Using the definition of the Derivative

I. The definition:

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

This is the formal definition, don't worry about memorizing it, if you do enough problems it will be in your head….

You might see the formula adapted to various functions, such as position.

Velocity, v(t), is the derivative of position, s(t).

$\frac{ds}{dt}=v(t)$ This signifies change of position with respect to change in time; derivatives should make you think of rates of change. Change of the dependent variable, in this case s, with respect to the change of the independent variable, in this case t.

$s'(t)=v(t)=\lim_{h\to 0}\frac{s(t+h)-s(t)}{h}$ This would be the equation for velocity, and if a specific time were given, you could calculate the velocity at that time by plugging in the time given into your answer.

Slope is another rate of change:

$\frac{dy}{dx} = m$ The change in y with respect to x. You could then calculate the slope at a specific point. What you are finding is the slope of a tangent line at that point. A tangent line is a line that hits your function once and only once.

$$f'(x) = \frac{dy}{dx} = slope of \tan line = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Once simplified you would plug in the x-value at which they wanted to find the slope.

II. Using the definition:

I will demonstrate the steps using a simpler polynomial, but note that some functions, such as fractions and square roots, will require more complex simplification(or maybe use of trig identities) than the factoring and canceling that I am about to do.

Example: f(x) = $x^2 - 2x$

$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$ Always begin by writing the definition, then plug in

$$f'(x) = \lim_{h \to 0} \frac{(x+h)^2 - 2(x+h) - (x^2 - 2x)}{h} -> \frac{"0"}{0} IND$$

$$\lim_{h \to 0} \frac{x^2 + 2xh + h^2 - 2x - 2h - x^2 - 2x}{h} -> \frac{2xh - 2h + h^2}{h} ->$$

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

First step will always give you “0”/0 upon simplification. You will then need to use algebra to simplify. If given a fraction for a problem, you will have to find a common denominator and simplify the complex fraction. If given a square root, you will have to multiply the top and bottom by the conjugate. If trig you will need to use either the the sum to product identity or the sum identity. Do as many as you can and they will become second nature. Remember, those of you that have had Calc before can check your answer by using the shortcut.