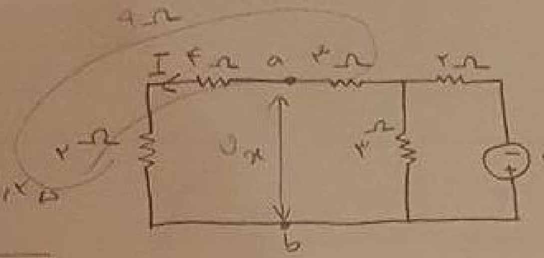
سؤال ۶

قضیه‌ی برهم‌نهی

$\frac{9\times 3}{9+3} = 2.25$

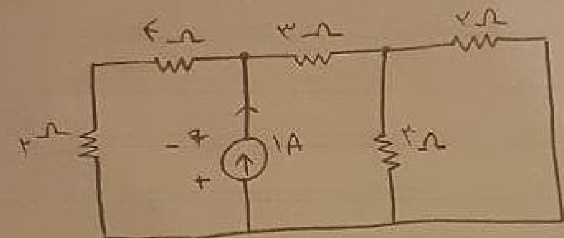
$R' = 2.25 + 2 = 4.25$

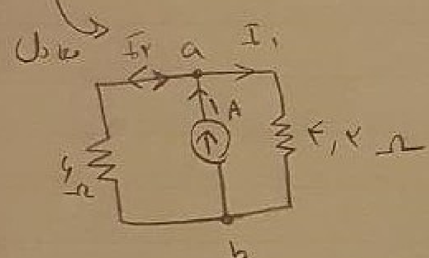


$I = \frac{12}{\frac{17}{4}} = \boxed{\frac{48}{17}}$

$I = \frac{48}{17} \times \frac{1}{4} = \frac{12}{17}$

$v_x = v_b - v_a = v_a + 4\times\frac{12}{17} + 2\times\frac{12}{17} - v_a = \boxed{\frac{72}{17}}\ v_1$



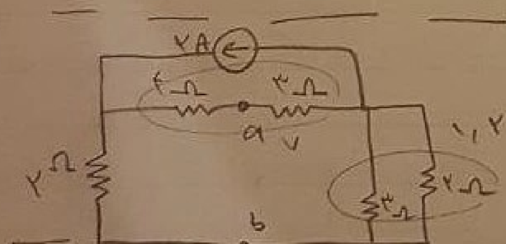


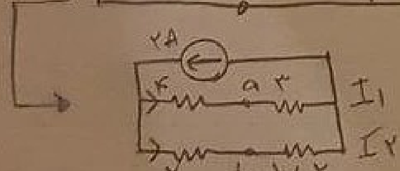
$I_1 + I_2 = 1A$

$6\times I_2 = \frac{4.2}{0.7}\times I_1$

$\rightarrow 1.7 I_1 = 1 \rightarrow I_1 = \frac{10}{17}$

$v_b - v_a = v_a - \frac{10}{17}\times 4.2 - v_a = \boxed{\frac{-42}{17}}\ v_2$





$I_1 + I_2 = 2A \rightarrow \frac{102}{70} I_2 = 2$

$7 I_1 = 3.2 I_2$ $\quad I_2 = \frac{70}{51}$

$\rightarrow I_1 = \frac{32}{70} I_2$ $\quad I_1 = \frac{32}{51}$

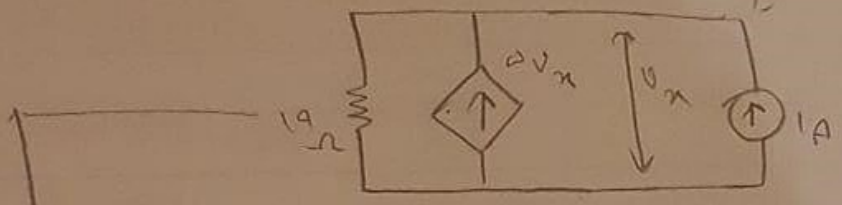
$v_b - v_a = v_a + \frac{32}{51}\times 4 - \frac{70}{51}\times 2 - v_a$

$= \frac{-12}{51} = \frac{-4}{17}\ v_3$

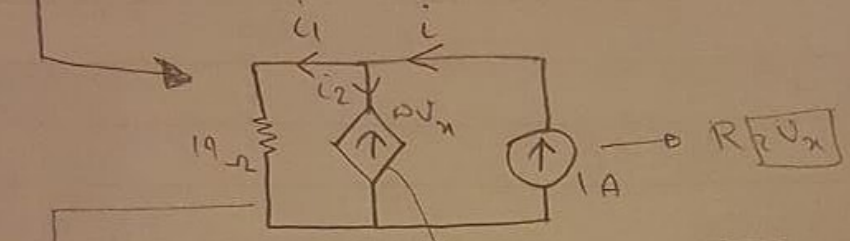
$v = v_1 + v_2 + v_3 = \frac{72 - 42 - 4}{17} = \boxed{\frac{26}{17}\ v}$

سؤال ①

منبع مستقل را صفر می‌کنیم:



سر یک منبع جریان ۱A را فعلاً باز می‌گذاریم:



$$R_{\text{منبع}} = \frac{V_x}{5V_x} = \frac{1}{5}$$

$$i_2 = 5V_x$$

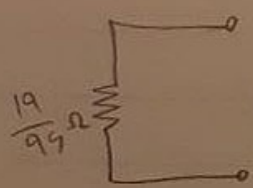
$$i_1 = \frac{V_x}{19}$$

$$i_1 + i_2 = 1A \rightarrow 5V_x + \frac{V_x}{19} = 1A$$

$$V_x = \frac{19}{94}\,V$$

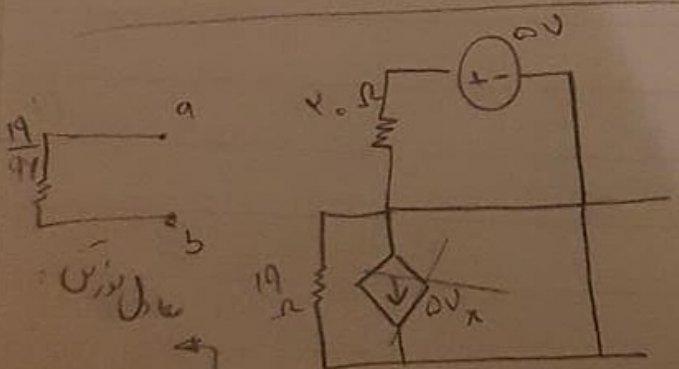
$$R_{th} = \frac{V_x}{1A} = \frac{19}{94}\,\Omega$$

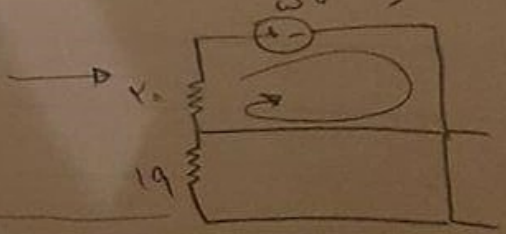
منبع مستقل نیست ← $V_{oc} = 0$



اتصال کوتاه a و b ←

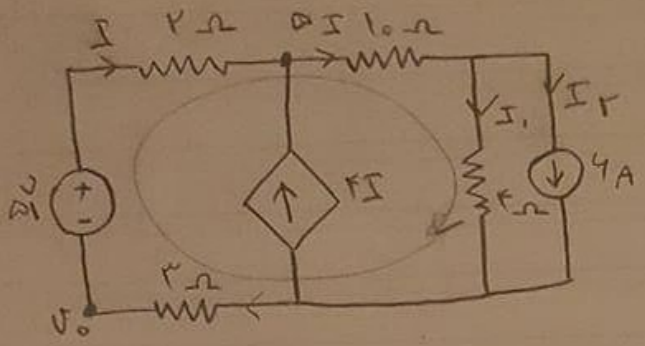
جریان می‌تواند از مسیر بدون مقاومت رد شود.





i_{ab} ناچون

سوال (۲)



$I_1 + I_2 = 2I$

$I_1 = 2I - 4$

حلقه: $V_0 + 5I - 2I - 10 \times 5I - (5I - 4) \times 4 - I \times 3 = V_0$

$-2I - 50I - 20I - 3I + 5I + 24 = 0$

$-75I = -75 \longrightarrow I = 1A$

توان صای منابع:

منبع وابسته ۵ ولت: $P = VI = 1 \times 5 = 5 \text{ wat}$

حلقه منبع جریان وابسته: $V_0 + 5I - 2 \times 1 + 4 \times R_{منبع} - 3 \times 1 = V_0$

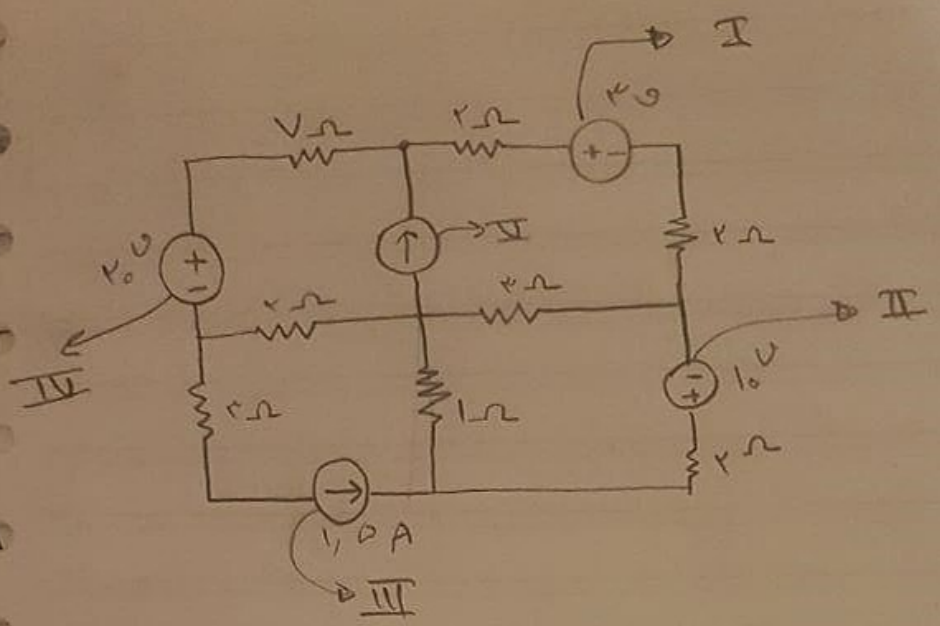
$R_{منبع} = \frac{4}{4}$ $\quad P = RI^2 = \frac{4}{4} \times 4^2 = 16 \text{ wat}$

منبع جریان مستقل: حلقه: $V_0 + 5I - 2 \times 1 - 10 \times 5 - V_{منبع} - 3 \times 1 = V_0$

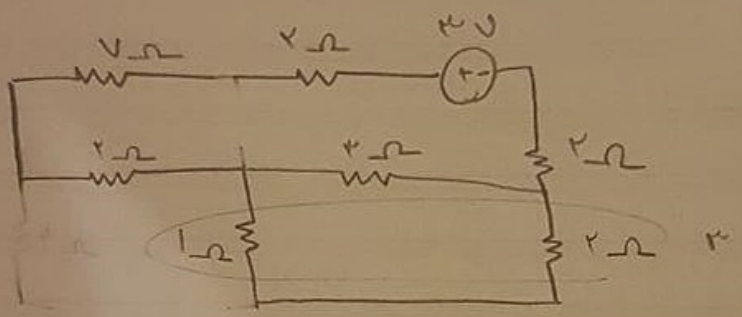
$V_{منبع} = -4 \longrightarrow P = VI = -24 \text{ wat}$

منبع در حال شارژ

سوال ۴

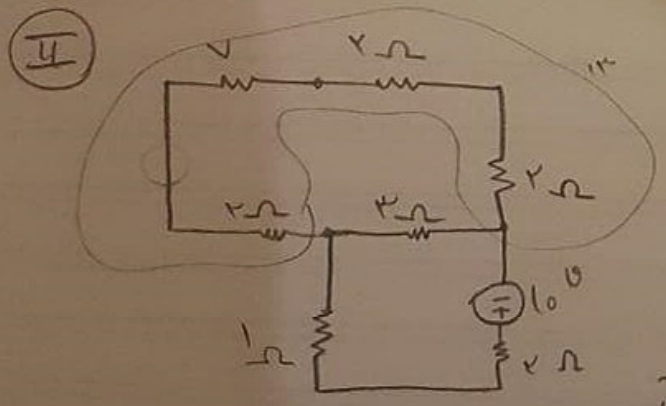


قضیه ی برهم نهی



$$R = (3+4) + 2 + 7 + 2 + 1,5 = 14,5 = \frac{29}{2}$$

$$I = \frac{3}{\frac{29}{2}} = \frac{6}{29}$$ چپ به راست



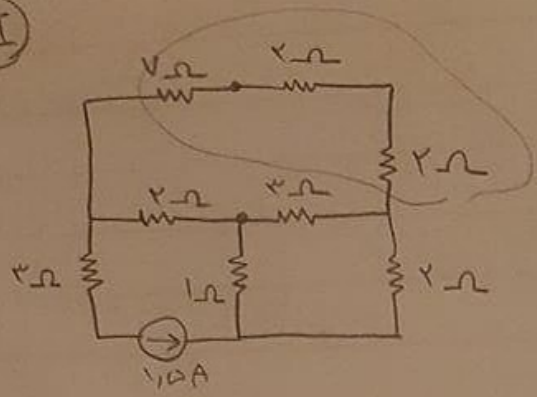
$$\frac{14+6}{14+6} = \frac{29}{14}$$

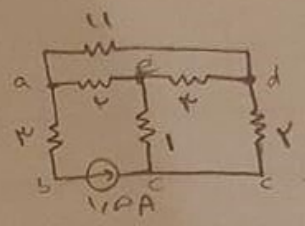
$$R_{کل} = \frac{29}{14} + 1 + 2 = \frac{87}{14}$$

$$I_{کل} = \frac{10}{\frac{87}{14}} = \frac{140}{87}$$

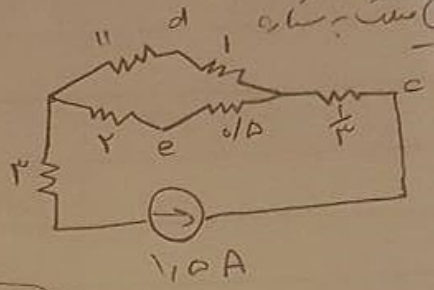
$$I_{2\Omega} = \frac{140}{87} \times \frac{3}{14} = \frac{30}{29}$$ راست به چپ

III



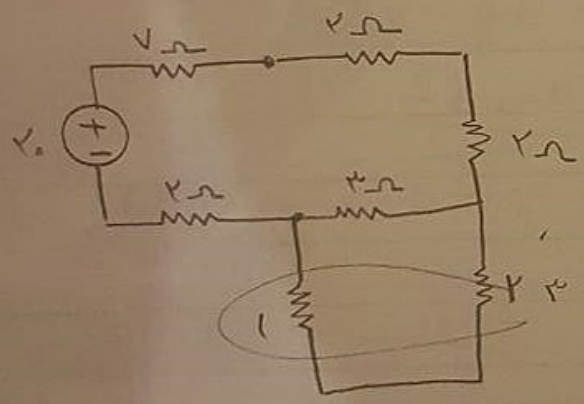


تبدیل مثلث به ستاره



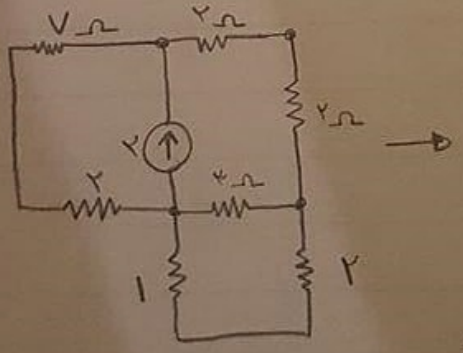
$$I_{\text{خواسته شده}} = \frac{۱۲}{۱۴٫۵} \times ۱٫۵A = \frac{-۳۶}{۲۹} A$$ ← درجهت راست به چپ

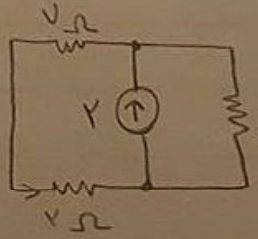
IV



$$I_{\text{خواسته شده}} = \frac{-۲۵}{۲۹}$$ ← راست به چپ

V



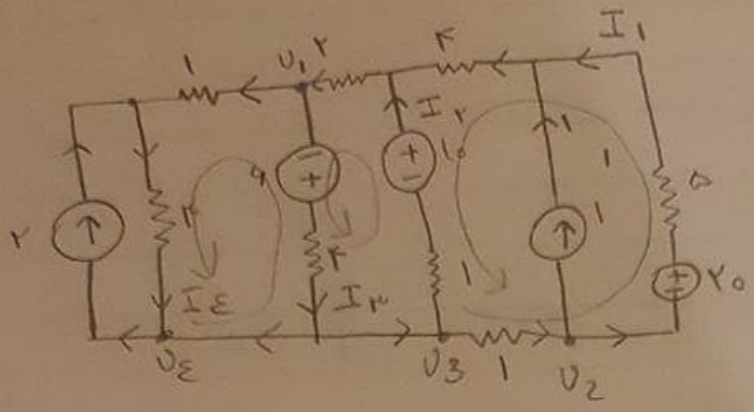


$$I_{\text{خواسته شده}} = \frac{۱٫۵}{۱۴٫۵} \times ۲A = \frac{۲۲}{۲۹} A$$

$$I_{\text{کل}} = \sum i = \frac{۶۰ - ۳۶ - ۲۰ + ۲۲}{۲۹} = -۲A$$

یعنی ۲ آمپر درجهت راست به چپ

سوال ۴



$$+۲۰ - ۵\times I_1 - ۴\times(I_1+I_3) - ۱۰ + ۱\times I_2 - ۱\times(I_1+I_3) = ۰$$

$$-۵\times I_1 - ۴\times I_1 - I_1 + I_2 + ۲۰ - ۴ - ۱ - ۱۰ = ۰$$

$$\boxed{۱۰ I_1 - I_2 = ۵}$$

$$-۱\times I_2 + ۲\times(I_1+I_2+I_3) + ۷ - ۴\times I_4$$

$$-I_2 - ۲I_2 - ۲I_1 - ۴I_4 + ۱۰ - ۲ + ۷ = ۰$$

$$\boxed{۳I_2 + ۲I_1 + ۴I_4 = ۱۴}$$

$$-۲\times I_4 + ۴\times I_4 - ۷ - ۱\times(I_1 + I_2 - I_4) = ۰$$

$$\boxed{I_1 + I_2 - ۵I_4 + ۳I_3 = -۷}$$

$$I_1 + ۱ + I_2 - I_4 - I_3 + ۲۰$$

$$\boxed{I_1 + I_2 - I_4 - I_3 = -۳}$$

$$I_4 = \frac{۱۷۹}{۱۰۸} = ۱,۶۶$$

$$\boxed{I_2 = 3.025}$$

$$I_4 = ۲,۶۶$$

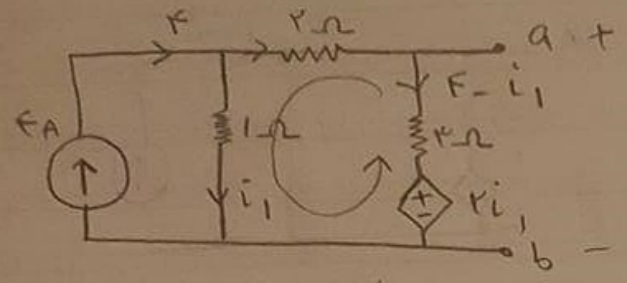
$$I_2 = ۰/۷۲$$

اگر V_4 را زمین بگیریم، $V_2 = V_3 - ۱\times(۱+۳,۰۲۵)$، $V_4 = V_3 = ۲۰$،

$V_1 = ۰ + ۴\times ۲,۶۶$ ، $= -۴,۰۲۵$

$= ۴,۶۴$

سؤال ⑤



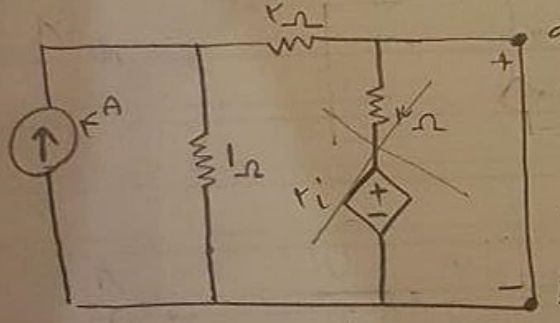
حلقه : $-1\times i_1 + 2i_1 + 3\times(4-i_1) + 2\times(4-i_1) = 0$

$-i_1 + 2i_1 - 3i_1 - 2i_1 + 12 + 8 = 0$

$-4i_1 = -20 \rightarrow i_1 = 5\,A$

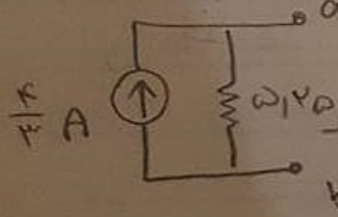
$v_{oc} = v_a - v_b = +3(4-i_1) + 2i_1$

$= +12 + 3\times5 + 2\times5 = \boxed{+27\,v}$

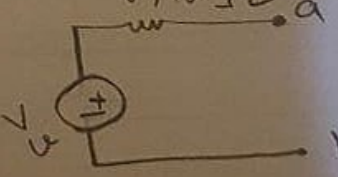


$\rightarrow i_{sc} = 4\times\frac{1}{4} = \boxed{\frac{4}{3}}$

$R_{th} = \frac{v}{\frac{4}{3}} = \frac{21}{4} = \boxed{5{,}25\,\Omega}$



نورتن



تونن