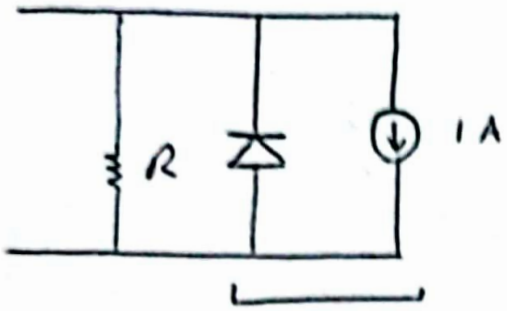
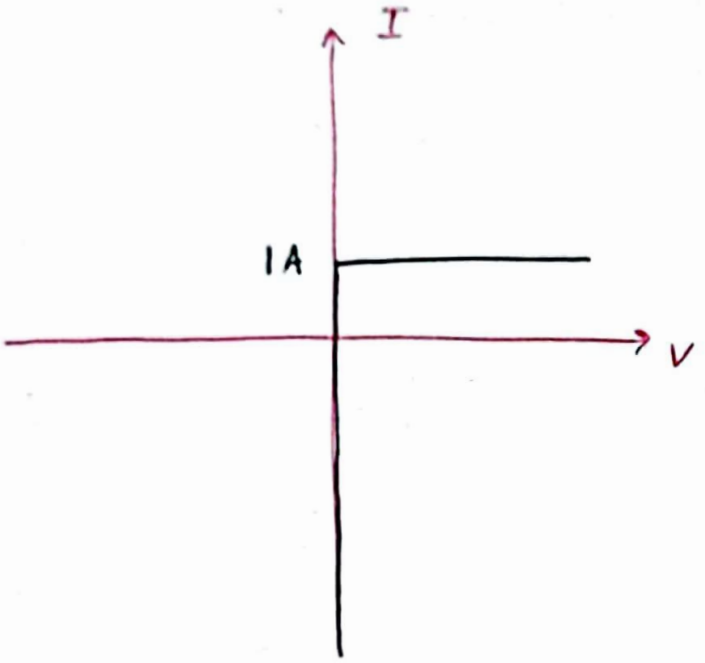
پاسخنامه‌ی تمرین سری ۳:

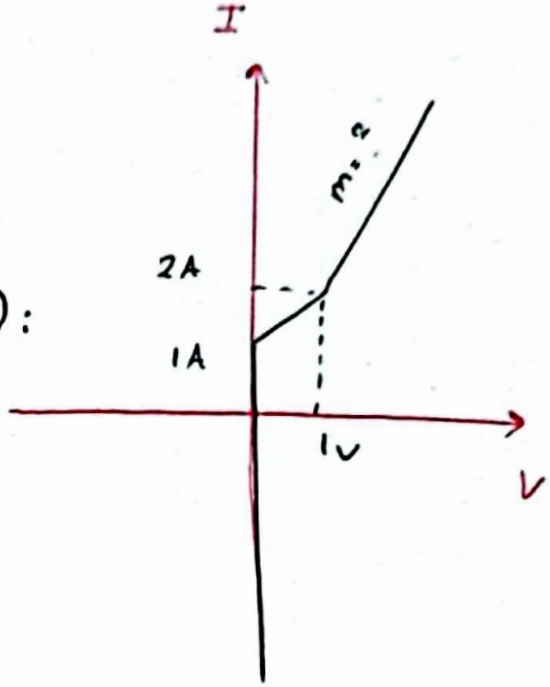
سوال اول:

①

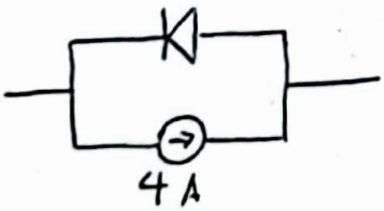


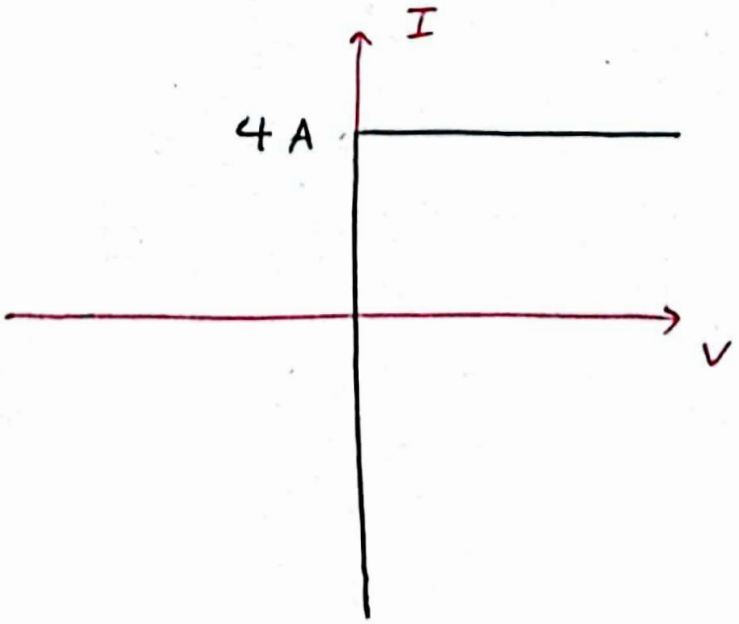


⇒ ①:



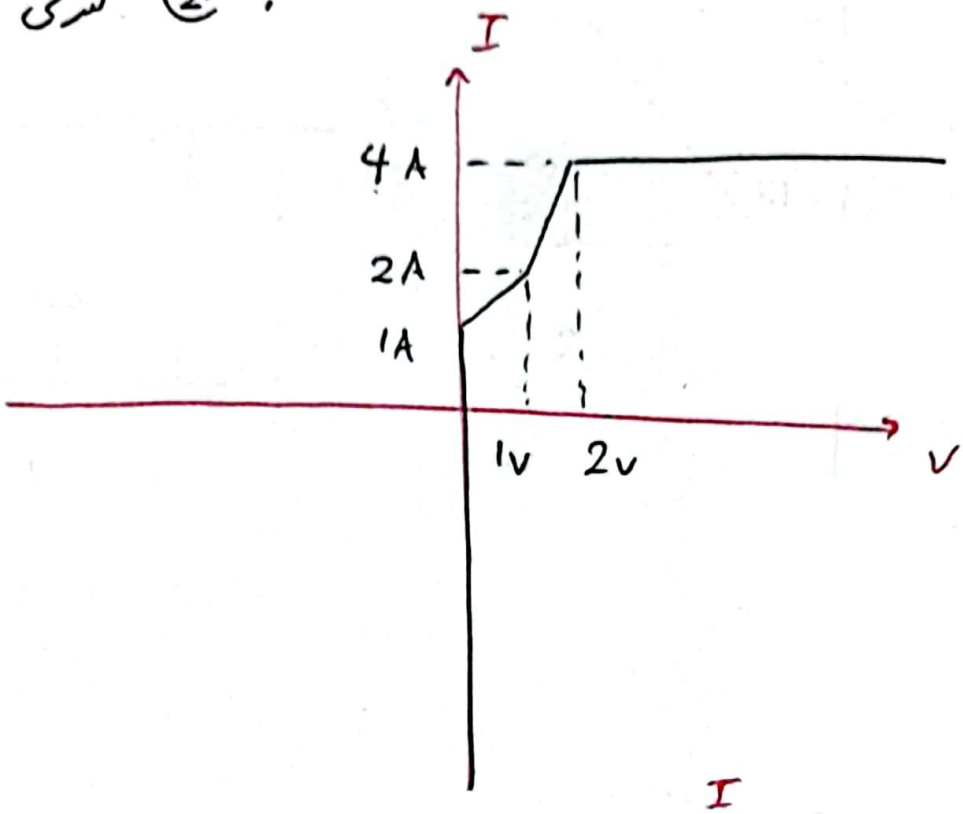
②





⇒

③ : ① سری ② :



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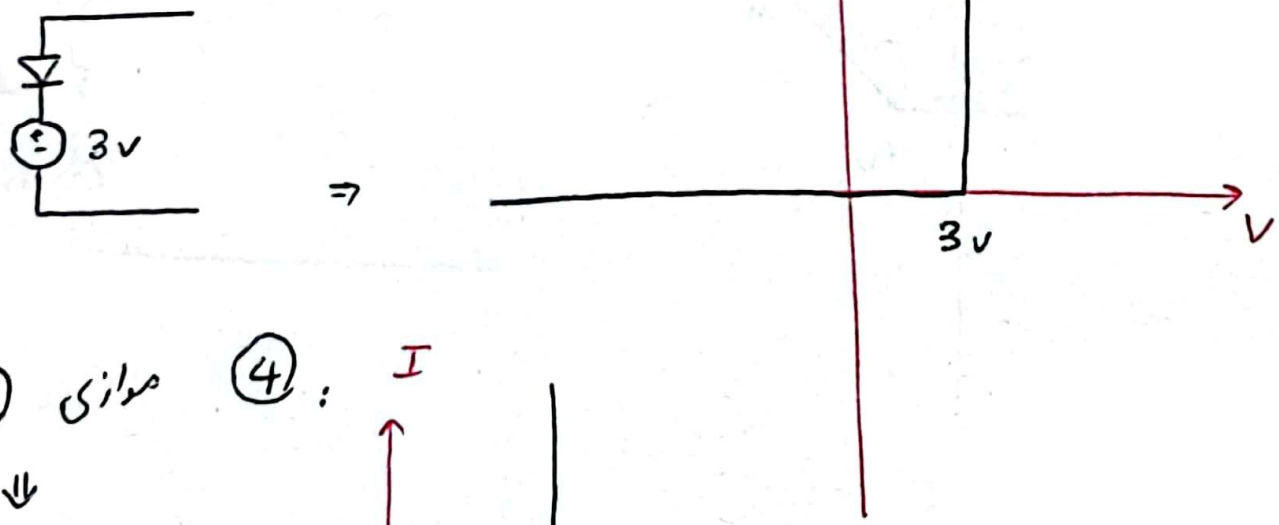
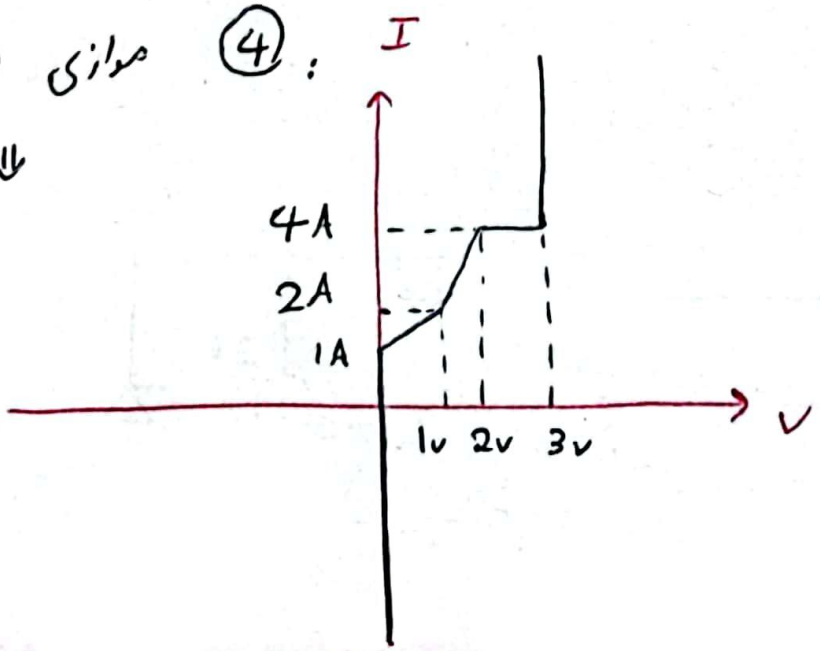


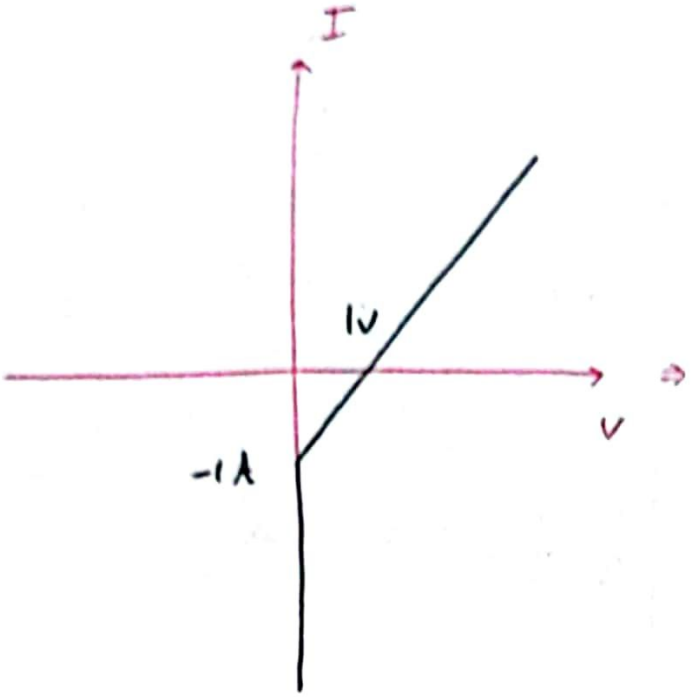
⇒ ③ موازی ④ :

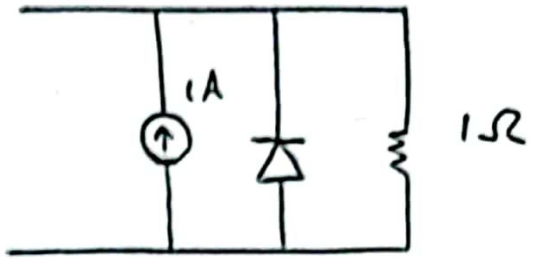
⇓



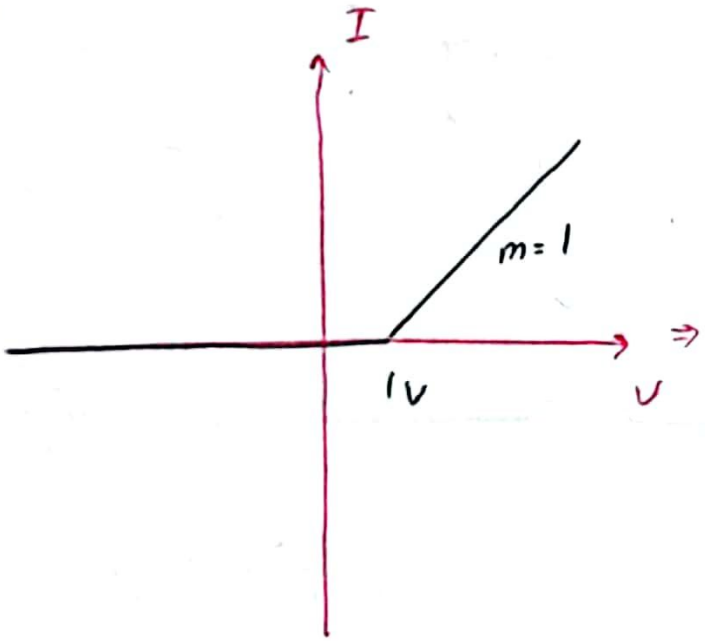
سوال ۳ :

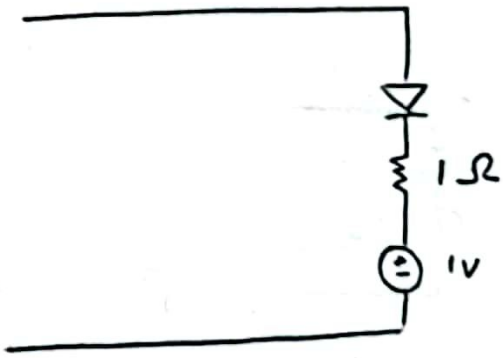
①



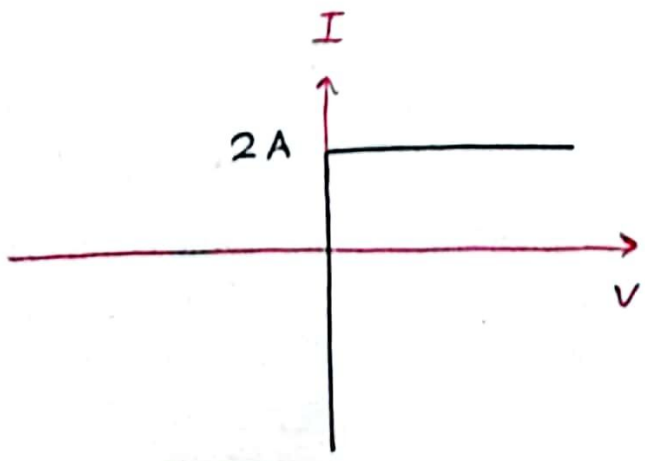


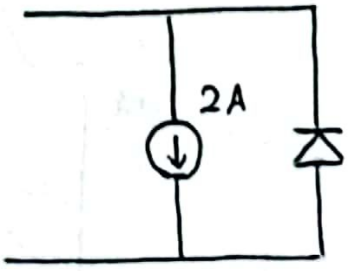
②



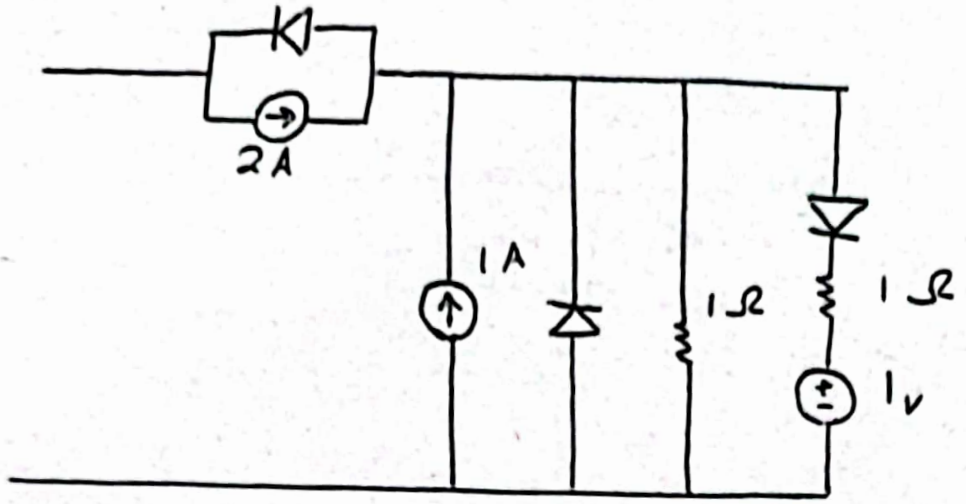


③





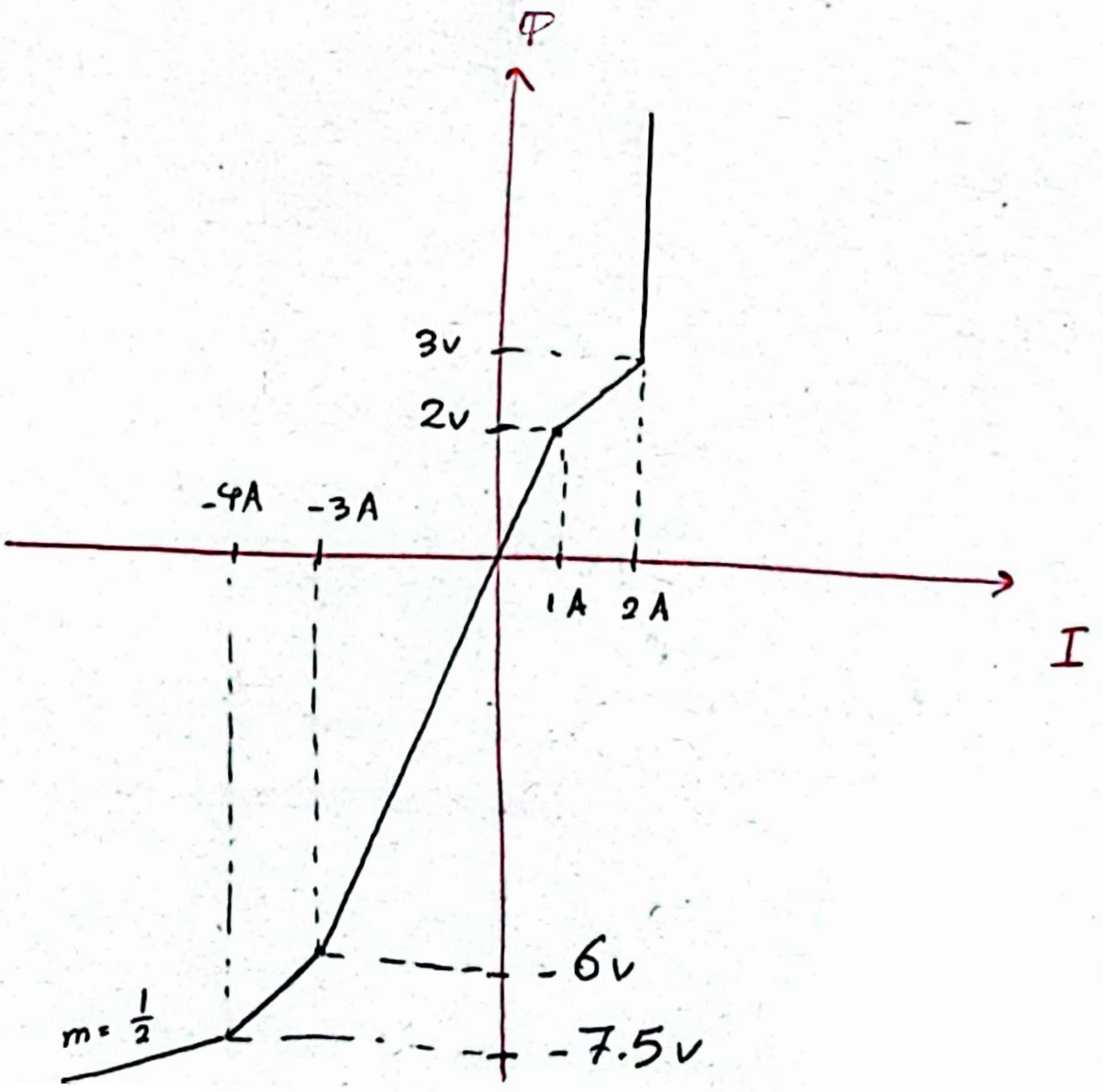
پاسخ نهایی : (① موازی ② سری ③)



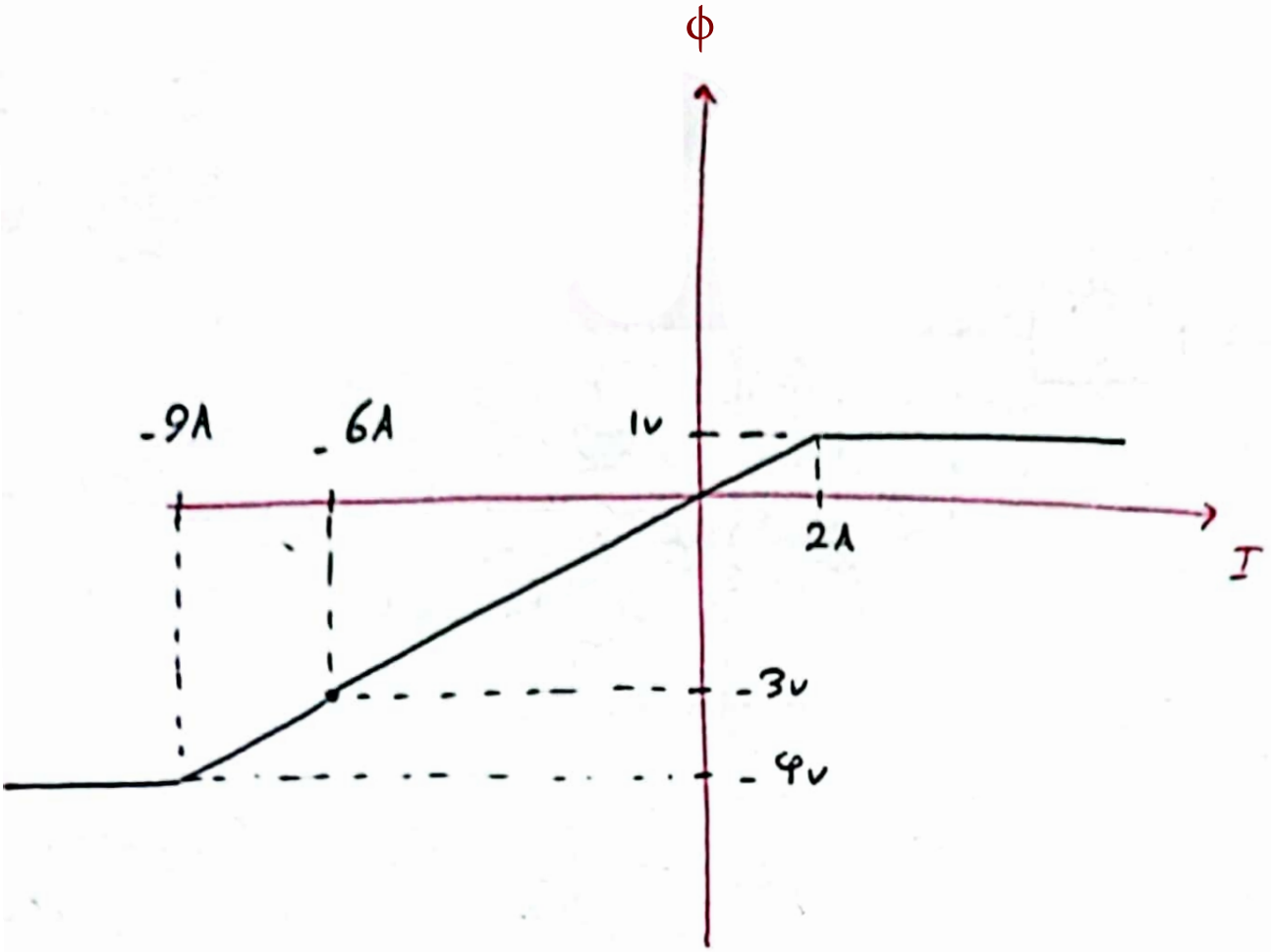
سوال سوم :

الف)

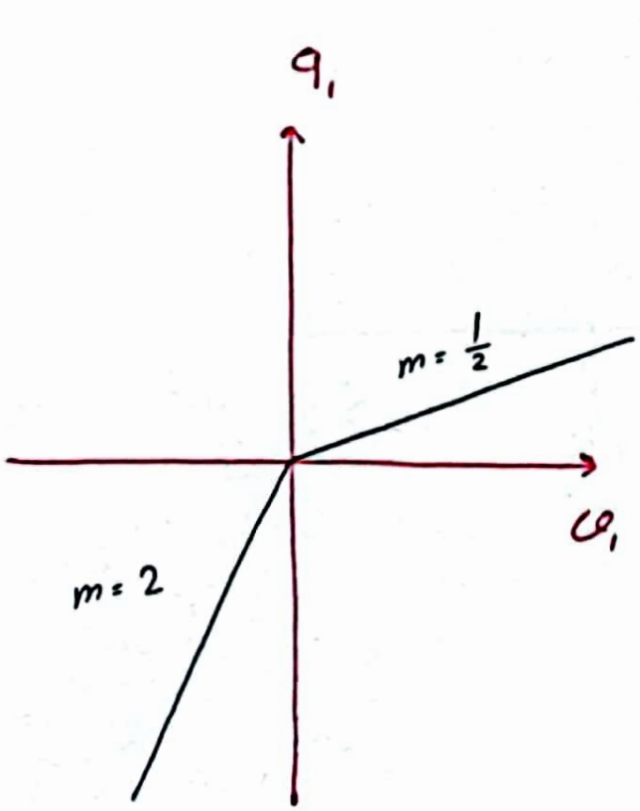
سری :

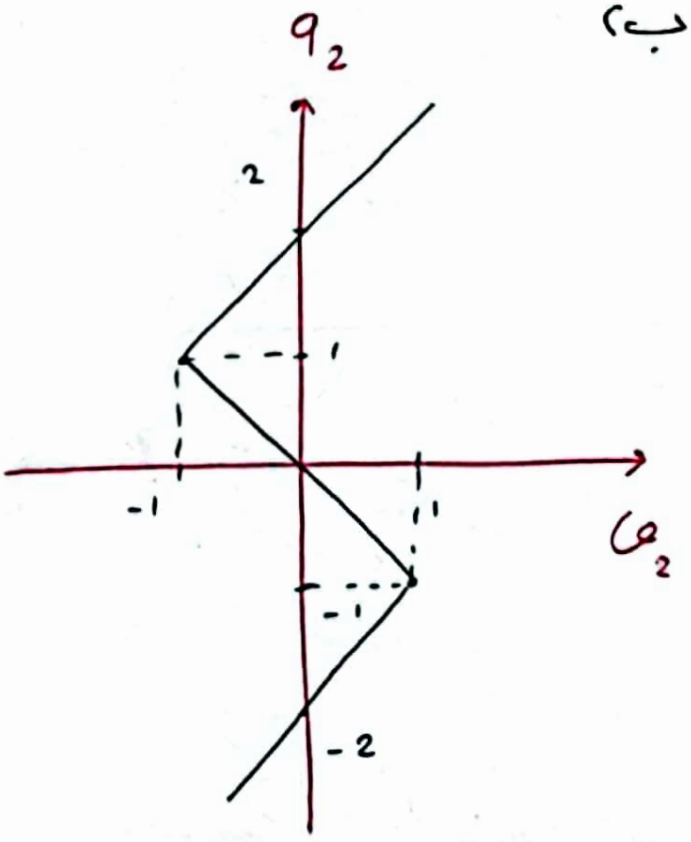


حدازی :

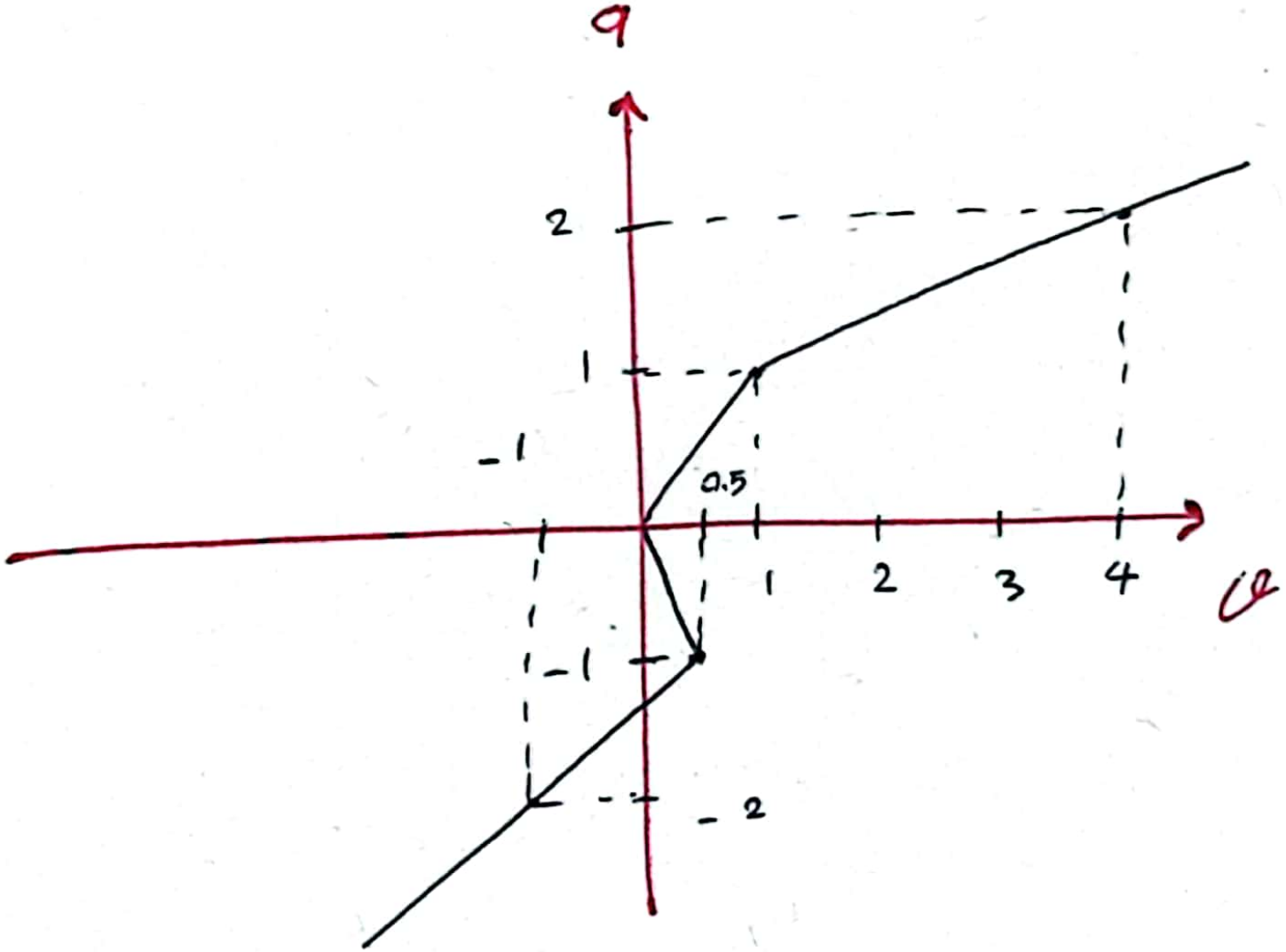


ب)

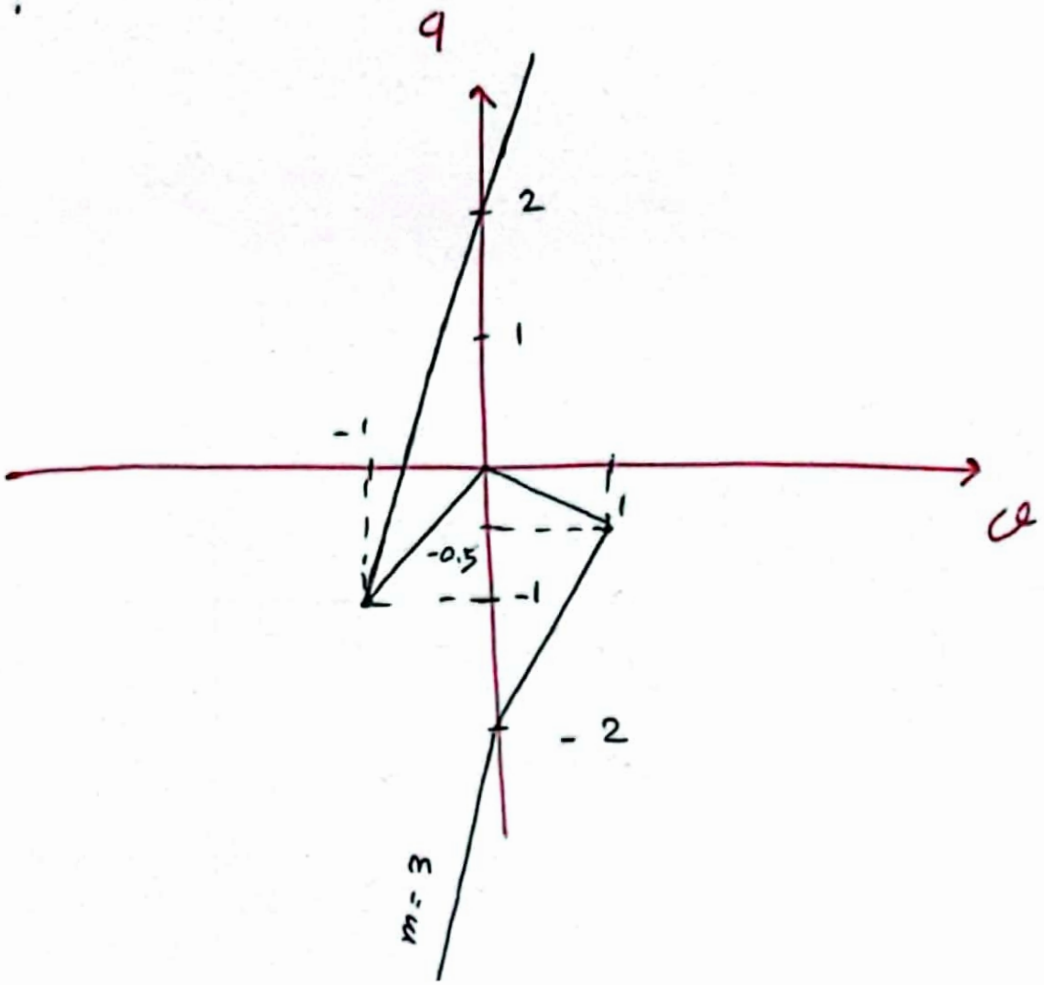




سری :

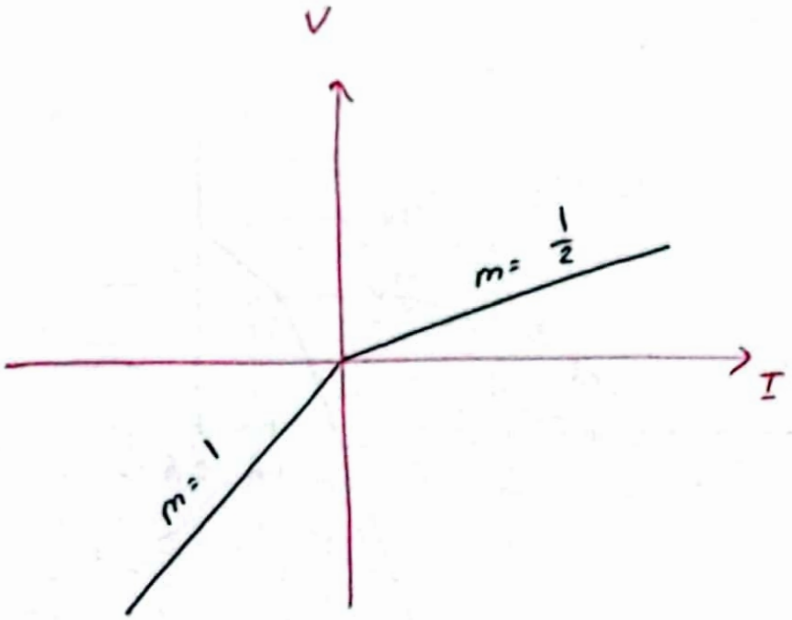


موازی :

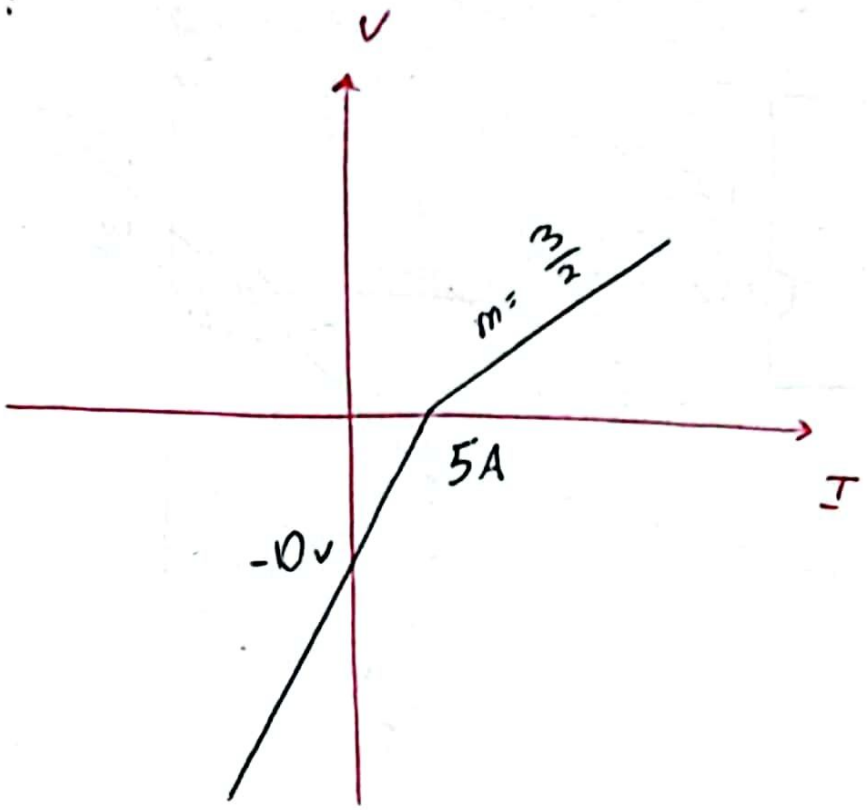


مثال چهارم :

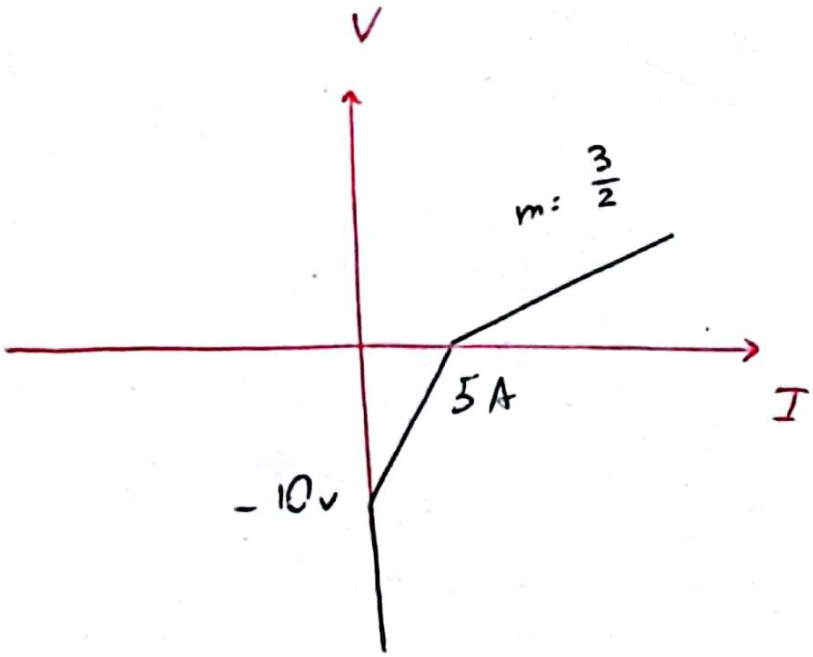
یک نقطه که شرط خواسته شده ی مسئله را بر طرف می کند :



① موازی با مقاومت و منبع جریان :

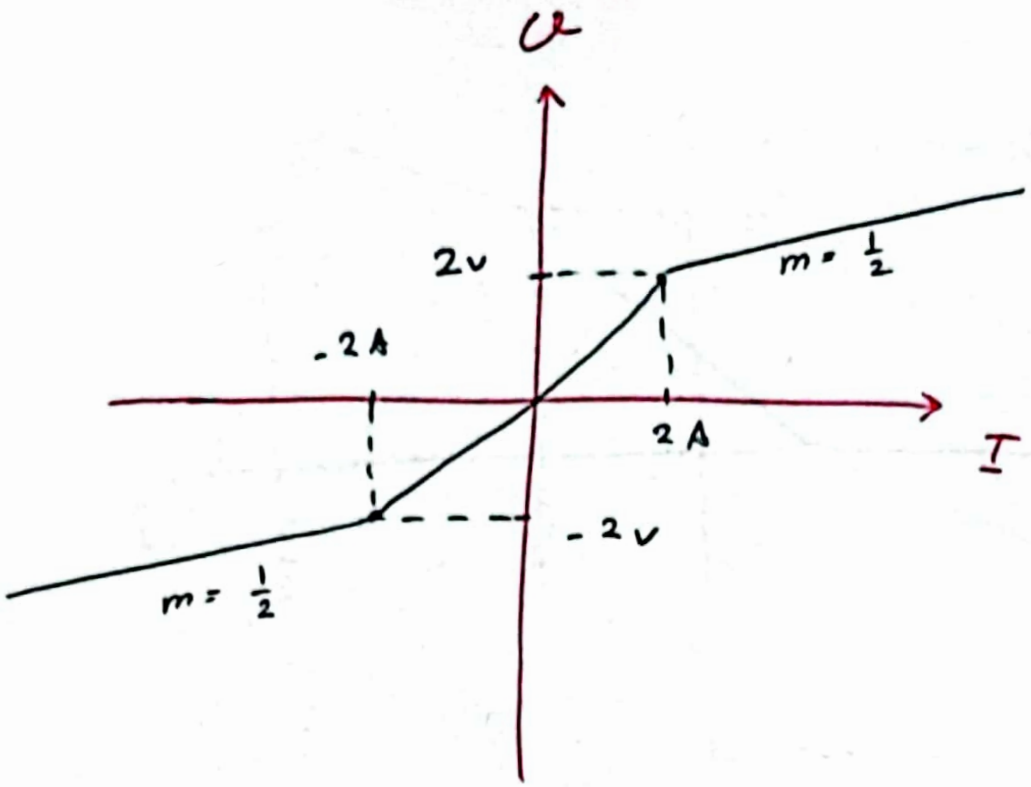


⇒ مشخصه‌ی نهایی :



سوال پنجم:

الف)

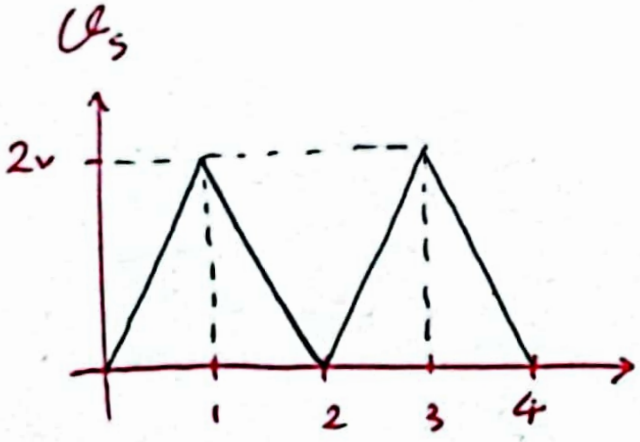


ب)

$v_s = 5v \xrightarrow{\text{طبق نمودار}} 5 = 2 + (I - 2) \times \frac{1}{2}$

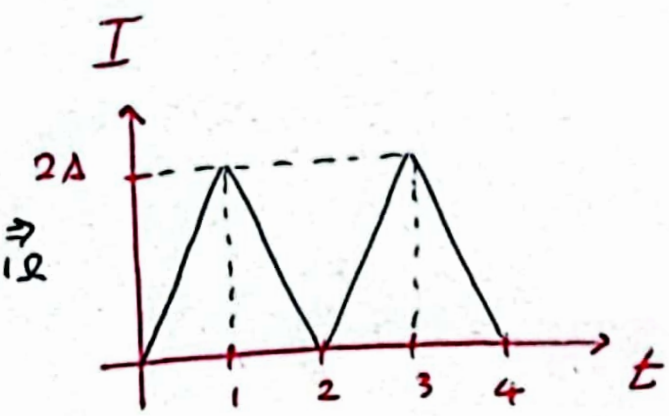
$\Rightarrow 6 = I - 2 \Rightarrow I = 8A$

ب)



طبق نمودار قسمت الف داریم:

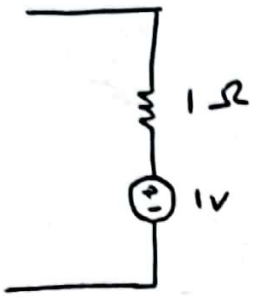
$-2v \leq v \leq 2v \Rightarrow v_{(t)} = I_{(t)} \times 1\Omega \Rightarrow$

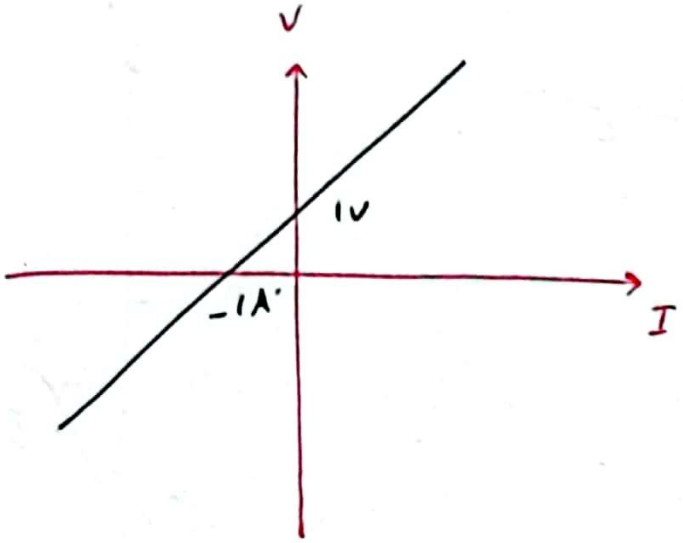


سوال ششم،

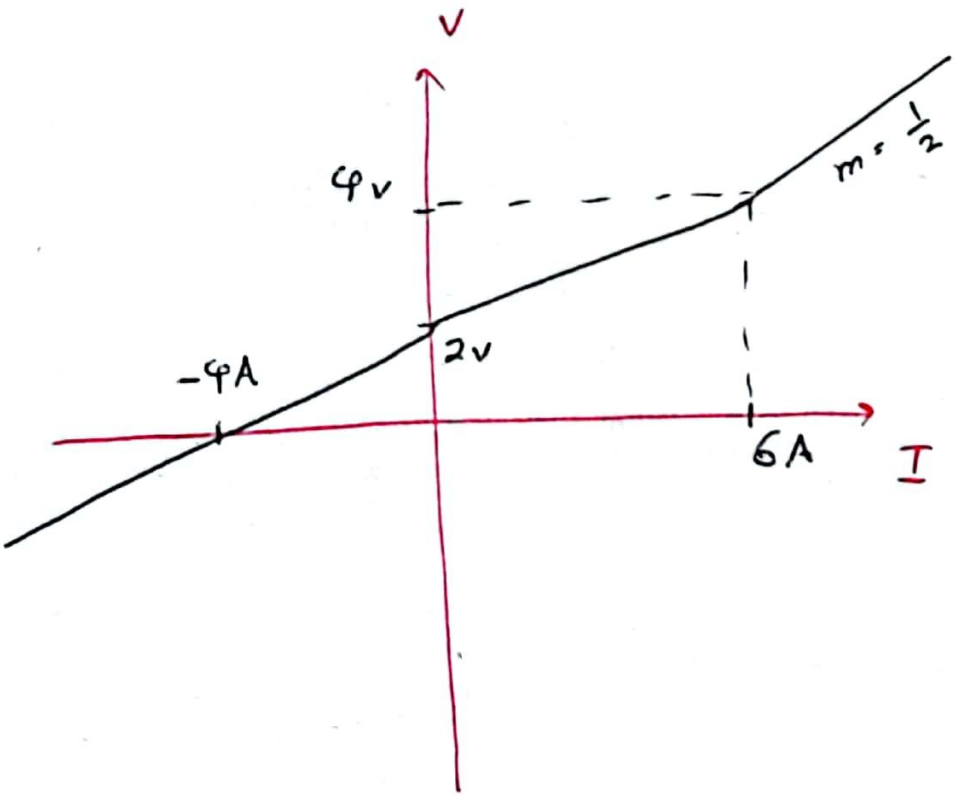
الف)

①



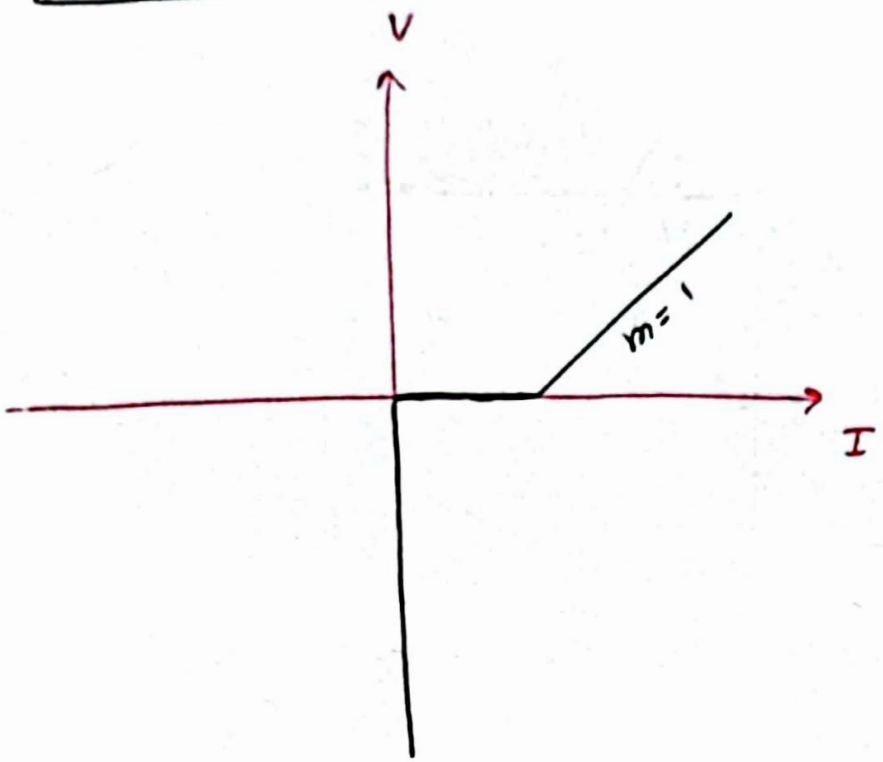


⇒

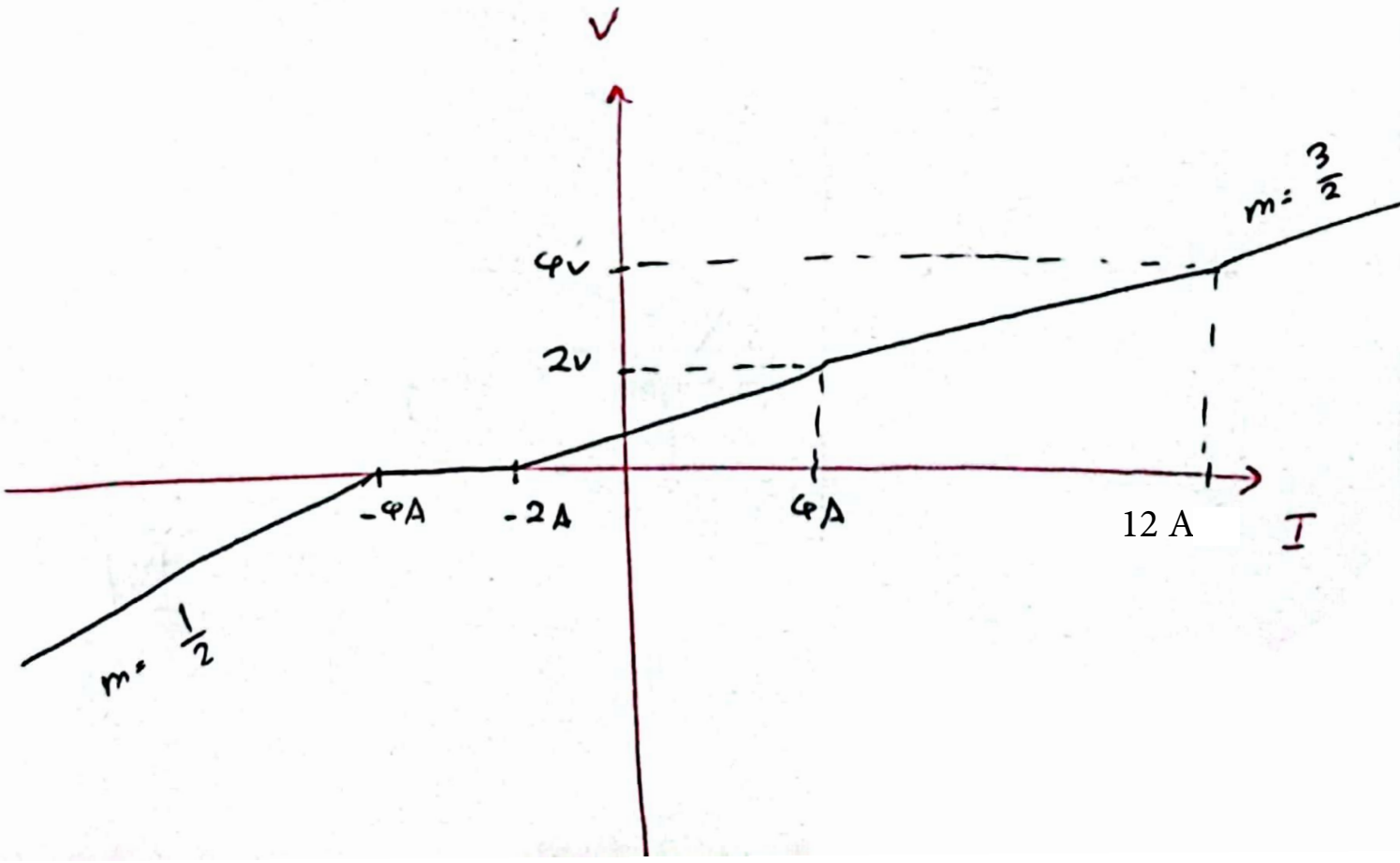


(ب)

①

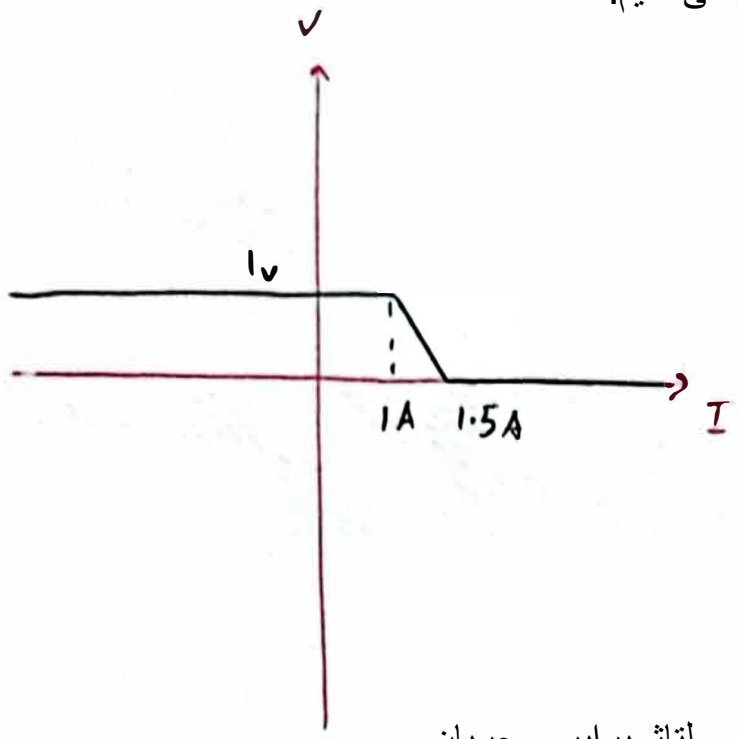


⇒



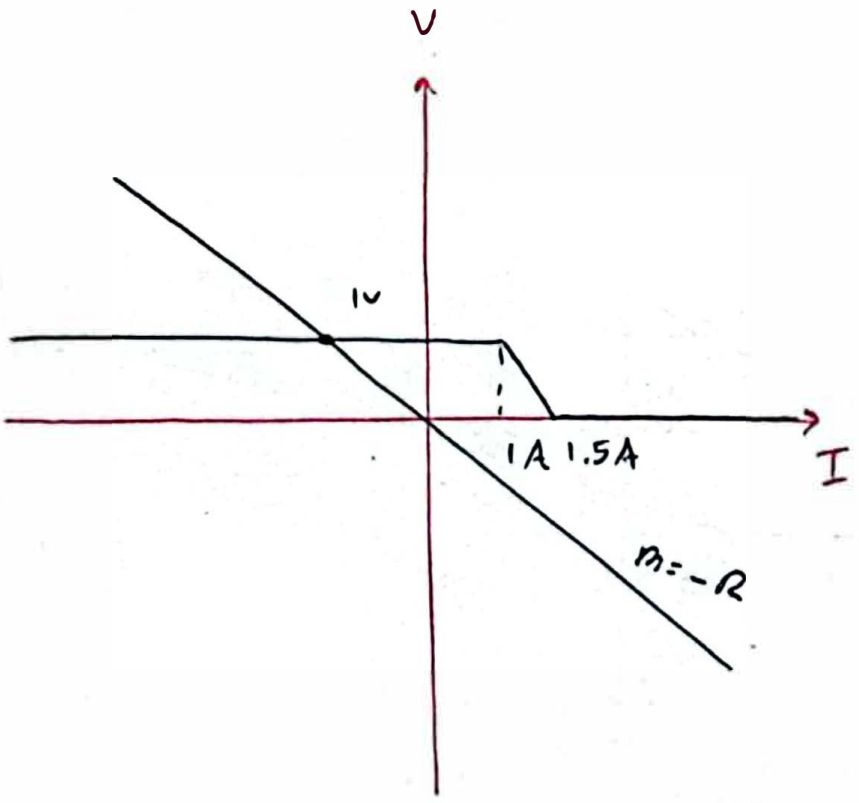
سوال هفتم:

ابتدا دو سیستم داده شده را باهم موازی می کنیم:



حال یک سیستم و یک مقاومت داریم که دارای ولتاژ برابر و جریان های عکس هم هستند. پس در مشخصه ی مقاومت جریان را عکس کرده و دو مشخصه را باهم رسم میکنیم. نقطه ی تداخل دو مشخصه ولتاژ خواسته شده را نتیجه می دهد

با فرض پسیو بودن R :



$\Rightarrow V = \underline{|v|}$

سوال هشتم:

الف)

$C_{eq} = [(C_2 \text{ سری } C_3) \text{ موازی } C_4] \text{ سری } C_1$

$= [(\frac{4}{5}F) \text{ موازی } 5F] \text{ سری } 3F$

$= (\frac{4}{5}F + 5F) \text{ سری } 3F = \frac{\frac{29}{5} \times 3}{\frac{29}{5} + 3} F = \frac{87}{44} F$

$v_1(0^+) = 1v$

$v_2(0^+) = 1v$

$v_3(0^+) = 2v$

$v_4(0^+) = 3v$

$\Rightarrow v_{eq}(0^+) = 3v + 1v = \underline{4v}$

ب)

راه اول

$t = 0^- \Rightarrow$ سلف ها اتصال کوتاه می شوند:

$I_1(0^-) = \frac{5v}{1\Omega} = 5A$, $I_2(0^-) = \frac{10v}{1\Omega} = 10A$

$I_3(0^-) = \frac{15v}{1\Omega} = 15A$, $I_4(0^-) = \frac{20v}{1\Omega} = 20A$

$t = 0^+$

$\Rightarrow I_1(0^+) = I_2(0^+) = I_3(0^+) = I_4(0^+) = I(0^+)$

KVL:

$$v_{L1}(t) = 1 \times I_1(t) + v_{L4}(t) + 1 \times I_4(t)$$

$$+ v_{L3}(t) + 1 \times I_3(t) + 1\Omega \times I_R(t) + v_{L2}(t) + 1\Omega \times I_2(t)$$

$$= 0$$

$$\Rightarrow \frac{dI_1(t)}{dt} + I_1(t) + 4\frac{dI_4(t)}{dt} + I_4(t) + 3\frac{dI_3(t)}{dt} + I_3(t)$$

$$+ I_R(t) + 2\frac{dI_2(t)}{dt} + I_2(t) = 0$$

$$\xrightarrow{\int_{0^-}^{0^+}} I_1(0^+) - I_1(0^-) + 4I_4(0^+) - 4I_4(0^-) + 3I_3(0^+) - 3I_3(0^-)$$

$$+ 2I_2(0^+) - 2I_2(0^-) = 0$$

$$\Rightarrow$$

$$10\, I(0^+) = 150A \Rightarrow I(0^+) = \underline{15\,A}$$

$$\Rightarrow I_1(0^+) = I_2(0^+) = I_3(0^+) = I_4(0^+) = \underline{15\,A}$$

راه دوم: با استفاده از اصل بقاء شارمیتوان به صورت زیر به
پاسخ مشابه رسید:

$$I(0^+) = \frac{L_1 \cdot I_1(0^-) + L_2 \cdot I_2(0^-) + L_3 \cdot I_3(0^-) + L_4 \cdot I_4(0^-)}{L_1 + L_2 + L_3 + L_4}$$

$$= \frac{1 \times 5A + 2 \times 10A + 3 \times 15A + 4 \times 20A}{10} = 15A$$

سوال نهم:

در جریان را در چهار بازه برحسب ولتاژ می نویسیم:

$v < -2$:

$$\left.\begin{aligned} i_1 &= 2v + 3 \\ i_2 &= 2v + 4 \end{aligned}\right\} \Rightarrow i = i_1 + i_2 = 4v + v$$

$$\Rightarrow v = \frac{i - v}{4} \quad i < -1$$

$-2 < v < -1$:

$$\left.\begin{aligned} i_1 &= \frac{1}{2}v \\ i_2 &= 2v + 4 \end{aligned}\right\} \Rightarrow i = i_1 + i_2 = \frac{5}{2}v + 4$$

$$\Rightarrow v = \frac{2}{5}i - \frac{8}{5} \quad -1 < i < \frac{3}{2}$$

$-1 < v < 2$:

$$\left.\begin{aligned} i_1 &= \frac{1}{2}v \\ i_2 &= \frac{1}{2}v + \frac{5}{2} \end{aligned}\right\} \Rightarrow i = i_1 + i_2 = v + \frac{5}{2}$$

$$\Rightarrow v = i - \frac{5}{2} \quad \frac{3}{2} < i < \frac{9}{2}$$

$v > 2$:

$$\left.\begin{aligned} i_1 &= 2v - 3 \\ i_2 &= \frac{1}{2}v + \frac{5}{2} \end{aligned}\right\} \Rightarrow i = i_1 + i_2 = \frac{5}{2}v - \frac{1}{2}$$

$$\Rightarrow v = \frac{2}{5}i + \frac{1}{5} \quad i > \frac{9}{2}$$

حال روابط بالا را در روابط v ، i_2 جایگذاری می کنیم:

$$\Rightarrow \begin{cases} i_2 = \frac{1}{2}i + \frac{1}{2} & i < -1 \\ i_2 = \frac{4}{5}i + \frac{4}{5} & -1 < i < \frac{3}{2} \\ i_2 = \frac{1}{2}i + \frac{5}{4} & \frac{3}{2} < i < \frac{9}{2} \\ i_2 = \frac{1}{5}i + \frac{13}{55} & i > \frac{9}{2} \end{cases}$$