Phys 3150/5190 Homework Assignment 3

Due Wednesday, September 19

1. Convert the following gain values between their expression in dB and their expression as a normal multiplier (denoted with an '×' after the number). Use a calculator to give an answer accurate to 1%.

(a) 6 dB	(e) 16×
(b) 10 dB	(f) 300×
(c) 35 dB	(g) $\frac{1}{8}\times$
(d) -15 dB	(h) 1.1×

2. Again, convert the following gain values between dB and ×. This time, do not use a calculator, but instead use the properties of logarithms and the approximate relations 6 dB $\approx$ 2× and 10 dB $\approx$ 3×. Note that the 20 dB = 10× relation is exact and the 6 dB relation is accurate to about 0.2%, but the 10 dB relation is only accurate to about 5%. When there are multiple ways to solve a problem, try to find the most accurate approximation. Your solutions should show how you obtained your answer.

(a) -100 dB	(e) 100×
(b) -10 dB	(f) 5×
(c) 26 dB	(g) 4×
(d) 34 dB	(h) $\frac{1}{15}\times$

3. Suppose that the diode drop V_D for a diode is defined as the voltage required to produce some specified forward current I_0. At room temperature (300 K), the diode drop is determined to be 0.6 V. How much will the diode drop change if the temperature is increased by 30 K?

4. Suppose a diode satisfies the I-V relation $I = I_s(e^{V/V_0} - 1)$ with $I_s = 1$ nA and $V_0 = 50$ mV. Determine the differential impedance, defined by

$$z = \frac{dV}{dI}$$

as a function of the voltage drop V. This describes how the voltage drop varies in response to small changes in current. Compare the differential impedance values at $V = 0$ and $V = 0.5$ volts. For small current variations, z can often be interpreted as the output impedance of the diode.