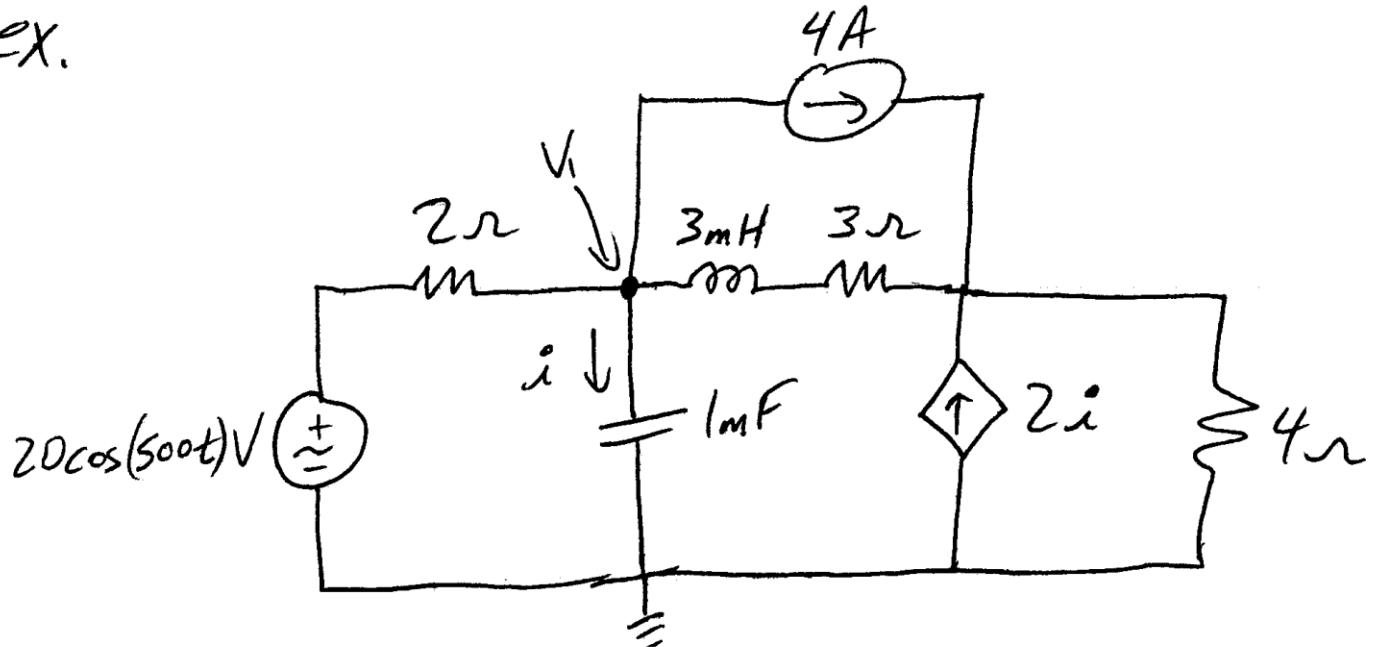


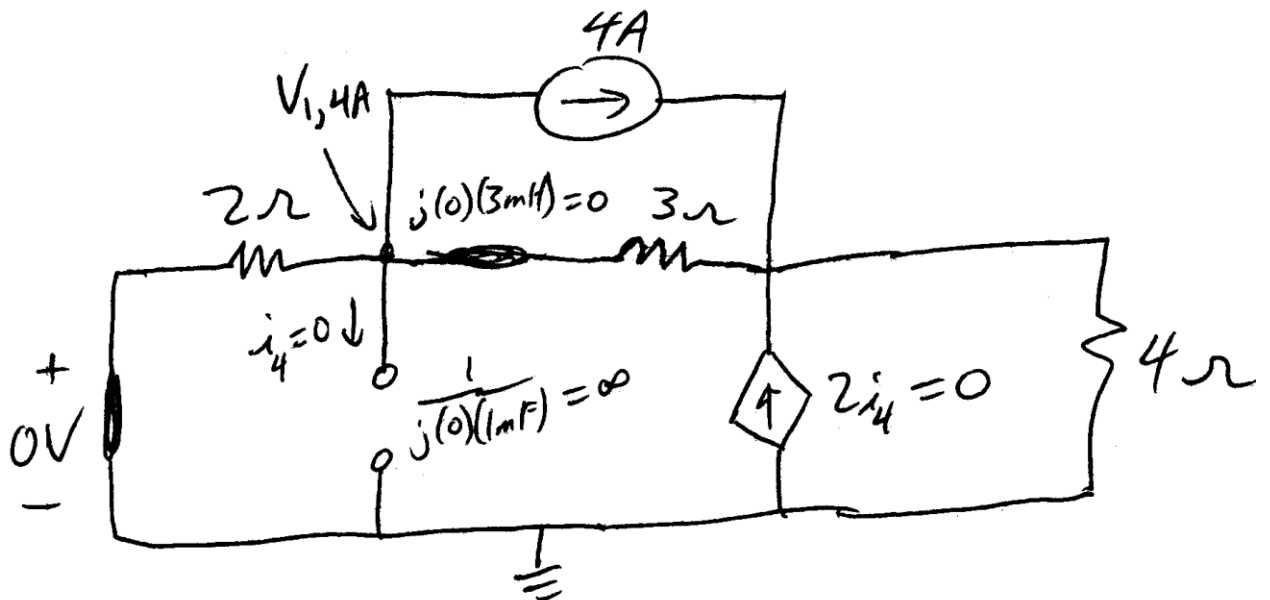
Determine the node voltage $v_1(t)$ using the Principle of Superposition.

ex.



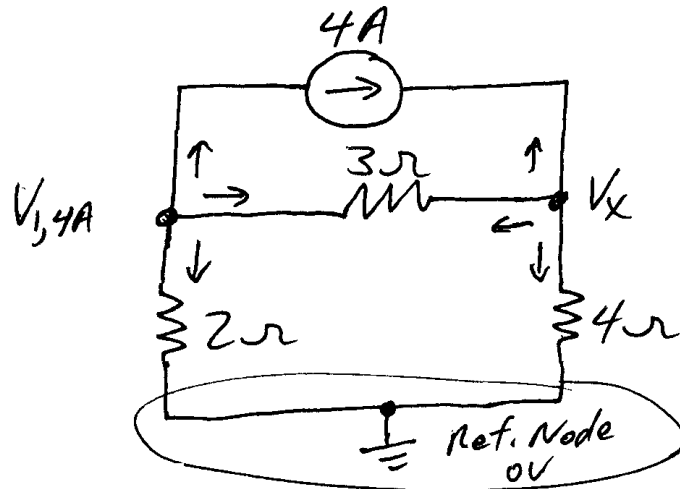
⇒ 2 independent sources

- ① 4A DC ($\omega=0$) current source
(set voltage source to zero)



⇓ Simplify ckt

ex. cont.



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

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

⇓ Put in standard form

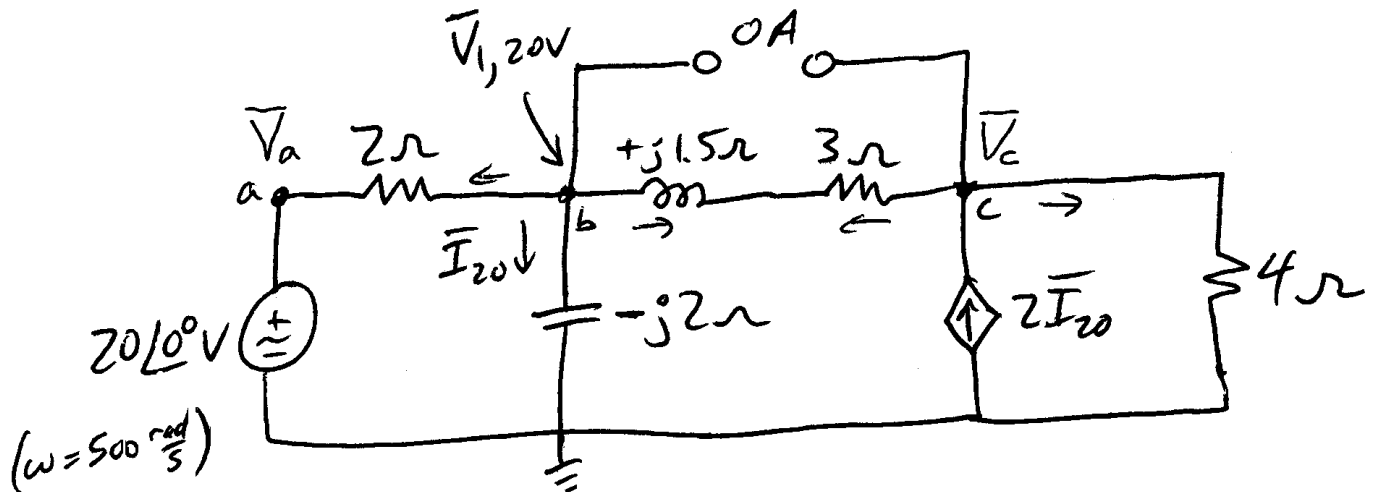
$$\left[\frac{1}{2} + \frac{1}{3}\right] V_{1,4A} + \left[-\frac{1}{3}\right] V_x = -4$$

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

⇓ solve

$$\underline{V_{1,4A} = -2.66\text{ V}} \quad \text{and} \quad V_x = 5.33\text{ V}$$

② 20V sinusoidal source ($\omega = 500\text{ rad/s}$)
(set indep. current source to zero)



ex. cont.

② cont. Use Nodal Analysis

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

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

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

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

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

2 eqn - 2 unknowns (use TI-68) ↲

$$\begin{aligned} \bar{V}_{1,20\text{V}} &= 18.85 + j2.743 \text{ V} & \bar{V}_c &= -3.18584 + j32.212 \text{ V} \\ &= \underline{19.05 \angle 8.28^\circ \text{ V}} \end{aligned}$$

③ $V_1(t) = \text{Re}\{-2.66 e^{j0t}\} + \text{Re}\{19.05 \angle 8.28^\circ e^{j500t}\}$

$$V_1(t) = -2.66 + 19.05 \cos(500t + 8.3^\circ) \text{ V}$$