

3.3a p. 207 (3-23 odd, 37-43 odd, 47-63 even)

$$(3) \log_3 24 = \frac{\log_{10} 24}{\log_{10} 3} \quad \text{or} \quad \boxed{\frac{\ln 24}{\ln 3}}$$

$$(5) \log_5 x = \frac{\log_{10} x}{\log_{10} 5} = \frac{\ln x}{\ln 5}$$

$$(7) \log_{\frac{1}{6}} x = \frac{\log_{10} x}{\log_{10} \frac{1}{6}} = \frac{\ln x}{\ln \frac{1}{6}}$$

$$(9) \log_a \frac{3}{10} = \frac{\log_{10} \frac{3}{10}}{\log_{10} a} = \frac{\ln \frac{3}{10}}{\ln a}$$

$$(11) \log_{2.6} x = \frac{\log_{10} x}{\log_{10} 2.6} = \frac{\ln x}{\ln 2.6}$$

$$(13) \log_3 7 = \frac{\log 7}{\log 3} \approx 1.771$$

$$(15) \log_{\frac{1}{2}} 16 = \frac{\log 16}{\log (.5)} \approx -4$$

$$(17) \log_6 0.9 = \frac{\log 0.9}{\log 6} \approx -0.059$$

$$(19) \log_{15} 1460 = \frac{\log 1460}{\log 15} \approx 2.691$$

$$(21) \ln 20 = \ln 4 \cdot 5 = \ln 4 + \ln 5$$

$$(23) \ln \frac{25}{4} = \ln 25 - \ln 4 \\ = \ln 5^2 - \ln 4 \\ = 2(\ln 5) - \ln 4$$

$$(37) \log_4 8 = \log_4 (4 \cdot 2) \\ = \log_4 4 + \log_4 2 \\ = 1 + \frac{1}{2} \quad 4^{\frac{1}{2}} = 2 \\ = 1\frac{1}{2} = \boxed{\frac{3}{2}}$$

$$(39) \log_2 4^2 \cdot 3^4 \\ = \log_2 4^2 + \log_2 3^4 \\ = 2(\log_2 4) + 4(\log_2 3) \\ = 2[2(\log_2 2)] + 4(\log_2 3) \\ = 2[2(1)] \\ = \boxed{4 + 4(\log_2 3)}$$

$$(41) \ln 5e^6 \\ = \ln 5 + \ln e^6 \\ = \ln 5 + 6(\ln e) \\ = \ln 5 + 6(1) \\ = \boxed{\ln 5 + 6}$$

$$(43) \ln \frac{6}{e^2} \\ = \ln 6 - \ln e^2 \\ = \ln 6 - 2(\ln e) \\ = \ln 6 - 2(1) \\ = \boxed{\ln 6 - 2}$$

$$\begin{aligned} (47.) \quad & \log_{10} 10x \\ &= \log_{10} 10 + \log_{10} x \\ &= \boxed{1 + \log_{10} x} \end{aligned}$$

$$\begin{aligned} (51.) \quad & \log_8 x^4 \\ &= \boxed{4(\log_8 x)} \end{aligned}$$

$$\begin{aligned} (55.) \quad & \ln x \cdot y \cdot z \\ &= \boxed{\ln x + \ln y + \ln z} \end{aligned}$$

$$\begin{aligned} (59.) \quad & \ln \sqrt[3]{\frac{x^4}{y^3}} \\ &= \ln \left(\frac{x^4}{y^3} \right)^{\frac{1}{3}} \\ &= \frac{1}{3} \left[\ln \left(\frac{x^4}{y^3} \right) \right] \\ &= \frac{1}{3} \left[\ln x^4 - \ln y^3 \right] \\ &= \frac{1}{3} \left[4 \ln x - 3 \ln y \right] \\ &= \boxed{\frac{4}{3} \ln x - \ln y} \end{aligned}$$

$$\begin{aligned} (63.) \quad & \log_b \frac{x^4 \sqrt{y}}{z^5} \quad \sqrt{y} = y^{\frac{1}{2}} \\ &= \log_b x^4 + \log_b \sqrt{y} - \log_b z^5 \\ &= \boxed{4(\log_b x) + \frac{1}{2}(\log_b y) - 5 \log_b z} \end{aligned}$$