

# MATH 16020 Lesson 3: Substitution with Natural Log

Spring 2021

**Definition.** The inverse of  $f(x) = e^x$  is \_\_\_\_\_, whose properties are given below:

- A.
- B.
- C.
- D.
- E.
- F.
- G.
- H.
- I.

**Example 1.** Evaluate  $\int_0^{\pi/20} \frac{5 \sec^2(5x)}{3 + \tan(5x)} dx$  rounded to 4 decimal places.

**Example 2.** Evaluate  $\int \frac{(\ln(3x^5))^2}{5x} dx$

**Example 3.** Suppose a hot air balloon is deflating in such a way that its volume changes at a rate of:

$$V'(t) = \frac{2}{\sqrt[3]{t}(t^{2/3} - 25)} \text{ m}^3/\text{min}.$$

with  $0 \leq t \leq 120$ . If the volume before it starts deflating is  $15000 \text{ m}^3$ , find the volume one hour later. Round to 3 decimal places.

**Example 4.** Thankfully, the person driving the hot air balloon notices the balloon deflating and so descends the balloon in a way modeled by:

$$H(t) = \frac{180}{3t - 100} \text{ meters}$$

with  $60 \leq t \leq 120$  in minutes. Find the average height of the balloon over this interval. (You may have noticed that the balloon doesn't go very high in this interval of time; it's a starting business.)