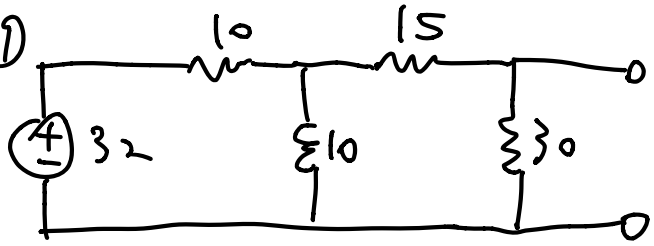
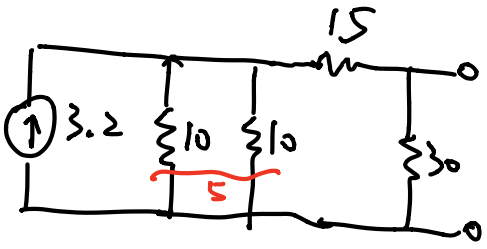
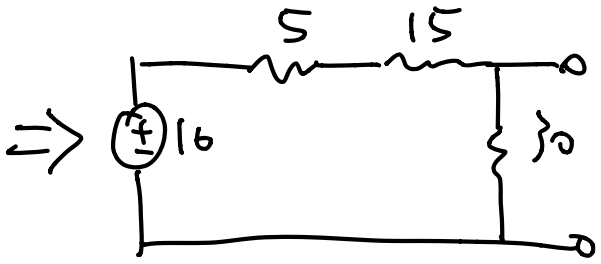
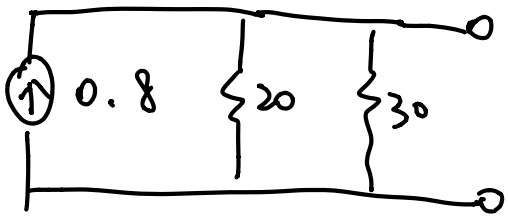
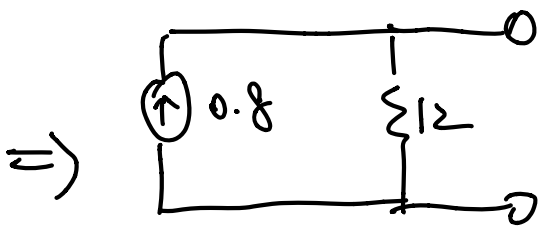
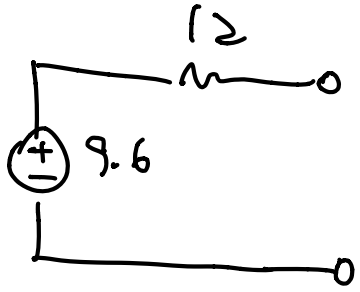
1. ① 

⇒ 



⇒ 

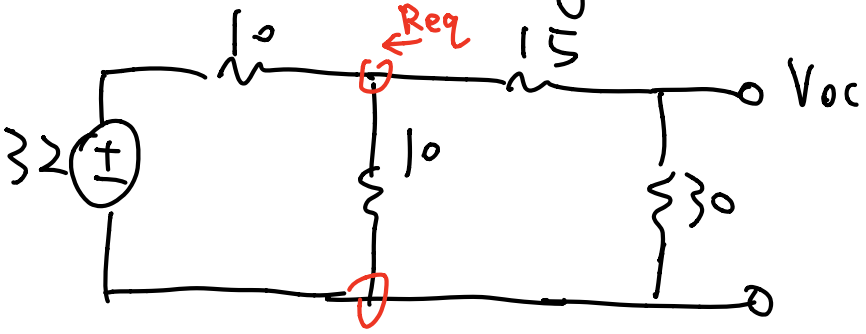




② Short the voltage source

$R_{th} = ((10 \| 10) + 15) \| 30 = 12\ \Omega$

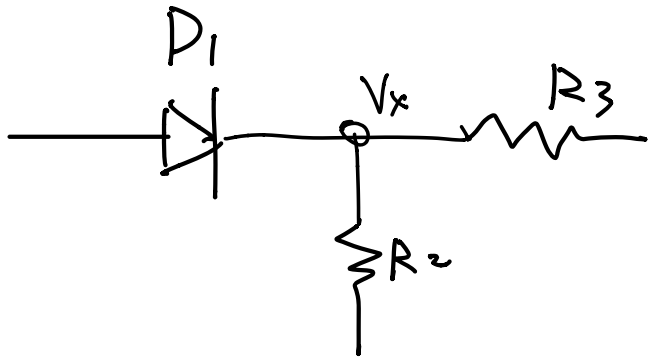
Thevenin voltage



$R_{eq} = \frac{90}{11}\ \Omega \quad V_{eq} = 32 \times \frac{\frac{90}{11}}{\left(10 + \frac{90}{11}\right)} = 14.4\ V$

$V_{oc} = \frac{30}{30+15} \cdot 14.4 = 9.6\ V$

2.



$$I_{D1} = I_{D2} + I_{R2}$$

$$\frac{5 - 0.7 - V_x}{1k} = \frac{V_x - 0.7}{1.5} + \frac{V_x}{2.2}$$

$$\Rightarrow V_x = 2.247 \approx 2.25\ V$$

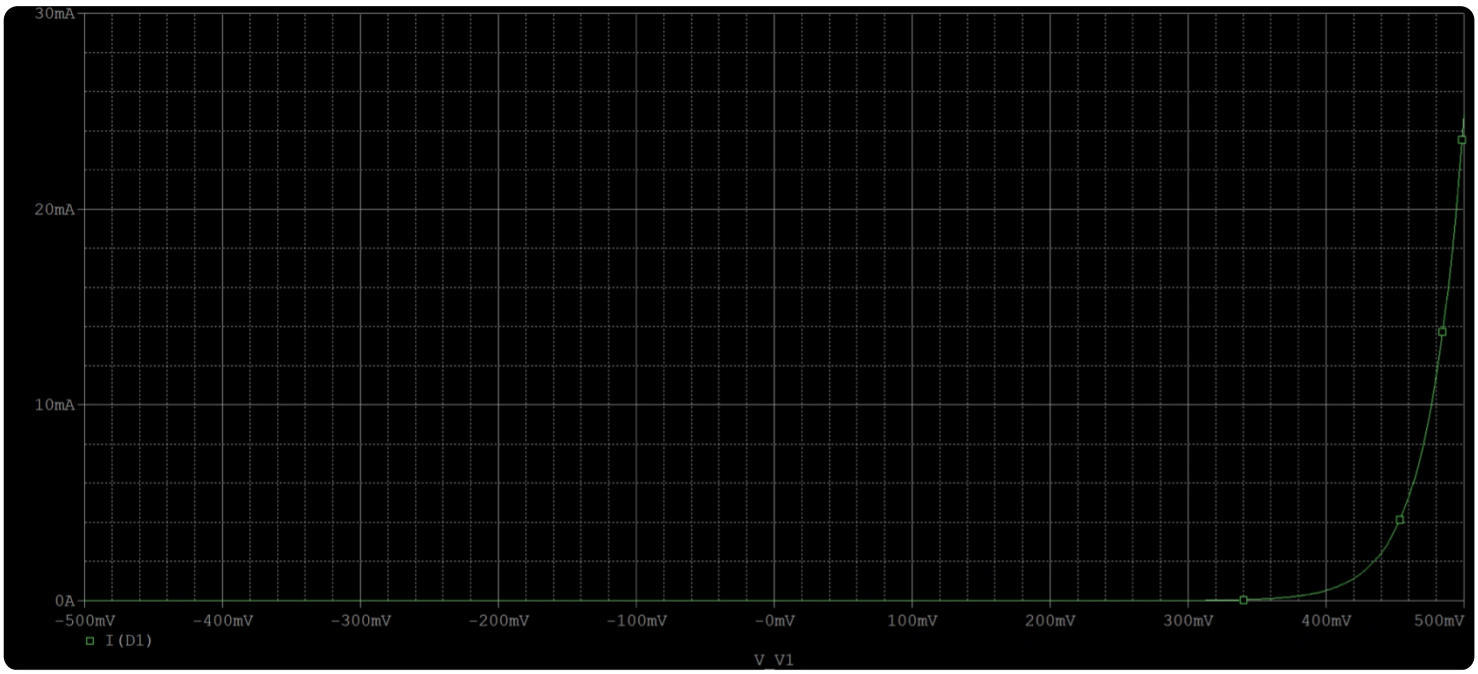
$$\Rightarrow I_{D2} = \frac{V_x - 0.7}{1.5} \approx 1.0314\ mA$$

$$I_{R2} = \frac{V_x}{2.2} \approx 1.0214\ mA$$

3.

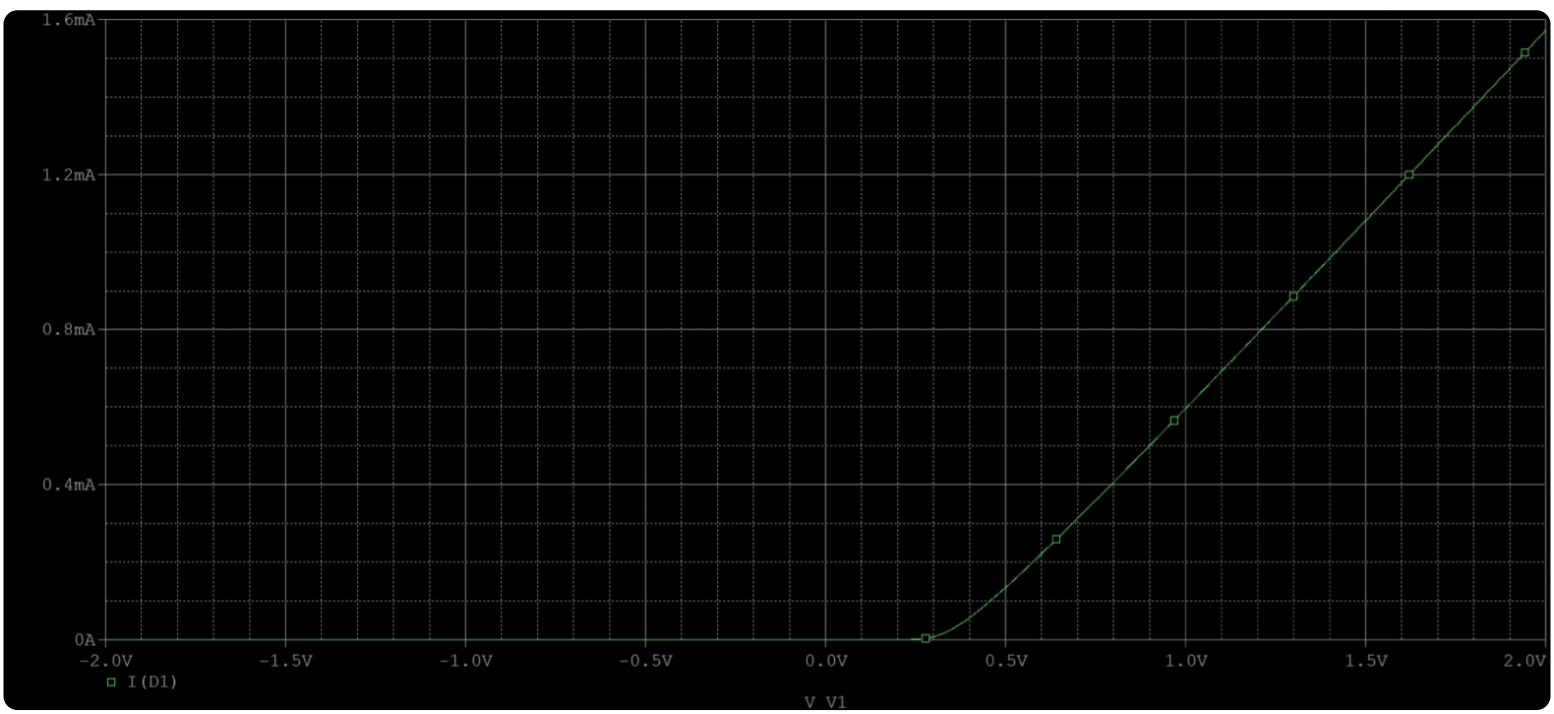
Sample Plot:

(a)



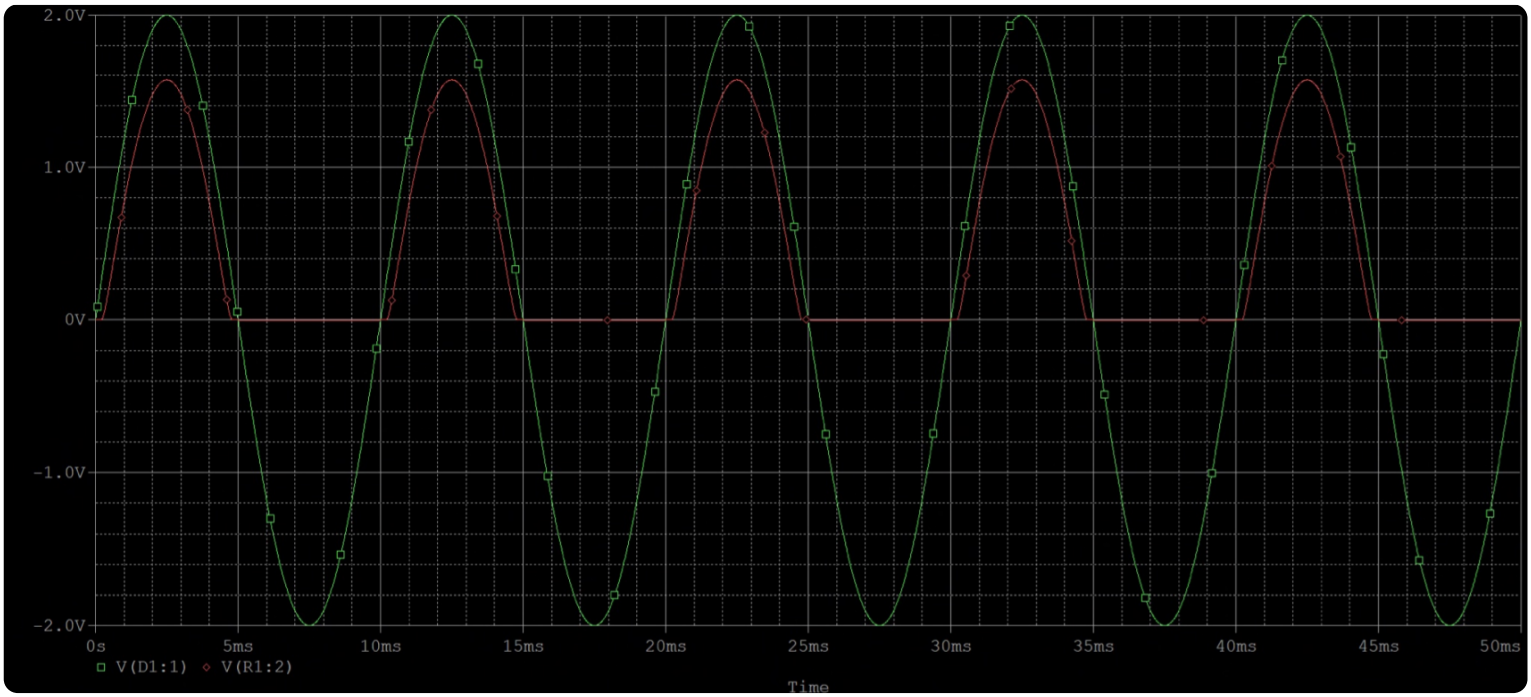
$V_{on} = 0.4V$ ($0.3V \sim 0.5V$ is all OK)

(b)

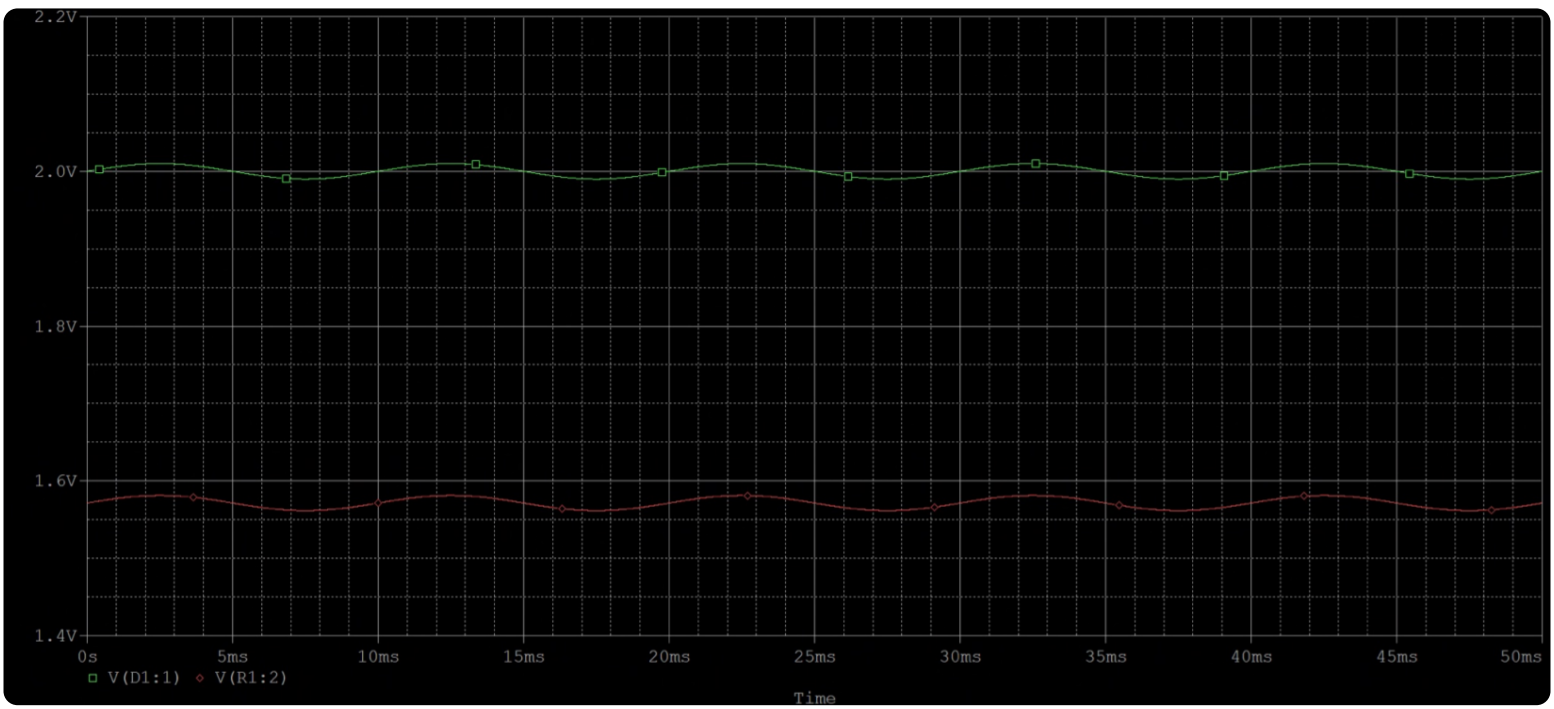


$I_D = \frac{V_{in} - V_D}{R}$ => linear increase with slope $\frac{1}{1000}$

(c)


2.0V
1.0V
0V
-1.0V
-2.0V
0s
5ms
10ms
15ms
20ms
25ms
30ms
35ms
40ms
45ms
50ms
V(D1:1)
V(R1:2)
Time

(d)


2.2V
2.0V
1.8V
1.6V
1.4V
0s
5ms
10ms
15ms
20ms
25ms
30ms
35ms
40ms
45ms
50ms
V(D1:1)
V(R1:2)
Time