Engr228 **Exam #1** **Spring, 2020**

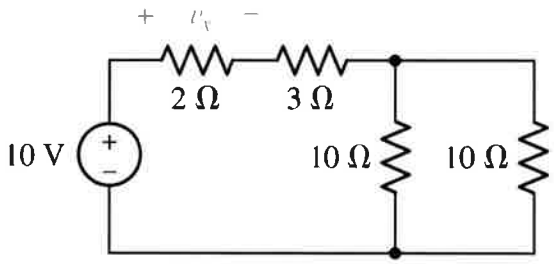
SCORE KEY /30

Rules of engagement:

- This test is 90 minutes in length. Time extensions for documented disabilities will be honored.
- Resources you may use are your calculator and an 8 ½" x 11" cheat sheet.
- When you are finished, submit a scan, photos, pdf, or docx document of your test into D2L dropbox **test1** no later than 3:30pm on Monday, April 27 **along with your cheat sheet**. You may email me your test directly if D2L is not available.
- You may not communicate with each other about anything related to engr228 by any means between now and the time you receive an email message from me saying that the last exam has been finished.
- **I will be available for questions by email only.**
- You will be asked to sign your name below. When you do, I will take this to indicate that you abided by these rules. You must sign your name to get a non-zero grade on the exam.

NAME_____

2 pts Find the equivalent resistance seen by the terminals of the 10V DC power supply.



$$R_{eq} = 2+3+\frac{10(10)}{10+10}$$

$$= 10\Omega$$

2 pts Find the current through one of the 10Ω resistors.

$$i_{total} = \frac{10V}{10\Omega} = 1A$$

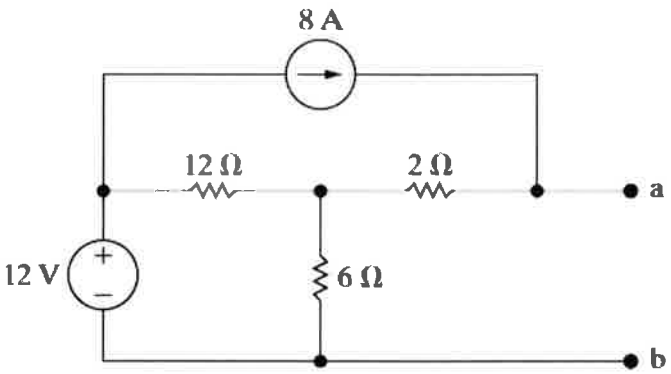
i splits evenly in the 10Ω resistors so

$$i_{10\Omega} = 0.5A$$

2 pts Find the voltage across the 2Ω resistor (v_x).

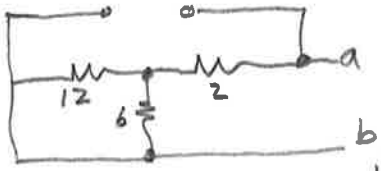
$$v_x = i_{total} R = (1)(2) = 2V$$

8 pts Use any method you wish, find the Thevenin equivalent with respect to the terminals **a,b** for the circuit shown at the right.



FIND R_{th}

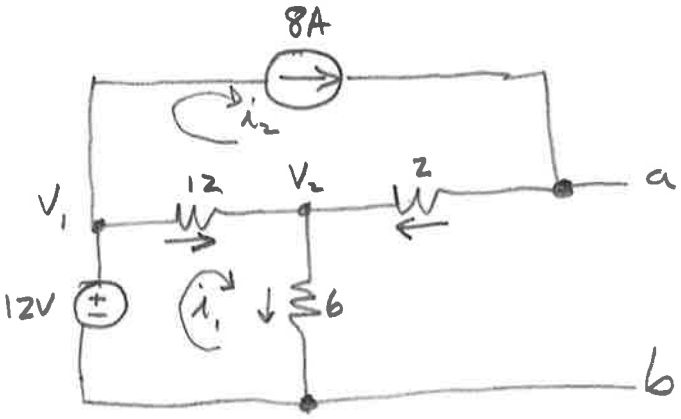
Voltage Sources → short
Current Sources → open



$R_{th} = (12 \| 6) + 2 = \boxed{6\,\Omega}$

FIND V_{th}

Set reference at Bottom (b)



NODE

Node V_2: $\sum i_{IN} = \sum i_{OUT}$

$$\frac{V_1 - V_2}{12} + 8 = \frac{V_2}{6}$$

$V_1 = 12$ so $V_2 = \underline{36\,V}$

$V_{th} = V_A = 36 + 2(8) = \boxed{52V}$

MESH

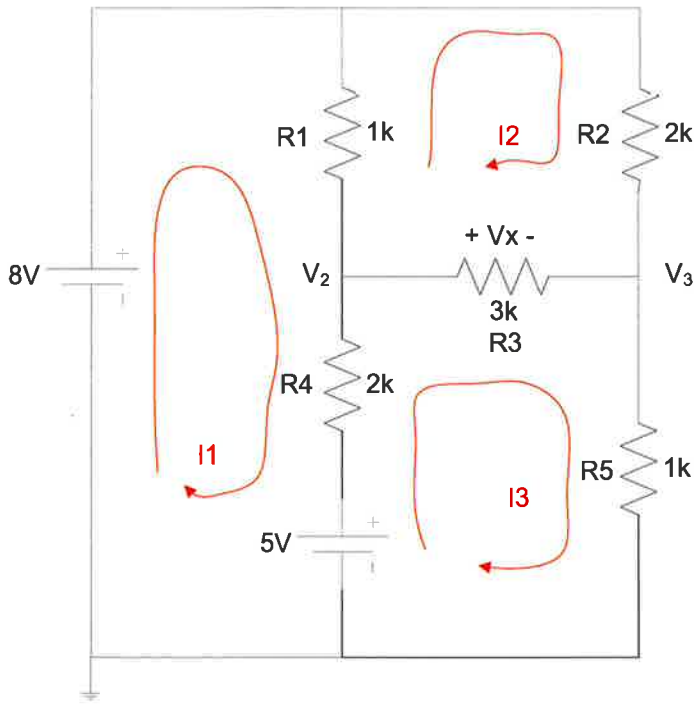
mesh i_1: $-12 + 12(i_1 - 8) + 6i_1 = 0$

$i_1 = 6A$

$V_2 = 6(6) = 36V$

$V_{th} = V_A = V_2 + 2(8) = \boxed{52\,V}$

Using the two methods indicated below, solve for the voltage labelled V_X



8 pts **Node** equations.

$$V_2: \frac{8-V_2}{1K} = \frac{V_2-5}{2K} + \frac{V_2-V_3}{3K}$$

$$V_3: \frac{8-V_3}{2K} + \frac{V_2-V_3}{3K} = \frac{V_3}{1K}$$

$$11V_2 - 2V_3 = 63$$
$$2V_2 - 11V_3 = -24$$
$$V_2 = 6.33\,V$$
$$V_3 = 3.33\,V$$
$$V_X = V_2 - V_3 = \boxed{3.00\,V}$$

8 pts **Mesh** equations.

$$\text{mesh } i_1: \; -8 + 1K(i_1 - i_2) + 2K(i_1 - i_3) + 5 = 0$$
$$\text{mesh } i_2: \; 2K\,i_2 + 3K(i_2 - i_3) + 1K(i_2 - i_1) = 0$$
$$\text{mesh } i_3: \; 1K\,i_3 - 5 + 2K(i_3 - i_1) + 3K(i_3 - i_2) = 0$$

$$30K\,i_1 - 10K\,i_2 - 20K\,i_3 = 3$$
$$-10K\,i_1 + 60K\,i_2 - 30K\,i_3 = 0$$
$$-20K\,i_1 - 30K\,i_2 + 60K\,i_3 = 5$$
$$i_1 = 4\,mA$$
$$i_2 = 2.333\,mA$$
$$i_3 = 3.333\,mA$$
$$V_X = (i_3 - i_2)\,3K = \boxed{3.00\,V}$$