Problem 5.32  Determine $L_{eq}$ at terminals $(a,b)$ in the circuit of Fig. P5.32. All inductor values are in millihenrys.

Solution:

$$L_{eq} = \left(\frac{1}{3} + \frac{1}{3+3}\right)^{-1} = 2$$

$$L_{eq} = \left(\frac{1}{2+2} + \frac{1}{4}\right)^{-1} + 4 = 6$$

$$L_{eq} = 1 + 1 + \frac{3 \times 6}{3+6} = 4 \text{ mH}$$

Figure P5.32
Problem 5.22  Determine (a) the amount of energy stored in each of the three capacitors shown in Fig. P5.22, (b) the equivalent capacitance at terminals \((a,b)\), and (c) the amount of energy stored in the equivalent capacitor.

![Figure P5.22](image)

**Solution:** (a) Under dc conditions, the capacitors behave like open circuits. Hence, no currents flow anywhere in the circuit, and no voltage drop exists across the resistor. Hence, \(v_{ab} = 15\) V.

For 6-\(\mu\)F capacitor,

\[
\begin{align*}
  w_1 &= \frac{1}{2} \times 6 \times 10^{-6} \times 15^2 = 0.675 \text{ (mJ)}. \\

\end{align*}
\]

For the 20-\(\mu\)F and 5-\(\mu\)F capacitors, from Eq. (5.47) for two capacitors in series,

\[
20\mu v_2 = 5\mu v_3
\]

or

\[
20\mu = 5\mu \frac{v_3}{4}. \\
\]

Also,

\[
v_2 + v_3 = 15.
\]

Solution of Eqs. (1) and (2) gives:

\[
\begin{align*}
  v_2 &= 3 \text{ V}, \quad v_3 = 12 \text{ V}. \\
  w_2 &= \frac{1}{2} \times 20 \times 10^{-6} \times 3^2 = 0.09 \text{ (mJ)} \\
  w_3 &= \frac{1}{2} \times 5 \times 10^{-6} \times 12^2 = 0.36 \text{ (mJ)}
\end{align*}
\]

(b) \[C_{eq} = 6 \mu F + \left(\frac{20 \mu \times 5 \mu}{20 \mu + 5 \mu}\right) F = 10 \mu F\]

(c) \[w_{eq} = \frac{1}{2} \times C_{eq} \times 15^2 = \frac{1}{2} \times 10 \times 10^{-6} \times 15^2 = 1.125 \text{ (mJ)} \]

\[w_1 + w_2 + w_3 = (0.675 + 0.09 + 0.36) \text{ mJ} = 1.125 \text{ (mJ)},\]

as expected.