

## APPLIED PROJECT

### Building a Better Roller Coaster

Suppose you are asked to design the first ascent and drop for a new roller coaster. By studying photographs 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 there can't be abrupt changes in direction, so you want the linear segments  $L_1$  and  $L_2$  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.

- Suppose 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.
- Solve the equations in part (a) for  $a$ ,  $b$ , and  $c$  to find a formula for  $f(x)$ .
- Plot  $L_1$ ,  $f$ , and  $L_2$  to verify graphically that the transition is smooth.
- Find the difference in elevation between P and Q.

