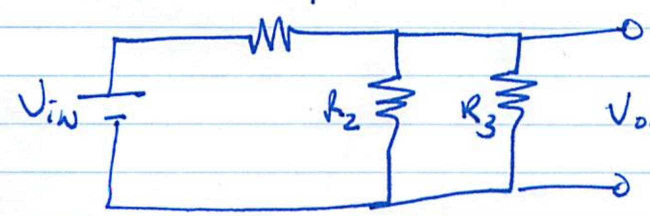
Electronics Homework #2
By hand: 2.27, 2.28
LTSpice: 2.20, 2.33

2.27/2.28



we are looking for $\frac{V_{out}}{V_{in}}$ which is a voltage divider between R_1 ; $R_{23} = \frac{R_2 R_3}{R_2 + R_3}$

so

$$\frac{V_{out}}{V_{in}} = \frac{R_{23}}{R_1 + R_{23}} = \frac{1}{\frac{R_1}{R_{23}} + 1}$$

$$= \frac{1}{\frac{R_1(R_2+R_3)}{R_2 R_3} + 1}$$

for resistances a

$R_1 = 50\Omega$, $R_2 = 10^4\Omega$, $R_3 = 10^6\Omega$

and

$$\frac{V_{out}}{V_{in}} = \frac{1}{\frac{5\times10^1(10^4+10^6)}{10^{10}} + 1} = \frac{1}{1 + 5\times10^{-3}(1.01)}$$

$$= 0.995$$

for resistances b $R_1 = 50\Omega$, $R_2 = 5\times10^5\Omega$, $R_3 = 10^6\Omega$

$$\frac{V_{out}}{V_{in}} = \frac{1}{\frac{5\times10^1(5\times10^5+10^6)}{5\times10^{11}} + 1} = \frac{1}{1 + 1.5\times10^{-4}}$$

$$= 0.9999$$

compared w/ the ideal voltmeter $R_3 \to \infty$

and

$$\frac{V_{out}}{V_{in}} = \frac{1}{\frac{R_1}{R_2} + 1}$$ is a voltage divider.

for resistors a

$$\frac{V_{out}}{V_{in}} = \frac{1}{\frac{50}{10^4}+1} = \frac{1}{1+5\times10^{-3}} = 0.995$$

and resistors b

$$\frac{V_{out}}{V_{in}} = \frac{1}{\frac{50}{5\times10^5}+1} = \frac{1}{1+1\times10^{-4}} = 0.9999$$

So if you are truely trying to measure $\frac{V_{out}}{V_{in}}$ the difference in both cases ~~is~~ less than a part in 10^4 ~~and~~ If instead you are trying to get a faithful measure of the voltage across R_2 w/ a real power supply and real Voltmeter the power supply has the stronger effect on the reading but they are ~~both~~ all 1 to within 1/2 % or better.