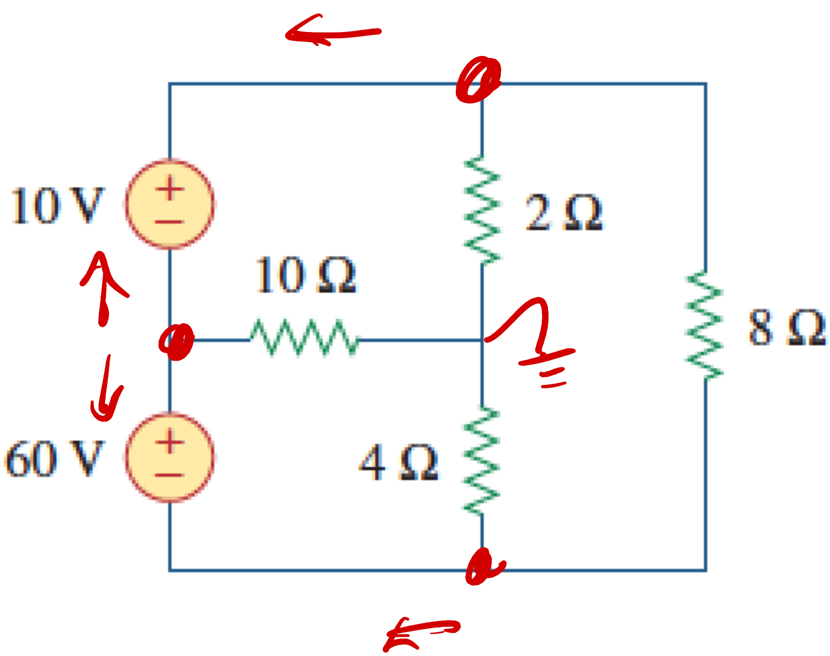
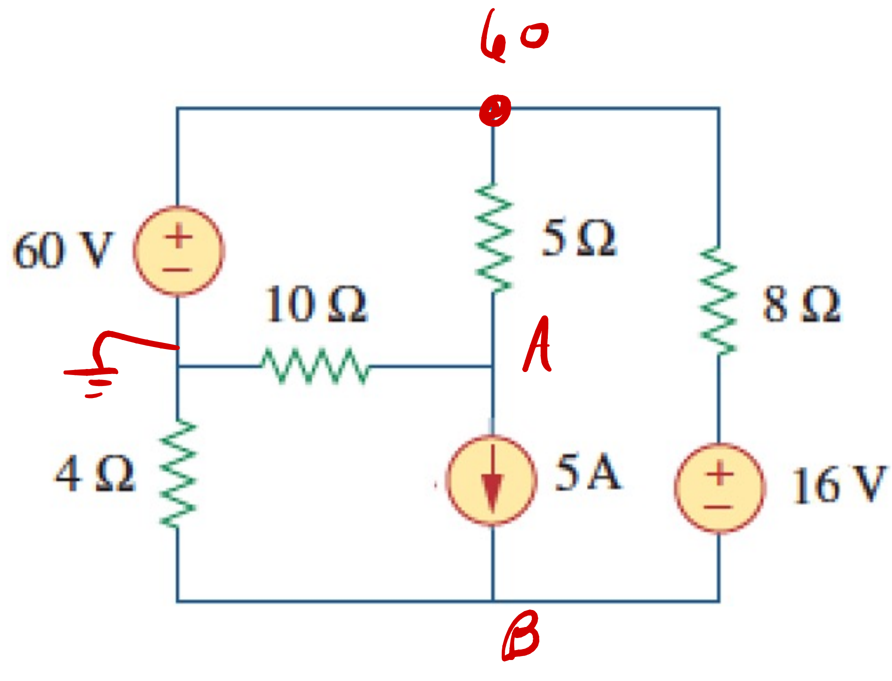
Lecture 12
Node Analysis – 5 of 7

supernodes

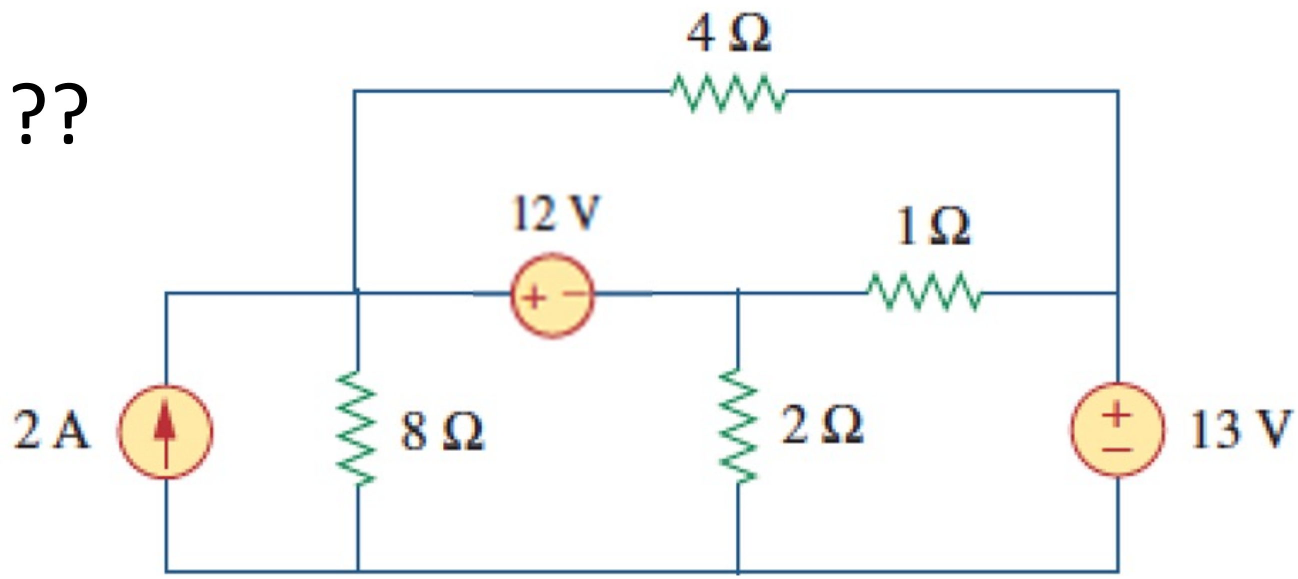
Extension #4 – multiple V-only branches

- There might be an obvious solution

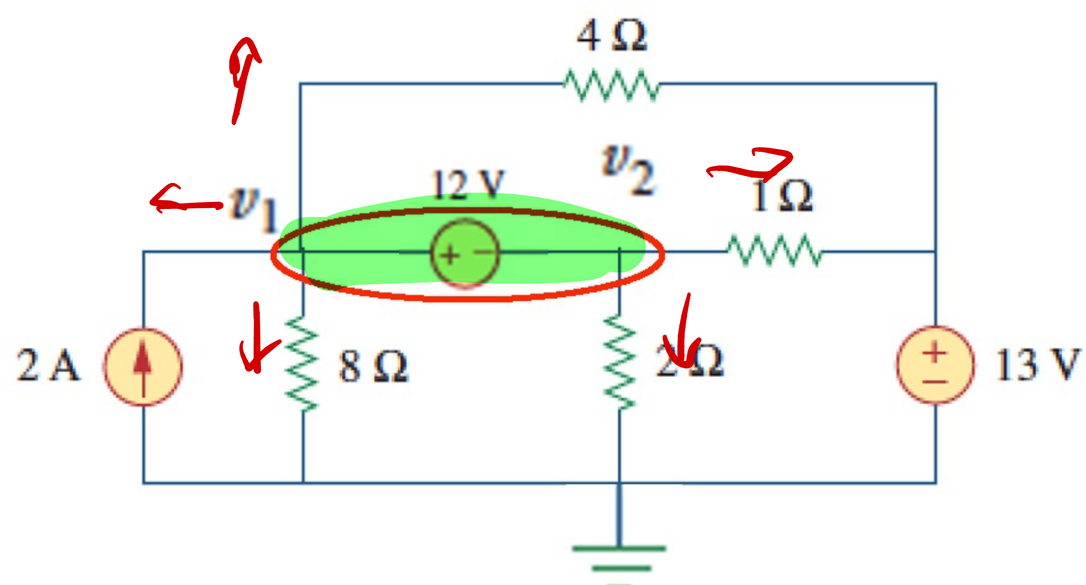




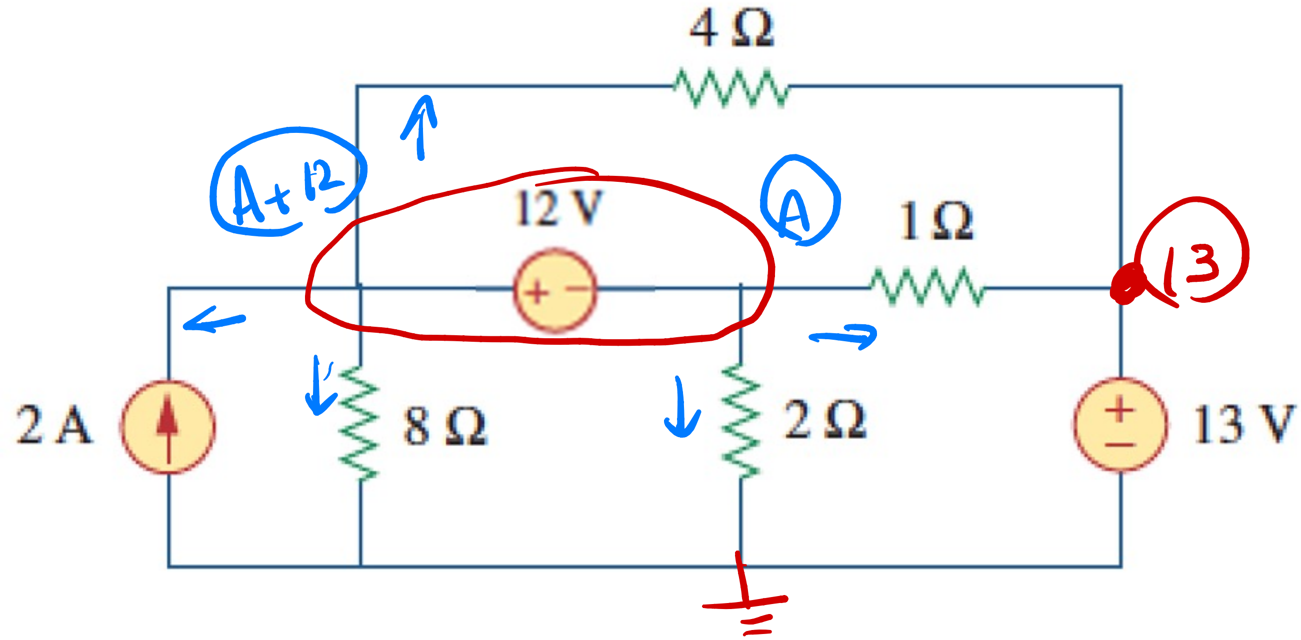
But sometimes ??



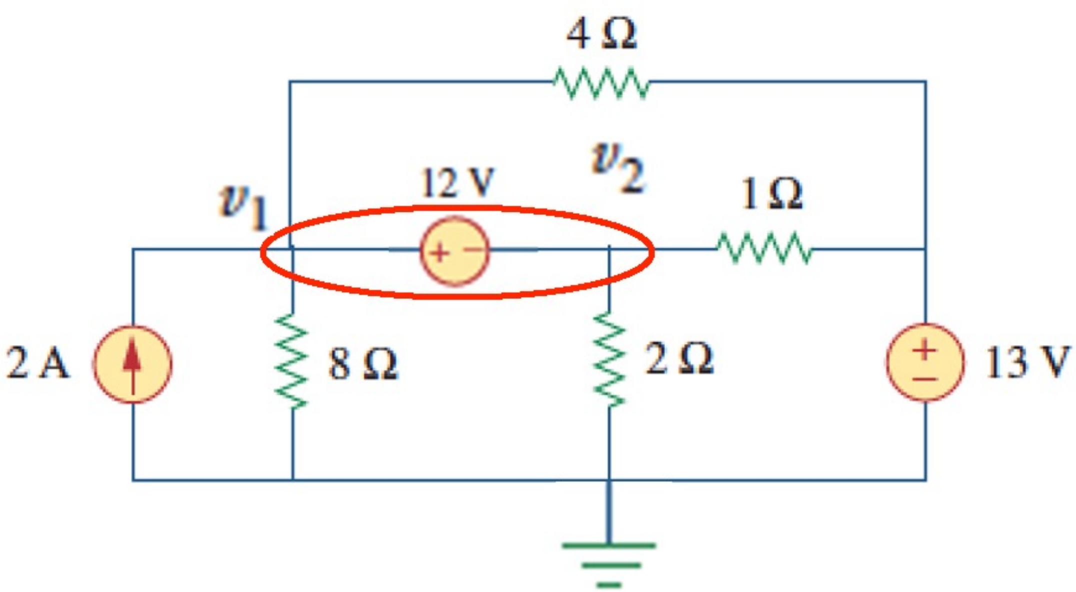
- Define a "supernode" (a cutset)
- Apply KCL on it
- Relate the voltages across it



Example (details on next slide)



$$-2 + \frac{A+12}{8} + \frac{A}{2} + \frac{A-13}{1} + \frac{A+12-13}{4} = 0$$



Relate nodes:

$$v_2 = v_1 - 12$$

Node equation:

$$\frac{v_1}{8} - 2 + \frac{v_1 - 13}{4} + \frac{v_2 - 13}{1} + \frac{v_2}{2} = 0$$

$$3v_1 + 12v_2 = 146$$

$$3v_1 + 12(v_1 - 12) = 146$$

$$15v_1 = 290$$

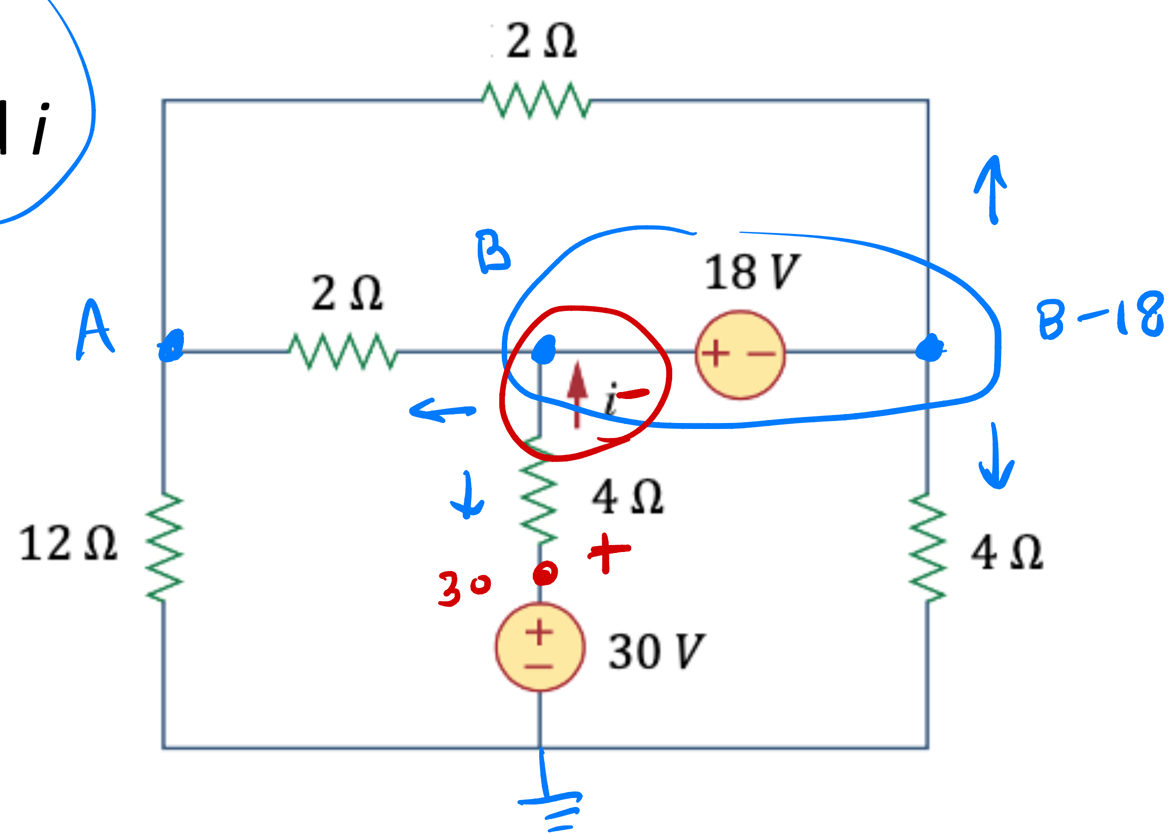
$$v_1 = 19\frac{1}{3}$$

$$v_2 = 7\frac{1}{3}$$

Example: find i

1- labelling

2- KCL

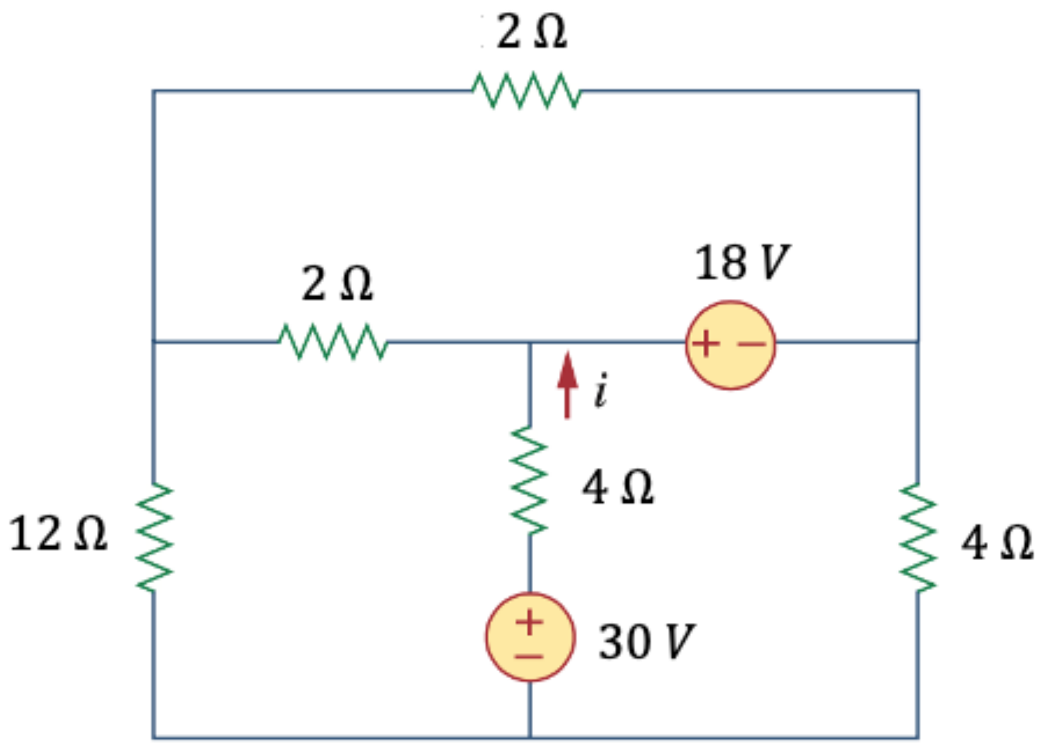


$$A: \quad \frac{A}{12} + \frac{A-B}{2} + \frac{A-(B-18)}{2} = 0$$

$$\text{supernode}: \quad \frac{B-A}{2} + \frac{B-30}{4} + \frac{B-18-A}{2} + \frac{B-18}{4} = 0$$

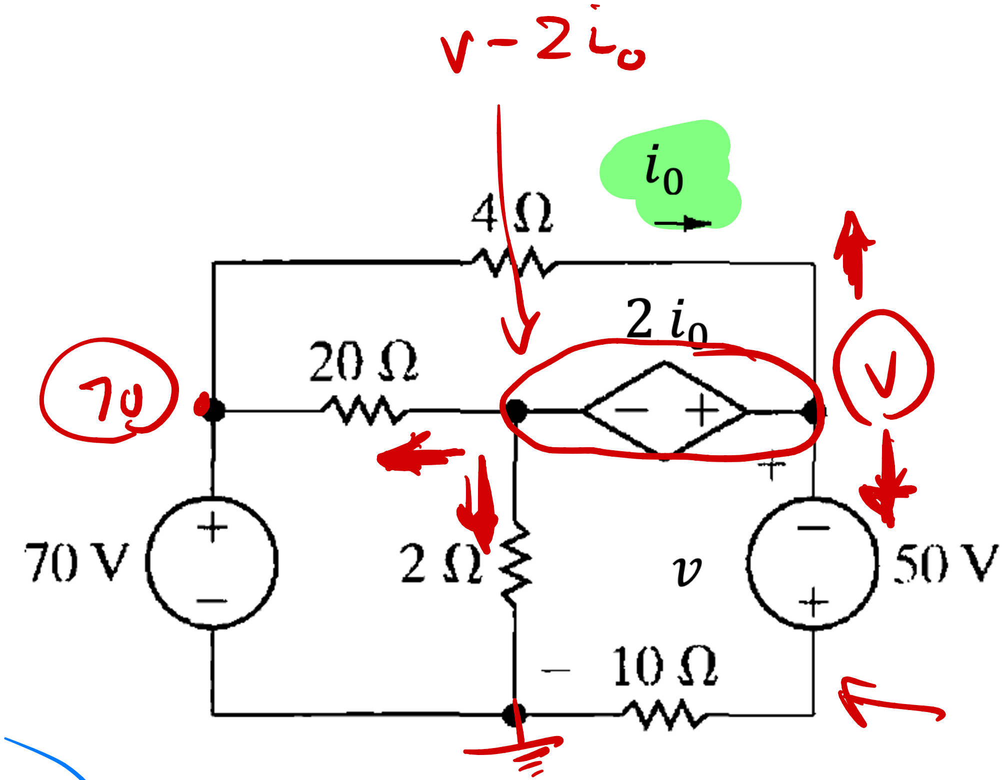
3- solve for A, B ...

4- $\boxed{i = \frac{30-B}{4}}$



$i = 2\ A$

Example: find v



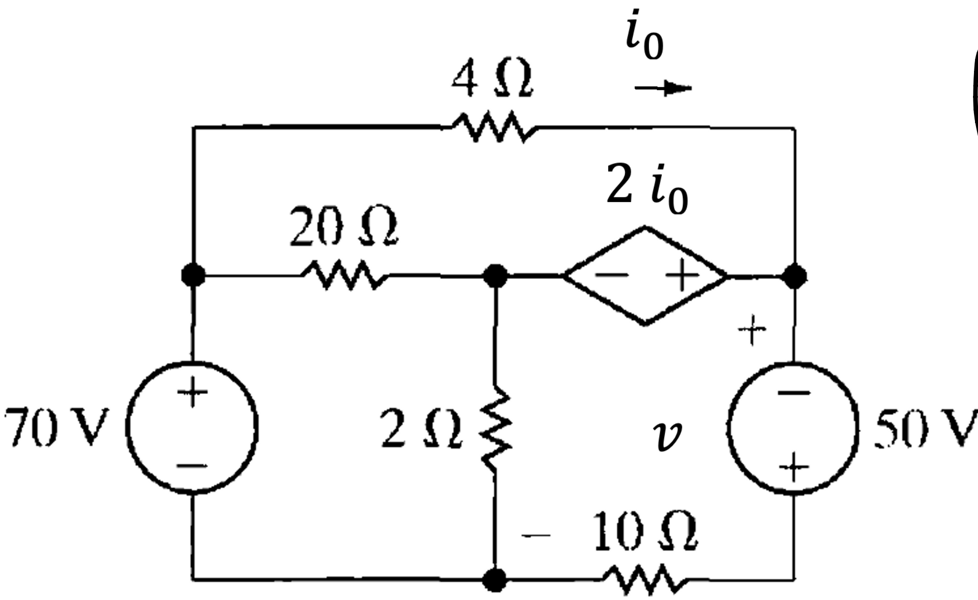
1- labelled

2- define i_o

$$i_o = \frac{70 - V}{4}$$

3- KCL on supernode

$$\frac{V - 2i_o - 70}{20} + \frac{V - 2i_o}{2} + \frac{V + 50}{10} \cancel{- i_o} \; \frac{V - 70}{4} = 0$$



4. solve Cramer

$$\boxed{\begin{aligned} 4i_0 + v &= 70 \\ -22\,i_0 + 18v &= 320 \end{aligned}}$$

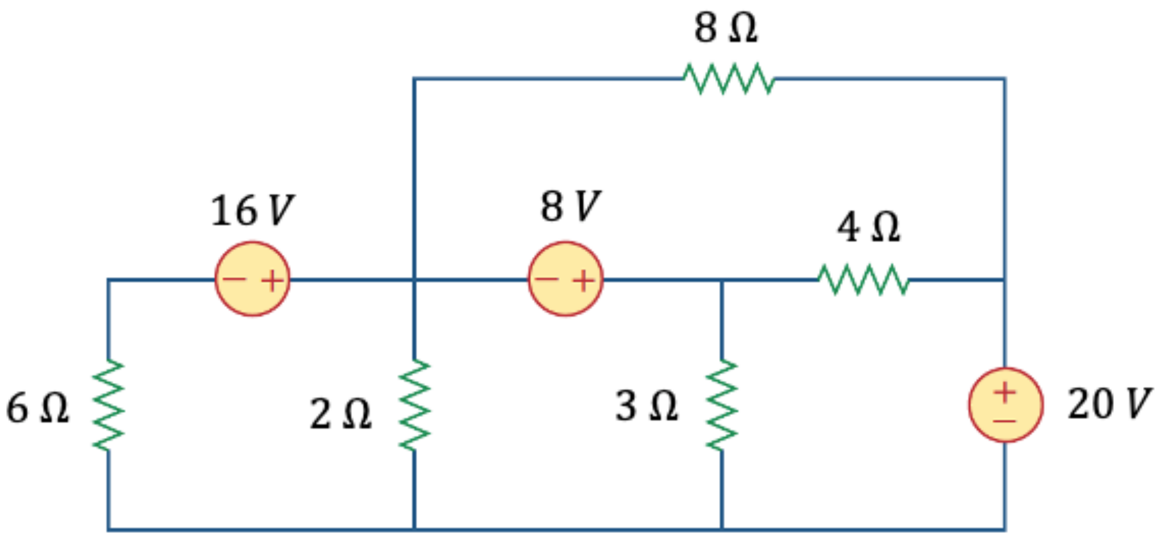
$v = 30\ V$

$$v = \frac{\begin{vmatrix} 4 & 70 \\ -22 & 320 \end{vmatrix}}{\begin{vmatrix} 4 & 1 \\ -22 & 18 \end{vmatrix}} = \frac{1280 + 1540}{72 + 22 \quad 94}$$

$$V = \frac{2820}{94} = \boxed{30\ V}$$

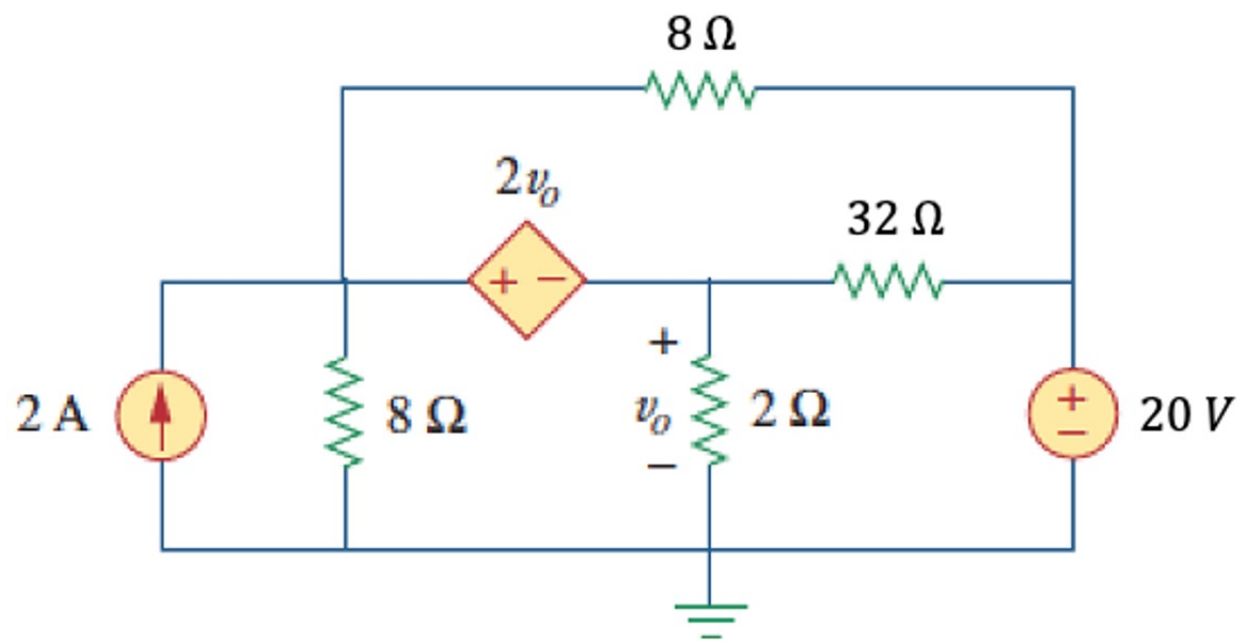
48 W

Practice problem: find the power of the 3 Ω resistor



$v_0 =$

Practice problem: find v_o



$v_0 =$

Practice problem : find v_o