1. **Using the limit definition of the derivative**, calculate the equation of the tangent line to the function $y = \frac{3}{x}$ at the point $(1, 3)$. You may use the power rule to *check* your answer, but in order to receive credit, you must use the limit definition.

$$\frac{dy}{dx} = \lim_{h\to 0} \frac{f(x+x) - f(x)}{h} = \lim_{h\to 0} \frac{\frac{3}{x+h} - \frac{3}{x}}{h} = \lim_{h\to 0} \frac{\frac{3x}{(x)(x+h)} - \frac{3(x+h)}{(x)(x+h)}}{h} =$$

$$\lim_{h\to 0} \frac{\frac{3x-3x-3h}{(x)(x+h)}}{h} = \lim_{h\to 0} \frac{\frac{-3h}{x^2+xh}}{h} = \lim_{h\to 0} \frac{-3}{x^2+xh} = \frac{-3}{x^2}$$

Thus our derivative at $x = 1$ is -3. Now, to find the tangent line, you use the point-slope formula:

$$y - y_1 = m(x - x_1)$$

$$y - 3 = -3(x - 3)$$

$$y = -3x + 6$$

2. **Choose any two of the functions below**, and use the set of differentiation rules to calculate their derivatives:

(a) $f(x) = \dfrac{x}{3 - e^x}$

$$f'(x) = \frac{1 \cdot (3 - e^x) - x \cdot -e^x}{(3 - e^x)^2}$$

(b) $g(x) = (6x + 4e^x) \cdot \sqrt{x}$

$$g'(x) = (6 + 4e^x) \cdot \sqrt{x} + (6x + 4e^x) \cdot \frac{1}{2}x^{-\frac{1}{2}}$$

(c) $h(x) = \sqrt{x} + \dfrac{x^2}{8}$

$$h'(x) = \frac{1}{2}x^{-\frac{1}{2}} + \frac{2}{8}x$$