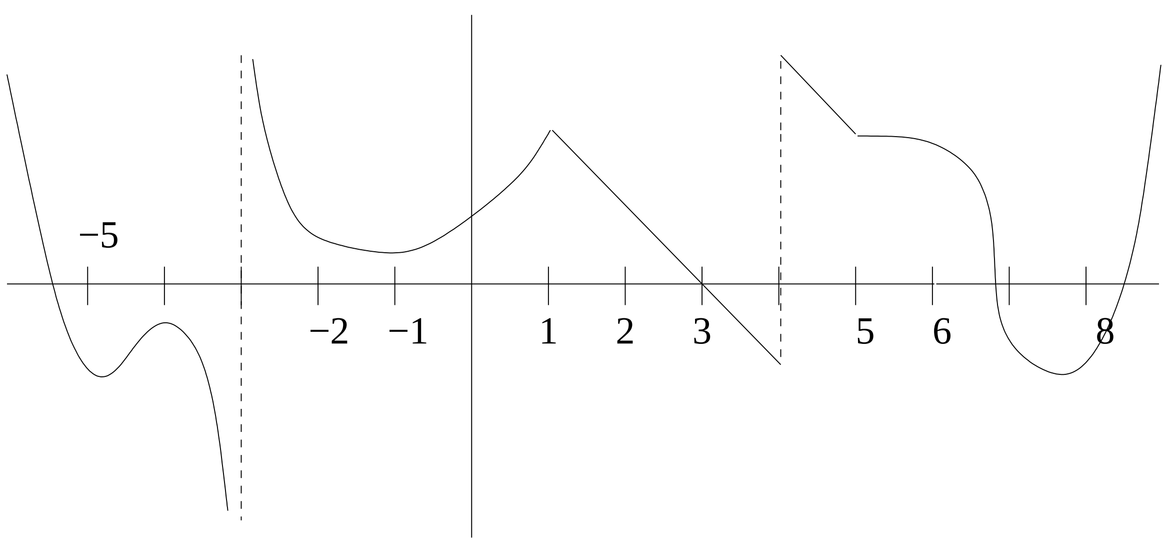
(a) Suppose that the horizontal distance between P and Q is 100 ft. Write equations in a, b and c that will ensure that the track is smooth at the transition points.

(b) Solve the equations found in part (a) for a, b and c to find a formula for $f(x)$.

(c) Find the difference in elevation between P and Q.

(d) Write the equations for the functions $L_1(x)$, $f(x)$ and $L_2(x)$.

Problem 3, part 2.
The graph of the function $k(x)$ is given below. On the same axes, graph the derivative $k'(x)$.



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