Student Name: .....
Student Number: .....

Question 1

Use circuit analysis to find and plot the iv curve of the diode circuit shown in Fig. 1(a), where the diodes are described by the characteristic curve given in Fig. 1(b).

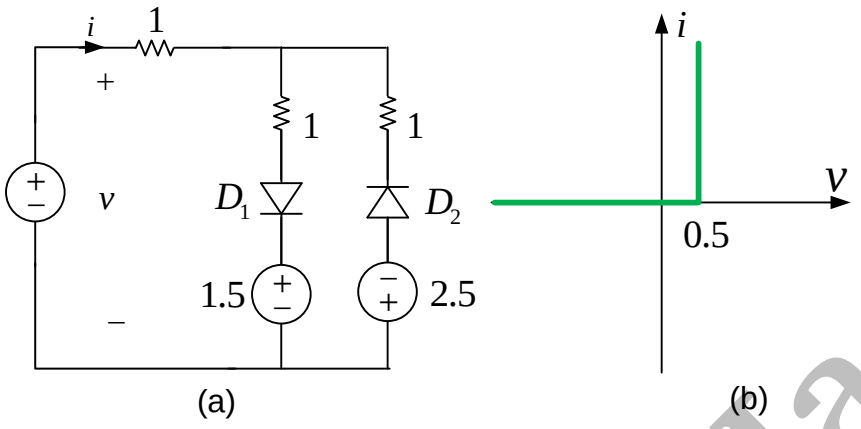
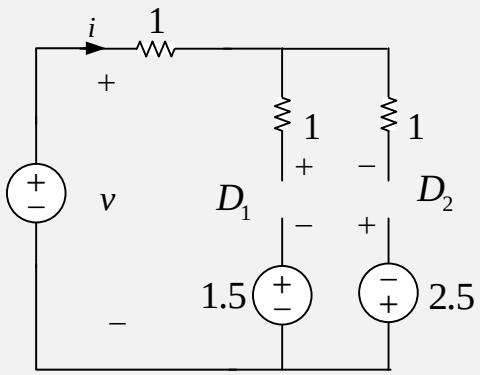


Figure 1: (a) Diode circuit (b) diode characteristic curve.

Here, the diode is off and acts like an open circuit when $v_D < 0.5$. On the other hand, the diode is on and can be considered as a 0.5 V voltage source if $i_D > 0$. Now, we have 4 cases.

Case 1: D1: off and D2: off, shown in the figure below. 1.

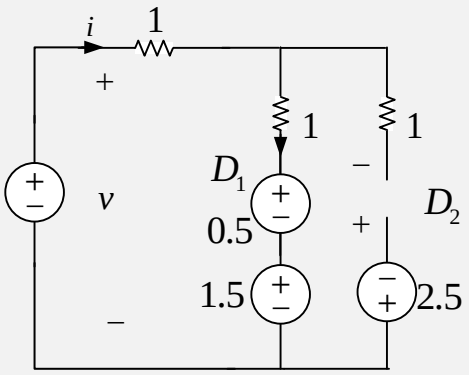


$$i = 0$$
$$v_{D_1} = v - 1.5 \leq 0.5 \Rightarrow v \leq 2$$
$$v_{D_2} = -v - 2.5 \leq 0.5 \Rightarrow v \geq -3$$

, which is feasible for $-3 \leq v \leq 2$.

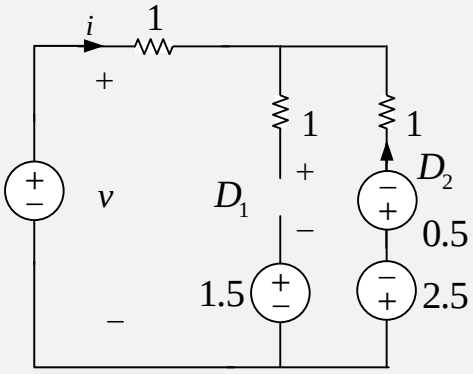
Case 2: D1: on and D2: off, shown in the figure below.

Question 1 continued on next page...



$$i = \frac{v - 1.5 - 0.5}{2}$$
$$i_{D_1} = i \geq 0 \Rightarrow v \geq 2$$
$$v_{D_2} = -v - 2.5 + \frac{v - 1.5 - 0.5}{2} \leq 0.5 \Rightarrow v \geq -8$$

, which is feasible for $v \geq 2$.
Case 3: D1: off and D2: on, shown in the figure below.



$$i = \frac{v + 2.5 + 0.5}{2}$$
$$v_{D_1} = v - 1.5 - \frac{v + 2.5 + 0.5}{2} \leq 0.5 \Rightarrow v \leq 7$$
$$i_{D_2} = -i \geq 0 \Rightarrow v \leq -3$$

, which is feasible for $v \leq -3$.
Case 4: D1: on and D2: on, shown in the figure below.

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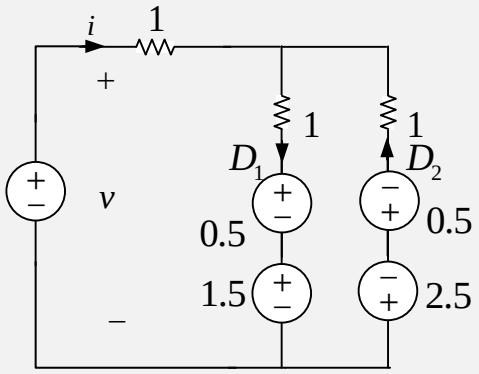

$$\frac{e-v}{1}+\frac{e-(0.5+1.5)}{1}+\frac{e+(0.5+2.5)}{1}=0\Rightarrow e=\frac{v-1}{3}$$

$$i=\frac{v-e}{1}=\frac{2v+1}{3}$$

$$i_{D_1}=e-2=\frac{v-7}{3}\geq 0\Rightarrow v\geq 7$$

$$i_{D_2}=-(e+3)=-\frac{v+8}{3}\geq 0\Rightarrow v\leq -8$$

, which is infeasible. The iv curve equals

$$i=\begin{cases}\frac{v+3}{2}, & v\leq -3\\ 0, & -3<v\leq 2\\ \frac{v-2}{2}, & v>2\end{cases}$$

and is plotted in the figure below.