

You must always justify your answers. This means: show your work, show it neatly, and when in doubt, use words (and pictures!) to explain your reasoning. No justification = no points.

1. (6 pts) Find all numbers x such that $y = (x^2 - x - 1)e^x$ has a horizontal tangent at (x, y) .

We use the product rule to take the derivative, set it equal to 0, and solve:

$$\begin{aligned}y &= (x^2 - x - 1)e^x \\y' &= (x^2 - x - 1)'e^x + (x^2 - x - 1)(e^x)' \\&= (2x - 1)e^x + (x^2 - x - 1)e^x \\&= (2x - 1 + x^2 - x - 1)e^x \\&= (x^2 + x - 2)e^x\end{aligned}$$

$$\begin{aligned}0 &= (x^2 + x - 2)e^x \\&= (x - 1)(x + 2)e^x \\x &= \boxed{1 \text{ or } -2}, \text{ since } e^x \neq 0\end{aligned}$$

2. (4 pts) Find the derivative of the following function:

$$f(x) = \frac{x^2}{1 + 5x}$$

We use the quotient rule:

$$\begin{aligned}f(x) &= \frac{x^2}{1 + 5x} \\f'(x) &= \frac{(x^2)'(1 + 5x) - (x^2)(1 + 5x)'}{(1 + 5x)^2} \\&= \frac{(2x)(1 + 5x) - (x^2)(5)}{(1 + 5x)^2} \\&= \frac{2x + 10x^2 - 5x^2}{(1 + 5x)^2} \\&= \boxed{\frac{5x^2 + 2x}{25x^2 + 10x + 1}}\end{aligned}$$

3. (bonus) On the back of this page, explain something you did well on the midterm, and something you didn't.