Theorem

$$\left(x^n\right)' =$$

Theorem

$$\left(x^n\right)' = nx^{n-1}$$

Theorem

$$\left(x^n\right)' = nx^{n-1}$$

Plickers Exercise

Find the derivative of $f(x) = x^3$.

A. $3x^2$ B. $3x$ C. $6x$ D. 6

Fact

$(x + h)^2 =$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

$$(x+h)^3 =$$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

$$(x+h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

$$(x+h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$$

$$(x+h)^4 = x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

$$(x+h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$$

$$(x+h)^4 = x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$$

$$x^n$$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

$$(x+h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$$

$$(x+h)^4 = x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$$

$$x^n + nx^{n-1}h$$

Fact

$$(x+h)^2 = x^2 + 2xh + h^2$$

$$(x+h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$$

$$(x+h)^4 = x^4 + 4x^3h + 6x^2h^2 + 4xh^3 + h^4$$

$$x^n + nx^{n-1}h \quad + \quad (\cdots)h^2$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$
\begin{aligned}
& f(x+h) \\
= \quad & x^n + nx^{n-1}h + (\cdots)h^2
\end{aligned}
$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$
\begin{aligned}
& f(x+h) - f(x) \\
= \quad & x^n + nx^{n-1}h + (\cdots)h^2 - x^n
\end{aligned}
$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$
\begin{aligned}
& f(x+h) - f(x) \\
= \quad & \cancel{x^n} + nx^{n-1}h + (\cdots)h^2 - \cancel{x^n}
\end{aligned}
$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$
\begin{aligned}
& (f(x+h) - f(x))\tfrac{1}{h} \\
= \quad & (\cancel{x^n} + nx^{n-1}h + (\cdots)h^2 - \cancel{x^n})\tfrac{1}{h}
\end{aligned}
$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$
\begin{aligned}
& (f(x+h) - f(x))\frac{1}{h} \\
= \quad & (\cancel{x^n} + nx^{n-1}\cancel{h} + (\cdots)h^{\cancel{2}} - \cancel{x^n})\frac{1}{\cancel{h}}
\end{aligned}
$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$\lim_{h\to 0} (f(x+h) - f(x))\frac{1}{h}$$

$$= \lim_{h\to 0} (\cancel{x^n} + nx^{n-1}\cancel{h} + (\cdots)h^{\cancel{2}} - \cancel{x^n})\frac{1}{\cancel{h}}$$

Proof.

Fix a positive integer n. Let $f(x) = x^n$.

Then

$$\lim_{h\to 0} (f(x+h) - f(x))\frac{1}{h}$$

$$= \lim_{h\to 0} (\cancel{x^n} + nx^{n-1}\cancel{h} + (\cdots)h^{\cancel{2}} - \cancel{x^n})\frac{1}{\cancel{h}}$$

$$= nx^{n-1} \qquad \square$$