Question 1

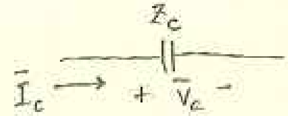
The average power in a resistor is determined in terms of rms voltage and current.

$$p = i_{rms}^2 R \quad \text{or} \quad p = v_{rms}\, i_{rms} \quad \text{or} \quad p = \frac{v_{rms}^2}{R}$$

We have $i(t) = 2\cos(120\pi t)$, so $i_{rms} = 2/\sqrt{2}$

Therefore $p = (2/\sqrt{2})^2 \times 4\,\Omega \; \boxed{= 8\,W}$

Question 2

For a capacitor,  where $Z_C = \frac{1}{j\omega C}$

Here, the phasor current is $\bar{I}_C = 2\angle 0^\circ$

$$\text{and} \quad Z_C = \frac{1}{j\omega C} = \frac{1}{j(120\pi \times 400 \times 10^{-6})}$$

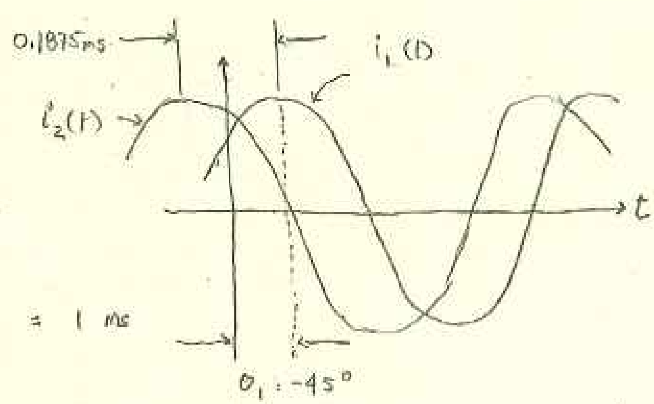
$$= -j\,6.6315\,\Omega$$

$$\text{so} \quad \bar{V}_C = Z_C \bar{I}_C = (-j\,6.6315)(2)$$
$$= -j\,13.2629$$

$$\text{therefore} \quad V_C = |\bar{V}_C| = \boxed{13.2629 \; V}$$

Question 3

A sketch often helps:



- Need to convert the time 0.1875 ms into degrees.

One period $T = \frac{1}{f} = \frac{1}{1000} = 1$ ms

Therefore 1 ms of time corresponds to 360° (one complete period)

We have a simple ratio: $\frac{0.1875\ ms}{1\ ms} = \frac{\psi}{360^\circ}$

so $\psi = 0.1875 \times 360^\circ = 67.5^\circ$

So $i_2(t)$ leads $i_1(t)$ by 67.5°.

Hence $\theta_2 = \theta_1 + \psi$
$= -45^\circ + 67.5^\circ$

$$\boxed{\theta_2 = 22.5^\circ}$$

Question 4

The voltage phasor $\tilde{V}_1 = 30\angle 30^\circ$, so peak amplitude is 30

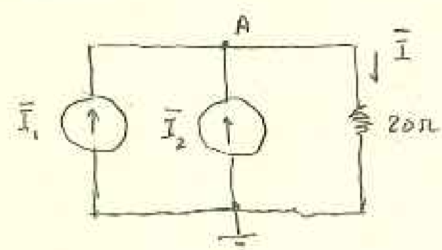
The current phasor has an RMS amplitude of 10, and leads $\tilde{V}_1$ by 40°, so $\bar{I}_1$'s phase is $30^\circ + 40^\circ = 70^\circ$

The peak amplitude of $\bar{I}_1 = \sqrt{2} \times 10 = 14.14$ A

The current phasor is $14.14\angle 70^\circ$

$$\boxed{\text{Answer is (c)}}$$

Question 5



A node-voltage equation at A

$-\bar{I}_1 - \bar{I}_2 + \bar{I} = 0$

so $\bar{I}_2 = \bar{I} - \bar{I}_1$

We are given $\bar{I}_1 = 10\angle 45^\circ$ and $\bar{I} = 8\angle 30^\circ$

so $\bar{I}_2 = 8\angle 30^\circ - 10\angle 45^\circ$
$= (6.9282 + j4) - (7.0711 + j7.0711)$
$= -0.14286 - j3.07107$

$\bar{I}_2 = 3.07439\angle -92.663^\circ$, so $\boxed{\theta_2 = -92.663^\circ}$

Question 6

From above, the peak amplitude of $i_2(t)$ was found to be

$$|I_2| = 3.07439 \text{ A}$$

And its rms value $|\bar{I}_{2,rms}| = 3.07439/\sqrt{2} = \boxed{2.1739 \text{ A}}$

Question 7

We have $\bar{V} = 400\angle 120^\circ$ and $\bar{I} = 5\angle 30^\circ$

Therefore, the impedance must be $Z = \bar{V}/\bar{I}$

$$Z = \frac{400\angle 120^\circ}{5\angle 30^\circ} = 80\angle 90^\circ \ \Omega$$

$$\text{or} \quad Z = j80\Omega$$

Since this purely imaginary and positive, it is inductive impedance

$$Z_L = j\omega L = j\,80\Omega$$

We are given $\omega = 100$ rads/sec, so

$$\omega L = 80$$
$$100L = 80$$

$$\text{giving} \quad \boxed{L = 0.8 \text{ H}}$$