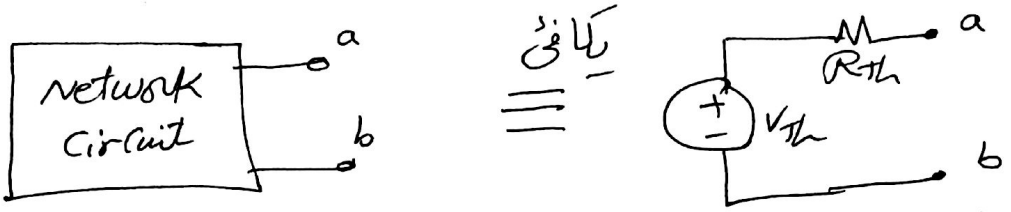
Lec (8)

4.10 , 4.11 **Thevenin and Norton Theorem**



There are (3) Methods to find equivalent Circuit of any Circuit to find I, or V, or P between (a b) terminals

method [1] [a] make O.C between a, b and calculate $V_{ab} = V_{Th}$

[b] " S.C " " " " I_{sc}

$\therefore R_{Th} = \frac{V_{th}}{I_{sc}}$

method (2) Source eleminations (independent sources only)

→ remove Voltage source (S.C)

→ " Current " (O.C)

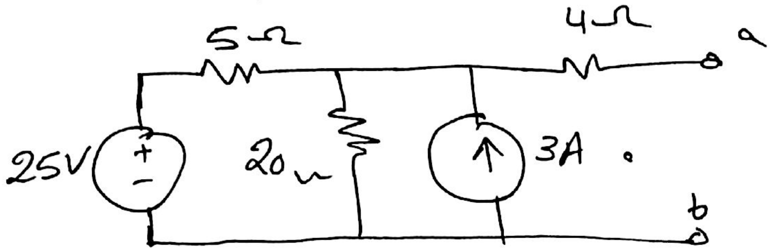
method (3) - assume Voltage source (V_{test}) & has a Current (I_{test})
- apply source elemination Too;

∴ then $V_{test} = V_{Th}$ & $R_{Th} = \frac{V_{test}}{I_{test}}$

Example (1)

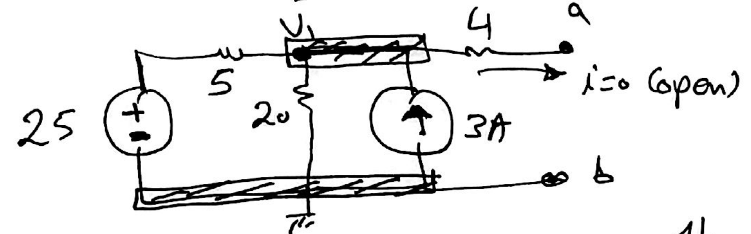
1- Find equivalent thevenin's

Solution



step(1) → First open circuit between a, b
→ Calculate $V_{ab} = V_{Th}$

We can use Node

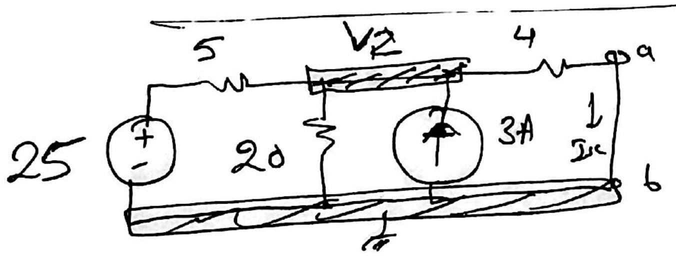


$$\frac{V_1 - 25}{5} + \frac{V_1}{20} - 3 = 0$$

$$\therefore V_1 = 32V$$

$V_1 = V_{ab}$ (والمقاومة 4 أوم ملهاش لزمة عشان open وهشيلها)

step(2) make short circuit between a, b to find I_{sc}



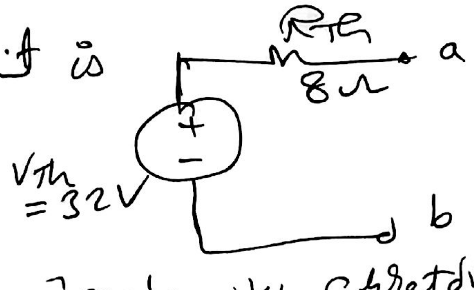
$$\frac{V_2 - 25}{5} + \frac{V_2}{20} - 3 + \frac{V_2}{4} = 0$$

$$\therefore V_2 = 16V$$

$$I_{sc} = \frac{V_2}{4} = 4A$$

$$R_{th} = \frac{V_{th}}{I_x} = \frac{32}{4} = 8\,\Omega$$

∴ equivalent circuit is

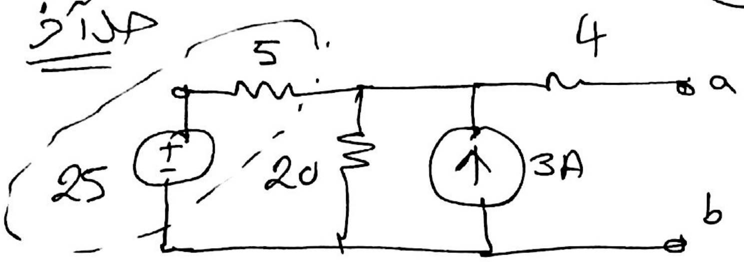


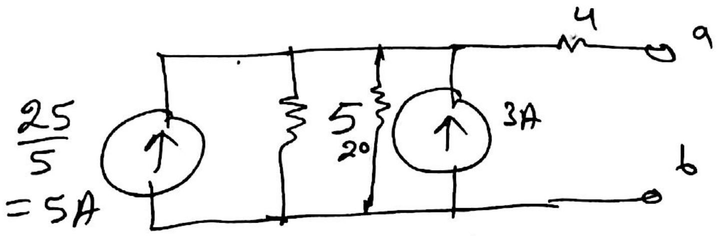
و ممكن استخدام current divider بدل node ف step 2 كحل تاني

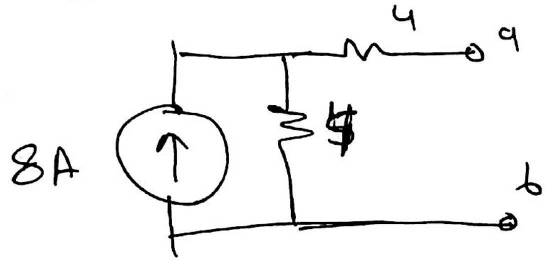
We can Re-answer the Previous Problem using source transformation

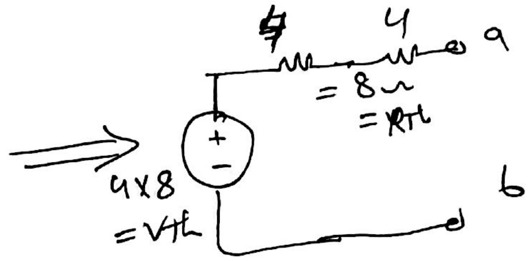
حل آخر

A ممكن الوصول للشكل Thevenin's اختصار من الدائرة عن طريق source Transformation









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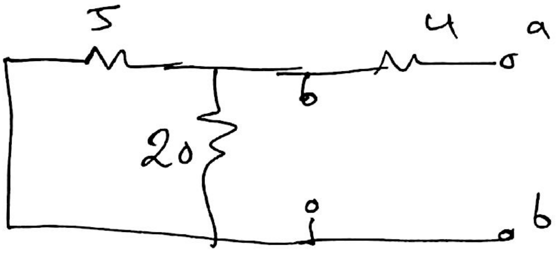
method ② source elemination (لحساب Rth فقط أما Vth فنجيبه بأي طريقة عادية)

let Voltage source SC
current " OC



القاومات المشافة بين a & b هي Rth

$5 // 20 + 4 = R_{th}$

$R_{th} = 8\,\Omega$

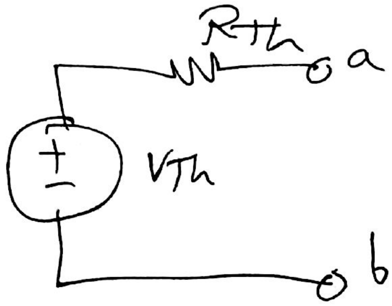
أما Vth فهي 32V حسبناها بأي طريقة عادية

الطريقة الثالثة Itest & Vtest مش هستخدمها

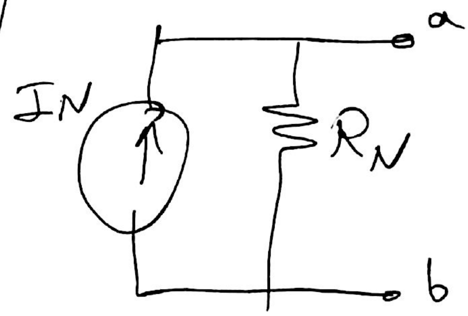
(مش مطالب بيها في الامتحان)

2- Norton equivalent

Thevenin's

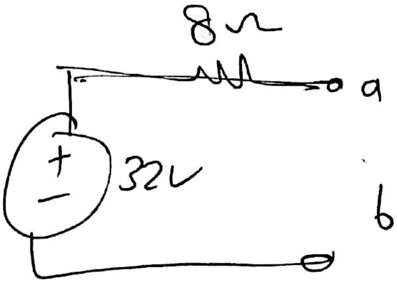


Norton



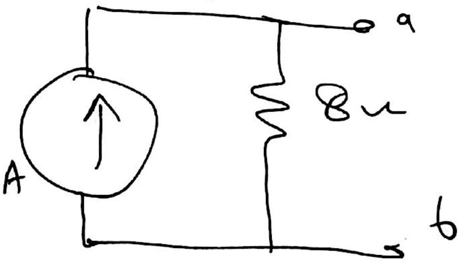
$R_{Th} = R_N$

$I_N = I_{SC}$ or $\frac{V_{Th}}{R_{Th} = R_N}$



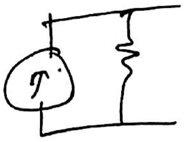
في المسألة الحالية موصلة لـ Thevenin's :

Norton



$\frac{32}{8} = 4A$

و دخول الحالة N مع موصل



صدر الكهرباء كما عادة إلى معه

Source Transformation

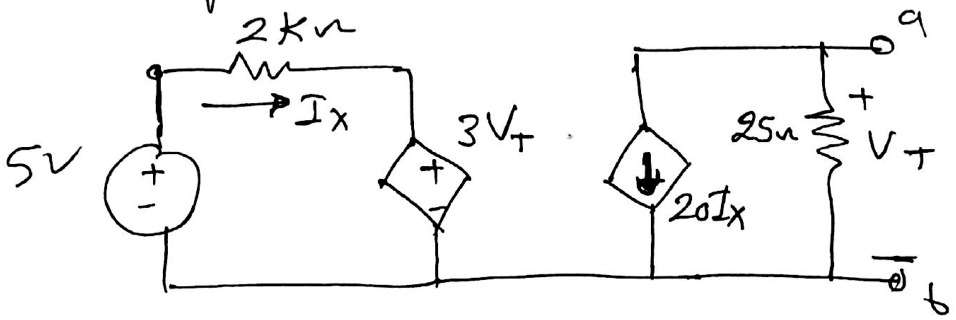
Example (2)

(if there is dependant source)

لاحظ لو مفيش أي independent source فأصبح الدائرة

∴ $V_{Th} = 0$

ومش نقدر R_{Th}



Find Thevenin's equivalent & Norton's equivalent

Step (1)

$* \; V_{Th} = V_{ab} = V_T = V_{25\Omega}$

(التيار لأسفل)

$V_T = (25)(-20I_x) = -500 I_x$

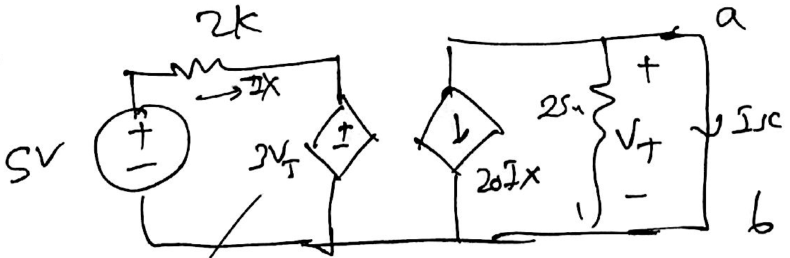
But $I_x = \dfrac{5 - 3V_T}{2K}$ ~~or 2000 Ix = 5 - 3VT~~

$\therefore \; V_T = -500\left[\dfrac{5-3V_T}{2K}\right] = -500\left[\dfrac{5-3V_T}{2000}\right]$

$V_T = -\dfrac{5}{4} + \dfrac{3}{4}V_T$ or $\dfrac{1}{4}V_T = -\dfrac{5}{4}$ or $\boxed{V_T = -5V}$

$\therefore \; V_{Th} = -5V$

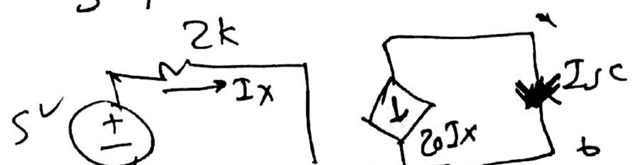
Step (2)



ال SC يلغي المقاومة 25 وبالتالي تصبح سلكها كأنه وبالتالي VT = صفر

$\because 25\Omega \parallel SC \;\therefore\; V_T = 0V$

$\therefore \; 3V_T = 0$ also



$I_x = \dfrac{5}{2K}$

$I_{SC} = -20 I_x$

عشان 20Ix عكس اتجاه I_{sc}

$I_{SC} = -20\left[\dfrac{5}{2000}\right] = -0.05A$

$\therefore R_{Th} = V_{Th}/I_{SC} = \dfrac{-5}{-0.05} = 100\Omega$