Once the exam begins, tear this page away to use for scratch calculations.

Math135 Engineering Calculus I

# Second Midterm Exam

Colorado Mesa University 2024 Spring

NAME: ______________________________

1. What's a formula for this derivative?

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(13x + x^{13} + \sqrt{13}\right)$$

2. What's a formula for this derivative?

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\sqrt{x^{13}} + \sqrt[13]{x} + \frac{1}{13}\right)$$

3. What's a formula for this derivative?

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(13\tan\left(\sqrt{x}\right)\right)$$

4. What's a formula for this derivative?

$$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{\sec(13x)}{x}\right)$$

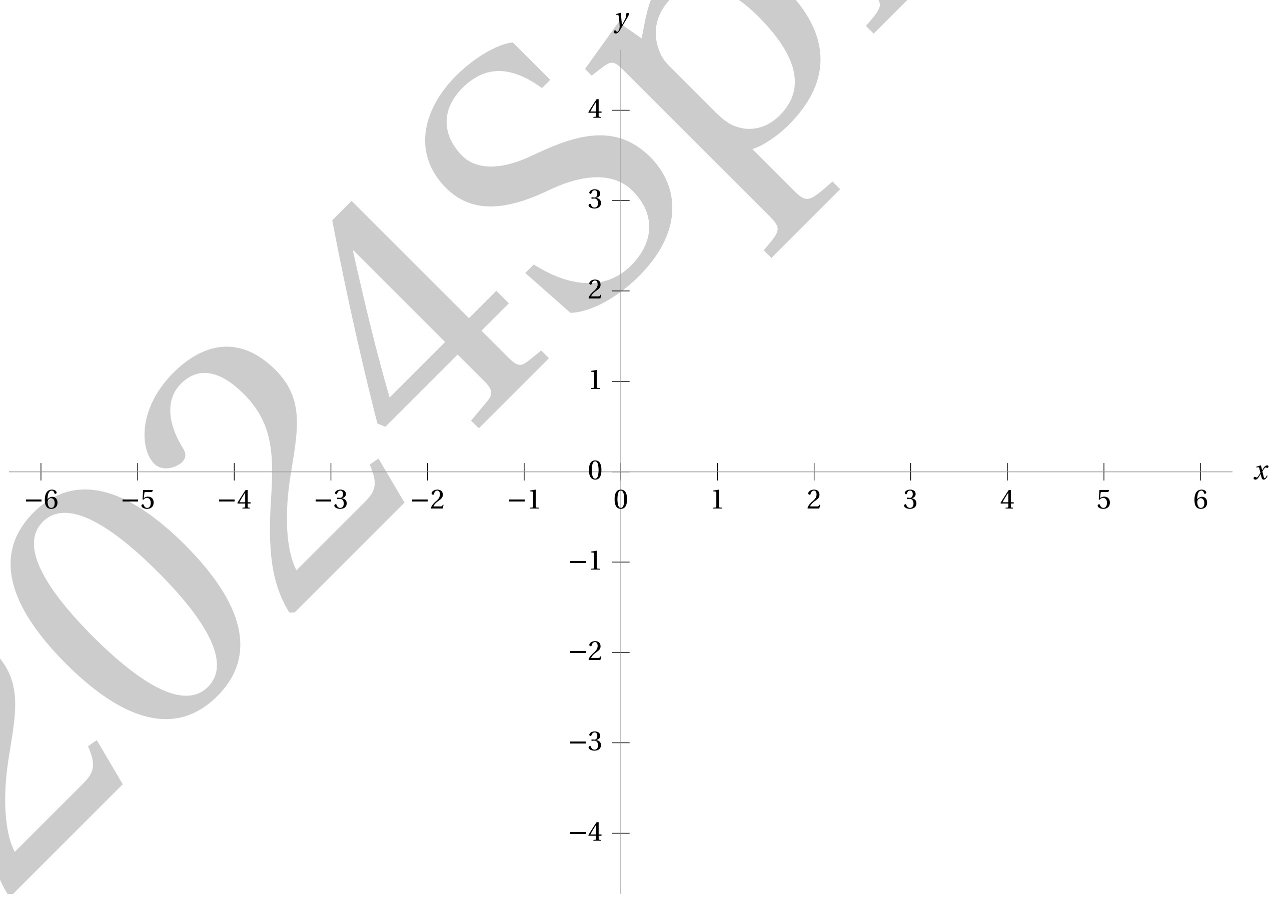
5. Write down the mathematical *definition* of the derivative $f'$ of a continuous function $f$.

6. Figure out an equation of the line tangent to the curve $y = x + x\cos(x)$ at the point where $x = \frac{\pi}{6}$. Write the equation in the form $y = mx + b$ with parameters $m$ and $b$ accurate to within $\pm 0.001$.

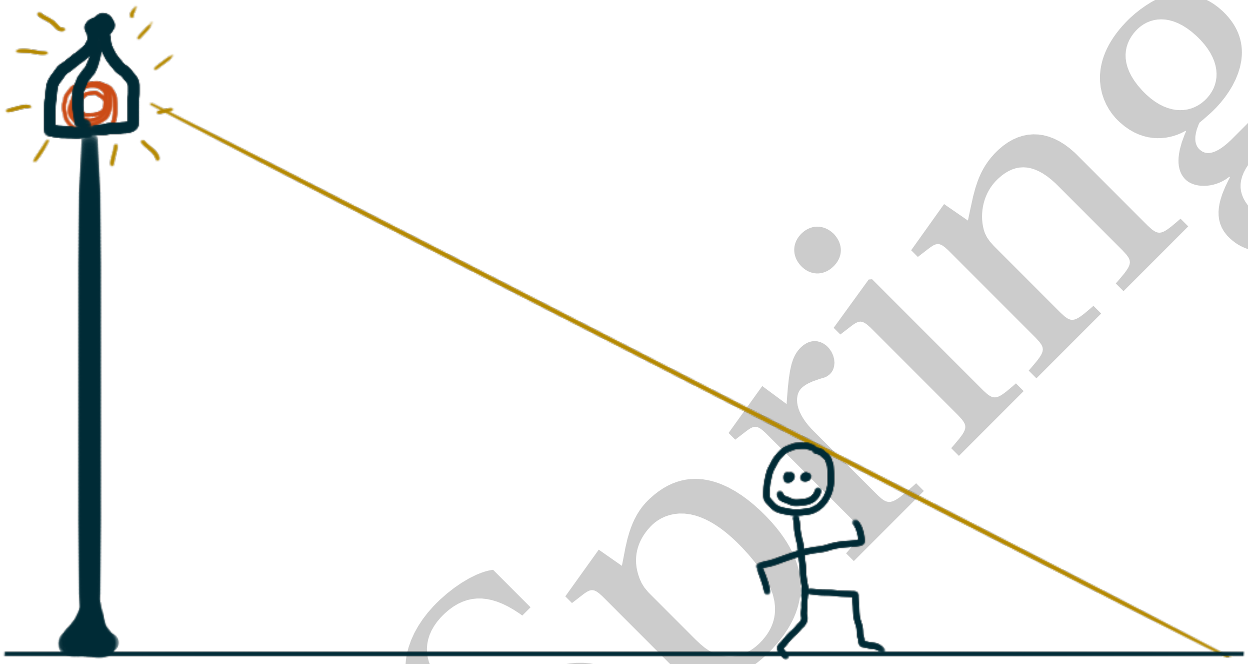
7. On the axes below, sketch the graph of a function $f$ that has the following properties:

- The function $f$ is continuous everywhere *except* at $x = 2$
- The function $f$ is differentiable everywhere *except* at $x = 2$ and $x = -1$.
- $f(0) = 0$ and $f(4) = 2$.
- $f'(-4) = 0$ and $f'(4) = 4$ and $f''(4) = 0$.
- $f'(x) = -1$ for all $x$ in the interval $(-1, 2)$.
- $f''(x) > 0$ for all $x$ in the intervals $(-\infty, -1)$ and $(4, \infty)$.
- $f''(x) < 0$ for all $x$ in the interval $(2, 4)$.

Protip: draft the graph on scratch paper first.



8. It’s midnight. A $5'$-tall man walks on a sidewalk, under and past a streetlamp mounted at the top of a $24'$-tall pole. If the man is walking at a pace of 6 ft/s away from the pole, how fast is the tip of his shadow moving along the sidewalk the moment he is $36'$ from the pole?



9. Consider a rectangle that has a perimeter of 16 inches. Imagine revolving that rectangle in three-dimensional space about one of its edge, tracing out a circular cylinder. What must the dimensions of the rectangle be that results in a cylinder with maximum volume?