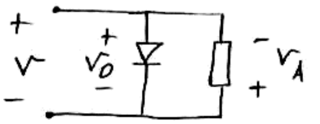
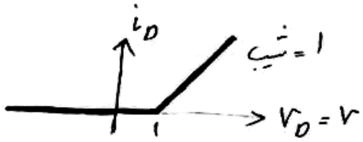
# پاسخنامه تشریحی تمرین سری چهارم مبانی مدار های الکتریکی و الکترونیکی

نویسنده: محمدعلی پشنج

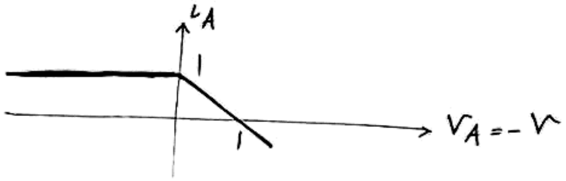
**پاسخ سوال ۱:** پلاریته ی دیود و عنصر A ، عکس یکدیگر است. لذا ،



$$V = V_D \quad , \quad \boxed{V = -V_A} \Rightarrow \boxed{V_A = -V}$$

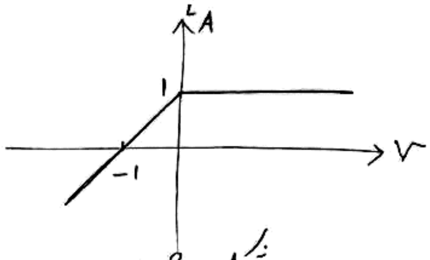


« شکل ۱ »



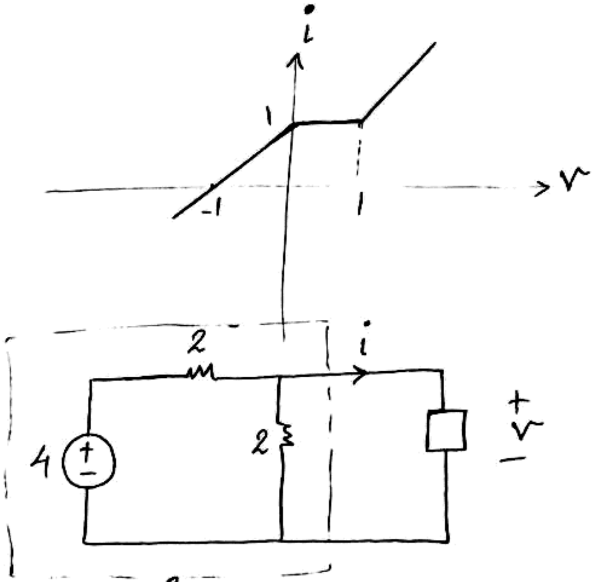
$$\Rightarrow i_A = \begin{cases} -V_A + 1 & V_A > 0 \\ 1 & V_A < 0 \end{cases}$$

$$\boxed{V_A = -V} \Longrightarrow i_A = \begin{cases} V + 1 & V < 0 \\ 1 & V > 0 \end{cases} \Rightarrow$$

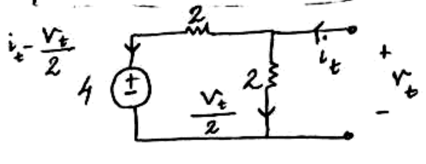


« شکل 2 » ،

شکل های ۱، 2 را جمع می کنیم

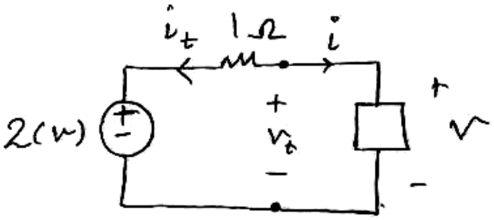


معادل بدست می آوریم:



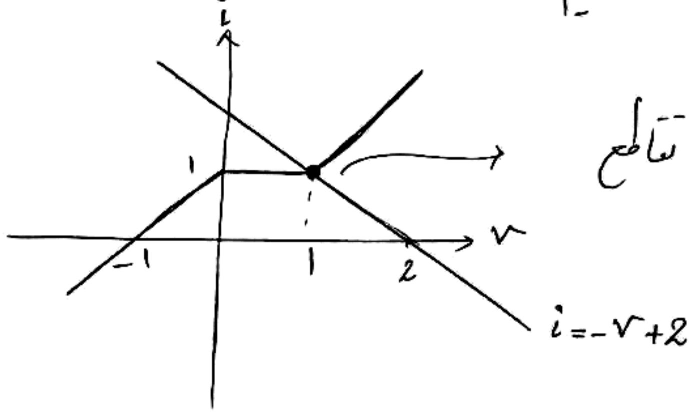
$$\text{KVL)}\ 2\left(i_t - \frac{V_t}{2}\right) + 4 - V_t = 0 \Rightarrow \boxed{V_t = i_t + 2}$$

$\Rightarrow V_t = i_t + 2$ ⊛ $\Rightarrow R_{th} = 1\Omega \qquad V_{th} = 2\ (v)$



$$\begin{cases} i_t = -i \\ V_t = V \end{cases}$$

⊛ در $\Rightarrow V = -i + 2 \Rightarrow$ ترسیم $\Rightarrow i = -V + 2$

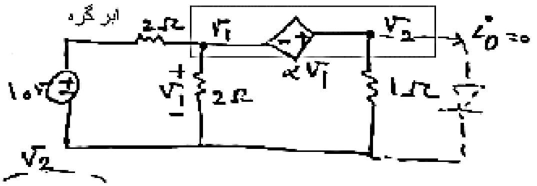


تقاطع $(V, i) = (1, 1)$ → نقطه کار

$V = 1 \Rightarrow V_D = V = 1 \Rightarrow (i_D - V_D)$ مشخصه $\Rightarrow i_D = 0$

$P_D = V_D i_D = (1)(0) = 0\ W$

پاسخ سوال ۲:



$$\frac{V_1 - 10}{2} + \frac{V_1}{2} + \frac{\overset{V_2}{(\alpha+1)V_1}}{1} + \cancel{i_D}^{0} = 0 \qquad V_1 = \frac{5}{\alpha+2}$$

$V_2 = V_1 + \alpha V_1$ $\quad V_2 \leq 0$ اگر ولتاژ سر آند دیود منفی باشد، جریانی از آن عبور نمی‌کند

$$\longrightarrow \frac{5(\alpha+1)}{(\alpha+2)} \leq 0 \longrightarrow \boxed{-2 < \alpha \leq -1}$$

پاسخ سوال ۳:

First, let us show that $D_1$ on $\Rightarrow$ $D_2$ off, and $D_2$ on $\Rightarrow$ $D_1$ off.

Consider $D_1$ to be on $\rightarrow V_{AB} = 0.7 + 1 + i_1 R_1$ .

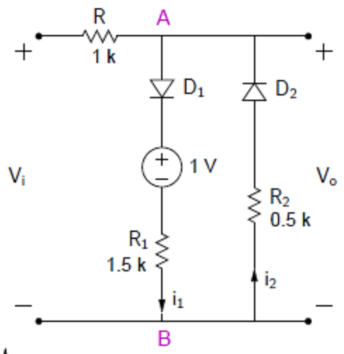
Note that $i_1 > 0$, since $D_1$ can only conduct in the forward direction.

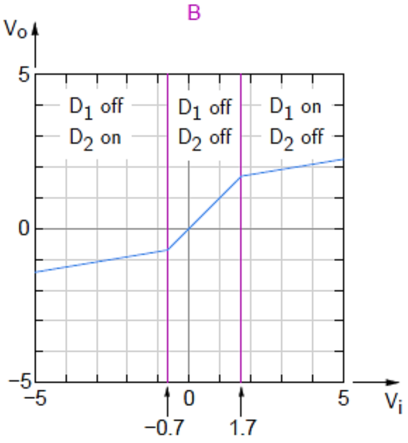
$\Rightarrow V_{AB} > 1.7\ V \Rightarrow D_2$ cannot conduct.

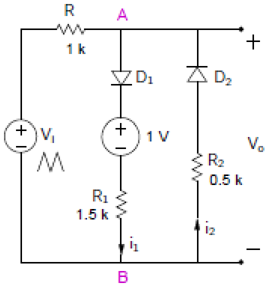
Similarly, if $D_2$ is on, $V_{BA} > 0.7\ V$, i.e., $V_{AB} < -0.7\ V \Rightarrow D_1$ cannot conduct.

Clearly, $D_1$ on $\Rightarrow$ $D_2$ off, and $D_2$ on $\Rightarrow$ $D_1$ off.

- For $-0.7\ V < V_i < 1.7\ V$, both $D_1$ and $D_2$ are off.
  $\rightarrow$ no drop across $R$, and $V_o = V_i$. (1)
- For $V_i < -0.7\ V$, $D_2$ conducts. $\rightarrow V_o = -0.7 - i_2 R_2$ .
  Use KVL to get $i_2$: $V_i + i_2 R_2 + 0.7 + R i_2 = 0$.
  $$\rightarrow i_2 = -\frac{V_i + 0.7}{R + R_2}\ , \text{ and}$$
  $$V_o = -0.7 - R_2 i_2 = \frac{R_2}{R + R_2}\, V_i - 0.7\,\frac{R}{R + R_2}\ . \qquad (2)$$
- For $V_i > 1.7\ V$, $D_1$ conducts. $\rightarrow V_o = 0.7 + 1 + i_1 R_1$ .
  Use KVL to get $i_1$: $-V_i + i_1 R + 0.7 + 1 + i_1 R_1 = 0$.
  $$\rightarrow i_1 = \frac{V_i - 1.7}{R + R_1}\ , \text{ and}$$
  $$V_o = 1.7 + R_1 i_1 = \frac{R_1}{R + R_1}\, V_i + 1.7\,\frac{R}{R + R_1}\ . \qquad (3)$$
- Using Eqs. (1)-(3), we plot $V_o$ versus $V_i$.

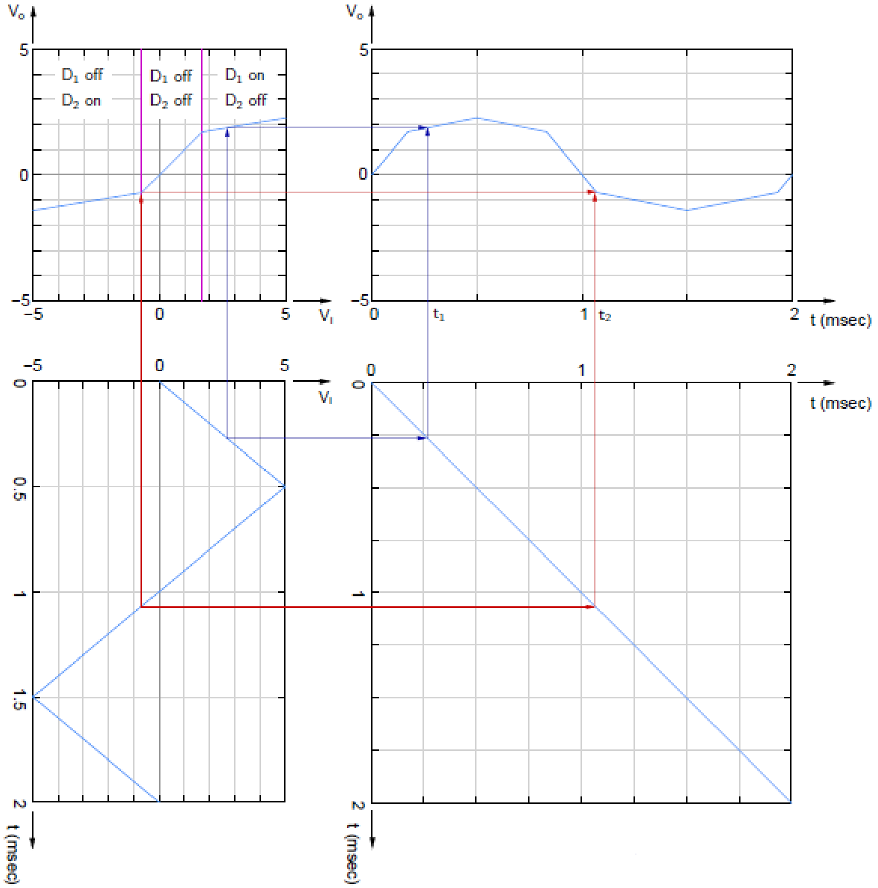




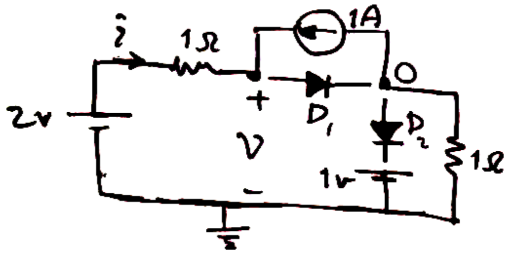


Point-by-point construction of $V_o$ versus t:

Two time points, $t_1$ and $t_2$, are shown as examples.



پاسخ سوال ۴:



ابتدا فرض می‌کنیم هر دو دیود قطع هستند:

$$i_{D_1} = i_{D_2} = 0 \Rightarrow i = -1A$$

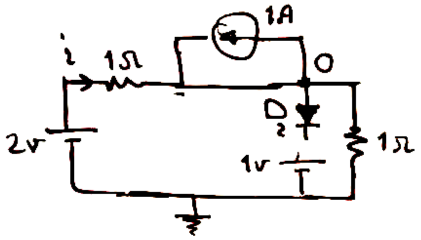
$$v = +2 - i = 2 - (-1) = 3v$$

$$v_o = 0 + 1 \times i = -1v$$

$$\Delta V_{D_1} = v - v_o = 3 - (-1) = 4v \geq 0 \xRightarrow{\text{پس}} D_1$$

روشن است

برای مدار داریم $\longrightarrow$



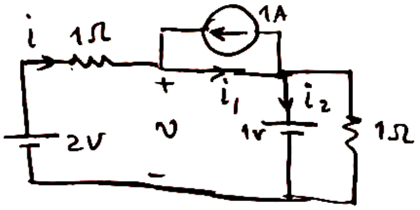
$$\frac{v_o - 0}{1} + \frac{v_o - 2}{1} = 0 \Rightarrow v_o = 1v$$

$$\Downarrow$$

$$\Delta V_{D_2} = v_o - 1 = 0v \geq 0$$

$\Leftarrow$ $D_2$ هم وصل است.

پس مدار $\longrightarrow$ این چنین می‌شود.



$$i = \frac{2-1}{1} = 1$$

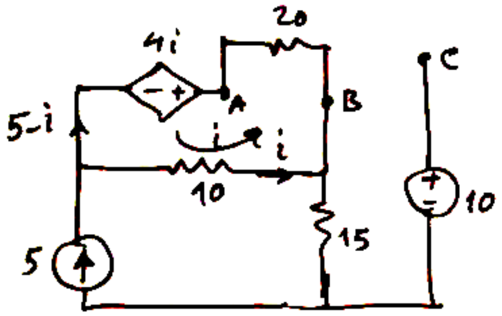
$$\boxed{i = 1}$$

$$v = 2 - 1 \times i = 2 - 1 = 1v$$

$$\boxed{v = 1v}$$

پاسخ سوال 5 :

ابتدا فرض می‌کنیم هر دو دیود قطع هستند :



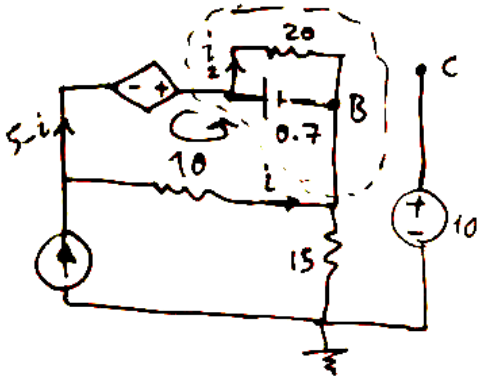
$-10i + 20(5-i) - 4i = 0$

$\to -34i = -100 \to i = \frac{100}{34} = \frac{50}{17}$

$\Rightarrow V_A - 20(5-i) = V_B \longrightarrow V_A - V_B = 20\left(5 - \frac{50}{17}\right) \simeq \boxed{41.18\,v}$

پس دیود بین A و B وصل است ، ←

چون 41.18 > 0.7



$i_2 = \frac{0.7}{20}$

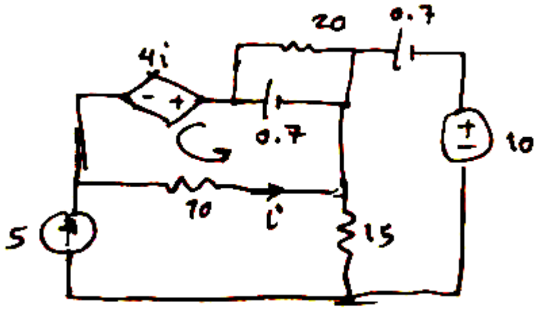
$-10i + 0.7 - 4i = 0 \to 0.7 = 14i$

$i = \frac{0.1}{2} = \frac{1}{20}$

B سوپرگره KCL : $\frac{V_B - 0}{15} + (-i) + (-(5-i)) = 0 \to \frac{V_B}{15} = 5 \to V_B = 75v$

$V_C = 0 + 10 = 10 \longrightarrow V_B - V_C = 75 - 10 = 65v > 0.7v$

پس دیود بین B و C نیز وصل است :



KVL : $-10i + 0.7 - 4i = 0$

$\boxed{i = \frac{1}{20}A}$