

$$1. \ln(x^2 - 1) - 2\ln(x+1) + \ln(x^2 + x)$$

$$= \ln(x^2 - 1) - \ln(x+1)^2 + \ln(x^2 + x)$$

$$= \ln\left(\frac{(x^2 - 1)(x^2 + x)}{(x+1)^2}\right)$$

$$= \ln\left(\frac{x(x^2 - 1)}{x+1}\right)$$

$$= \ln\left(\frac{x^3 - x}{x+1}\right)$$

$$2. \log_3(x+17) - 2 = \log_3 2x$$

$$\Rightarrow \log_3(x+17) - 2\log_3 3 = \log_3 2x$$

$$\Rightarrow \log_3\left(\frac{x+17}{9}\right) = \log_3 2x$$

$$\Rightarrow \frac{x+17}{9} = 2x$$

$$\Rightarrow x+17 = 18x$$

$$\Rightarrow 17 = 17x$$

$$\Rightarrow x = 1$$

$$3. 4\ln 2 - 3\ln 4 = -\ln k$$

$$\Rightarrow \ln 16 - \ln 64 = \ln \frac{1}{k}$$

$$\Rightarrow \ln \frac{16}{64} = \ln \frac{1}{k}$$

$$\Rightarrow k = \frac{64}{16}$$

$$= 4$$

$$4. \log_9 81 + \log_9 \frac{1}{9} + \log_9 3 = \log_9 x$$

$$\Rightarrow \log_9 27 = \log_9 x$$

$$\Rightarrow x = 27$$

$$5. q^{x-1} = \left(\frac{1}{3}\right)^{2x}$$

$$= \left(\frac{1}{9}\right)^x$$

$$= q^{-x}$$

$$\Rightarrow x-1 = -x$$

$$\Rightarrow x = \frac{1}{2}$$

$$6. \quad a = \log x, \quad b = \log y, \quad c = \log z$$

$$\log\left(\frac{x^2 \sqrt{y}}{z^3}\right)$$

$$= \log(x^2) + \log(\sqrt{y}) + \log z^3$$

$$= 2\log x + \frac{1}{2}\log y + 3\log z$$

$$= 2a + \frac{b}{2} + 3c$$

$$7. \quad 9 \log_s x = 25 \log_x 5 \quad \text{expressing } S^{\frac{p}{q}}$$

$$= 25 \left( \frac{1}{\log_s x} \right)$$

$$\Rightarrow 9 (\log_s x)^2 = 25$$

$$\text{let } y = \log_s x$$

$$\Rightarrow 9y^2 - 25 = 0$$

$$\Rightarrow (3y + 5)(3y - 5) = 0$$

$$\Rightarrow y = \frac{5}{3} \text{ or, } y = -\frac{5}{3}$$

$$\Rightarrow \log_s x = \frac{5}{3} \text{ or, } \log_s x = -\frac{5}{3}$$

$$\Rightarrow x = S^{\frac{5}{3}} \text{ or, } S^{-\frac{5}{3}}$$