

# HW - 4.6 #41

$$41.) \log_{16} x + \log_4 x + \log_2 x = 7$$

① Use the change of base formula for each of the log expressions on the left side of the equal sign.

↳ change each base to the lowest of the bases, which in this case is 2.

Change of base Formula

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

$$\frac{\log_2 x}{\log_2 16} + \frac{\log_2 x}{\log_2 4} + \frac{\log_2 x}{\log_2 2} = 7$$

$$\frac{\log_2 x}{4} + \frac{\log_2 x}{2} + \frac{\log_2 x}{1} = 7$$

$$\frac{1}{4} \log_2 x + \frac{1}{2} \log_2 x + \log_2 x = 7 \quad (\text{combine like terms})$$

$$\left(\frac{1}{4} + \frac{1}{2} + 1\right) \log_2 x = 7$$

$$\frac{7}{4} \log_2 x = 7$$
$$\frac{\cancel{7}}{4} \log_2 x = \frac{7}{\cancel{4}}$$

→

$$\log_2 x = \frac{7 \cdot 4}{7}$$

$$\log_2 x = 4$$

$$x = 2^4 \rightarrow \boxed{x = 16}$$