Extra Credit:

Feb. 27

Idea:

Building piece of roller coaster —

= straight section defined on $x = (-50, 0)$

slope = .8

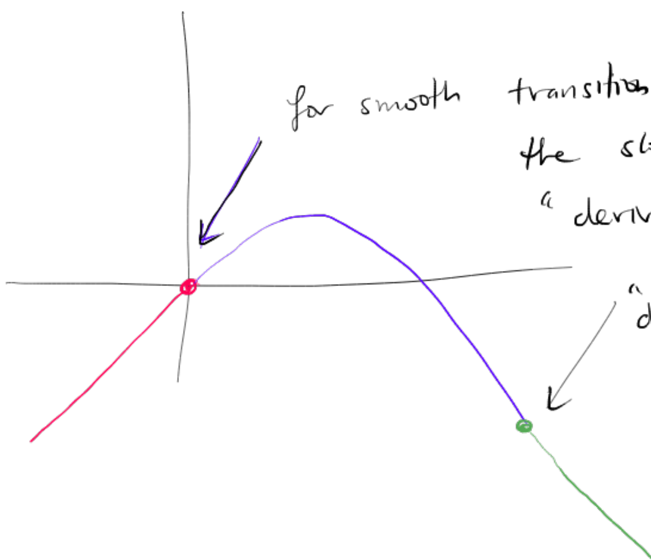
= peak section | curve

$ax^2 + bx + c$ on $[0, 100]$

= straight downhill section

slope = -1.6

You'll need:



for smooth transition you need the slopes to agree.

"derivative of curve at $x=0$ = slope of red line"

"deriv of curve at $x=100$ = slope of green line"

graphs to all touch.

Derivative Formulas —

$$f(x) = e^x, \quad f'(x) = e^x$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \to 0} \frac{e^{x+h} - e^x}{h}$$

$$= \lim_{h \to 0} \frac{e^x \cdot e^h - e^x}{h}$$

$$= e^x \boxed{\lim_{h \to 0} \frac{(e^h - 1)}{h}}^{=1} = e^x$$

side note:

$$\lim_{h \to 0} \frac{e^h - 1}{h} = 1$$

guess by substituting

$h = 0.1, 0.01, 0.001$

$-0.1, -0.01$

use graph $\frac{e^x - 1}{x}$

or

what is height (approx) when x is near 0.

Ex.

$$f(x) = e^x + 5e^x + x^2$$

$$f'(x) = e^x + 5e^x + 2x$$

PRODUCT RULE

$$\big(g(x)\cdot k(x)\big)' = g(x)k'(x) + g'(x)h(x)$$

The derivative of a product is:

the first times the derivative of the second PLUS the second times the derivative of the first

$$f(x) = \overbrace{(x^2+1)}^{g(x)}\overbrace{(3x^4 - x)}^{k(x)}$$

$$f'(x) = (x^2+1)(12x - 1) + (2x)(3x^4 - x)$$

QUOTIENT RULES

negative; get order right!

$$f(x) = \frac{g(x)}{h(x)} = \frac{Hi}{Ho}, \quad f'(x) = \frac{Ho\, dHi - Hi\, dHo}{Ho\, Ho}$$

$$f(x) = \frac{x^2+1}{3x}$$

$$f'(x) = \frac{3x(2x) - (x^2+1)(3)}{(3x)^2} = \frac{6x^2 - 3x^2 - 3}{(3x)^2} = \frac{3x^2-3}{(3x)^2}$$

$$= \frac{3(x^2-1)}{9x^2}$$

$$= \frac{x^2-1}{3x^2}$$

TRIG RULES!

$f(x) = \sin x$	$f(x) = \cos x$	$f(x) = \tan(x)$
$f'(x) = \cos x$	$f'(x) = -\sin x$	

$$\tan x = \frac{\overset{=Hi}{\sin x}}{\underset{= Ho}{\cos x}}, \quad \tan'(x) = \frac{\cos x(\cos x) - (\sin x)\overbrace{(-\sin x)}^{dHo}}{\cos^2 x}$$

$$= \frac{\cos^2 x + \sin^2 x}{\cos^2 x} = \frac{1}{\cos^2 x} = \sec^2 x$$