3.3. Power Rule

$f(x)$	$f'(x)$
x^4	$4x^3$
x^3	$3x^2$
x^2	$2x$
$x^1 = x$	$1 \cdot x^0 = 1$
$x^0 = 1$	$0 \cdot x^{-1} = 0$
$x^{-1} = \frac{1}{x}$	$-\frac{1}{x^2} = -1x^{-2}$
$x^{-2} = \frac{1}{x^2}$	$-\frac{2}{x^3} = -2x^{-3}$

Previously, we figured out the derivatives in this table. Note that they follow the pattern...

$$f(x) = x^p \Rightarrow f'(x) = p x^{p-1} \qquad p \in \mathbb{I}$$

($\mathbb{I}$: Integers)

These properties follow directly from the difference quotient

1) $f(x) = kg(x)$, k = constant $\Rightarrow f'(x) = kg'(x)$

2) $f(x) = g(x) \pm h(x) \Rightarrow f'(x) = g'(x) \pm h'(x)$

Example. Calculate $f'(x)$ for

(a) $f(x) = 5x^3 - 2x^2 + 8x - 7$ (b) $f(x) = \frac{3}{x^3} - \frac{7}{x^5}$

SOLUTIONS:

(a) $f'(x) = 5 \cdot 3x^2 - 2 \cdot 2x + 8 - 0 = 15x^2 - 4x + 8$

(b) $f(x) = 3x^{-3} - 7x^{-5}$, $f'(x) = 3 \cdot -3x^{-4} - 7 \cdot -5x^{-6} = -\frac{9}{x^4} + \frac{35}{x^6}$

CLASS WORK

Calculate $f'(x)$ for

(a) $f(x) = \frac{1}{5}x^5 - \frac{3}{4}x^4 + 17x^7 + 23$ (b) $f(x) = -\frac{1}{2x^3} - \frac{8}{x^4} + \frac{1}{x^{12}}$

SOLUTIONS

(a) $f'(x) = \frac{1}{5} \cdot 5x^4 - \frac{3}{4} \cdot 4x^3 + 17 \cdot 7x^6 + 0 = x^4 - 3x^3 + 119x^6$

(b) $f(x) = -\frac{1}{2}x^{-3} - 8x^{-4} + x^{-12}$, $f'(x) = -\frac{1}{2} \cdot -3x^{-4} - 8 \cdot -4x^{-5} + -12x^{-13}$

$$f'(x) = \frac{3}{2x^4} + \frac{32}{x^5} - \frac{12}{x^{13}}$$