1. Calculate the derivative (slope of the tangent line) using the definition.

Distribute/FOIL: $$f'(3) = \lim_{h\to 0} \frac{9 + 6h + h^2 + 15 + 5h - 24}{h}$$	Step: 4
Collect like terms: $$f'(3) = \lim_{h\to 0} \frac{h^2 + 11h}{h}$$	Step: 5
Evaluate the limit: $$f'(3) = 11$$	Step: 8
Definition of the derivative at $x = 3$: $$f'(3) = \lim_{h\to 0} \frac{f(3+h) - f(3)}{h}$$	Step: 1
Factor: $$f'(3) = \lim_{h\to 0} = \frac{h(h+11)}{h}$$	Step: 6
Begin Simplifying: $$f'(3) = \lim_{h\to 0} \frac{(3+h)(3+h) + 5(3+h) - 24}{h}$$	Step: 3
Cancel: $$f'(3) = \lim_{h\to 0} h + 11$$	Step: 7
Use $f(x) = x^2 + 5x$ $$f'(3) = \lim_{h\to 0} \frac{(3+h)^2 + 5(3+h) - 24}{h}$$	Step: 2

2. $f(x) = 3x^2 - x$. Find $f'(-2)$ by circling the correct next step from each row. In the third column, explain why this is the correct step and what caused the error in the incorrect step.

Step 1.	$\boxed{\lim_{h\to 0} \frac{f(-2+h)-f(-2)}{h}}$	$\lim_{h\to -2} \frac{f(-2+h)-f(-2)}{h}$	The definition of derivative has $h \to 0$.
Step 2.	$\lim_{h\to 0} \frac{3(-2+h)^2+2+h+14}{h}$	$\boxed{\lim_{h\to 0} \frac{3(-2+h)^2+2-h-14}{h}}$	The numerator should be $3(-2+h)^2 - (-2+h) - 14$. In left column the negative is not distributed, and then there is another sign error with $f(-2)$.
Step 3.	$\boxed{\lim_{h\to 0} \frac{3(4-4h+h^2)+2-h-14}{h}}$	$\lim_{h\to 0} \frac{3(4+h^2)-2-h-14}{h}$	$(-2+h)^2 = (-2+h)(-2+h) = 4 - 4h + h^2$. Algebra error in the right column - it was not distributed correctly.
Step 4.	$\lim_{h\to 0} \frac{12-4h+h^2+2-h-14}{h}$	$\boxed{\lim_{h\to 0} \frac{12-12h+3h^2+2-h-14}{h}}$	The 3 wasn't distributed to all three terms in the left column.
Step 5.	$\boxed{\lim_{h\to 0} \frac{-12h+3h^2-h}{h}}$	$\lim_{h\to 0} \frac{3h^2-13h+12}{h}$	In the right column the constants were added wrong. The left column is correct, although not fully simplified yet.
Step 6.	$\lim_{h\to 0} \frac{-12\cancel{h}+3h^2-h}{\cancel{h}}$	$\boxed{\lim_{h\to 0} \frac{3h^2-13h}{h}}$	The left column has a serious algebra error - no cancellation unless the h is factored out first.
Step 7.	$\frac{3h^2-13h}{h}$	$\boxed{\lim_{h\to 0} \frac{h(3h-13)}{h}}$	The left column is missing a limit.
Step 8.	$\boxed{\lim_{h\to 0}(3h-13)}$	$3h-13h$	The right column is missing a limit. Also, it looks like they used the wrong answer from Step 7, and then incorrectly simplified.
Step 9.	$-10h$	$\boxed{-13}$	The left column is a (correct) simplification of the wrong choice for Step 8.

3. $f(x) = \sqrt{x}$. Find $f'(4)$ by filling in the boxes with the correct mathematical expressions.

$$f'(4) = \lim_{h \to 0} \frac{f(\boxed{4+h}) - f(\boxed{4})}{h}$$

$$= \lim_{h \to 0} \boxed{\frac{\sqrt{4+h} - \sqrt{4}}{h}}$$

$$= \lim_{h \to 0} \frac{\sqrt{4+h} - 2}{h} \cdot \frac{\sqrt{4+h} + 2}{\sqrt{4+h} + 2}$$

$$= \lim_{h \to 0} \boxed{\frac{4+h+2\sqrt{4+h}-2\sqrt{4+h}-4}{h\left(\sqrt{4+h}+2\right)}}$$

$$= \lim_{h \to 0} \frac{4 + h + \boxed{-4}}{h\left(\sqrt{4+h}+2\right)}$$

$$= \lim_{h \to 0} \frac{\boxed{h}}{h\left(\sqrt{4+h}+2\right)}$$

$$= \lim_{h \to 0} \frac{1}{\sqrt{4+h}+2}$$

$$= \frac{1}{\sqrt{4 + \boxed{0}} + 2}$$

$$= \boxed{\frac{1}{4}}$$

4. Now you're on your own! Use the definition of the derivative to calculate the following derivatives.

   (a) $f(x) = 7x^2 + 5x$. Find $f'(2)$.

Definition of derivative at $x = 2$: $$f'(2) = \lim_{h \to 0} \frac{f(2+h) - f(2)}{h}$$

Use the function $f(x) = 7x^2 + 5x$: $$= \lim_{h \to 0} \frac{(7(2+h)^2 + 5(2+h)) - (7 \cdot 2^2 + 5 \cdot 2)}{h}$$

FOIL and simplify: $$= \lim_{h \to 0} \frac{(7(4 + 4h + h^2) + 10 + 5h) - (28 + 10)}{h}$$

Distribute and simplify: $$= \lim_{h \to 0} \frac{28 + 28h + 7h^2 + 10 + 5h - 38}{h}$$

Collect constant terms: $$= \lim_{h \to 0} \frac{28h + 7h^2 + 5h}{h}$$

Collect all like terms: $$= \lim_{h \to 0} \frac{7h^2 + 33h}{h}$$

Factor: $$= \lim_{h \to 0} \frac{h(7h + 33)}{h}$$

Cancel: $$= \lim_{h \to 0} 7h + 33$$

Evaluate the limit: $$= 7(0) + 33$$

$$= 33.$$

(b) $f(x) = \dfrac{1}{x}$. Find $f'(3)$.

Definition of derivative at $x = 3$: $$f'(3) = \lim_{h\to 0} \frac{f(3+h) - f(3)}{h}$$

Use the function $f(x) = \dfrac{1}{x}$: $$= \lim_{h\to 0} \frac{\frac{1}{3+h} - \frac{1}{3}}{h}$$

Clear mini-denominators (optional): $$= \lim_{h\to 0} \frac{\frac{1}{3+h} - \frac{1}{3}}{h} \cdot \frac{3(3+h)}{3(3+h)}$$

Distribute: $$= \lim_{h\to 0} \frac{\frac{3(3+h)}{3+h} - \frac{3(3+h)}{3}}{3h(3+h)}$$

Simplify: $$= \lim_{h\to 0} \frac{3 - (3+h)}{3h(3+h)}$$

$$= \lim_{h\to 0} \frac{-h}{3h(3+h)}$$

Cancel: $$= \lim_{h\to 0} \frac{-1}{3(3+h)}$$

Evaluate the limit: $$= \frac{-1}{3(3+0)}$$

$$= -\frac{1}{9}.$$

(c) $f(x) = \dfrac{2}{\sqrt{x}}$. Find $f'(4)$.

Definition of derivative at $x = 4$: $$f'(4) = \lim_{h \to 0} \frac{f(4+h) - f(4)}{h}$$

Use the function $f(x) = \dfrac{2}{\sqrt{x}}$: $$= \lim_{h \to 0} \frac{\frac{2}{\sqrt{4+h}} - \frac{2}{\sqrt{4}}}{h}$$

Simplify just a little: $$= \lim_{h \to 0} \frac{\frac{2}{\sqrt{4+h}} - 1}{h}$$

Clear mini-denominator (optional): $$= \lim_{h \to 0} \frac{\frac{2}{\sqrt{4+h}} - 1}{h} \cdot \frac{\sqrt{4+h}}{\sqrt{4+h}}$$

Distribute and simplify: $$= \lim_{h \to 0} \frac{2 - \sqrt{4+h}}{h\sqrt{4+h}}$$

Multiply by a conjugate: $$= \lim_{h \to 0} \frac{\left(2 - \sqrt{4+h}\right)}{h\sqrt{4+h}} \cdot \frac{\left(2 + \sqrt{4+h}\right)}{\left(2 + \sqrt{4+h}\right)}$$

FOIL: $$= \lim_{h \to 0} \frac{4 + 2\sqrt{4+h} - 2\sqrt{4+h} - (4+h)}{h\sqrt{4+h}\left(2 + \sqrt{4+h}\right)}$$

Simplify: $$= \lim_{h \to 0} \frac{-h}{h\sqrt{4+h}\left(2 + \sqrt{4+h}\right)}$$

Cancel: $$= \lim_{h \to 0} \frac{-1}{\sqrt{4+h}\left(2 + \sqrt{4+h}\right)}$$

Evaluate the limit: $$= \frac{-1}{\sqrt{4+0}\left(2 + \sqrt{4+0}\right)}$$

$$= -\frac{1}{8}.$$