1 Differentiate. (Show your work, not just the answers)

2 points.

(1) \( y = \sqrt{x} \)

(2) \( y = \sqrt{x} \sqrt{x} \sqrt{x} \)

(3) \( y = 3x^4 - 5x^3 + 2x^2 - 7 \)

(4) \( y = (x - 3)(2x - 1) \) (product rule)

(5) \( y = (x^2 + 2)(x - 1) \) (product rule)

(6) \( y = \frac{4x^3 + x - 1}{x^2} \) (quotient rule)

(7) \( y = \frac{x + 2}{x^2 + 2x + 3} \)

(8) \( y = \left( \frac{x}{x^2 + 1} \right)^3 \) (chain rule, quotient rule, leave answer factored)

2 Find \( f'''(x) \):

1 point.

(1) \( f(x) = x^3 e^x \)

(2) \( f(x) = e^x \ln x \)

3 R Work

1 point. Consider the function from Question #2.1, \( f(x) = x^3 e^x \). Please do the following:

- Write this function as an expression in R, and compute the first and second derivatives in R.
- Convert all three expressions into functions.
- Have R compute the values of the original function, first derivative, and second derivative when \( x = -\frac{1}{2} \).
- Draw a line plot that includes the original function, first derivative, and second derivative all in the same space. Plot these functions for \( x \in [-5, 3] \). Please label each line clearly.