1. (35 pts) The switch has been open for a long time and is closed (as shown) at time \( t = 0 \).

   a) Find the complete expression for \( i_L(t) \).

   \[ V_S := 24 \text{ V} \]

   \[ R_1 := 20 \Omega \]

   \[ R_2 := 30 \Omega \]

   \[ R_3 := 60 \Omega \]

   \[ L := 5.4 \text{ mH} \]

   b) Find \( i_L \) at time \( t = 1.2 \tau \). \( i_L(1.2 \tau) = ? \)

   c) At time \( t = 1.2 \tau \) the switch is opened again. Find the complete expression for \( i_L(t') \), where \( t' \) starts at \( t = 1.2 \tau \). Be sure to clearly show the time constant.

2. (20 pts) Find \( Z_{eq} \) in simple polar form (give me numbers).

   For partial credit, you must show work and/or intermediate results.

   \( f = 318.31 \text{ Hz} \)
3. (24 pts) a) Find $V_{in}$ in polar form.

b) Find $I_F$.

c) Circle 1:  i) The source current leads the source voltage  
    ii) The source voltage leads the source current

d) By how much? I.E. what is the phase angle between the voltage and current?

4. (21 pts) The voltage across a 5 $\mu$F capacitor is shown below. Make an accurate drawing of the capacitor current. Make reasonable assumptions where necessary. Label your graph.

Note: You will be graded on the accuracy of your plot at 0, 5, 7 and 8 ms, so calculate those values and plot or label them carefully. Between those points your plot must simply be the correct shape.

You MUST SHOW how you calculate your values starting from the original relationships between voltage and current.

That is: Start with the integral and/or differential equations for the capacitor!  

\[ C := 5 \mu F \]

\[ V_C \]

\[ i_C \]

Answers
1. a) $400 \text{-mA} \cdot e^{-t/180\mu s}$  
   b) $120.5 \text{-mA}$  
   c) $400 \text{-mA} - 279.5 \text{-mA} \cdot e^{-t/120\mu s}$

2. $31.2 / -51.3^\circ \Omega$

3. a) $8V / 53.13^\circ$  
   b) $176mA / 60.6^\circ$  
   c) i)  
   d) 7.43-deg

4. start: (0,0), straight line to (5ms, -20mA), straight up to (5ms, +25mA),  
   flat to (7ms, +25mA), down to (7ms, 0mA), flat to (8ms, 0mA).