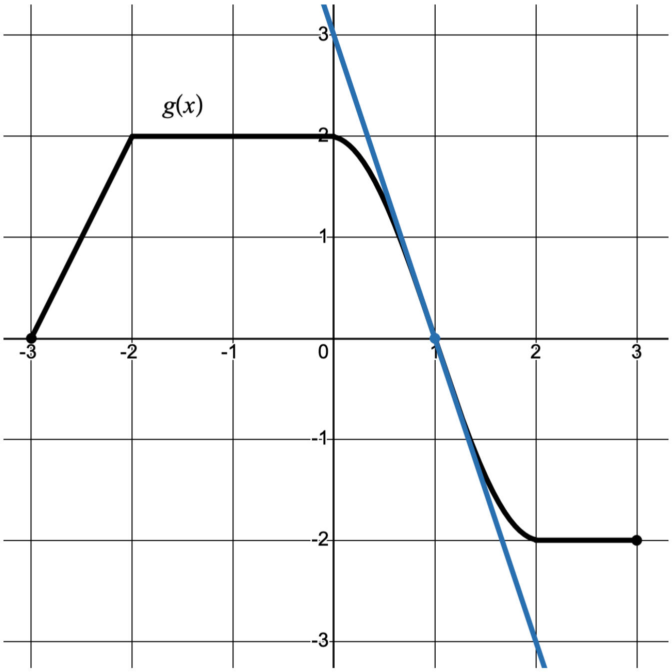
1. The following are unrelated:
   (a) (8 pts) Suppose y is a function of x, find y' if $\sin(xy) = \dfrac{2}{3}$.
   (b) (8 pts) Suppose $f(x) = \sqrt[3]{-x + |x|}$. Find the derivative of $f(x)$ for all $x < 0$.
   (c) (8 pts) Find $\dfrac{d^2y}{dx^2}$ at $x = \dfrac{\pi}{4}$ if $\dfrac{dy}{dx} = x\sec^2(x) + \tan(x)$.
   (d) (8 pts) For a differentiable function $g(x)$, find $\dfrac{d}{dx}\left(\dfrac{g\left(x^2\right)}{x}\right)$.

2. (26 pts) Consider the function $y = x\sqrt{2+4x}$, with domain $\left[-\dfrac{1}{2}, \infty\right)$, to answer the following.
   (a) Find the x and y-intercepts of the function.
   (b) The first derivative is $y' = \dfrac{2+6x}{\sqrt{2+4x}}$. On what intervals is y increasing? Decreasing?
   (c) Find x and y coordinates of the local maximum and minimum extrema, if any.
   (d) Find the absolute maximum and absolute minimum values of y on the interval $\left[-\dfrac{1}{2}, 3\right]$.

3. (12 pts) For two resistors, R_1 and R_2, connected in parallel, the combined electrical resistance, R, is given by $(R)^{-1} = (R_1)^{-1} + (R_2)^{-1}$ where R, R_1, and R_2 are all functions of time and are measured in ohms. Suppose R_1 and R_2 are each increasing at a rate of $\dfrac{1}{2}$ ohms per second. At what rate is the combined resistance, R, changing when R_1 = 2 ohms and R_2 = 4 ohms?

4. (8 pts) A company, Better Boulder Dice (BBD), is going to produce new metallic dice in the shape of a cube. Suppose x represents the edge length of a metal cube.
   (a) The volume of a cube is $V(x) = x^3$. Find dV, the differential of V.
   (b) The edges of each cube are designed to have a length of 2 cm, but the machine creating the cube produces edge lengths of 2.01 cm. Use differentials to estimate ΔV, the difference between the designed volume and the machine-produced volume.

5. (22 points)



Shown above is the graph of $y = g(x)$ and the tangent line to g at $(1, 0)$. The function is differentiable on $(-3, -2) \cup (-2, 3)$.

(a) Sketch the graph of $y = g'(x)$. Clearly label the tick marks.

(b) Use the linearization of g at $a = 1$ to estimate the value of $g(1.3)$.

(c) The mean value theorem states that there exists a value of c in $(-2, 3)$ such that $g'(c)$ equals a certain value.

i. What is the value of $g'(c)$?

ii. Suppose we wish to narrow down the possible values for c. In which of the following six intervals can c be found? Circle all possible answers. No explanation is necessary.

$(-3, -2)$ $(-2, -1)$ $(-1, 0)$

$(0, 1)$ $(1, 2)$ $(2, 3)$