CHAPTER 2 cont.: Differentiation
Concepts/Skills to know:

- Use **Chain Rule** to differentiate composite functions

  $$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

  y = *f(u)*, u = *g(x)*, and y = *f(g(x))* so ***f(u)*** is outer func, ***g(x)*** is inner func, ***f(g(x))*** is composite func

- Use **Generalized Power Rule** to differentiate composite power functions

  $$\frac{d}{dx}\left(u^{n}\right) = n \cdot u^{n-1} \cdot \frac{du}{dx}$$

  y = u^n, u = *g(x)*, and y = $(g(x))^n$ so $\mathbf{u^n}$ is outer func, ***g(x)*** is inner func, $\boldsymbol{(g(x))^n}$ is composite func

- Use **Generalized Trig Rules** to differentiate composite trig functions

  $$\frac{d}{dx}(\sin u) = \cos u \cdot \frac{du}{dx}$$

  y = sin*u*, u = *g(x)*, and y = sin*(g(x))* so **sin*u*** is outer func, ***g(x)*** is inner func, **sin*(g(x))*** is composite func

  $$\frac{d}{dx}(\cos u) = -\sin u \cdot \frac{du}{dx}$$

  y = cos*u*, u = *g(x)*, and y = cos*(g(x))* so **cos*u*** is outer func, ***g(x)*** is inner func, **cos*(g(x))*** is composite func

- Use shortcuts for differentiation: Quotient rule, Product rule, Difference rule, Sum rule, Constant multiple rule, Power rule, Derivatives of linear and constant functions

- Use **Implicit Differentiation** to differentiate equations when there is no obvious way to solve for ***y*** in terms of ***x*** to obtain ***f(x)***.
  1. Differentiate both sides and use rules for differentiation.
  2. Isolate terms with $\frac{dy}{dx}$.
  3. Factor out $\frac{dy}{dx}$.
  4. Solve for $\frac{dy}{dx}$.

- Use implicit differentiation to find **slope** of tangent line at a specific point ***P(x, y)*** of the graph.

- Find **second derivatives** of implicit functions.

- Solve **Related Rates** problem in which there are **3** variables i.e. ***x***, ***y***, and ***t***.

  Use implicit differentiation with respect to ***t*** and find $\frac{dx}{dt}$ and $\frac{dy}{dt}$.   x = *f(t)* and y = g*(t)*

  Don't forget units!