Signature
Name (print, please)
Student No.

ECE 2300 Circuit Analysis
Summer 2009

Quiz 2

DO NOT OPEN THIS QUIZ BOOKLET UNTIL INSTRUCTED TO DO SO

This quiz has 4 pages including this cover page. If you are missing any pages, raise your hand. You have 30 minutes to complete the quiz.

Notes

1. Be sure your name and signature appear above.
2. The quiz is closed-book. You may have a calculator and one 8 ½ " x 11" crib sheet.
3. To receive full credit for a problem, you must:

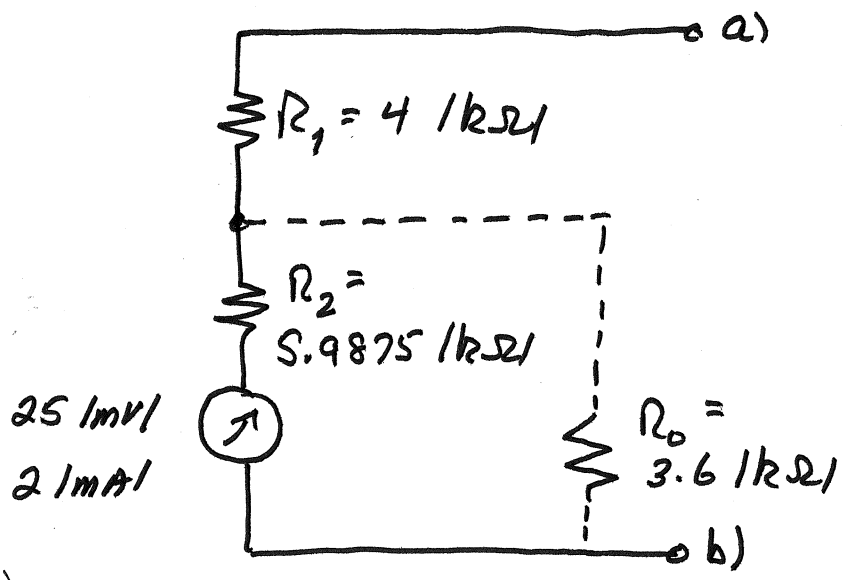
- Show all work necessary to solve the problem;
- Define all variables and parameters and label them on circuit diagrams;
- Use the proper notation for all variables.
- Show all units explicitly in intermediate and final results;
- Indicate clearly whether power being calculated is absorbed or delivered;

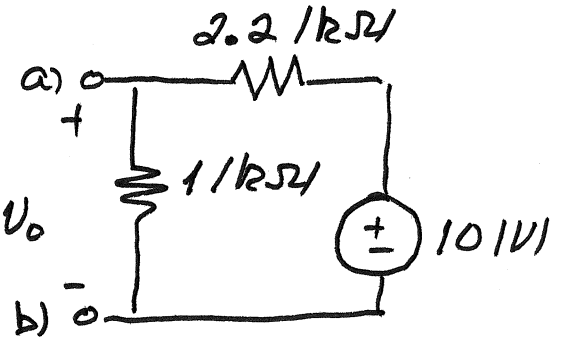
_____/20

A voltmeter is constructed with a d'Arsonval meter movement and resistances R_1 and R_2, as shown below on the left. Ignoring the resistance R_o, the full scale reading of the voltmeter is 20 /V/.

+12 i) If we add the resistance R_o (as indicated by the dashed lines), what voltage must be present at terminals a) and b) in order to read full-scale? (*Hint: it is* ***not*** *20 /V/.*)

ii) If the voltmeter with R_o attached is used to measure the voltage v_o in the circuit on the right, what ×8 does the meter read?

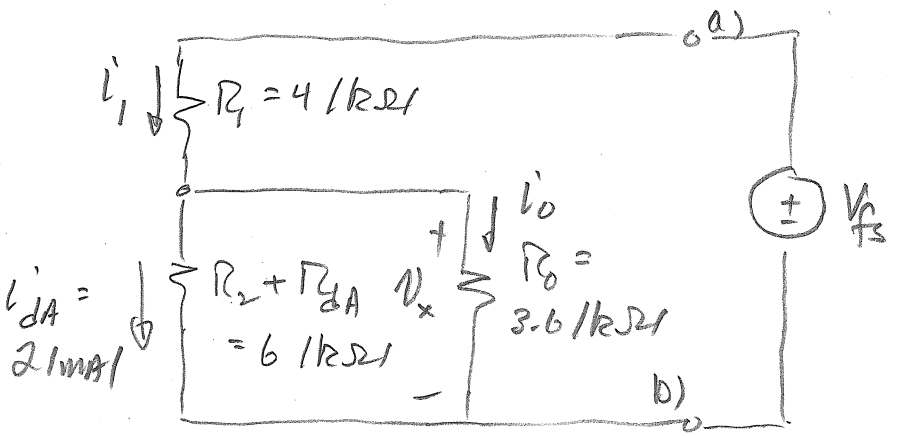




$$R_{dA} = \frac{25\,/mV/}{2\,/mA/} = 12.5\,/\Omega/$$

1')

With R_o attached and a hypothetical source V_{fs} connected at a), b), we have the following:



$R_{eq} = (R_2 + R_{dA}) \,//\, R_o = 2.25$ /kΩ/

For full-scale reading,

$i_{dA}' = 2$ /mA/ $\Rightarrow$

$v_x = 12$ /V/.

$\therefore\ i_o' = 3.333$ /mA/

$\Rightarrow\ i_1' = i_{dA}' + i_o'$

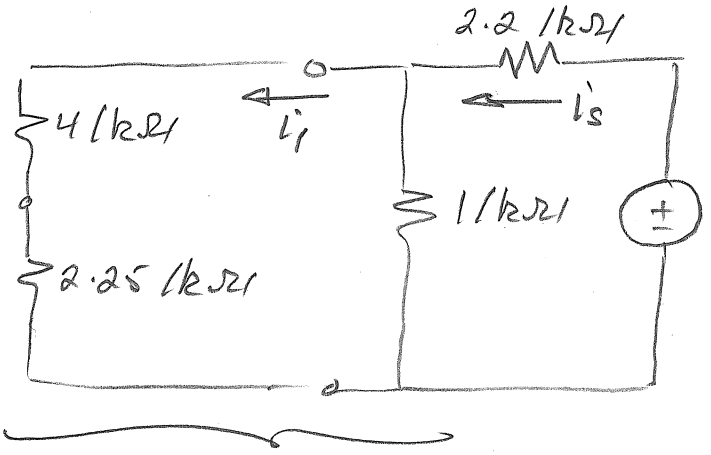
$= 5.333$ /mA/

Room for Extra Work

Finally, $V_{fs} = i_1' \cdot 4\,\text{k}\Omega + V_x = \underline{\underline{33.333\ \text{V}}}$

So this is the full-scale voltage.

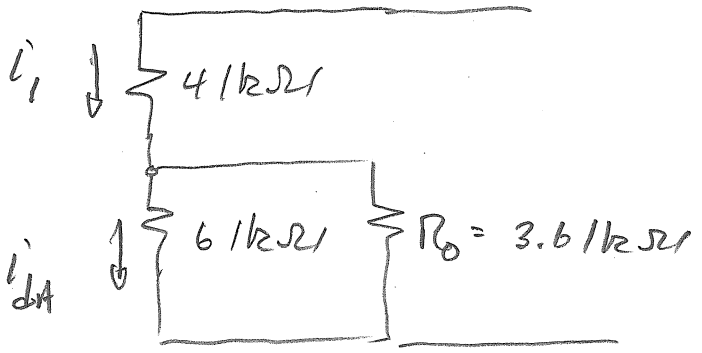
ii). Re-drawing with the circuit attached, we have:



$$i_s' = \frac{10}{2.2\,\text{k}\Omega + 0.862\,\text{k}\Omega} = 3.266\ \text{mA}$$

$$\therefore i_1' = i_s' \frac{1\,\text{k}\Omega}{1\,\text{k}\Omega + 6.25\,\text{k}\Omega} = 0.450\ \text{mA}$$

$$R_{eq} = (6.25\,\text{k}\Omega) \parallel 1\,\text{k}\Omega = 0.862\,\text{k}\Omega$$



$$\text{So } i_{dA}' = i_1' \cdot \frac{3.6\,\text{k}\Omega}{3.6\,\text{k}\Omega + 6\,\text{k}\Omega} = 0.169\ \text{mA}$$

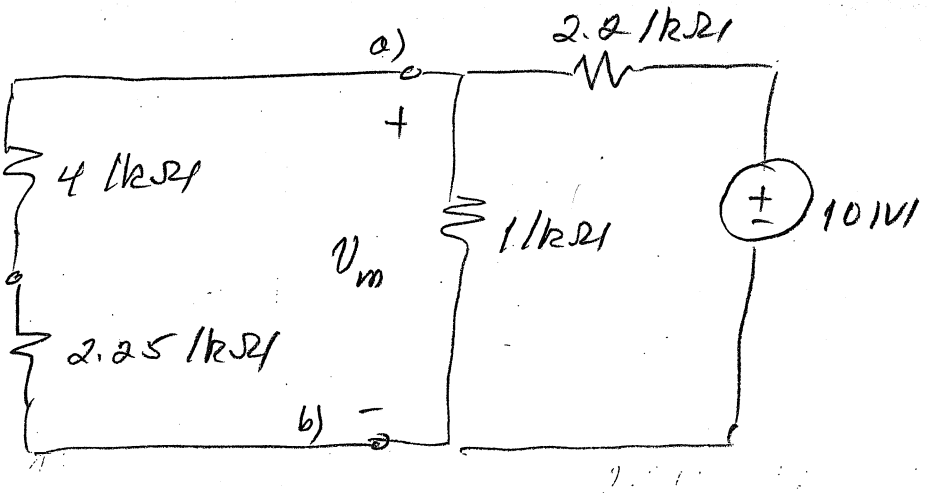
(over)

If the current in the d'Arsonval is 0.169 mA, then

$$\text{reading} = \frac{0.169\ \text{mA}}{2\ \text{mA}} \cdot 33.333\ \text{V} = \underline{\underline{2.815\ \text{V}}}$$

(0.169 mA: full scale current; 33.333 V: full-scale voltage; reading: 2.815 V)

Alternative solution to ii):



The meter measures the voltage at the terminals V_m:

$$R_{eq} = (4+2.25)\,\|\,1 = 0.862\ k\Omega$$

$$\therefore \quad V_m = 10 \cdot \frac{0.862}{0.862 + 2.2} = 2.815\ V$$