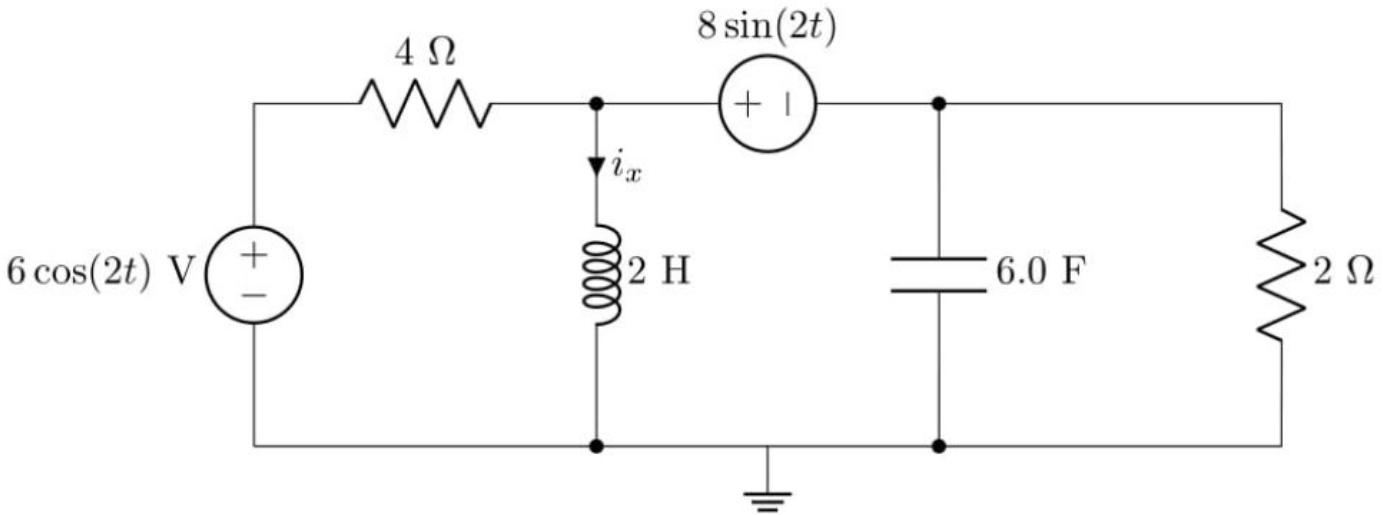
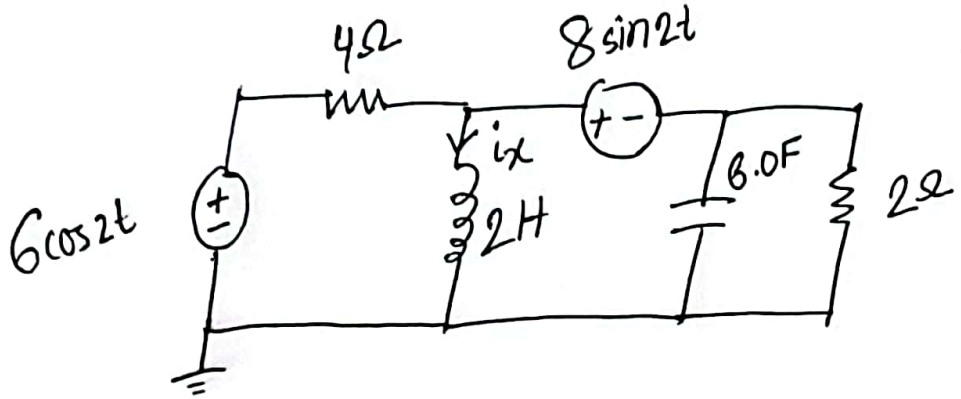


1) Redraw the circuit with **complex number values**. [6 marks]

2) Identify and CLEARLY write all the node equations. [10 marks]

3) Solve them and figure out the node voltages. [2 marks]

4) What is the value of current through the inductor,
ix(t) as a function of time? (not complex value) [2 marks]



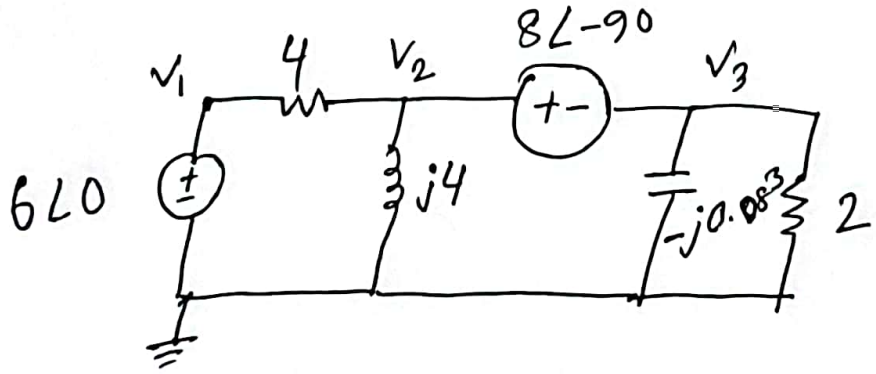
Here, $\boxed{\omega = 2 \quad , \quad 6\cos 2t = 6\angle 0 \quad , \quad 8\sin 2t = 8\angle -90^\circ}$

So,

$$Z_L = j\omega L = j \times 2 \times 2 = j4\ \Omega$$

$$Z_c = \frac{1}{j\omega C} = \frac{1}{j \times 2 \times 6} = \frac{1}{j12}\ \Omega = 0.083(-j)\ \Omega$$

Ans 1: Redraw with Complex Values



Ans 2: node 1: $V_1 = 6\angle 0$

node (2&3) → Supernode

$$V_2\left(\frac{1}{4} + \frac{1}{j4}\right) - \frac{V_1}{4} + V_3\left(\frac{1}{-j0.083} + \frac{1}{2}\right) = 0 \quad \text{—— (II)}$$

$$V_2 - V_3 = 8\angle -90 \quad \text{—— (III)}$$

Eqn (II) $\Rightarrow$ (Value of V_1) $\frac{1}{-j0.083} = j12$

$$V_2\left(\frac{1}{4}+\frac{1}{j4}\right) - \frac{6}{4} + V_3\left(j12+\frac{1}{2}\right) = 0$$

or, $$V_2\left(\frac{1}{4}+\frac{1}{j4}\right) + V_3\left(j12+\frac{1}{2}\right) = \frac{6}{4}$$

from Eqn (III) $\Rightarrow$

$$V_2 = V_3 + 8\angle -90 = V_3 + 8(-j) = V_3 - 8j$$

$$\left(V_3 + 8\angle -90\right)\left(\frac{1}{4}+\frac{1}{j4}\right) + V_3\left(j12+\frac{1}{2}\right) = \frac{6}{4}$$

or, $$V_3\left(\frac{1}{4}+\frac{1}{j4}\right) + \left(8\angle -90\right)\left(\frac{1}{4}+\frac{1}{j4}\right) + V_3\left(j12+\frac{1}{2}\right) = \frac{6}{4}$$

or, $$V_3\left(\frac{1}{4}+\frac{1}{j4}+j12+\frac{1}{2}\right) = \frac{6}{4} - \left(8\angle -90\right)\left(\frac{1}{4}+\frac{1}{j4}\right)$$

or, $$V_3 = \frac{6/4 - \left(8\angle -90\right)\left(\frac{1}{4}+\frac{1}{j4}\right)}{\left(\frac{1}{4}+\frac{1}{j4}+j12+\frac{1}{2}\right)}$$

$$\therefore V_3 = -\frac{\cancel{107}}{\cancel{1109}} - j\frac{\cancel{341}}{\cancel{1109}} \frac{209}{1109} - j\frac{317}{1109}$$

$$\therefore V_2 = V_3 + 8\angle -90 = V_3 - j8 = \frac{209}{1109} - j\frac{9189}{1109}$$

Ans: 4

$$i_x = \frac{V_2}{j4} = -\frac{9189}{4436} - j\frac{209}{4436}$$

converting to r∠θ format

$$i_x = 2.07 \angle -178.69^\circ$$

$$\therefore i_x(t) = 2.07 \cos(2t - 178.69^\circ)$$