The purpose of these exercises is to compute the derivatives of functions of the form $f(x) = x^n$, where $n$ is an integer.

**Directions:**
Use Derive™ 6 for the following exercises. Use standard mathematical notation to record the results on a separate sheet of notebook paper. Do not turn in a print-out of your Derive session.

For each function in the exercises below, do the following:

(a) Author the expression $\frac{f(x + h) - f(x)}{h}$ for the specific function $f(x)$.

(b) Simplify the expression $\frac{f(x + h) - f(x)}{h}$. (Notice that this simplification is valid only if $h \neq 0$.)

(c) Compute $\lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$, which is $f'(x)$.

**Copying Results from Derive onto Your Homework Paper:**
What you record on your homework paper should look something like this. That is, you should record more than just the end result from Derive.

\[
\begin{align*}
\frac{f(x) = x^2}{f(x + h) - f(x)} &= \frac{(x + h)^2 - x^2}{h} = 2x + h \\
\therefore f''(x) &= \lim_{h \to 0} (2x + h) = 2x
\end{align*}
\]

You need to author $\frac{(x + h)^2 - x^2}{h}$. Then have Derive simplify to get $2x + h$.

**Exercises**

1. $f(x) = x^3$
2. $f(x) = x^4$
3. $f(x) = x^5$
4. $f(x) = x^6$

Complete the following sentence: Based on my results in Exercises 1-4, I believe that if $n$ is a positive integer and $f(x) = x^n$, then $f'(x) = \underline{\phantom{00}}$.

Does your formula work when $n = 2$? (See the example above.) Does your formula work when $n = 1$? Use Derive to find out!

For the functions below, use your formula to find $f'(x)$. Then follow steps (a)-(c) above to have Derive compute $f'(x)$.

5. $f(x) = x^{-1}$
6. $f(x) = x^{-2}$
7. $f(x) = x^{-3}$

Does your formula for $f'(x)$ seem to work when $n$ is a negative integer?