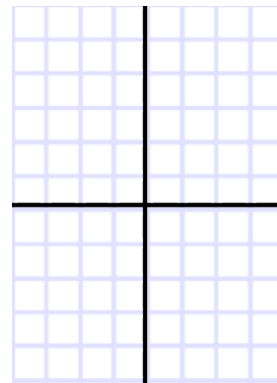


## 3.2b The Natural Logarithmic Function

Since the function  $f(x) = e^x$  passes the horizontal line test --> it has an inverse! That inverse is the natural log function with base e.



Definition of a Natural Logarithmic Function

For  $x > 0$ ,  $y = \ln x$  if and only if  $x = e^y$

The function given by  $f(x) = \log_e x = \ln x$  is called the natural logarithmic function

Ex 1: Write the logarithmic equation in exponential form:

a.  $\ln 4 = 1.3862\dots$

b.  $\ln e^3 = 3$

c.  $\ln \sqrt[3]{e} = 1/3$

Ex 2: Write the exponential equation in logarithmic form

a.  $e^0 = 1$

b.  $e^{2.5} = 12.1824$

c.  $3^{(3/4)} = 2.1170\dots$

Ex 3: Evaluate each:

a.  $f(x) = \ln x$ , if  $x = 18.31$  \_\_\_\_\_

b.  $f(x) = \ln x$ ,  $x = \sqrt{0.65}$  \_\_\_\_\_

### Properties of Natural Logarithms!!!



1.  $\ln 1 = \underline{\quad}$  because  $e^0 = \underline{\quad}$



2.  $\ln e = \underline{\quad}$  because  $e^1 = \underline{\quad}$



3.  $\ln e^x = \underline{\quad}$  and  $e^{\ln x} = \underline{\quad}$

• inverse properties



4. If  $\ln x = \ln y$ , then \_\_\_\_\_

• one-to-one property

### Ex 4: Solve using Properties of Natural Logarithms:

a.  $\ln(1/e)$

b.  $e^{\ln 5}$

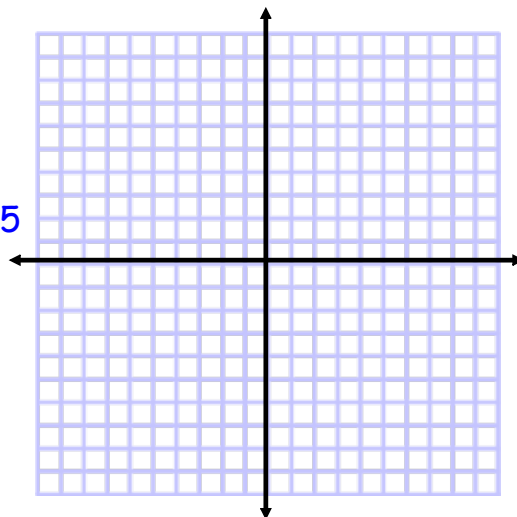
c.  $4 \ln 1$

d.  $2 \ln e$

Ex 5: Graph each, describe the transformation:

a.  $f(x) = \ln x$

b.  $g(x) = \ln(x - 2) + 5$



### Ex 6:

Students participating in a psychology experiment attended several lectures on a subject and were given an exam. Every month for a year after the exam, the students were retested to see how much of the material they remembered. The average scores for the group are given by the *human memory model*

$$f(t) = 75 - 6 \ln(t + 1), \quad 0 \leq t \leq 12$$

where  $t$  is the time in months. The graph of  $f$  is shown in Figure 3.17.

- What was the average score on the original exam ( $t = 0$ )?
- What was the average score at the end of  $t = 2$  months?
- What was the average score at the end of  $t = 6$  months?

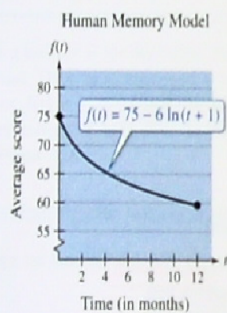


Figure 3.17