1. (a)

The voltage across \( C_1 \) is the same as the voltage across the terminals, so
\[
V_1 = V_0
\]
Likewise,
\[
V_2 = V_0
\]
The total current into the + terminal is
\[
I = I_1 + I_2
\]
\[
= C_1 \frac{dV_1}{dt} + C_2 \frac{dV_2}{dt}
\]
\[
= C_1 \frac{dV}{dt} + C_2 \frac{dV}{dt}
\]
\[
= (C_1 + C_2) \frac{dV}{dt}
\]
Therefore, the equivalent capacitance is
\[
C = C_1 + C_2
\]

(b)

For the series connection,
\[
I_1 = I_2 = I
\]
Because the capacitors are in series,
\[ V = V_1 + V_2 \]
\[ \Rightarrow \dot{V} = \dot{V}_1 + \dot{V}_2 \]
\[ = \frac{\dot{i}_1}{C_1} + \frac{\dot{i}_2}{C_2} \]
\[ = \frac{\dot{i}}{C_1} + \frac{\dot{i}}{C_2} \]

Therefore,
\[ \dot{i} = \left( \frac{1}{C_1} + \frac{1}{C_2} \right)^{-1} \dot{V} \]
\[ = \frac{C_1 C_2}{C_1 + C_2} \dot{V} \]

\[ \Rightarrow \boxed{C = \frac{C_1 C_2}{C_1 + C_2}} \text{ is the equivalent capacitance} \]

(c)

Because the inductors are in series,
\[ i = i_1 = i_2 \]
\[ V = V_1 + V_2 \]
\[ = L_1 \frac{di_1}{dt} + L_2 \frac{di_2}{dt} \]
\[ = L_1 \frac{di}{dt} + L_2 \frac{di}{dt} \]
\[ = (L_1 + L_2) \frac{di}{dt} \]
Therefore, the equivalent inductance is

\[ L = L_1 + L_2 \]

Because the inductors are in parallel,

\[ V_s = V_1 = V_2 \]

\[ i_s = i_1 + i_2 \]

\[ \Rightarrow \frac{di}{dt} = \frac{d}{dt} i_1 + \frac{d}{dt} i_2 \]

\[ = \frac{1}{L_1} V_1 + \frac{1}{L_2} V_2 \]

\[ = \frac{1}{L_1} V + \frac{1}{L_2} V \]

\[ = \left( \frac{1}{L_1} + \frac{1}{L_2} \right) V \]

Therefore, the equivalent inductance is

\[ L = \left( \frac{1}{L_1} + \frac{1}{L_2} \right)^{-1} = \frac{L_1 L_2}{L_1 + L_2} \]
2. One way to label the nodes is:

\[ e_1: \left( c_2 \frac{d}{dt} + 6_1 \right) e_1 - c_2 \frac{d}{dt} e_2 = 0 \]

\[ e_2: -c_2 \frac{d}{dt} e_1 + \left( c_3 \frac{d}{dt} + c_4 \frac{d}{dt} \right) e_2 - c_4 \frac{d}{dt} e_3 = 0 \]

\[ e_3: -c_4 \frac{d}{dt} e_2 + \left( c_4 \frac{d}{dt} + G_5 \right) e_3 = 0 \]

Plugging in component values,

\[ (2 \frac{d}{dt} + 1) e_1 - 2 \frac{d}{dt} e_2 = 0 \]

\[ -2 \frac{d}{dt} e_1 + 8 \frac{d}{dt} e_2 - 4 \frac{d}{dt} e_3 = 0 \]

\[-4 \frac{d}{dt} e_2 + (4 \frac{d}{dt} + 0.2) e_3 = 0 \]