In the circuit below, the switch moves from position 1 to position 2 at time $t = 0$. For $t < 0$ (switch in position 1), you may assume that the system is in steady state. The voltage source is sinusoidal with $\omega = W_1$.

The diagram shows two phasors, **A** and **B**. (Note that the phasors are not drawn to scale. Also, we show three diagrams to illustrate the situation depending on the value of a you were given. You need to select the diagram that corresponds to your given value.) In your diagram, one phasor represents the capacitor voltage v_C and the other the resistor voltage v_R (but you are not told which one is which).

a. Find $i_1 = i_R(0^-)$ (i.e., just before the switch moves to position 2).

b. Find $i_2 = i_R(0^+)$ (i.e., just after the switch moves to position 2).

$W_1 = 1$ rad/s

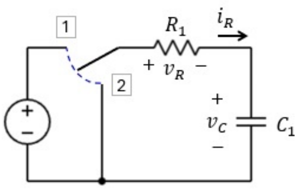
$X = 10$

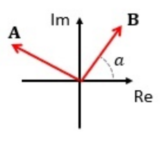
$a = 45°$

$R_1 = 2\Omega$

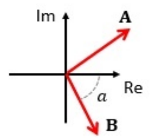
$C_1 = 1F$

$|\mathbf{A}| = X\sqrt{2}$

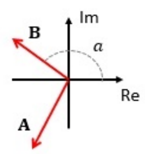




If $0 < a < \pi/2$

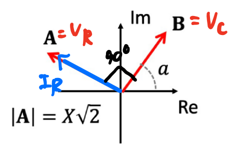


If $-\pi/2 < a < 0$



If $\pi/2 < a < \pi$

a. Assume $A = V_R$ and $B = V_C$



We plot I_R such that it is in phase with V_R

$I_R = I_C$ since the resistor is series with the capacitor

$\Rightarrow$ the capacitor current is ahead of the capacitor voltage $\Rightarrow$ our assumption is correct ✓

At $t = 0^-$

$$V_R = X\sqrt{2}\, e^{j(a+90)} = 10\sqrt{2}\, e^{j135}$$

$$i_R = \frac{V_R}{R_1} = \frac{10\sqrt{2}\, e^{j135}}{2} = 5\sqrt{2}\, e^{j135}$$

$$i_R(t) = 5\sqrt{2}\cos(t + 135)$$

$$i_R(0^-) = 5\sqrt{2}\cos(0 + 135) = 5\sqrt{2}\cdot\left(-\frac{\sqrt{2}}{2}\right) \Rightarrow \boxed{i_1 = -5A}$$

b. At $t = 0^+$, the capacitor voltage cannot change instantaneously

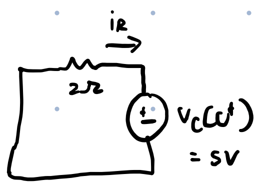
$$Z_C = \frac{1}{j\omega_1 C_1} = \frac{1}{j(1)(1)} = -j$$

$$V_C = i_R \cdot Z_C = 5\sqrt{2}\, e^{j135} \cdot -j = 5\sqrt{2}\, e^{j45}$$

$$V_C(t) = 5\sqrt{2}\cos(t + 45)$$

$$V_C(0^-) = 5\sqrt{2}\cos(0 + 45) = 5\sqrt{2}\cdot\left(\frac{\sqrt{2}}{2}\right) = 5V \Rightarrow V_C(0^+) = 5V$$

at $t = 0^+$



$$i_R(0^+) = \frac{-5}{2} A$$

$$\boxed{i_2 = -2.5 A}$$