1. Find $f'(a)$ using the definition of the derivative:

$$f(t) = 2t^2 + t$$

$$f'(a) = \lim_{h\to 0} \frac{2(a+h)^2 + (a+h) - (2a^2+a)}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{2a^2} + 4ah + 2h^2 + \cancel{a} + h - \cancel{2a^2} - \cancel{a}}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{h}(4a+2h+1)}{\cancel{h}} = 4a+1$$

2. Find $f'(3)$ using the definition of the derivative:

$$f(x) = x^{-2}$$

$$f'(3) = \lim_{h\to 0} \frac{\frac{1}{(3+h)^2} - \frac{1}{9}}{h} = \lim_{h\to 0} \frac{9-(3+h)^2}{9(3+h)^2 h}$$

$$= \lim_{h\to 0} \frac{\cancel{9} - (\cancel{9} + 6h + h^2)}{9(3+h)^2 h} = \lim_{h\to 0} \frac{-\cancel{h}(6+h)}{9(3+h)^2 \cancel{h}} = \frac{-6}{81} = \frac{-2}{27}$$

3. Find $f'(a)$ using the definition of the derivative:

$$f(x) = \sqrt{1+5x}$$

$$f'(a) = \lim_{h\to 0} \left(\frac{\sqrt{1+5(a+h)} - \sqrt{1+5a}}{h} \right)\left(\frac{\sqrt{1+5(a+h)} + \sqrt{1+5a}}{\sqrt{1+5(a+h)} + \sqrt{1+5a}} \right)$$

$$= \lim_{h\to 0} \frac{(\cancel{1} + 5(\cancel{a}+h)) - (\cancel{1} + \cancel{5a})}{h\left(\sqrt{1+5(a+h)} + \sqrt{1+5a}\right)}$$

$$= \lim_{h\to 0} \frac{5\cancel{h}}{\cancel{h}\left(\sqrt{1+5(a+h)} + \sqrt{1+5a}\right)} = \frac{5}{2\sqrt{1+5a}}$$

4. Find an equation of the tangent line to the curve at the given point:

$$f(x) = \frac{x+1}{x-1}, \qquad (2,3)$$

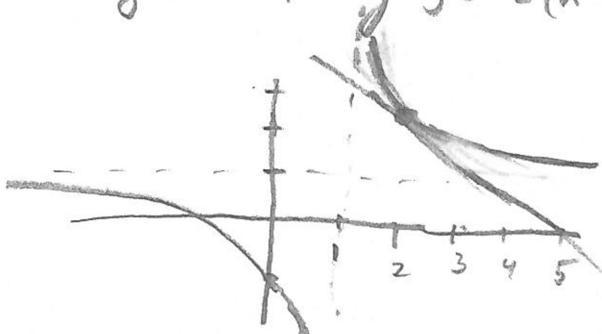
Also sketch both the curve $y = f(x)$ and the tangent line.

$$f'(2) = \lim_{h \to 0} \frac{\frac{(2+h)+1}{(2+h)-1} - 3}{h} = \lim_{h \to 0} \frac{3+h-3(1+h)}{(1+h)h}$$

$$= \lim_{h \to 0} \frac{-2\cancel{h}}{(1+h)\cancel{h}} = -2$$

tangent line: $y-3=-2(x-1)$ or $y=3-2(x-1)$

Or $y=5-2x$



5. A particle moves a distance $s = f(t)$ along a straight line, where s is measured in meters and t is in seconds:

$$f(t) = 40t - 5t^2$$

Find the velocity and speed when $t = 4$.

$$\text{velocity} = f'(4) = \lim_{h \to 0} \frac{40(4+h) - 5(4+h)^2 - (40\cdot 4 - 5(4)^2)}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{40\cdot 4} + 40h - 5(\cancel{4^2} + 2\cdot 4\cdot h + h^2) - \cancel{40\cdot 4} + \cancel{5(4)^2}}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(40-40-5h)}{\cancel{h}} = \lim_{h \to 0} -5h = 0 \ \frac{m}{sec}$$

$$\text{speed} = |f'(4)| = 0 \ \frac{m}{sec}$$