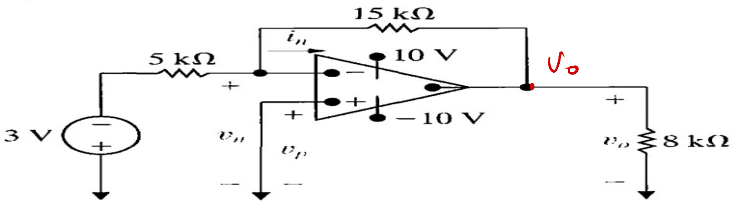
d) Calculate v_o.

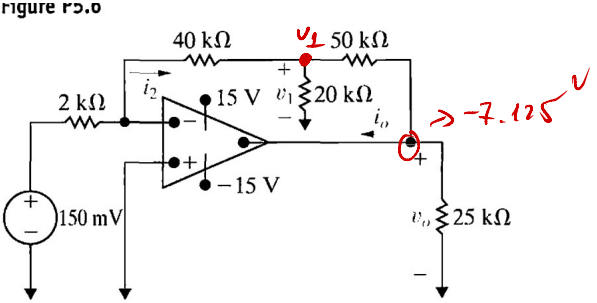
Figure P5.1



$$\frac{3}{5k} - \frac{V_o}{15k} = 0 \Rightarrow V_o = 9\,V$$

$$10 \angle \frac{V_{in}}{5k} - \frac{9}{15k} \angle -10$$

Figure P5.6

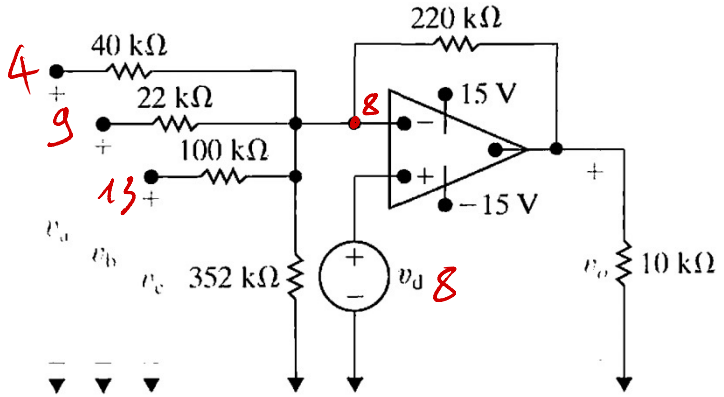


$$\frac{-0.15}{2000} + \frac{0 - V_1}{20000} = 0$$

$$\Rightarrow V_1 = -1.5\,V$$

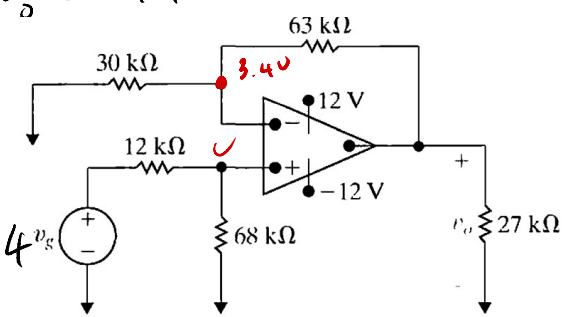
$$\frac{V_1}{60k} + \frac{V_1}{20k} + \frac{V_1 - V_o}{60k} = 0$$

$$\Rightarrow v_o = -7.125\,V$$



$$\frac{8-4}{40k} + \frac{8-9}{22k} + \frac{8-13}{100k} + \frac{8-0}{352k} + \frac{8-V_o}{220k}$$

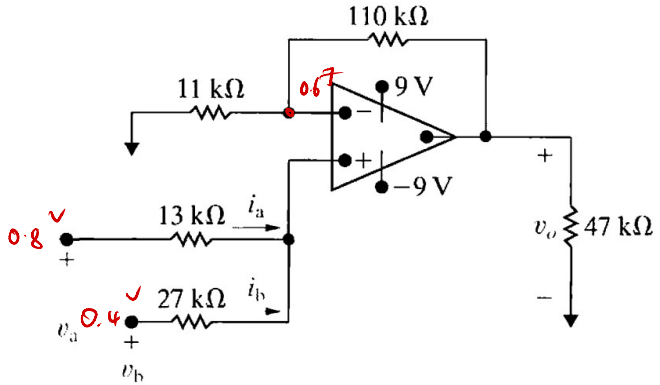
$$\Rightarrow V_o = 14\ V$$



$$\frac{V-4}{12k} + \frac{V}{68k} = 0 \rightarrow V = 3.4\ V$$

$$\frac{3.4}{30k} + \frac{3.4 - V_o}{65k} = 0$$

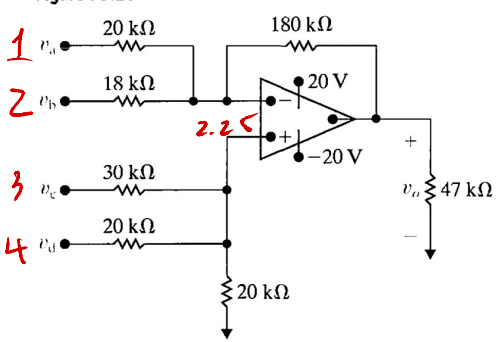
$$\Rightarrow V_o = 10.54$$



$$\frac{V-0.8}{13K}+\frac{V-0.4}{27K}=0 \Rightarrow V=0.67^{V}$$

$$\frac{V}{11K}+\frac{V-V_o}{110K}=0 \rightarrow V_o=7.37^{V}$$

Figure P5.28



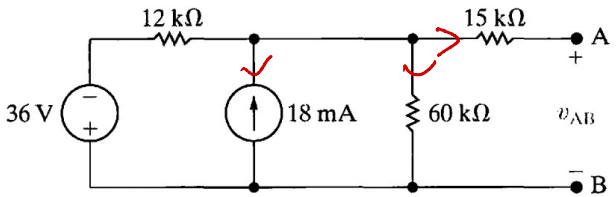
$$\frac{V-3}{30K}+\frac{V-4}{20K}+\frac{V}{20K}=0 \rightarrow V=2.25^{V}$$

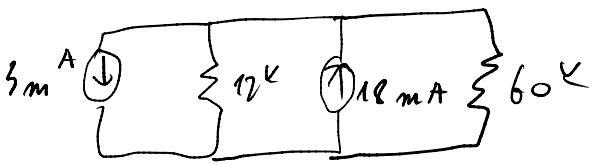
$$\frac{2.25-1}{20K}+\frac{2.25-2}{15K}+\frac{2.25-V_o}{180K}=0$$

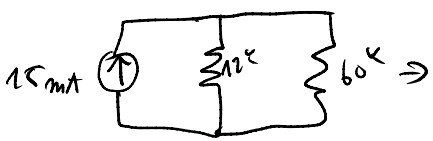
$$\Rightarrow V_o=16$$

$$-V_{cc} \le v_o \le V_{cc}$$

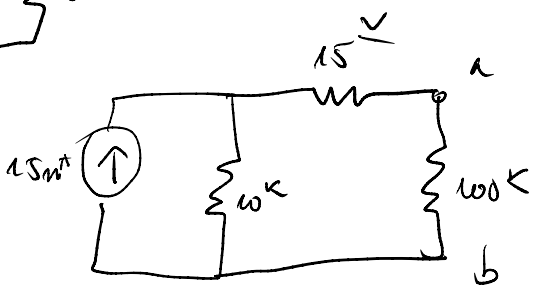
$$\Rightarrow v_o=9$$

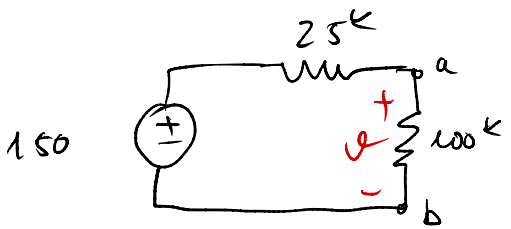






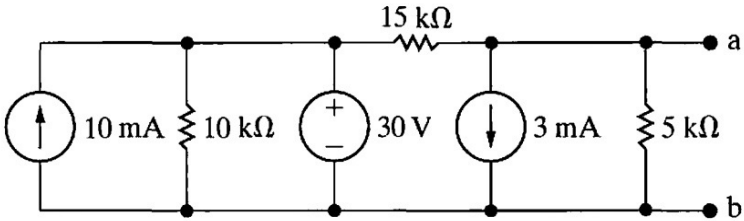
$\Rightarrow$

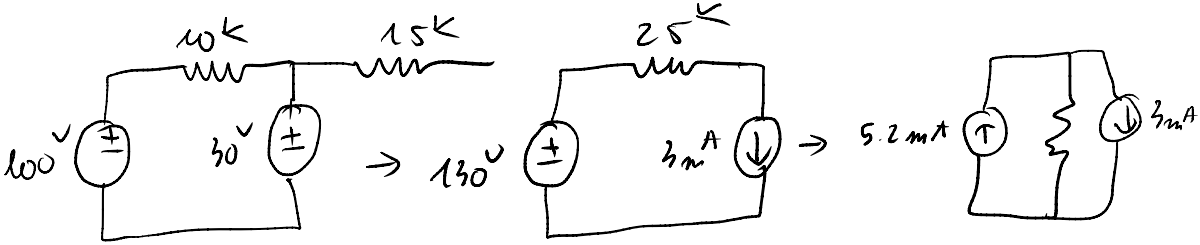


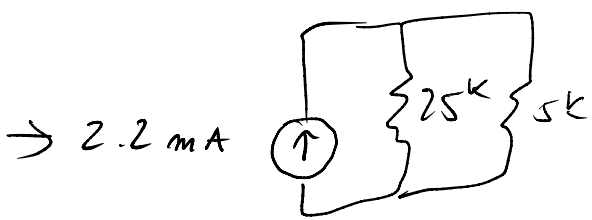


$$V_{ab} = 150 \frac{100K}{100K + 120K} = 120V$$

$$= V_{th}$$



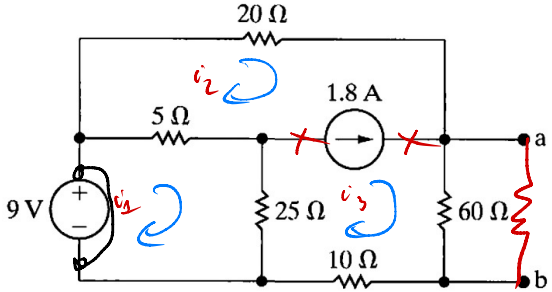




$$\Rightarrow i_{ab} = 2.2 \times 10^{-3} \times \frac{25^{K}}{25^{K} + 5^{K}}$$

$$= 1.83 \text{ mA}$$

$$V_{Ab} = 5^{K} \times i_{ab} = 9.167 \text{ (V)}$$



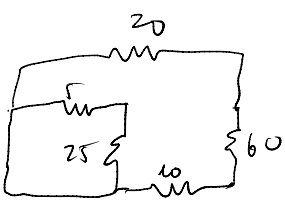
Loop 1 : $-9 + 5(i_1 - i_2) + 25(i_1 - i_3)$

Loop (1)(2) : $20i_2 + 5(i_2 - i_1) + 25(i_3 - i_1) + 10i_3 + 60i_3 = 0$

$\Leftrightarrow$

$$i_1 - i_2 = 1.8$$

$$\rightarrow \begin{cases} i_1 = 0.5 \\ i_2 = -1.5 \\ i_3 = 0.5 \end{cases} \rightarrow V_{th} = 0.5 \times 60 = 30\ V$$



$$60 \,||\, (20 + 10) = \frac{60 \times 30}{60 + 30} = 20\ \Omega$$