Problem Set 2 Hint Sheet

Q3
Apply Ohm's law: V = IR
Only magnitude is affected in a resistor since V and I are in phase in a resistor.

Q4
Impedance Z describes the relationship between current and voltage
Apply $Z = V/I = 1/j\omega C$
Therefore V lags I by 90^o (because of -j) and V is reduced by $1/\omega C$ relative to I
Magnitude of voltage = $4/\omega C$
Phase of voltage relative to the current = $25^o - 90^o$

Q5
Impedance Z describes the relationship between current and voltage
For an inductor: $Z = V/I = j\omega L$ ⇨ V leads I by 90^o (see j) and V is larger than I by ωL
⇨Magnitude of current = $60/\omega L$
⇨Phase of current relative to the voltage = $-65^o - 90^o$

Q6
Compare the phase of V relative to I ⇨ V leads I by 90°
Therefore apply the impedance formula for an inductor: $Z = V/I = j\omega L$

Q7
Apply voltage divider rule for both cases using the impedance expressions ($j\omega L$, $1/j\omega C$)

Q8
R_2 in series with C ⇨ Z_1
R_1 in series with L ⇨ Z_2
Total impedance seen by the source: $Z = Z_1 \parallel Z_2$

$$Z = \left(R_2 + \frac{1}{j\omega C}\right) \parallel \left(R_1 + j\omega L\right) = \frac{\left(R_2 + \frac{1}{j\omega C}\right)\left(R_1 + j\omega L\right)}{R_1 + R_2 + j\left(\omega L - \frac{1}{\omega C}\right)}$$

Q9

$$Z_{eq} = R + \frac{1}{j\omega C} + j\omega L$$
$$= R + j\left(\omega L - \frac{1}{\omega C}\right)$$

Q10
Find admittance first and convert to impedance. In this case, given that the components are in parallel, it is easier to find the admittance
$Y = 1/Z = j\omega C + 1/R + 1/j\omega L$ ⇨ $Z = 1.664\angle -0.983\ \Omega$ (Note that the phase is given in radians here)
Finally apply $V = IZ$ ⇨ $V = 16.64\angle -0.983$ V