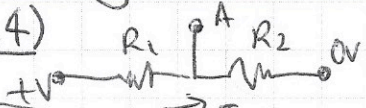
NAME: Jung Lin (Doris) Lee | LAB PARTNER | LOCKER/DESK NO. | COURSE & SECTION NO.

1.4)



$V = I R_{eq} = I(R_1+R_2)$

$I = \frac{V}{R_1+R_2}$

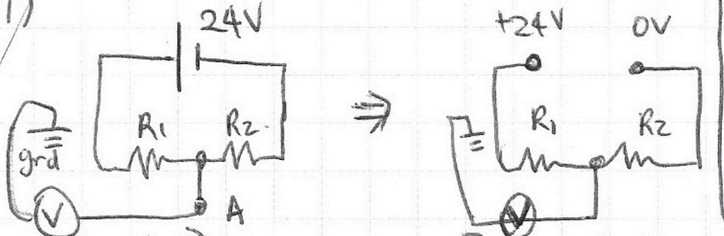
We build a voltage divider s.t $R_1 = 470k\Omega$, $R_2 = 10k\Omega$; $V = 24V$

$V_A = \frac{V R_2}{R_1+R_2}$

1.5) $I = \frac{V}{R_1+R_2} = \frac{24V}{(480\times10^3)\Omega} = \boxed{5.0\times10^{-5} A}$

1.6) $V_A = \frac{(24V)(10\times10^3)}{(470+10)\times10^3\Omega} = 0.5V$

1.7)

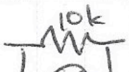


1.8) Actual resistance $R_1 = 465.6 k\Omega$
$R_2 = 9.89 k\Omega$

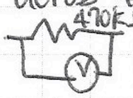
Actual voltage $V = 24.589 V$

within the 5% tolerance (specified by the gold band) $\delta R_1 = 4.4 k\Omega \rightarrow 0.94\%$ → tolerence ~2.45% (within tolerence level)
$\delta R_2 = 0.11 k\Omega \rightarrow 1.1\%$

1.8) we connect the DMM to ground on one terminal and A at the other. the mistake that we made was that we fed +24V to R_2 and 0V terminal to R_1. This caused us to get ~24V, because 24 − 0.5 is ~23.5V

1.7 a)  to measure Current thru the 10kΩ resistor connect in parallel and measure the V across the resistor. Using the nominal value we find that $I = \frac{V}{R} = \frac{0.510 V}{10 k\Omega} = 0.000051 A$ ≈ same as predicted in 1.5)

b) V drop across 470kΩ resistor = $\boxed{24.079 V}$



Connect "across" the resistor

$V_A = \frac{(24.589V)(9.89\ k\Omega)}{(465.6+9.89)\ k\Omega} = 0.5114 V$

1.9) $I = \frac{24.589 V}{(465.6+9.89) k\Omega} = 0.0000517 A = 0.0517 mA$

1.10) $V_A = 0.51086 V$

accuracy $= 0.012\%(0.51086V) + 0.004\% \cdot 1V$
$= 1.013068\times10^{-4} V$

So the $0.51086V \pm 10.13068 mV$

Our measurement is not within the range but if we round to 2 significant figures then it will fall within the range.

1.11) Current through $R_1 = \frac{24.072V}{470 k\Omega}$
Current though $R_2 = \frac{0.51079V}{9.89 k\Omega}$

$I_1 = 5.1217\times10^{-5} A$
$I_2 = 5.1671\times10^{-5} A$

Note: ammeter must be connected in series & prong need to be on the bottom two

1.11) Current Directly measured by DMM
$I = 0.0030\ mA$

1.12) a) $P_1 = IV = \frac{V^2}{R_1} = \frac{(24V)^2}{470 k\Omega} = 1.226\times10^{-3} W$ power dissapated from R_1

V=IR

$P_2 = \frac{(24V)^2}{10k\Omega} = 5.76\times10^{-2} W$

this makes sense ∵ it should be less than quarter watt.

b) decrease R value so that more current pass thru (∵ $P = I^2R$)

c) The 10kΩ resistor would reach the max power rating first

d) $P = \frac{V^2}{R} = 0.25 W = \frac{(24V)^2}{R}$

$R = 2.304 k\Omega$

make it approximatly 200 times smaller

e) we can arrange several resistors in parallel to decrease its ~~nominal~~ effective resistance. But in practice we would require a lot of parallel resistor so will be hard to build.

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NOTE: INSERT PERIODIC TABLE UNDER COPY SHEET BEFORE WRITING • THE HAYDEN-McNEIL STUDENT LAB NOTEBOOK

1.20)

Oscilloscope:

frequency (Hz)	10	31.6	100	316	1000	3160	10000	31600	100000	200000
V ~~omw~~	480×10^{-3}	480×10^{-3}	480×10^{-3}	480×10^{-3}	480×10^{-3}	480×10^{-3}	480×10^{-3}	485×10^{-3}	485×10^{-3}	485×10^{-3}

b/w 39 & 40 Hz

freq (Hz)	316000	300,000	1 MHz	3 MHz	5 MHz	6 MHz	7 MHz	5.5 MHz
V	485×10^{-3}	490×10^{-3}	490×10^{-3}	490×10^{-3}	495×10^{-3}	1.02	1.03	1.015

freq (Hz)	7.5 MHz	8.0 MHz	8.5 MHz	9.0 MHz	9.5 MHz	10 MHz
V_o (V)	1.04	1.06	1.06	1.08	1.09	1.10

~~Digimeter~~ DMM:

freq (Hz)	10	31.6	100	316	1000	3160	10,000	31600	10000	316000	1 MHz	2 MHz
V_o (V)	0.35388	0.35382	0.35377	0.35356	0.35329	0.35319	0.35331	0.35342	0.35360	0.36220	0.51622	56.538 mV

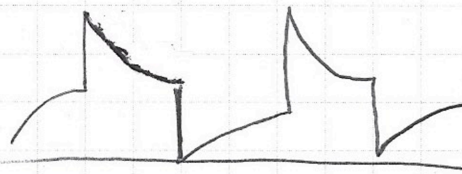
freq (Hz)	2.25 MHz	2.5 MHz	3 MHz	3.1 MHz
V_o (V)	32.921 mV	18.133 mV	3.925 mV	1.634 mV

1.21)

(10 Hz)

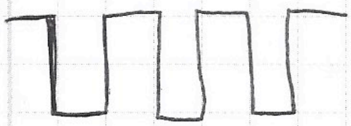
DC

AC



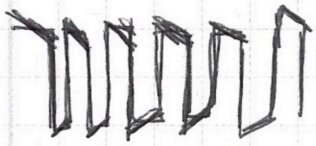
100 Hz

DC



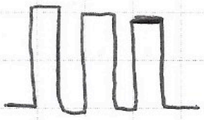
~~(Straight)~~

AC



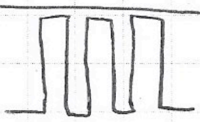
~~(thinner)~~

~~10kHz~~ 10 kHz DC



thinner in comparison

AC



The reason why the AC signal looks weird in the lower frequencies is that since there are fewer cycles in the same amount of sampling time the average is less accurate. What the AC does is that it subtracts off the average value from the DC signal.

So if the average value is not the actual mean then subtracting this off will result in the weird waveform as seen in the 10 Hz & 100 Hz AC signals.

Note: the 50Ω terminator introduces noise to the scope reading. So we didn't use it in our measurement. Instead we set Output Menu → Impedance → High Z for the terminator effect instead.

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NAME	LAB PARTNER	LOCKER/DESK NO.	COURSE & SECTION NO.
Jung Lin Lee (Doris)	Leah Tom		

Prelab Part I

Problem 1.1.13 Xiaofei Zhou.

1.15

1.18

1.21

Prelab Part II

1.2.2

1.2.7

1.2.8

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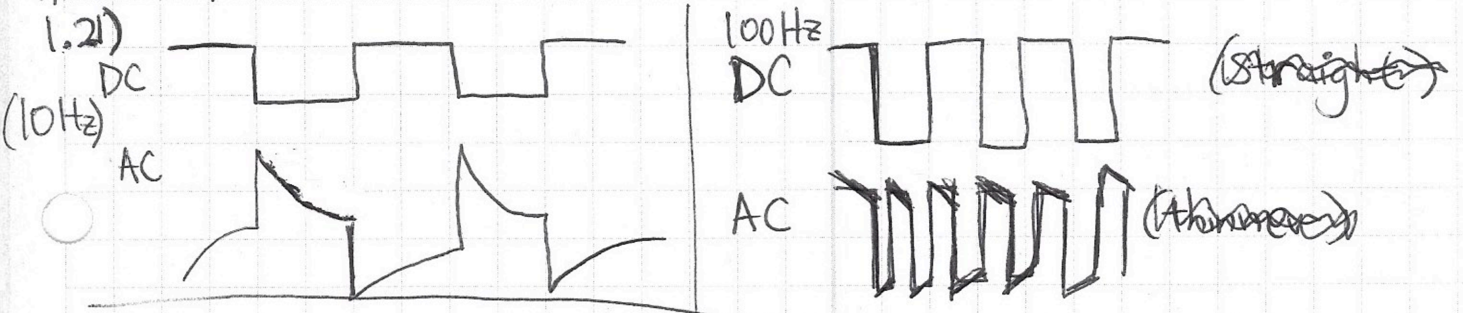

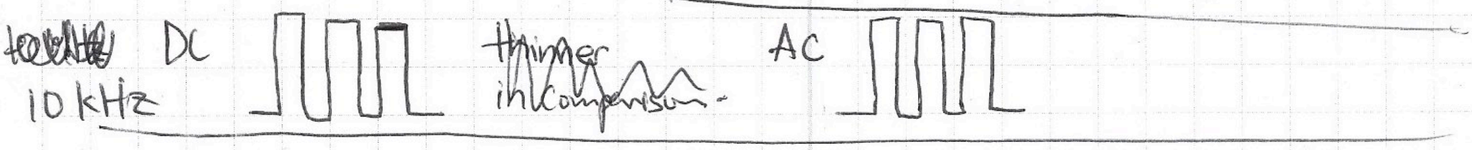

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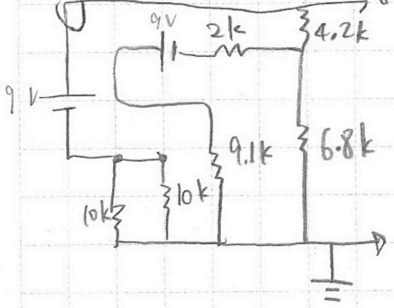
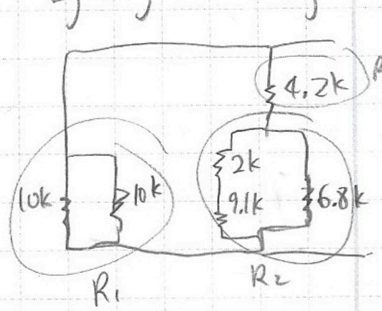
for $10k\Omega$:
$$R = \frac{1}{\frac{1}{3.1367} + \frac{1}{10}} = 2.387k\Omega \qquad I = \frac{V}{R} = \cancel{3.769A}\ \frac{9V}{2.387k\Omega}$$
$$I = 3.77\ mA$$

for 100Ω:
$$R = \frac{1}{\frac{1}{100} + \frac{1}{3136.7}} = 96.91\Omega \qquad I = \frac{9V}{96.91\Omega} = \cancel{0.0927}\ 92.87\ mA$$

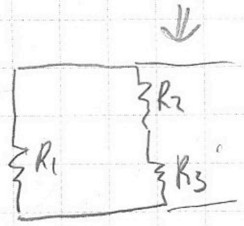
~~R = 0.00607 MΩ~~ after shorted across the 2 terminal
range = 0.0001 MΩ out — across wrong terminal need to ÷2
$\Rightarrow R = 0.00335\ M\Omega$

Ignoring the voltage sources



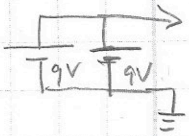


$$R_1 = \frac{1}{\frac{1}{10} + \frac{1}{10}} = \frac{1}{\frac{2}{10}} = \frac{10}{2} = 5k\Omega$$
range 4k $\approx 0.0034M\Omega$
$$\Rightarrow R_2 = \frac{1}{\frac{1}{2+9.1} + \frac{1}{6.8}} = 4.2167k\Omega$$
$R_3 = 4.2k$



$$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2+R_3}} = \frac{1}{\frac{1}{5} + \frac{1}{8.4167}} = 3.1367k\Omega$$

Ignoring all the resistors



$\therefore$ in parallel $V_{eq} \approx 9V$

for the $1k\Omega$
$$R = \frac{1}{\frac{1}{3.1367k} + \frac{1}{.1k}} = 757\Omega \qquad I = \frac{V}{R} = \frac{9V}{757\Omega} = 0.01187\ A$$

Redid the measurements

	100Ω	$1k\Omega$	$10k\Omega$
V th	0.1440 V	1.131 V	3.585 V
I th	1.448 mA	1.138 mA	0.3625 mA