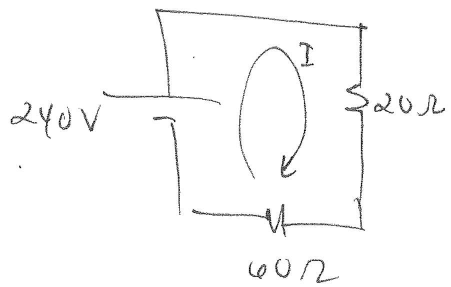
Exam 1 - Solutions

Part I

i.



$+240 - I(20+60) = 0$

$I = \frac{240}{80} = 3A$ for both resistors

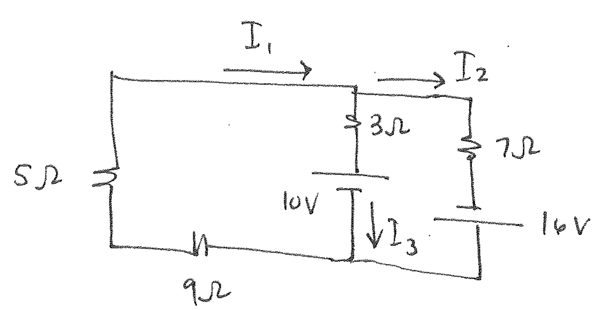
$V = IR$

$= (3)(20) = 60V$ for 20Ω resistor

$V = IR$

$= 3(60) = 180V$ for 60Ω resistor

ii



current/junc rule: $I_1 - I_2 - I_3 = 0$

$I_3 + I_2 - I_1 = 0$

voltage/loop rule:

left loop $-5I_1 - 3I_2 - 10 - 9I_1 = 0$

right loop $+10 + 3I_3 - 7I_2 + 16 = 0$

big loop $-9I_1 - 5I_1 - 7I_2 + 16 = 0$

to find I_1, I_2 + I_3

choose any 2 loop equations

and 1 junc. equation.

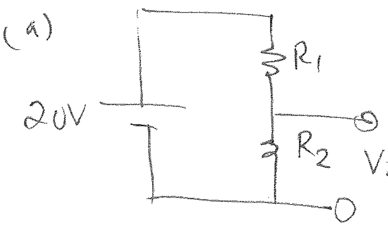
(3 equations for 3 unknowns)

Exam 1: Solutions, part 2

1. $$R_{AB} = \left[\frac{1}{40} + \frac{1}{30+50}\right]^{-1} = \left[\frac{1}{40} + \frac{1}{80}\right]^{-1} = \frac{80}{3}$$

2.

(a)



here, $V_{out} = 20V \cdot \frac{R_1}{R_1 + R_2}$

so R_2 needs to $\frac{1}{4}$ of total Resistance,

or $3R_2 = R_1$

$R_2 = \frac{R_1}{3}$

Choose	$R_2 = 250\,\Omega$
	$R_1 = 750\,\Omega$

- These choices satisfy $R_L \gg R_2$ (its 100x), and its more specific requirement of $R_L \gg R_{TH}$ (here $R_{TH} = R_1 \parallel R_2$)
- We also don't choose v. low R's, since these R's will dissipate power.

(b) No current flows through the output,
but current does flow through $R_1 + R_2$ at all times.
The divider itself dissipates power, even when there's no load.

3/ $E = E_0 + \frac{1}{2} k x^2$

$dE = dE_0 + \frac{1}{2} k (2x) dx$

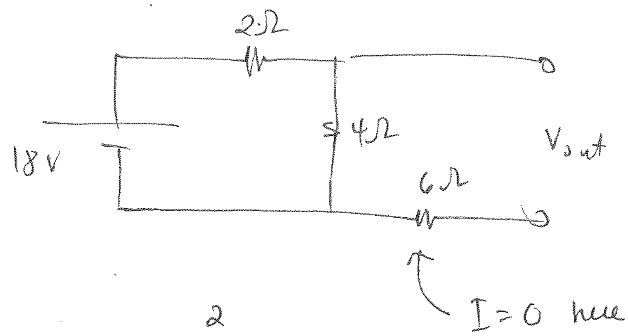
$\Delta E = \Delta E_0 + k x \Delta x$ here, $\Delta E_0 = 3$

$\Delta x = 4 \times (0.1) = 0.4$

$\Delta E = 3 + (10)(4)(0.4)$

$\Delta E = 19 J$

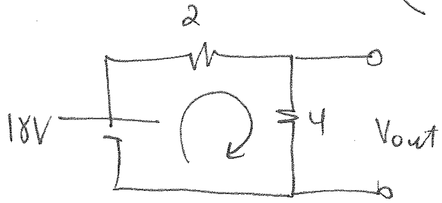
4/



here, $V_{TH} = V_{out}$ when there's no load

In this case, there's no current through the 6Ω resistor &

$V_{out} = V_{4\Omega}$



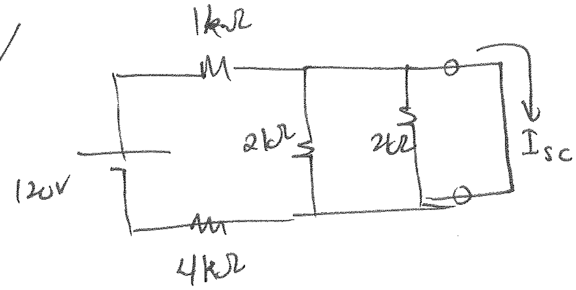
$18V - I(2+4) = 0$

$I = 3A$, the current through 2Ω + 4Ω resistor

$V_{4\Omega} = IR$

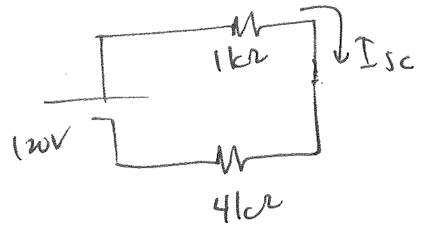
$= 3(4) = 12V$

5/



$$R_{TH} = \frac{V_{TH}}{I_{sc}}$$

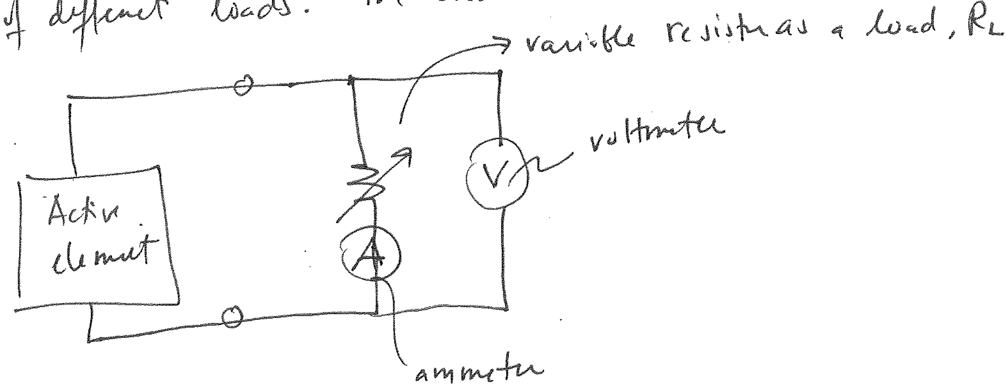
In this case, the short circuit means the 2 kΩ resistors don't play a part in the circuit



$$I_{sc} = \frac{120V}{5k\Omega} = 24mA$$

$$R_{TH} = \frac{20V}{24mA} = 833\,\Omega$$

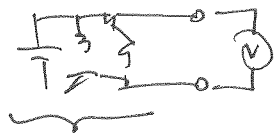
6/ The load curve of an active element is experimentally determined by measuring the voltage & current supplied by the element to a set of different loads. The circuit to use:



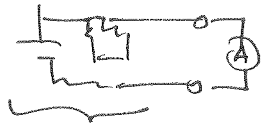
measure V, A for different R_L's

7/ (a) Its load curve. That is, the voltage (and power) supplied to an output.

(b) The Thevenin voltage is the open circuit voltage



The Thevenin resistance is $\frac{V_{TH}}{I_{SC}}$, where I_{SC} is the short circuit current.



8/ - ideal voltage source

any Thevenin circuit; for example a v-divider

a resistor

a diode