Problem 1. Find the derivative of each function by using the limit definition of the derivative.

a. $f(x) = x^2 + 2x$ *b.* $f(x) = \frac{1}{x+1}$ *c.* $f(x) = \frac{1}{\sqrt{x}}$

d. $f(x) = \sqrt[3]{x}$ *e.* $f(x) = \sin(x)$ *f.* $f(x) = \cos(x)$

Problem 2. Let $f(x) = |3 + 10x|$ then,

- For $x < -\frac{3}{10}$, $f'(x) =$
- Find $f'_-(-\frac{3}{10})$ (Left-hand derivative at $x = -\frac{3}{10}$)
- Find $f'_+(-\frac{3}{10})$ (Right-hand derivative at $x = -\frac{3}{10}$)
- Check whether f is differentiable at $x = -\frac{3}{10}$.

Problem 3. Find the derivative of each function using derivative rules.

a. $f(x) = 3x^4 + 6x^3 - 2x^2 + 3$ *b.* $f(x) = 4\sqrt[3]{x^2} - 3\sqrt{x} + 6\sqrt[5]{x}$

c. $f(x) = (3x^2 + 6x)(x + 1)$ *d.* $f(x) = \frac{3x^2+6x+2}{5x^3+2x^2}$

e. $f(x) = (4 - 3x + 3x^2)e^x$ *f.* $f(x) = \frac{\sqrt{x}}{4x+5}$

Problem 4. Find the equation of the tangent line to the graph of $f(x)$ at each given number.

- $f(x) = \sqrt{x+1}$ $x = 8$
- $f(x) = \frac{1}{\sqrt{x+1}}$ $x = 3$
- $f(x) = x\sin(x)$ $x = \frac{\pi}{2}$
- $f(x) = xe^x$ $x = 0.$