7-11 a. A looks like a power source because current flows out of the positive terminal. This is confirmed by the fact that the phasor diagram shows $E$ and $I$ in phase. $A$ is therefore an active power source.

b. $D$ looks like a power source ($I$ flows out of (+) terminal). However $I$ is $180^\circ$ out of phase with $E$. ∴ $C$ is the active power source.

c. $G$ looks like a power source ($I$ flows out of (+) terminal). It is not a reactive power source because $I$ leads $E$.

It is sometimes easier to look at the element which looks as if it is the load – in this case device $F$. It is not an inductive load, because the current leads the voltage. Hence $F$ must be an inductive source. We shall use this reasoning in the next three examples.

d. $H$ appears to be the load. It would be inductive because $E$ and $I$ are $90^\circ$ out of phase. It is the load because $I$ lags behind $E$. Consequently, $I$ is the reactive source.

e. $L$ appears to be the load. It is not the load because $E$ and $I$ are $180^\circ$ out of phase. Therefore $L$ is the active source.

f. $N$ appears to be the load. It is the load because $I$ lags $90^\circ$ behind $E$. Therefore $M$ is a reactive source.

Total: 15 points. 2.5 points off for one mistake, 5 points off for two mistakes.

7-13

\[ P = 2765 \text{ W} \]
\[ \cos \theta = \frac{2765}{3840} = 0.72 \]
\[ S = 240 \times 16 = 3840 \text{ VA} \]
\[ Q = \sqrt{3840^2 - 2765^2} = 2665 \text{ var} \]

Total: 10 points. 2 points for the calculation of $P$, 2 points for the calculation of power factor, 3 points for the calculation of complex power, 3 points for the calculations of reactive power.
a. 2765 W  
b. \( Q_c = \frac{240^2}{30} = 1920 \text{ var} \)  
\( Q_L = (2665 - 1920) = 745 \text{ var} \)  
c. \( S = \sqrt{2765^2 - 745^2} = 2864 \text{ VA} \)  
d. \( I = \frac{S}{E} = \frac{2864}{240} = 11.9 \text{ A} \)  
e. \( \cos \theta = \frac{P}{S} = \frac{2765}{2864} = 0.965 = 96.5 \% \)  
Total: 10 points. 2 points for each subproblem.

a. \( P = 10^2 \times 12 = 1200 \text{ W} \)  
b. \( Q = 10^2 \times 5 = 500 \text{ var} \)  
c. \( S = \sqrt{1200^2 + 500^2} = 1300 \text{ VA} \)  
d. \( \cos \theta = \frac{1200}{1300} = 0.923 \)  
Total: 10 points. 2.5 points for the calculation of each quantity.

a. 2765 W  
b. \( Q_L = 2665 - 500 = 2165 \text{ var} \)  
\( S = \sqrt{2165^2 + 2765^2} = 3512 \text{ VA} \)  
c. \( \cos \theta = \frac{2765}{3512} = 0.787 \)  
Total: 10 points. 3 points for each subproblem.
\[ S_L = 120 \times 5 = 60 \text{ VA} \]
\[ P_L = 0.6 \times 600 = 360 \text{ W} \]
\[ Q_L = \sqrt{600^2 - 360^2} = +480 \text{ var} \]

(positive because the power factor is lagging).

\[ P_{\text{resistor}} = 5^2 \times 2 = 50 \text{ W} \]
\[ Q_{\text{induct}} = 5^2 \times 3 = 75 \text{ var} \]
\[ Q_Z = 480 - 75 = 405 \text{ var} \]

The 120 V source supplies 480 var, and 75 var is absorbed by the inductor; the remainder must be absorbed by \( Z \).

\[ S_Z = \sqrt{310^2 + 405^2} = 510 \text{ VA} \]

a. \[ E = S_Z/I = 510/5 = 102 \text{ V} \]

b. \[ Z = E/I = 102/5 = 20.4 \Omega \]

also, \[ \cos \theta = 310/510 = 0.607 = \cos 52.56^\circ \]

\[ Z = 20.4 \angle -52.56^\circ = 20.4 \cos (-52.56) + j \sin (-52.56) \]

\[ = 12.4 - j 16.2 \]

Total: 15 points. 9 points for complex power, 3 points for \( E \), 3 points for the calculation of \( Z \).
8-15

\[ I = 22 \times \frac{6}{5} = 18.3 \text{ A} \]

Total: 10 points. 2.5 points for each calculation.

8-22

Frequency decrease in the ratio 5/6. The line current will increase in the ratio 6/5.

\[ I = 22 \times \frac{6}{5} = 18.3 \text{ A} \]

Total: 10 points.

8-23 a.

\[ I = 60 \text{ A} \]
\[ \frac{3I^2 R}{50 \text{ kW}} \]
\[ \therefore R = 4.63 \Omega \]

Also:
\[ 3I^2 X = 37.2 \text{ kvar} \]
\[ \therefore X = 3.44 \Omega \]

Total: 10 points. 3 points each for the calculation of R, X, and the phase angle.