#### Common and Natural Logarithms

#### Common Logarithms

- A common logarithm has a base of 10.
- If there is no base given explicitly, it is common.
- You can easily find common logs of powers of ten.
- You can use your calculator to evaluate common logs.

# Natural Logarithms

• A natural logarithm has a base of *e*.

- The mathematical constant e is the unique real number such that the value of the derivative (the slope of the tangent line) of the function  $f(x) = e^x$  at the point x = 0 is exactly 1.
- The function e<sup>x</sup> so defined is called the exponential function.
- The inverse of the exponential function is the natural logarithm, or logarithm with base e.
- The number *e* is also commonly *defined* as the base of the natural logarithm (using an integral to define the latter), as the limit of a certain sequence, or as the sum of a certain series.
- The number *e* is one of the most important numbers in mathematics, alongside the additive and multiplicative identities 0 and 1, the constant π, and the imaginary number *i*.
- *e* is irrational, and as such its value cannot be given exactly as a finite or eventually repeating decimal. The numerical value of *e* truncated to 20 decimal places is:
  - 2.71828 18284 59045 23536..

# Natural Logarithms

- A natural logarithm has a base of *e*.
- We write natural logarithms as ln.
  - In other words,  $\log_e x = \ln x$ .
- If  $\ln e = x...$

## Change of Base Formula

- Allows us to convert to a different base.
- If *a*, *b*, and *n* are positive numbers and neither *a* nor *b* is 1, then the following equation is true.

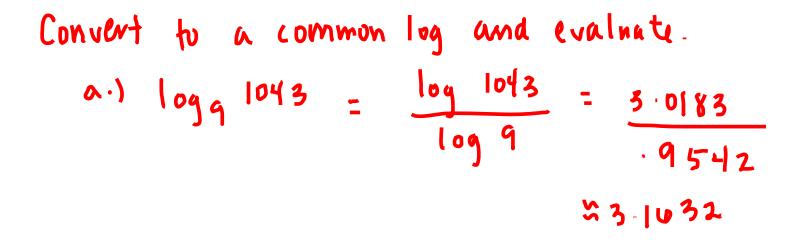
$$\log_a n = \frac{\log_b n}{\log_b a}$$

- Examples of evaluating expressions
- Change of base formula examples

Evaluate each expression. a.)  $\log 5(2)^3$ = 1095 + 31092 \$ 0 6990 + 3(0.3010) \$ 1 602 b.) log <u>192</u> = 210919-1096 × 2 ( 1. 2788) - 0.7782 : 1.7794

Evaluat:

c.) 
$$ln\left(\frac{b^2}{5}\right) = \lambda lnb - ln5$$
  
=  $\lambda (1.7918) - 1.6094$   
=  $3.5836 - 1.6094 \simeq 1.9742$ 



Convert to a natural log and evaluate.  
a) 
$$(096254 = \frac{2n254}{2n6} = \frac{5.5373}{1.7918}$$
  
 $5.5373 = \frac{2}{1.7918}$   
 $5.5373 = \frac{2}{1.7918}$   
 $5.5373 = \frac{2}{1.7918}$