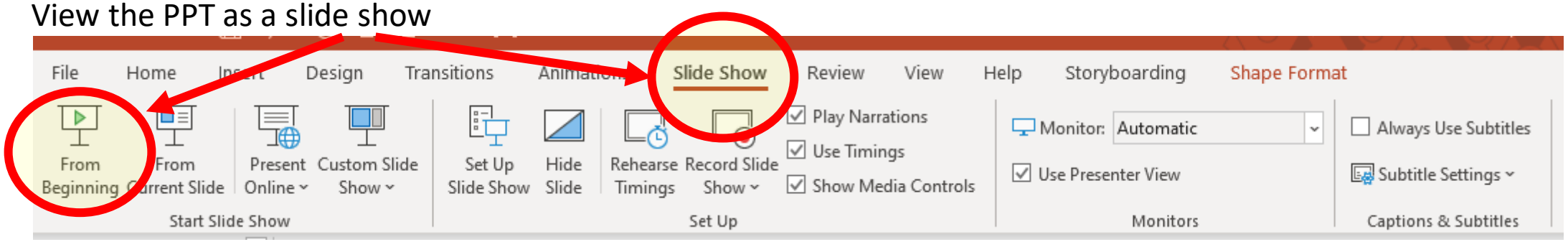
How to best use these slides…

- View the PPT as a slide show



- Then click through every step
  - Mouse clicks will advance the slide show
  - Left/right arrow keys move forward/backward
  - Mouse wheel scrolling moves forward/backward
- When a question is posed, stop and think it through, try to answer it yourself before clicking
- If you have questions, email me, ask in the Teams Student Center channel!

LESSON 6.6b

Solving Logarithmic Equations

Today you will:

- Solve logarithmic equations.

- Practice using English to describe math processes and equations

Core Vocabulary:

- Change-of-Base Formula, p. 329

Previous:

- Base of an exponent and of a logarithm

You will often see logarithmic equations in one of two forms

Hey! This sound familiar?

Log on each side,
common base each side

Example: $\log_2 x = \log_2 7$

- This is kind-of a duh…
- What is the only way this can be true?
  - since the bases are the same…
  - …the log number has to be the same
  - So $x = 7$

These are really simple…

Log & variable only on 1 side

Example: $\log_3(x-4) = 4$

- Convert to exponent form & do the simple algebra.

$$\log_3(x-4) = 4$$
$$x - 4 = 3^4$$
$$x - 4 = 81$$
$$x = 85$$

Solve (a) $\ln(4x - 7) = \ln(x + 5)$ and (b) $\log_2(5x - 17) = 3$.

SOLUTION

a. $\ln(4x - 7) = \ln(x + 5)$ Write original equation.

$4x - 7 = x + 5$ Property of Equality for Logarithmic Equations

$3x - 7 = 5$ Subtract x from each side.

$3x = 12$ Add 7 to each side.

$x = 4$ Divide each side by 3.

Check

$\ln(4 \cdot 4 - 7) \stackrel{?}{=} \ln(4 + 5)$

$\ln(16 - 7) \stackrel{?}{=} \ln 9$

$\ln 9 = \ln 9$ ✓

b. $\log_2(5x - 17) = 3$ Write original equation.

$5x - 17 = 2^3$ Convert to exponent form.

$5x - 17 = 8$ Simplify right side

$5x = 25$ Add 17 to each side.

$x = 5$ Divide each side by 5.

Check

$\log_2(5 \cdot 5 - 17) \stackrel{?}{=} 3$

$\log_2(25 - 17) \stackrel{?}{=} 3$

$\log_2 8 \stackrel{?}{=} 3$

Because $2^3 = 8$, $\log_2 8 = 3$. ✓

What if it is a bit messier?

Example: $\log_2 x = \log_2 3 + 5$

- Log on each side same base, but more stuff tossed in…
- Get all the logs on one side…
- …and use the log properties
  - $\log_b m + \log_b n = \log_b mn$
  - $\log_b m - \log_b n = \log_b \frac{m}{n}$
  - $\log_b m^n = n \cdot \log_b m$

Let's do it!

$\log_2 x = \log_2 3 + 5$ …get logs on same side

$\log_2 x - \log_2 3 = 5$ …$\log_b m - \log_b n = \log_b \frac{m}{n}$

$\log_2 \frac{x}{3} = 5$ …convert to exponent form

$\frac{x}{3} = 2^5$ …simple algebra!

$\frac{x}{3} = 32$

$x = 96$

Solve $\log 2x + \log(x - 5) = 2$.

SOLUTION

$\log 2x + \log(x - 5) = 2$	Write original equation.
$\log [2x(x - 5)] = 2$	Product Property of Logarithms
$2x(x - 5) = 100$	Convert to exponent using base 10.
$2x^2 - 10x = 100$	Distributive Property
$2x^2 - 10x - 100 = 0$	Write in standard form.
$x^2 - 5x - 50 = 0$	Divide each side by 2.
$(x - 10)(x + 5) = 0$	Factor.
$x = 10$ or $x = -5$	Zero-Product Property

Check

$\log(2 \cdot 10) + \log(10 - 5) \stackrel{?}{=} 2$

$\log 20 + \log 5 \stackrel{?}{=} 2$

$\log 100 \stackrel{?}{=} 2$

$2 = 2$ ✓

$\log[2 \cdot (-5)] + \log(-5 - 5) \stackrel{?}{=} 2$

$\log(-10) + \log(-10) \stackrel{?}{=} 2$

Because $\log(-10)$ is not defined, -5 is not a solution. ✗

The apparent solution $x = -5$ is extraneous. So, the only solution is $x = 10$.

Homework

Pg 338, #21-46