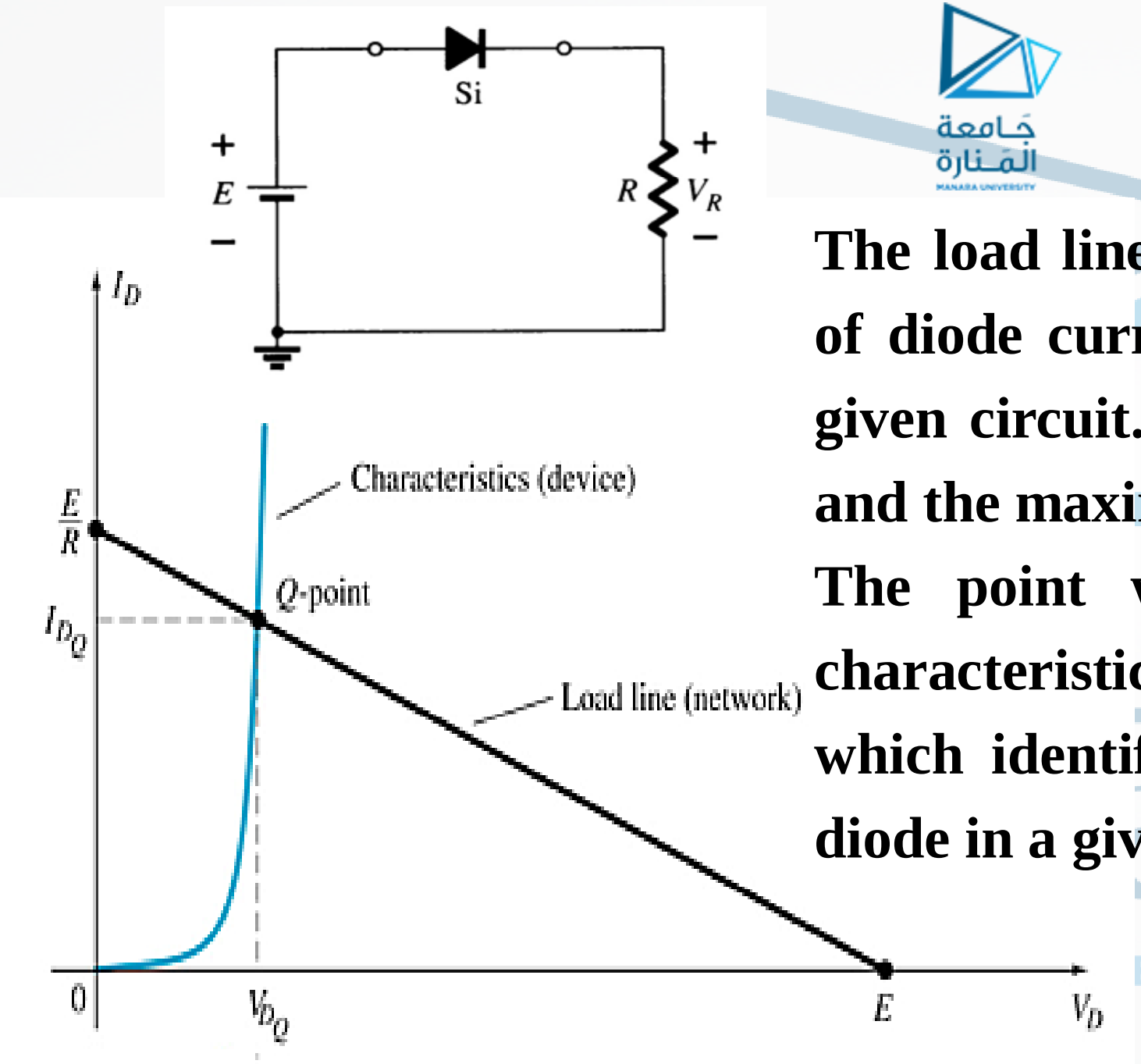
Lecture 4

DIODE PRACTICAL APPLICATIONS

DR. BASSAM ATIEH

Load-Line Analysis



The load line plots all possible combinations of diode current (I_D) and voltage (V_D) for a given circuit. The maximum I_D equals E/R, and the maximum V_D equals E.

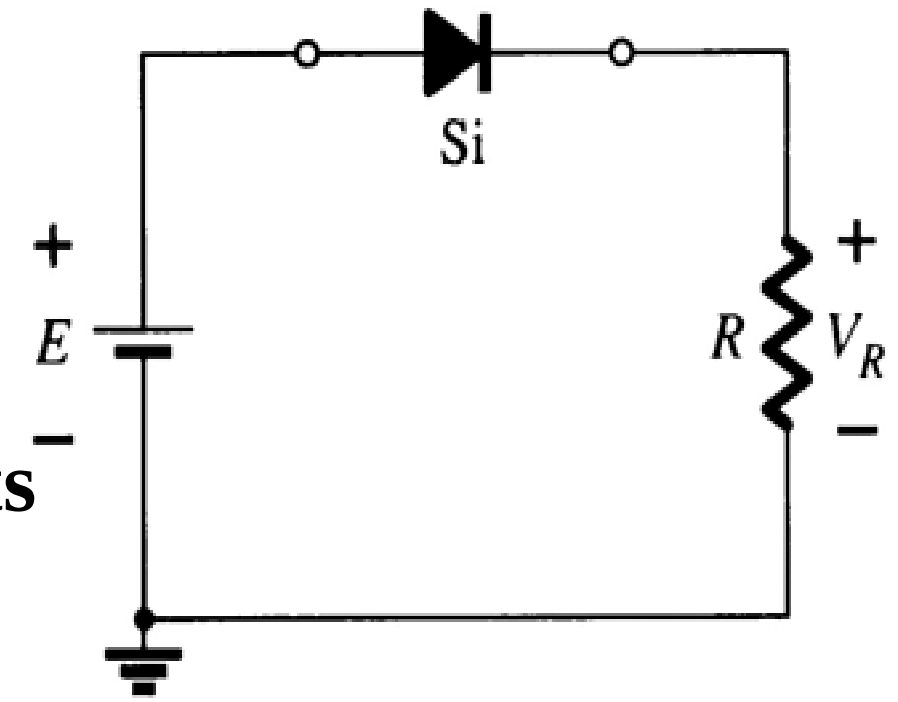
The point where the load line and the characteristic curve intersect is the Q-point, which identifies I_D and V_D for a particular diode in a given circuit.

Series Diode Configurations

Forward Bias

Analysis (for silicon)

- $V_D = 0.7\text{ V}$ (or $V_D = E$ if $E < 0.7$
- $V_R = E - V_D$
- $I_D = I_R = I_T = V_R / R$



Reverse Bias

Diodes ideally behave as open circuits

Analysis

- $V_D = E$
- $V_R = 0\text{ V}$
- $I_D = 0\text{ A}$

Parallel Configurations

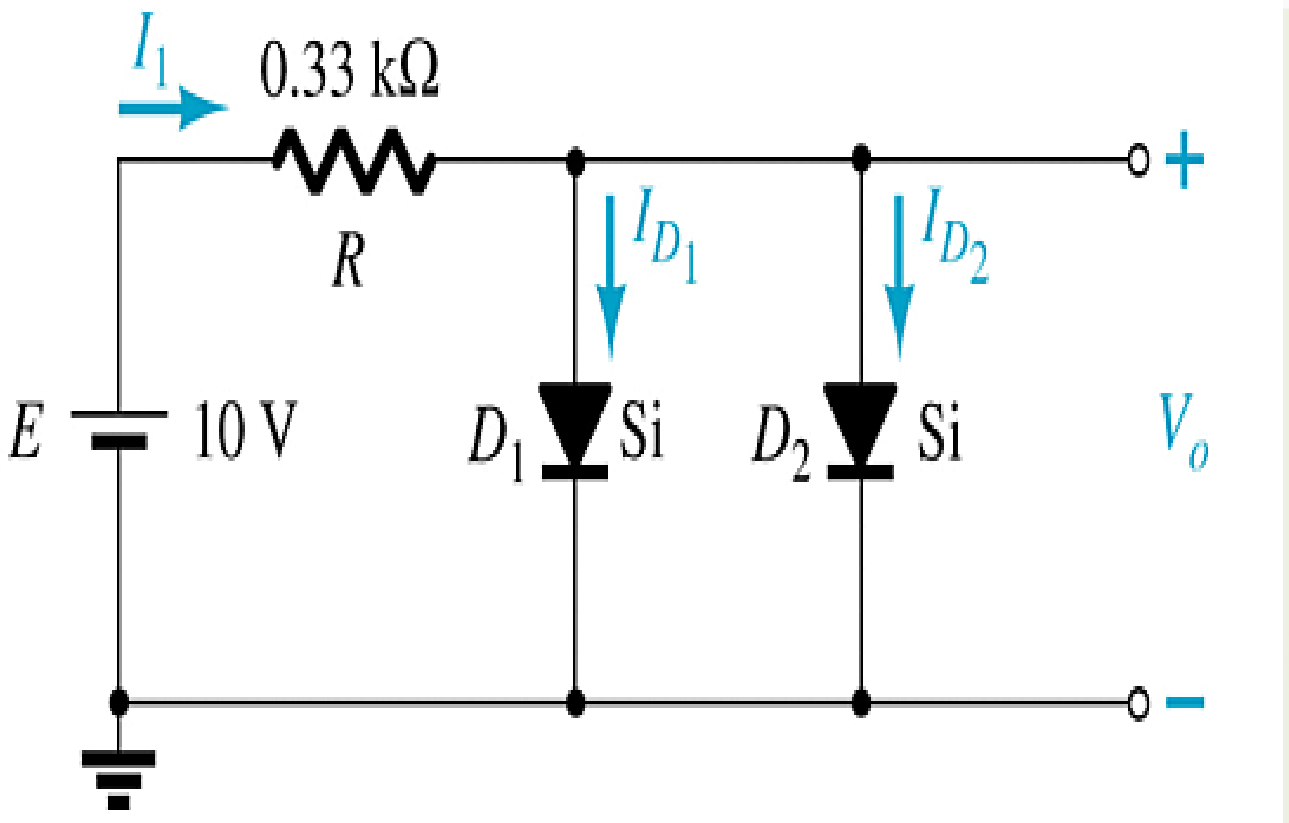
$$V_D = 0.7\,V$$

$$V_{D1} = V_{D2} = V_O = 0.7\,V$$

$$V_R = 9.3\,V$$

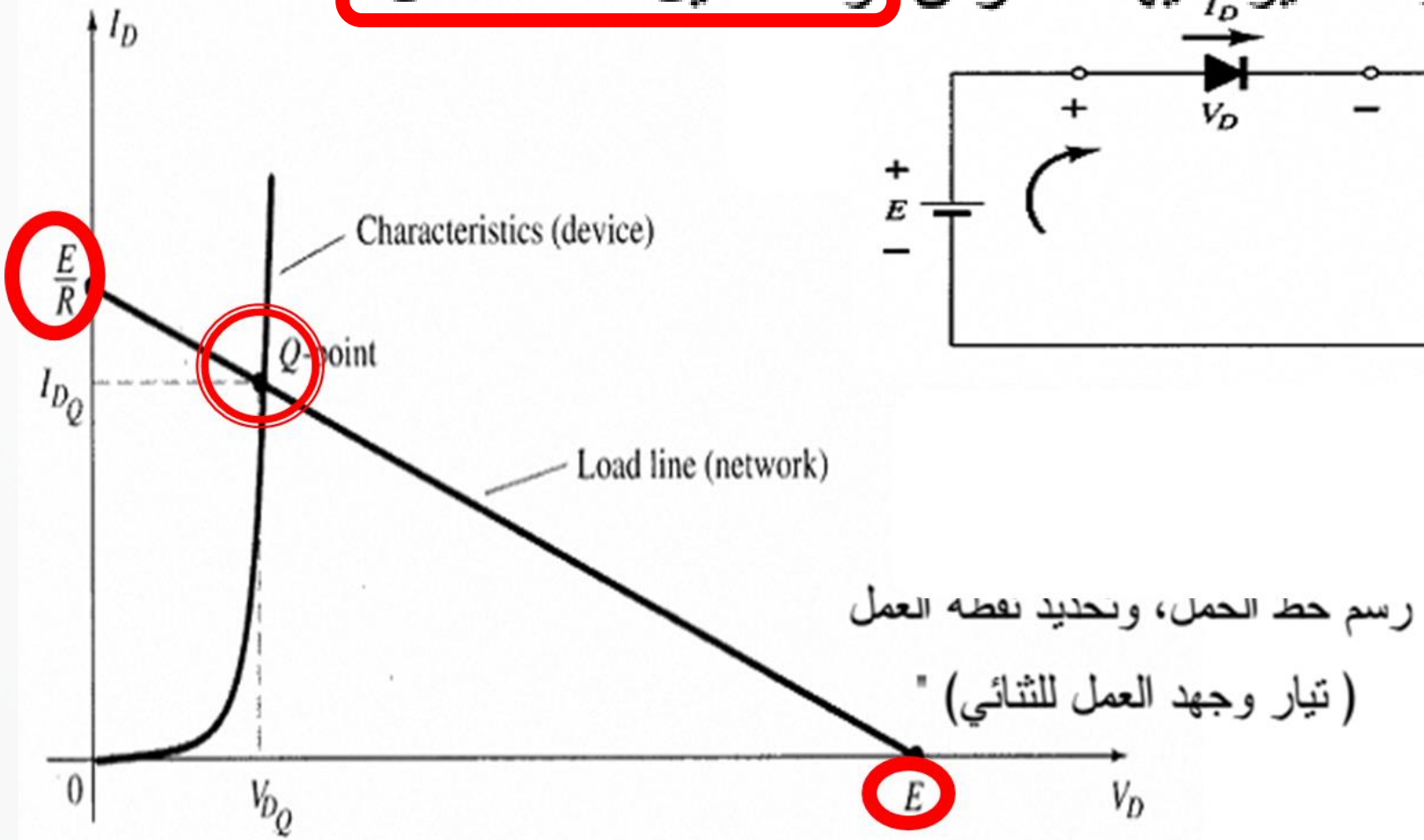
$$I_R = \frac{E - V_D}{R} = \frac{10\,V - .7\,V}{.33k\Omega} = 28\,mA$$

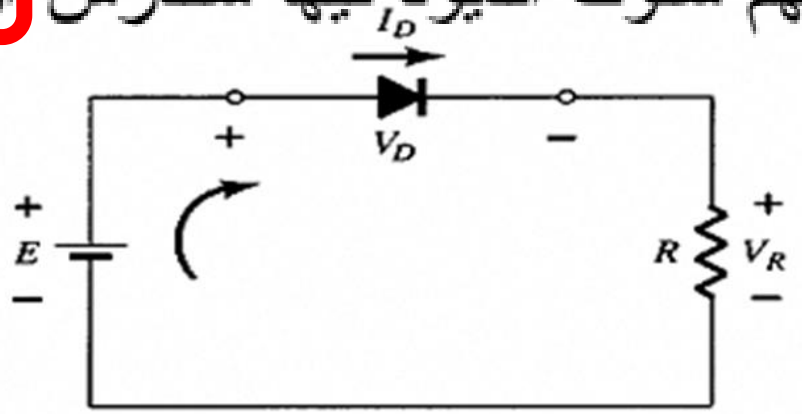
$$I_{D1} = I_{D2} = \frac{28\,mA}{2} = 14\,mA$$



تطبيقات الديود : Diode Applications

يستخدم الديود في مجالات عديدة كالتحديد، التقويم والقص.....إلخ . من أجل حل الدارات وفهم سلوك الديود فيها سندرس أولاً تحليل خط الحمل:



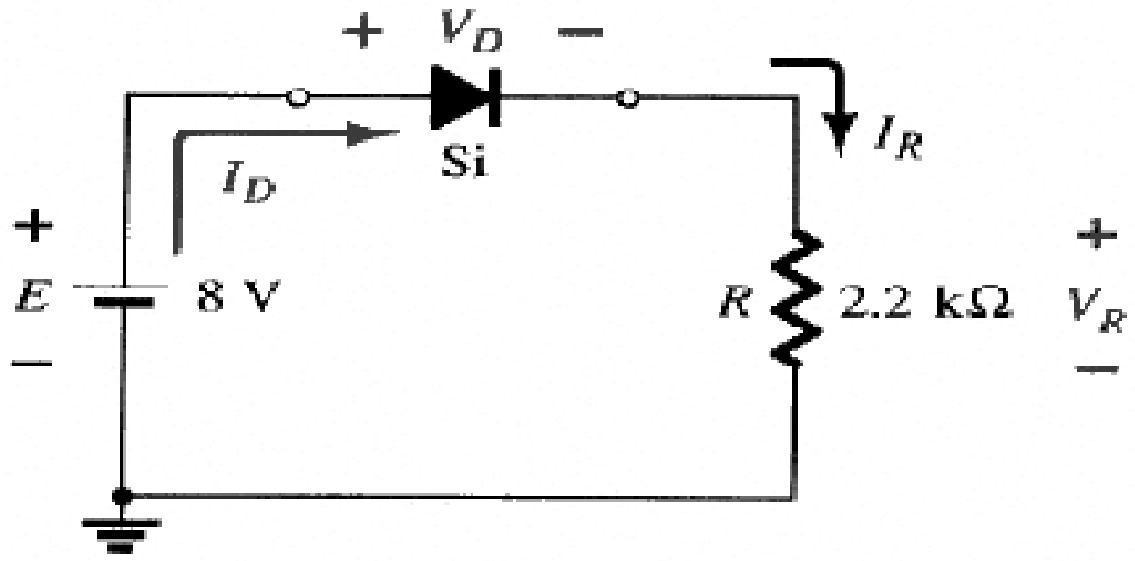


رسم خط الحمل، وتحديد نقطة العمل

(تيار وجهد العمل للثنائي) "

مثال

أوجد V_D و V_R و I_D في الدارة المبينة في الشكل



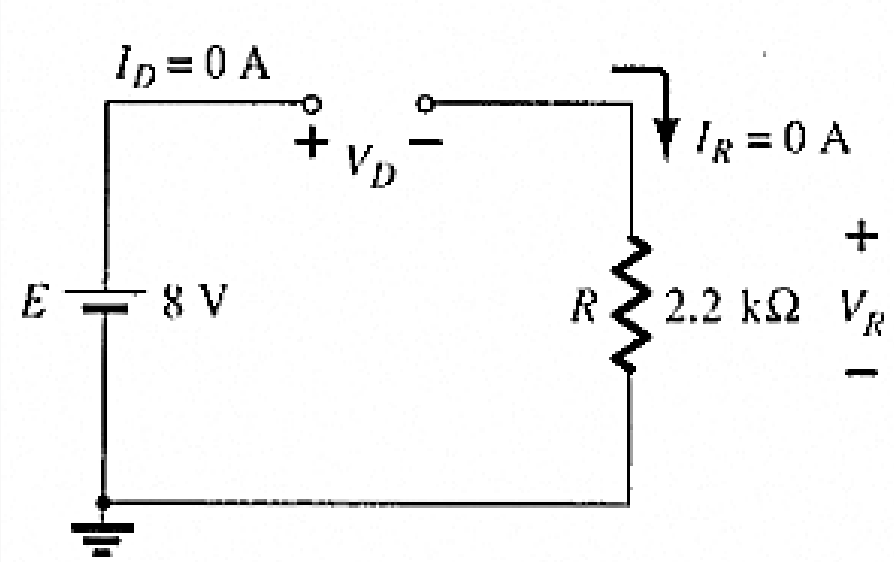
$$V_D = 0.7V$$

$$V_R = E - V_D = 8 - 0.7 = 7.3 volts$$

$$I_D = I_R = \frac{V_R}{R} = \frac{7.3V}{2.2 * 10^3 \Omega} \Rightarrow$$

$$I_D \cong 3.32\, mA$$

الديود مستقطب عكسياً.



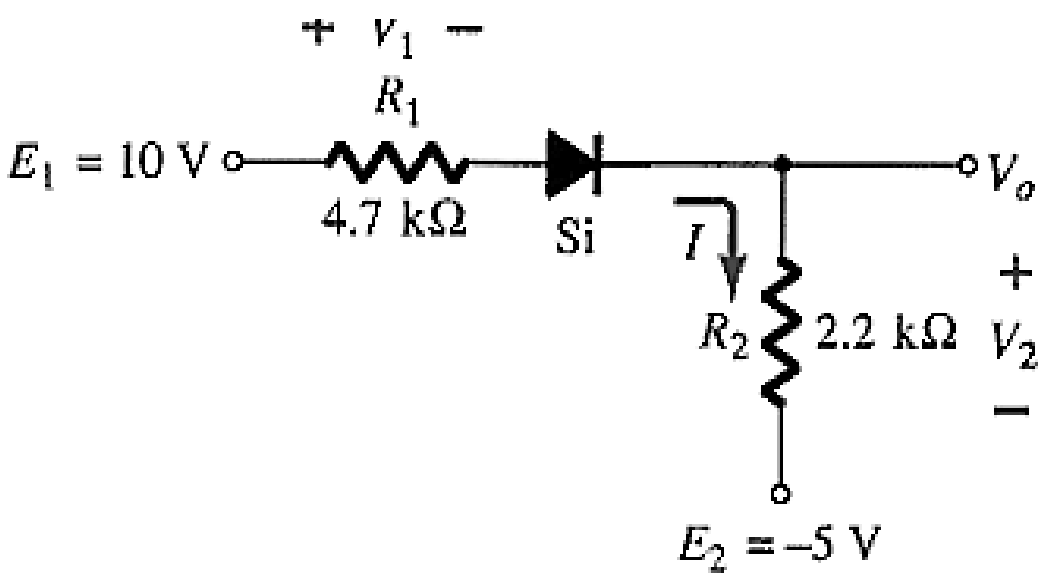
$$I_D = 0 \Rightarrow$$

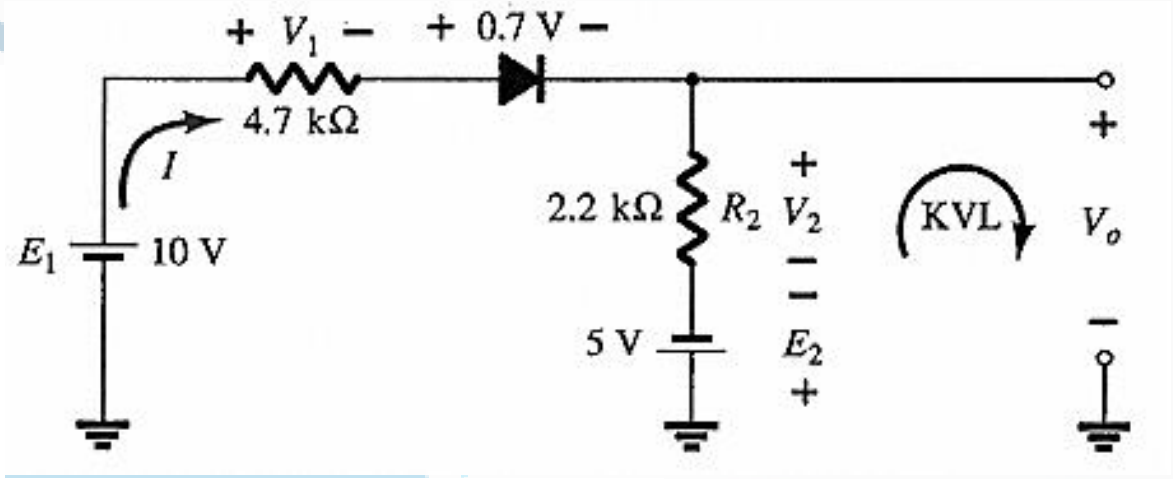
$$E - V_D - V_R = 0 \Rightarrow$$

$$V_D = E - V_R$$

$$V_D = E - 0 = 8 volts$$

مثال





$$I = \frac{E_1 + E_2 - V_D}{R_1 + R_2} = \frac{10+5-0.7}{(4.7+2.2)*10^3} = \frac{14.3 volts}{6.9*10^3\,\Omega} \Rightarrow$$

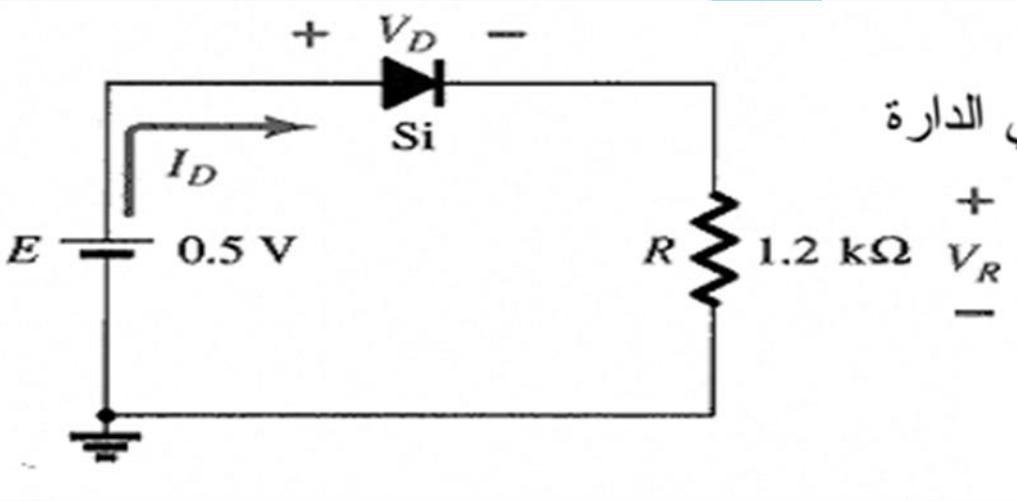
$$I = 2.07mA$$

$$V_1 = I*R_1 = 2.07*10^{-3}*4.7*10^3 = 9.73 volts$$

$$V_2 = I*R_2 = 2.07*10^{-3}*2.2*10^3 = 4.55 volts$$

$$V_0 = V_2 - E_2 = 4.55 - 5 = -0.45 volts$$

مثال



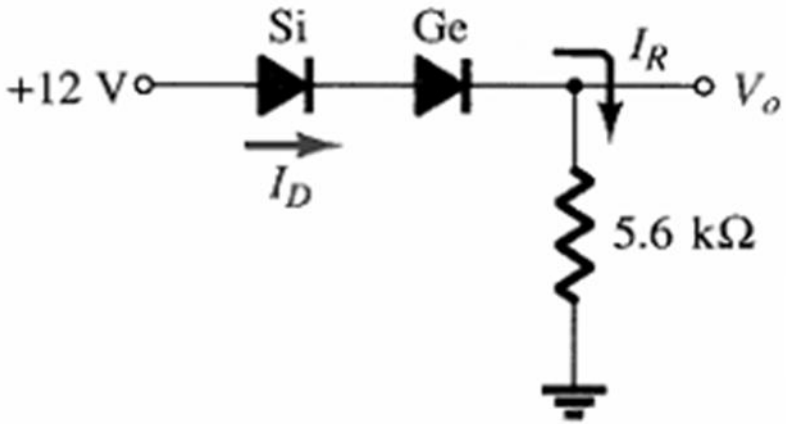
نلاحظ أن جهد التغذية أقل من الجهد اللازم لفتح الديود، لذا فإن التيار المار في الدارة

$$I_D = 0 Amper$$

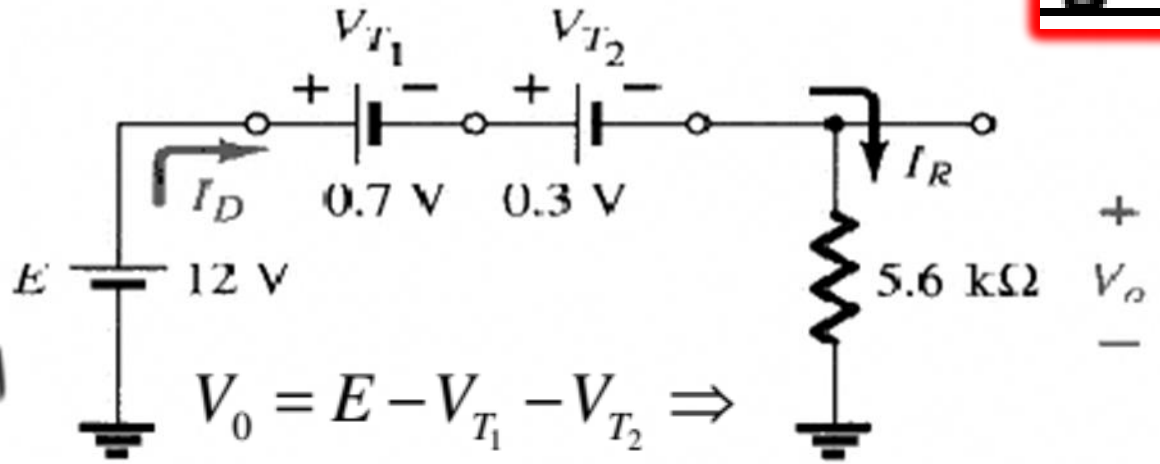
$$V_R = I_R * R = I_D * R = 0 volts$$

$$V_D = E - V_R = 0.5 - 0 = 0.5 volts$$

مثال



الدارة المكافئة

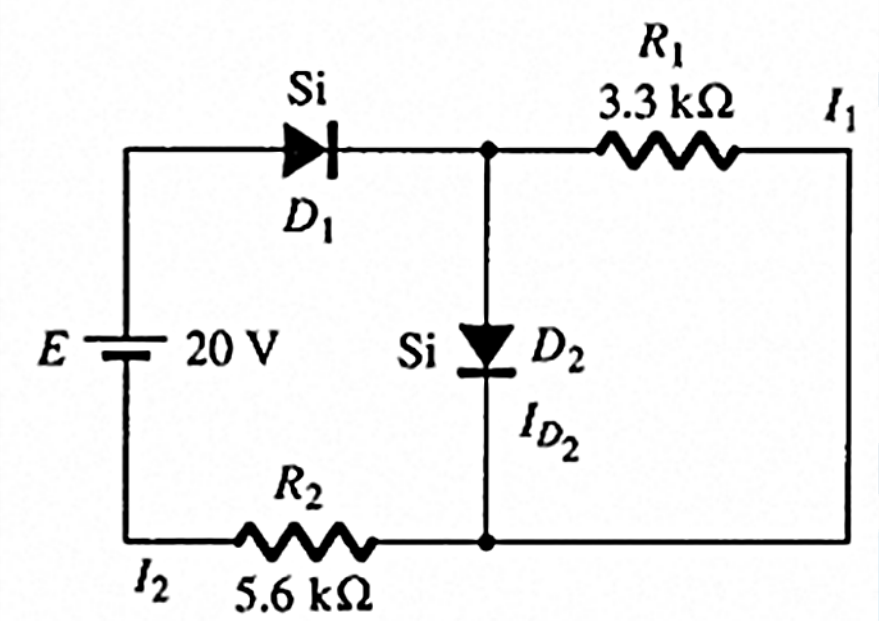


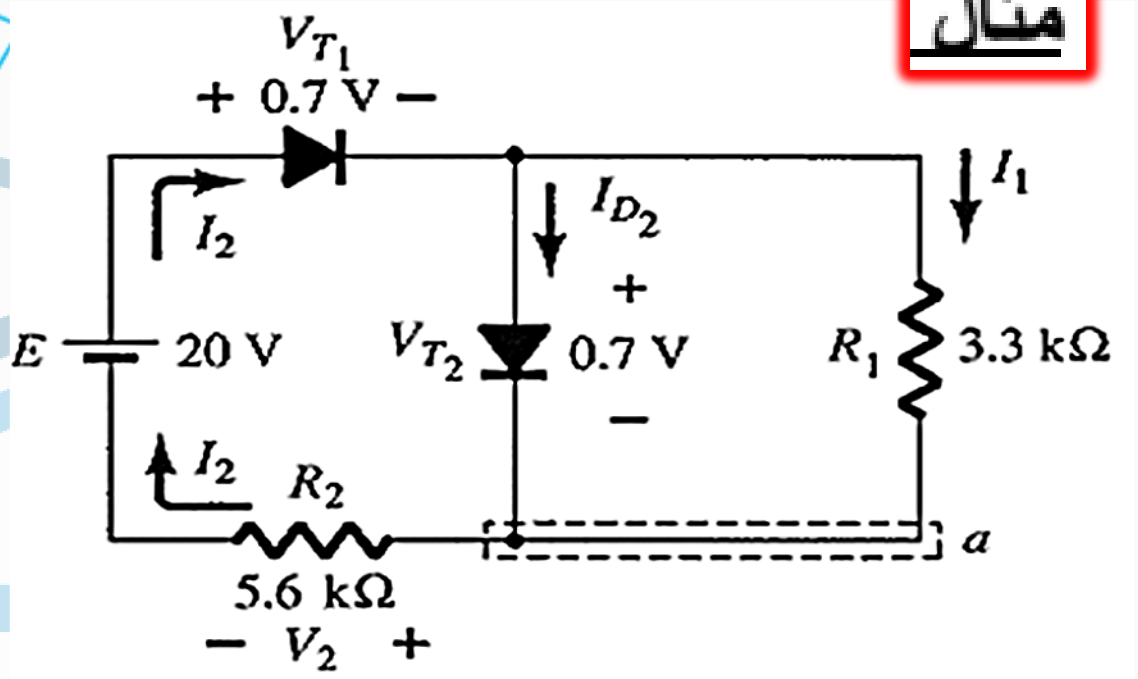
$$V_0 = E - V_{T_1} - V_{T_2} \Rightarrow$$

$$V_0 = 12 - 0.7 - 0.3 = 11 volts$$

$$I_D = I_R = \frac{V_0}{R} = \frac{11}{5.6 * 10^3} \cong 1.96 mA$$

مثال





$$I_1 = \frac{V_{T_2}}{R_1} = \frac{0.7\,v}{3.3 * 10^3\,A} = 0.212\ mA$$

$$-V_2 + E - V_{T_2} - V_{T_1} = 0 \Rightarrow$$

$$V_2 = +E - V_{T_2} - V_{T_1} = 20 - 0.7 - 0.7 \Rightarrow$$

$$V_2 = 18.6\,volts$$

$$I_2 = \frac{V_2}{R_2} = \frac{18.6\,v}{5.6 * 10^3\,\Omega} = 3.32\ mA$$

$$I_{D_2} + I_1 = I_2 \Rightarrow$$

$$I_{D_2} = I_2 - I_1 = 3.32\,mA - 0.212\,mA = 3.108\,mA.$$