## Solutions for practice problems in 3.3 Properties of logarithms

1. Expand these to a sum/difference of logs.

$$\log\frac{ab^2}{c} = \log(ab^2) - \log c = \log a + \log b^2 - \log c$$
$$= \log a + 2\log b - \log c$$

$$\ln\left(\frac{a}{2b}\right)^3 = 3\ln\left(\frac{a}{2b}\right) = 3\left(\ln a - \ln 2b\right) =$$
$$= 3(\ln a - \ln 2 - \ln b) =$$
$$= 3\ln a - 3\ln 2 - 3\ln b$$

2. Put these in a single logarithmic expression.

$$\ln a - 3\ln b + \tfrac{1}{2}\ln c = \ln a - \ln b^3 + \ln c^{\frac{1}{2}} = \ln\frac{a}{b^3} + \ln c^{\frac{1}{2}}$$
$$= \ln\frac{a}{b^3}c^{\frac{1}{2}} = \ln\frac{a\sqrt{c}}{b^3}$$

$$2\log a - 5\log b = \log a^2 - \log b^5 = \log\frac{a^2}{b^5}$$

3. If log 2 = .301 and log 3 =.477, determine the value of these by turning them into expressions involving only log 2 and log 3.

$$\log\frac{8}{9} = \log 8 - \log 9 = \log 2^3 - \log 3^2 =$$

$$= 3\log 2 - 2\log 3 = 3 \cdot 0.301 - 2 \cdot 0.477 =$$

$$= 0.903 - 0.954 = -0.051$$

$$\log\frac{\sqrt{6}}{24} = \log\frac{\sqrt{6}}{6 \cdot 4} = \log\frac{1}{\sqrt{6} \cdot 4} = \log 1 - \log 4 \cdot \sqrt{6}$$

$$0 - (\log 4 + \log\sqrt{6}) = -\log 2^2 - \log 6^{\frac{1}{2}} =$$

$$= -2\log 2 - \frac{1}{2}\log 6 = -2\log 2 - \frac{1}{2}(\log 2 + \log 3)$$

$$= -2 \cdot 0.301 - \frac{1}{2}(0.301 + 0.477) =$$

$$= -0.602 - \frac{1}{2}\, 0.778 = -0.602 - 0.389 =$$

$$= -0.991$$

4. Earthquakes of magnitude 3.4 are common in California. How many times more powerful is that than a minimal quake?

$$3.4 = \log\frac{I_1}{I_0}$$

$$10^{3.4} = \frac{I_1}{I_0}$$

$$I_1 = 10^{3.4} \cdot I_0$$

$$I_1 = 2511.87\, I_0$$

The common earthquake is about 2512 times more powerful than the minimal earthquake.