

$$\begin{aligned}
 -v(t) + 7i + 5 \frac{di}{dt} + L \frac{di'}{dt} - \frac{v}{4H} - \frac{v}{3H} &= 0 \\
 \Leftrightarrow -v(t) + 7i + 5 \frac{di}{dt} &= 0
 \end{aligned}$$

**Mutual Inductor**

**KVL:**

- Enter  $\rightarrow$  air con lèn (+) during tui ngay do +
- Polarity phai doi + (en dot)  $(+ -)$

$$L = 1H$$

$$L \frac{di'}{dt} = \frac{v}{4H} - \frac{v}{3H} = 0$$

$$L \frac{di'}{dt} = \frac{v}{4H} - \frac{v}{3H} = 0$$

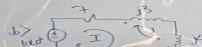
Question 1



- The circuit is shown above with mutual inductance  $M = 1H$
- (5 marks) a) Write KVL equation in time domain (do not try to solve)
- (5 marks) b) If  $v(A) = 10\cos(At)$ , Plot the current in phasor form and write KVL equation in frequency domain (phasor) (do not try to solve)

Solution Question 1:

$$\begin{aligned}
 \Rightarrow -v(t) + 7i + 3 \frac{di}{dt} + 4 \frac{di}{dt} - \frac{di}{dt} - \frac{di}{dt} &= 0 \\
 \Rightarrow -v(t) + 7i + 5 \frac{di}{dt} &= 0
 \end{aligned}$$

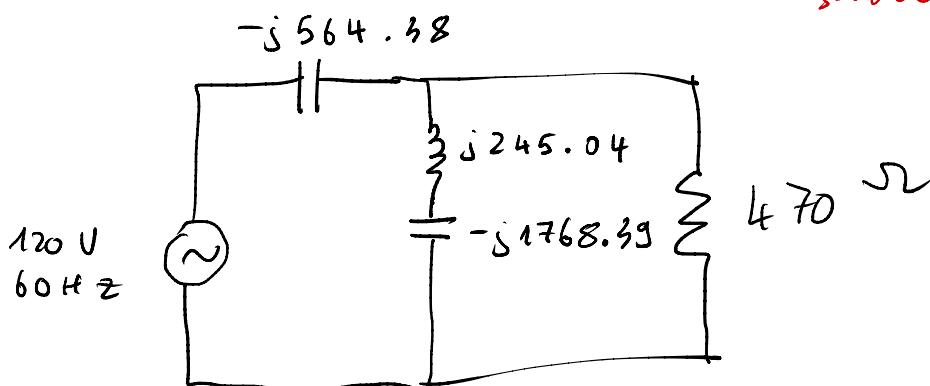


$$KVL: -10 + 7I + j3I + j4I - jI - jI = 0$$

$$\Leftrightarrow -10 + 7I + j5I = 0$$

Question 2:  $\omega = 2\pi f = 120\pi \text{ rad/s}$

sinusoidal



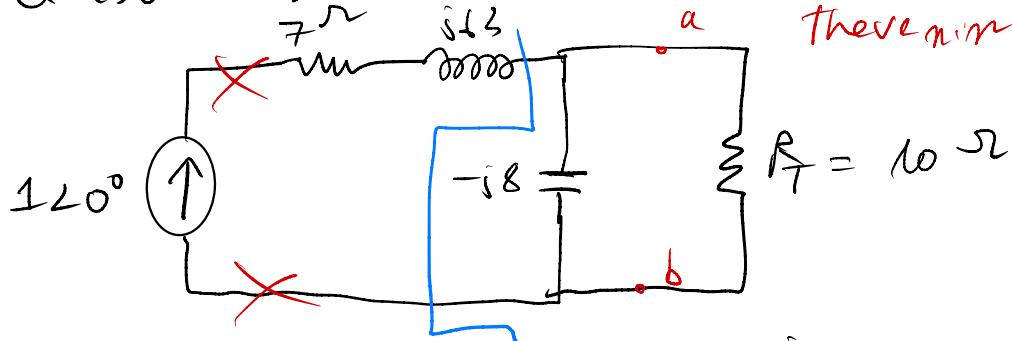
$$b) \frac{V-120}{-j 564.38} + \frac{V}{-j 1523.35} + \frac{V}{470} = 0$$

$$\Leftrightarrow V \left( \frac{1}{j 564.38} + \frac{1}{-j 1523.35} + \frac{1}{470} \right) = \frac{j 6000}{28219}$$

$$\Rightarrow V = 45.53 + j 45.40$$

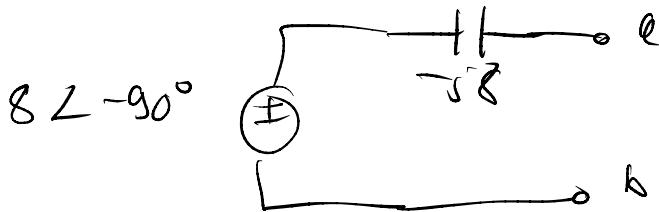
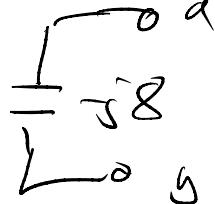
$$\Rightarrow V(t) = 65.85 \cos(120\pi t + 41.23^\circ)$$

Question 3:



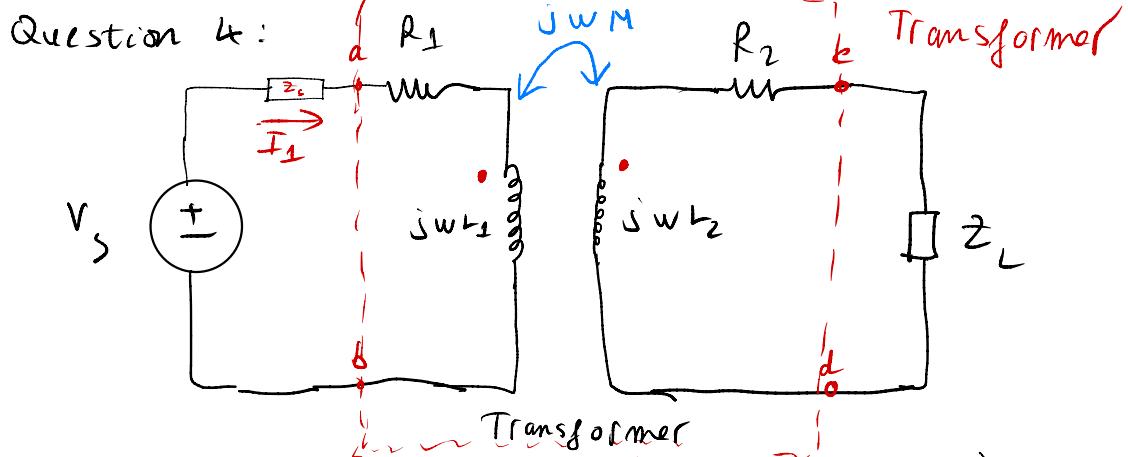
a)  $V_{th} = 120 \times (-j8) = -j8 = 8L - 90^\circ (\omega)$

$$R_{th} = -j8 \Omega$$



b)  $I_{R_T} = \frac{V_{th}}{-j8 + R_{th}} = 0.39 - j0.487$

c)  $S = \frac{1}{2} |I_{R_T}|^2 R_m$   
 $= \frac{1}{2} \left( \sqrt{0.39^2 + 0.487^2} \right)^2 \times 10$   
 $= 1.95 \text{ (w)}$



$$R_1 = R_2 = 0, jwL_1 = 150 \text{ } (\Omega), jwL_2 = j20 \text{ } (\Omega)$$

$$jwM = j10 \text{ } (\Omega), V_s = 20 \angle 0^\circ \text{ (V)}, Z_s = 10 + j20 \text{ } (\Omega)$$

$$Z_L = 50 + j10 \text{ } (\Omega)$$

$$Z = a + jb$$

a) Compute the required impedance from  $Z^* = a - jb$

b) Compute the current which is flow.

Sol:

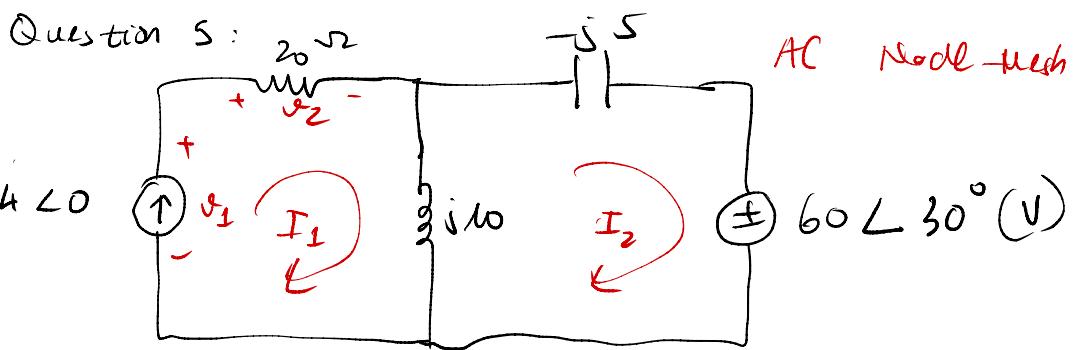
$$a) Z_{22} = R_2 + Z_L + jwL_2 = 50 + j30$$

$$Z_r = \frac{(wM)^2}{|Z_{22}|^2} Z_{22}^* = 1.471 - j0.88 \\ = 1.72 \angle -31^\circ$$

$$b) I_1 = \frac{V_s}{Z_s + R_1 + jwL_1 + Z_r}$$

$$= 0.285 \angle -80.5^\circ$$

$$I_2 = \left( \frac{jwM}{Z_{22}} \right) I_1 = ?$$



- a) What is the voltage of  $I_1$ ? and compute  $I_2$ .  
 b) KVL to compute  $v_1$   
 c) Compute the average power of voltage source.

$$P = \frac{1}{2} \operatorname{Re}[V I^*]$$

Sol:

a)  $I_1 = 4\angle 0^\circ$  (A)

$$\text{KVL: } (I_2 - I_1)j10 + I_2(-j5) + 60\angle 30^\circ = 0$$

$$\Rightarrow I_2 = 8 + j20 - 25 = 21.78 \angle 68.45^\circ$$

b) KVL:  $-v_1 + 20I_1 + j10(I_1 - I_2) = 0$

$$\Rightarrow v_1 = 282.57 - j40 = 285.42 \angle -8.05^\circ$$

$$P = \frac{1}{2} \operatorname{Re}[V_1 I_2^*] = \frac{1}{2} \times 60 \times 21.78 \cos(30^\circ - 68.45^\circ)$$

$$= 511.7 \text{ (W)}$$

Question 6:

Sol:

$$a) I_{AN} = \frac{220 \angle 0^\circ}{Z_L} = 4.83 - j 0.846 \text{ Arms}$$
$$= 4.81 \angle -11.5^\circ \text{ Arms}$$

$$b) V_{ab} = (\sqrt{3} \angle 30^\circ) \times (220 \angle 0^\circ) = 381 \angle 30^\circ \text{ Vrms}$$

$$c) P = 3 |V_{AN}| |I_{AN}| \cos \Delta \varphi$$
$$= 3 \times 220 \times 4.81 \times \cos(0 - -11.5^\circ)$$
$$= 2789.5 \text{ (W)}$$

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