

• Apply the Change-of-Base Formula

- Change of Base Formula

Let a and b be positive real numbers such that $a \neq 1$ and $b \neq 1$. Then for any positive real number x ,

$$\log_b x = \frac{\log_a x}{\log_a b}$$

"The up group, the down goes down"

Note: The change-of-base formula convert a logarithm of one base to a ratio of logarithm of a different base. For the purpose of using a calculator, we often apply the change-of-base formula with base 10 or base e .

$$\log_b x = \frac{\log x}{\log b}$$

original base is b ← Ratio of base 10 logarithms

$$\log_b x = \frac{\ln x}{\ln b}$$

original base is b ← Ratio of base e logarithms

~~scribble~~

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$$\log_b x = \frac{\log x}{\log b}$$

original
base is b ← ratio of
base 10
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$$\log_b x = \frac{\ln x}{\ln b}$$

original
base is b ← Ratio of base
 e logarithms

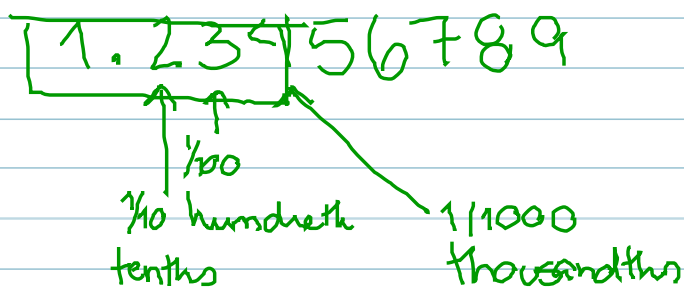
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- ALEKS Problems

$$(c) \log_7 3 = \frac{\log_{10} 3}{\log_{10} 7} = \frac{\log 3}{\log 7} \approx 0.565$$

$$(b) \log_{\frac{1}{5}} 6 = \frac{\log 6}{\log \frac{1}{5}} \approx -1.113$$

$$(a) \log_{\frac{1}{4}} \frac{1}{4} = \frac{\log(1/4)}{\log(1/4)} \approx 0.631$$



4.3 Let's do Domain

$$\textcircled{1} f(x) = \log_2 (9 - x^2)$$

$$\textcircled{2} f(x) = \ln(x^2 + 4)$$

① \mathbb{R}

② N/A

③ log argument > 0

$$9 - x^2 > 0$$

$$9 > x^2$$

$$x^2 < 9$$

$$\text{to } x \quad -3 < x < 3$$

$$(-3, 3)$$

$$x^2 + 4 > 0$$

$$x^2 > -4$$

$$(-\infty, \infty)$$

$$⑤ f(x) = \ln\left(\frac{1}{x+6}\right)$$

- ① \mathbb{R}
- ② N/A
- ③ log argument

$$\frac{1}{x+6} > 0$$

positive = positive

must be positive

$$x+6 = \text{positive}$$

$$x+6 > 0$$

$$x > -6$$

$$(-6, \infty)$$

$$④ \text{denom} \neq 0$$

$$x+6 \neq 0$$

$$x \neq -6$$

We must remove -6 from the domain we had at the end of step 3. However, it was already removed in step 3.

Final answer
 $(-6, \infty)$

→ Extra Problems

$$① \log_7\left(\frac{1}{x-9}\right) = (9, \infty)$$

$$① \mathbb{R} \quad ② \text{N/A}$$

$$③ \frac{1}{x-9} > 0$$

must be positive

$$x-9 > 0$$

$$x > 9$$

$$(9, \infty)$$

$$④ \text{denom} \neq 0$$

$$x-9 \neq 0$$

$$x \neq 9$$

$$② \log_8(16-x^2)$$

$$① \mathbb{R}$$

$$② \text{N/A}$$

$$③ \text{log argument} > 0$$

$$16-x^2 > 0$$

$$16 > x^2$$

$$x^2 < 16$$

$$-4 < x < 4$$

$$(-4, 4)$$

$$\textcircled{3} \ln(x^2 - 16)$$

$$\textcircled{1} \mathbb{R}$$

$$\textcircled{2} \text{N/A}$$

$$\textcircled{3} x^2 - 16 > 0$$

$$x^2 > 16$$

$$-4 < x$$

$$4 < x$$

$$-4 > x > 4$$

$$\cancel{(-\infty, -4)} \cup (4, \infty)$$

$$\textcircled{4} \log_3(x^2 + 1)$$

$$\textcircled{3} \log \text{ argument} > 0$$

$$x^2 + 1 > 0$$

$$x^2 > -1$$

$$(-\infty, \infty)$$

$$\textcircled{5} \ln \sqrt{x-2}$$

$$\textcircled{2} \text{Even radicand} \geq 0$$

$$x-2 \geq 0$$

$$x \geq 2$$

$$[2, \infty)$$

$$\textcircled{3} \log \text{ argument} > 0$$

$$(\sqrt{x-2})^2 > (0)^2$$

$$x-2 > 0$$

$$x > 2$$

$$\boxed{(2, \infty)}$$