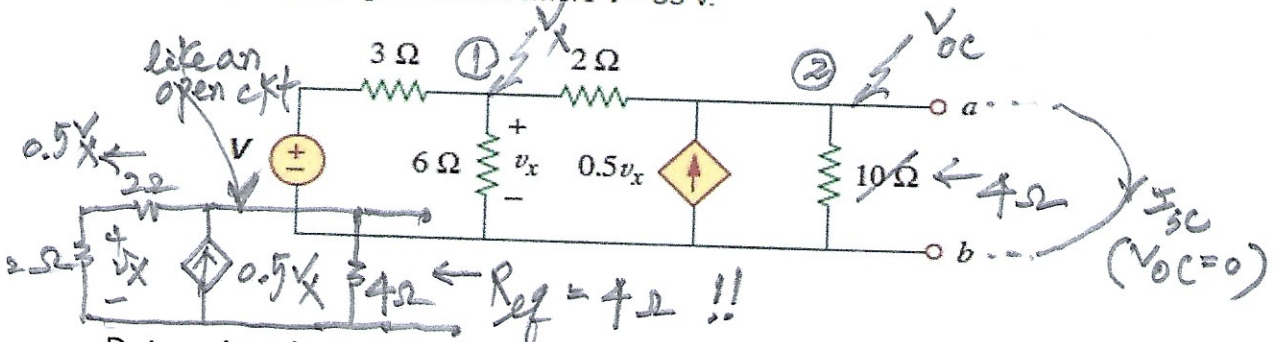
EE101 Quiz 4 February 5, 2018 solution

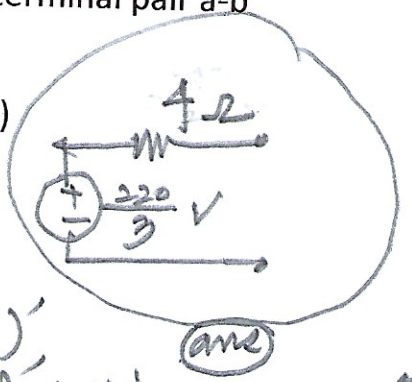
Name_____ ID_____

Consider the given circuit where $V = 55$ V.



Determine the maximum power that can be delivered to the terminal pair a-b when the 10 Ω resistor is replaced by 4 Ω resistor.

(i) First find a Thevenin's equivalent circuit (6 points)



KCL at ① $\frac{V-V_x}{3} = \frac{V_x}{6} + \frac{V_x - V_{oc}}{2}$ (1)

② $\frac{V_x - V_{oc}}{2} + 0.5V_x = \frac{V_{oc}}{4}$ (2)

(1)×6 → $2V - 2V_x = V_x + 3V_x - 3V_{oc}$ (1)'

(2)×4 → $2V_x - 2V_{oc} + 2V_x = V_{oc}$ (2)'

$$\begin{bmatrix} 6 & -3 \\ 4 & -3 \end{bmatrix}\begin{bmatrix} V_x \\ V_{oc} \end{bmatrix} = \begin{bmatrix} 2V \\ 0 \end{bmatrix} = \begin{bmatrix} 110 \\ 0 \end{bmatrix}$$

$$V_{oc} = \frac{\begin{vmatrix} 6 & 110 \\ 4 & 0 \end{vmatrix}}{\begin{vmatrix} 6 & -3 \\ 4 & -3 \end{vmatrix}} = \frac{0-440}{-18+12} = \boxed{\frac{220}{3}}$$

Next find I_{sc} between a and b : (set $V_{oc}=0$)

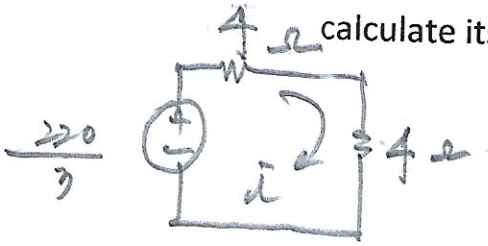
KCL Node ①, $2V - 2V_x = V_x + 3V_x - 0$ (3)

②, $\frac{V_x}{2} + 0.5V_x = I_{sc}$ (4)

From (3), $6V_x = 110$ or $V_x = 55/3$ & from (4), $V_x = I_{sc} = \frac{55}{3}$ [A]

$R_{eq} = V_{oc}/I_{sc} = (220/3)/(55/3) = 4\,\Omega$

(ii) By using the maximum power transfer theorem, find the load resistance value that can be connected to the a-b port, and calculate its maximum power (4 points)



$i = \left(\frac{220}{3}\right)/(4+4) = \frac{55}{6}$ [A]

$P_{R_L} = i^2 R_L = \left(\frac{55}{6}\right)^2 4 = \frac{3025}{36} 4$

$= \frac{3025}{9}$ W $= 336\frac{1}{9}$ W

ans