CheggSolutions - Thegdp

```html

## AC Circuit Analysis

### Given Data:

$$A1 = 100 \, V$$
$$A2 = 6 \, A$$
$$C = 0.1 \, mF = 0.1 \times 10^{-3} \, F$$
$$L = 1.5 \, H$$
$$R1 = 50 \, \Omega$$
$$R2 = 100 \, \Omega$$
$$v_s(t) = A_1 \cos(100t)$$
$$i_s(t) = A_2$$

### Step 1: Determining the Impedances

**Inductive Impedance:**

$$Z_L = j \omega L = j 100 \times 1.5 = j 150 \, \Omega$$

Explanation: The inductive impedance is calculated using the formula $Z_L = j\omega L$, where $\omega$ is the angular frequency.

**Capacitive Impedance:**

$$Z_C = \frac{1}{j \omega C} = \frac{1}{j 100 \times 0.1 \times 10^{-3}} = \frac{1}{j 0.01} = -j 100 \, \Omega$$

Explanation: The capacitive impedance is calculated using the formula $Z_C = \frac{1}{j\omega C}$, where $\omega$ is the angular frequency.

### Step 2: Writing Mesh Equations

Given: $v_s(t) = A_1 \cos(100t)$
$V_s = 100 \angle 0^\circ \, V$

**Total Impedance Seen by $v_s$:**

$$Z_{total} = R_1 + Z_L + \left( \frac{1}{\left(\frac{1}{R_2} + \frac{1}{Z_C}\right)} \right)$$

Calculating $Z_{R2 \parallel Z_C}$:

$$Z_{R2 \parallel Z_C} = \frac{R_2 \cdot Z_C}{R_2 + Z_C} = \frac{100 \cdot (-j100)}{100 - j100}$$

Simplifying:

$$Z_{R2 \parallel Z_C} = \frac{-j 10000}{100 - j 100} \times \frac{100 + j 100}{100 + j 100} = \frac{-j 10000 (100 + j 100)}{20000} = \frac{-j 10000 (100 + j 100)}{20000} = -j 50 \, \Omega$$

Thus:

$$Z_{total} = 50 + j 150 - j 50 = 50 + j 100 \, \Omega$$

### Step 3: Calculating $i_a(t)$

Applying Ohm's Law to find $i_a(t)$:

$$I_a = \frac{V_s}{Z_{total}} = \frac{100 \angle 0^\circ}{50 + j 100} = \frac{100}{\sqrt{50^2 + 100^2}} \angle -\tan^{-1}\left(\frac{100}{50}\right)$$

$$= \frac{100}{\sqrt{12500}} \angle -63.43^\circ = \frac{100}{111.8} \angle -63.43^\circ = 0.895$$
```

$\angle -63.43^\circ$

Converting to time domain:

$$i_a(t) = 0.895 \sqrt{2} \cos(100t - 63.43^\circ)$$

Given $i_a(t) = A_3 \sqrt{2} \cos(100t + B_3) + A_4$, compare and find:

$A_3 = 0.895$
$B_3 = -63.43^\circ$
$A_4 = 0$ (since no DC offset term)

Conclusion

$A3 \, (A) = 0.895 \, A$
$B3 \, (degrees) = -63.43^\circ$
$A4 \, (A) = 0 \, A$

Supporting the above results:

$A3 \, (A) = 0.895 \, A$

$B3 \, (degrees) = -63.43^\circ$

$A4 \, (A) = 0 \, A$

```
```