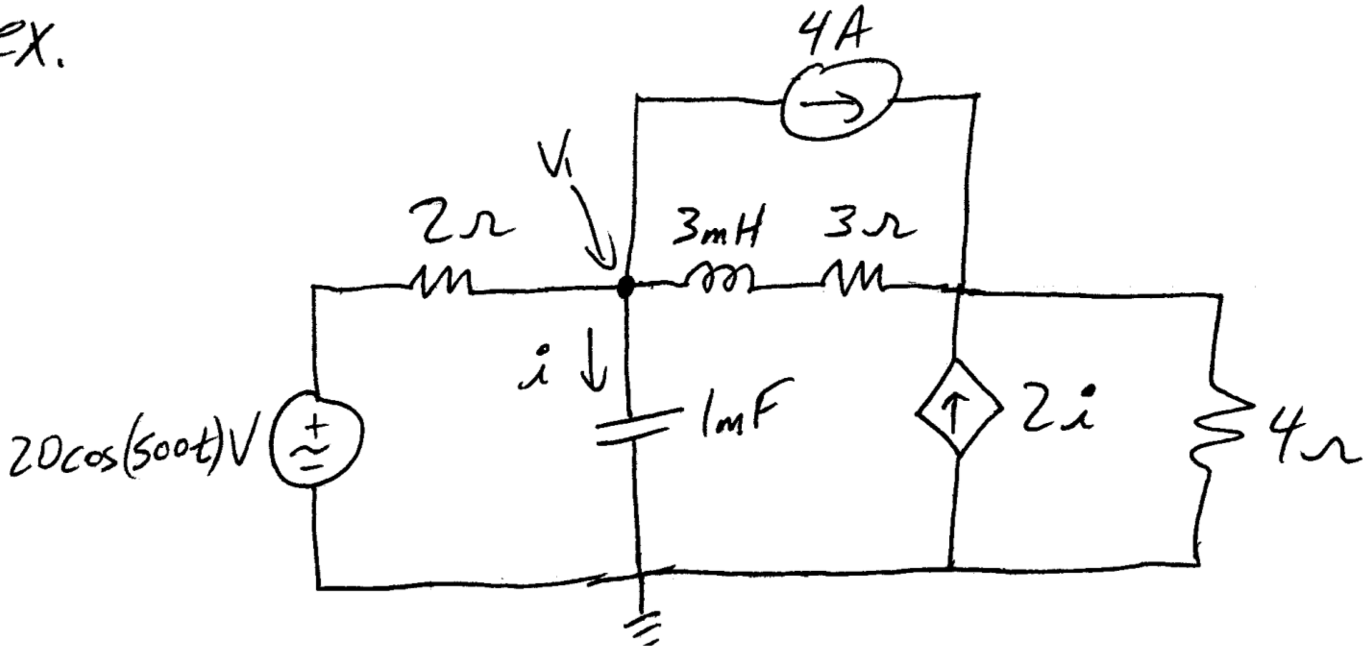
Determine the node voltage $v_1(t)$ using the Principle of Superposition.

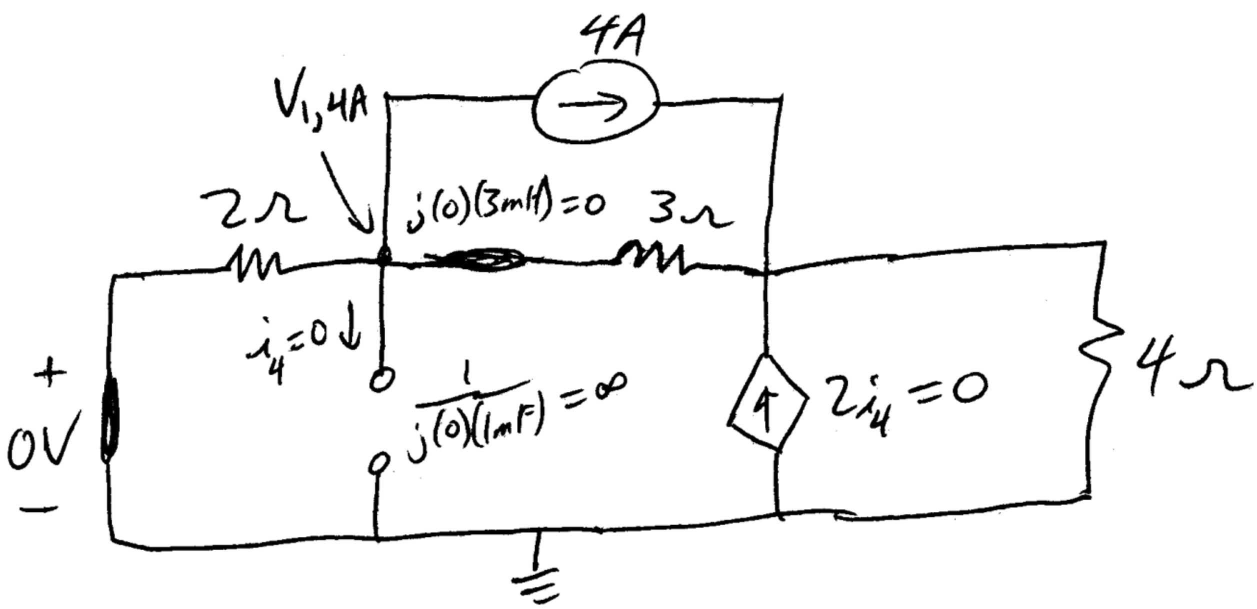
ex.



$\Rightarrow$ 2 independent sources

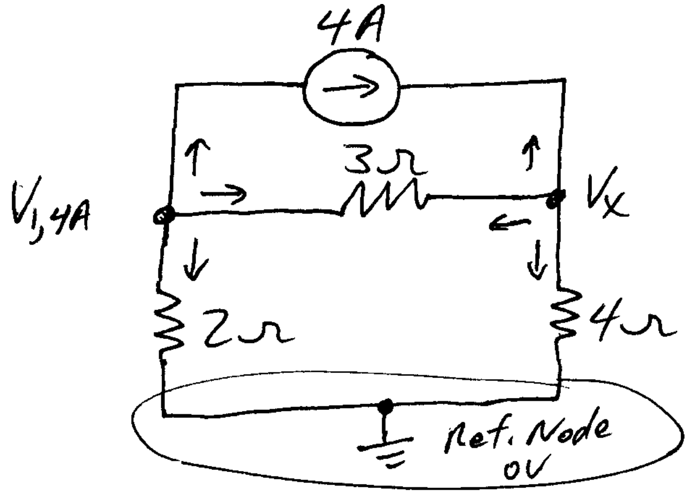
① 4A DC ($\omega = 0$) current source

(set voltage source to zero)



$\Downarrow$ Simplify ckt

ex. cont.



KCL @ Node 1 $\quad 4 + \frac{V_{1,4A} - 0}{2} + \frac{V_{1,4A} - V_x}{3} = 0$

KCL @ Node X $\quad -4 + \frac{V_x - V_{1,4A}}{3} + \frac{V_x - 0}{4} = 0$

$\Downarrow$ Put in standard form

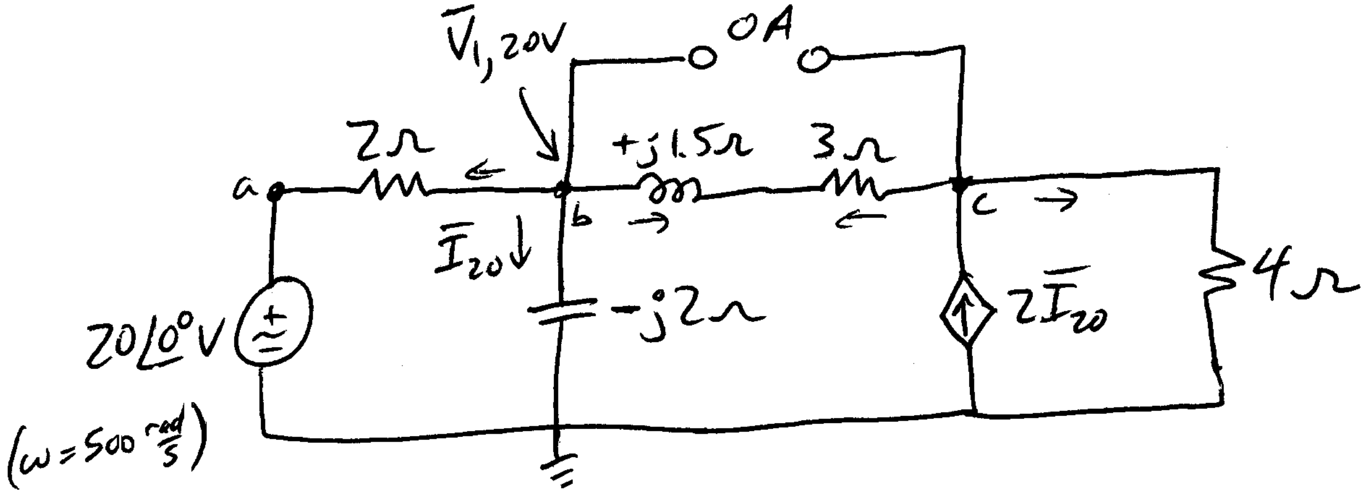
$$\left[\frac{1}{2} + \frac{1}{3}\right] V_{1,4A} + \left[\frac{-1}{3}\right] V_x = -4$$

$$\left[-\frac{1}{3}\right] V_{1,4A} + \left[\frac{1}{3} + \frac{1}{4}\right] V_x = 4$$

$\Downarrow$ solve

$$\underline{\underline{V_{1,4A} = -2.\overline{66}\ V}} \quad \text{and} \quad V_x = 5.\overline{33}\ V$$

(2) 20V Sinusoidal Source ($\omega = 500$ rad/s)
(set indep. current source to zero)



ex. cont.

(2) cont. Use Nodal Analysis

Node a: $\bar{V} = 20\angle 0^\circ V$

Node b: $$\frac{\bar{V}_{1,20V} - \overset{\bar{V}_a}{20\angle 0^\circ V}}{2\Omega} + \cancel{\bar{I}_{20}}^{\frac{V_{1,20V}}{-j2\Omega}} + \frac{\bar{V}_{1,20V} - \bar{V}_c}{(3+j1.5\Omega)} = 0$$

$$\left[\frac{1}{2} + \frac{1}{-j2} + \frac{1}{3+j1.5}\right]\bar{V}_{1,20V} + \left(\frac{-1}{3+j1.5}\right)V_c = \frac{20\angle 0^\circ}{2}$$

Node c: $$\frac{\bar{V}_c - \bar{V}_{1,20V}}{3+j1.5} - 2\cancel{\bar{I}_{20}}^{\frac{V_{1,20V}}{-j2\Omega}} + \frac{\bar{V}_c}{4} = 0$$

$$\left[\frac{-1}{3+j1.5} + \frac{-2}{-j2}\right]\bar{V}_{1,20V} + \left[\frac{1}{3+j1.5} + 1/4\right]\bar{V}_c = 0$$

2 eqn – 2 unknowns (use TI-68)

$\bar{V}_{1,20V} = 18.85 + j2.743 V$ $\qquad \bar{V}_c = -3.18584 + j32.212 V$

$= 19.05\angle 8.28^\circ V$

(3) $V_1(t) = Re\{-2.\overline{66} e^{j0t}\} + Re\{19.05\angle 8.28^\circ e^{j500t}\}$

$$V_1(t) = -2.\overline{66} + 19.05\cos(500t + 8.3^\circ)\ V$$