

## MATH 3D Prep: Substitution Rule

### Facts to Know:

Steps of computing integrals using substitution rule:

1. Choose a function  $u = g(x)$ , then  $du = g'(x)dx$

$$u' = \frac{du}{dx} = g'(x) \\ \Rightarrow du = g'(x)dx$$

2. Goal: Write the integral in terms of  $u$  and  $du$  only.

$$3. \int f(g(x))g'(x)dx = \int f(u)du$$

### Examples:

1. Find a function  $h(t)$  such that  $h'(t) = te^{t^2}$  and  $h(1) = e$ .

$$h(t) = \int h'(t) dt = \int te^{t^2} dt = \int e^{t^2} \cdot \frac{1}{2} \cdot 2t dt = \int e^u \cdot \frac{1}{2} \cdot du$$

$$\text{Try } u = t^2, \quad du = 2t dt \quad \left( \frac{du}{dt} = 2t \right)$$

$$\Rightarrow h(t) = \frac{1}{2} \int e^u du = \frac{1}{2} e^u + C = \frac{1}{2} e^{t^2} + C$$

$$h(1) = e \Rightarrow \frac{1}{2} e^1 + C = e \Rightarrow C = e - \frac{1}{2} e = \frac{1}{2} e$$

$$h(t) = \frac{1}{2} e^{t^2} + \frac{1}{2} e$$

2. Evaluate the indefinite integral  $\int \frac{[\ln(2x+1)]^2}{2x+1} dx$

try make this b