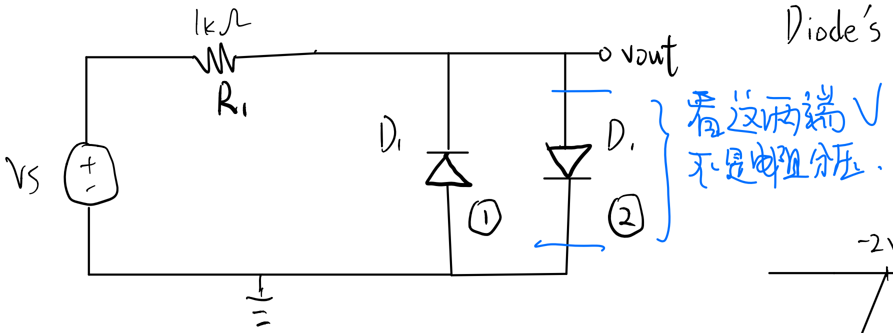
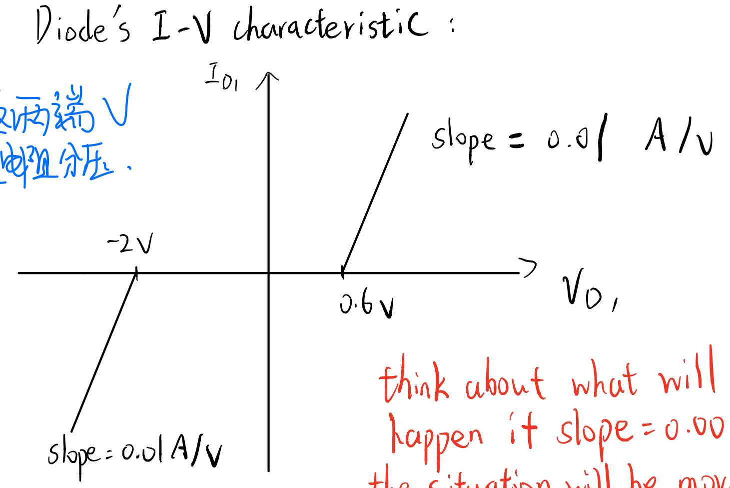
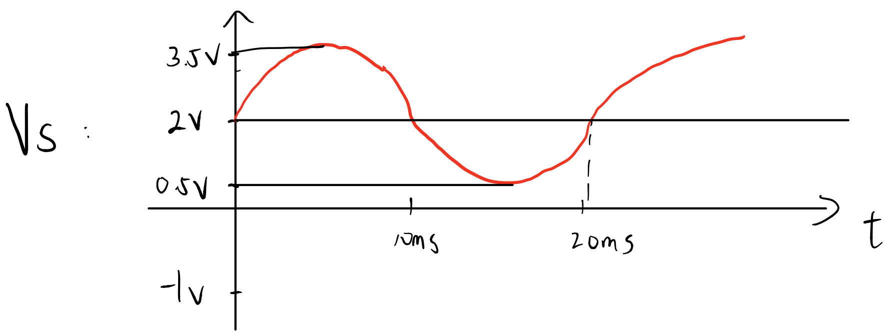
1.





think about what will happen if slope = 0.001, the situation will be more complicated.

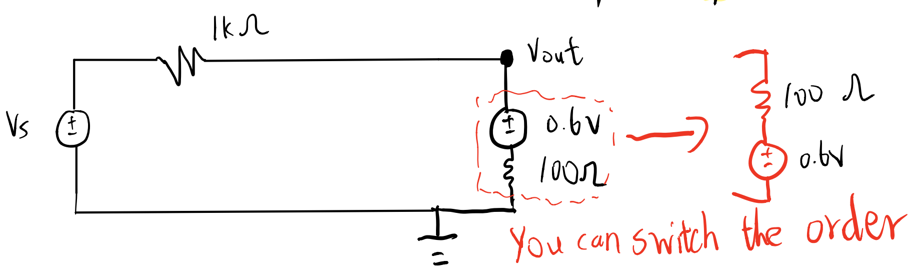


Draw Vout vs. t

Solution:

When $V_s < 0.6\,V$, definitely no diodes are turned on. $V_{out} = V_s$

When $0.6V \le V_s \le 2V$, definitely only ② can be turned on.



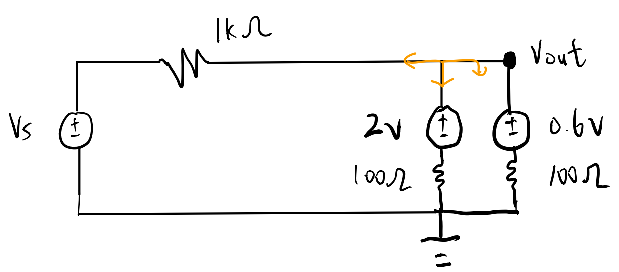
$$i = \frac{V_s - 0.6}{1100}$$

$$V_{out} = V_s - 1000 \cdot \frac{V_s - 0.6}{1100}$$

$$V_{out} = \frac{V_s}{11} + \frac{6}{11}$$

$2v < V_S < 3.6v$: It is possible that both ① and ② are turned on, but ① is not turned on as soon as $V_S = 2v$ because $V_{out} < V_S$,

Assume two diodes are turned on :



Nodal analysis on vout :

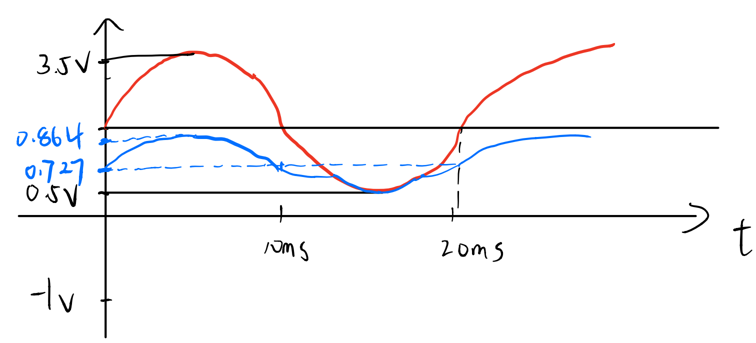
$$\frac{V_{out} - V_S}{1000} + \frac{V_{out} - 0.6}{100} + \frac{V_{out} - 2}{100} = 0$$

$$\Rightarrow V_{out} = \frac{V_S + 26}{21}$$

To meet the assumption : $\frac{V_S + 26}{21} > 2$, $V_S > 16v$, which is not possible.

Therefore, Vout looks like:

Vs
Vout :



PS: if slope = 0.001, the equation here will become :

$$\frac{V_{out} - V_S}{1000} + \frac{V_{out} - 0.6}{1000} + \frac{V_{out} - 2}{100} = 0$$

$$V_{out} = \frac{20.6 + V_S}{12},$$

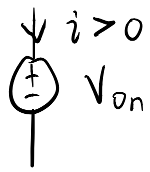
when $V_S = 3.5$, $V_{out} > 2$, ① can be turned on!!

Note :

① Use turn on voltage to divide Vs into several ranges but don't confuse Vs with the voltage of diode V_D, they may not be the same.

For example, for diode ② $V_D = V_S$ at first because the circuit is open when $V_S < 0.6V$. For diode ①

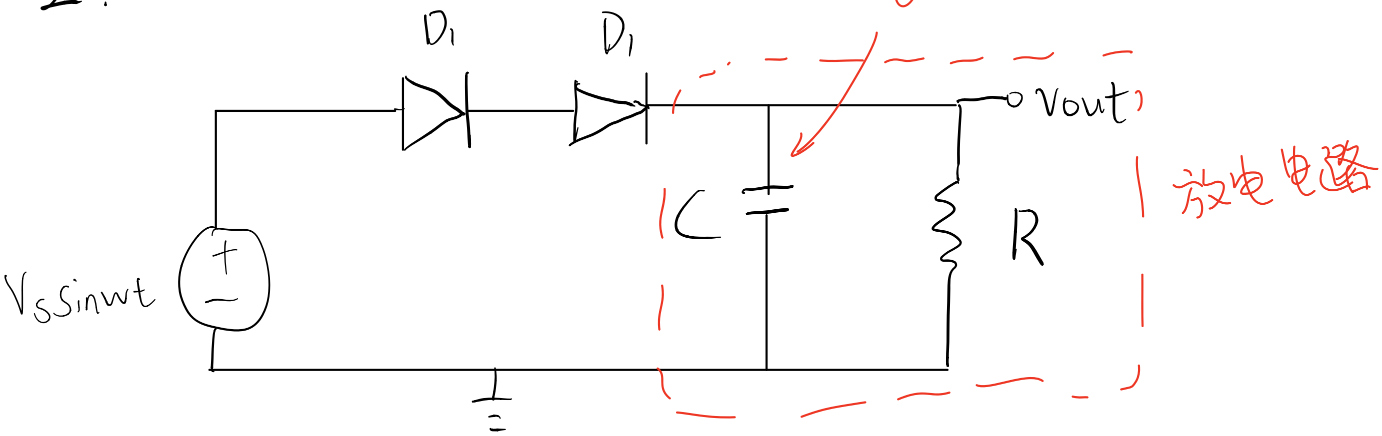
$V_D \neq V_s$, $V_D = V_{out}$, which explains why it is never turned on reversely.

② In equivalent circuit of diode, the direction of equivalent voltage source should always be: 

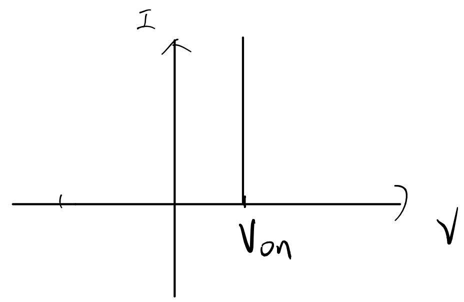
You can memorize this by the fact that diode doesn't generate energy, so it must cause the voltage to drop along the current, no matter in forward region or reverse bias.

③ Mark critical values on the plot during exam, Calculation step of them can earn partial points.

2. What is I_{dc}, ΔT, PIV?



D_1 I-V characteristic:



Solution:

$$V_{dc} = V_s - 2V_{on}$$

$$V_r = V_{dc} \cdot \frac{T}{RC} = V_{dc} \cdot \frac{2\pi}{wRC}$$

$$\Delta T = \frac{1}{w}\sqrt{\frac{2V_r}{V_s}}$$

$$PIV = \frac{2V_s - 2V_{on}}{2}$$

V_{dc} 理解电路，I_{dc}中R：放电电路的R

ΔT, V_r 套公式

PIV is defined as the largest voltage difference of a single diode.

Note:

① Prepare to deal with rectifiers with several diodes

② Make sure you understand each physical quantity's meaning.

③ Copy three types of rectifies and the equations to CTPP.

④ $Q = I_{dc} \cdot (T - \Delta T) \approx I_{dc} \cdot T$ uses the approximation $T - \Delta T \approx T$
检验关系
$V_r \approx (V_s - V_{on})\frac{T}{RC}$ uses condition $T - \Delta T \ll RC$, verify the condition if you are given exact numbers. (If there are no exact numbers you can assume that this is always true).