Section 3.1 **Derivatives of plynomials and exponentials functions.**

$$(C)' = 0,\ C \text{ is a constant}$$
$$(x)' = 1$$
$$(x^n)' = nx^{n-1} \text{ for any rational } n$$
$$(e^x)' = e^x$$

Definition of the number e.
e is the number such that

$$\boxed{\lim_{h\to 0} \frac{e^h - 1}{h} = 1}$$

$$e \approx 2.7182818284590452$$

Differentiation formulas

Suppose c is a constant and both functions $f(x)$ and $g(x)$ are differentiable.

1. $(cf(x))' = cf'(x)$,
2. $(f(x) + g(x))' = f'(x) + g'(x)$,
3. $(f(x) - g(x))' = f'(x) - g'(x)$,

Example 1. Differentiate each function.

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

2. $f(x) = 3x^{2/3} - 2x^{5/2} + x^{-3}$

3. $f(x) = x^2 \sqrt[3]{x^2}$

4. $f(x) = \dfrac{2}{\sqrt[3]{x^2}} - \dfrac{1}{x\sqrt[3]{x}}$

5. $f(x) = x^{1.2} + e^{1.2}$

6. $f(x) = x^e + e^x$

Example 2. Find an equation of the tangent line to the curve $y = x^4 + 1$ that is parallel to the line $32x - y = 15$.

Example 3. Let

$$f(x) = \begin{cases} x^2 & \text{if} \quad x \leq 2 \\ mx + b & \text{if} \quad x > 2 \end{cases}$$

Find the values for m and b that make f differentialbe everywhere.

Example 4. Find equations of both lines through the point (2,-3) that are tangent to the parabola $y = x^2 + x$.