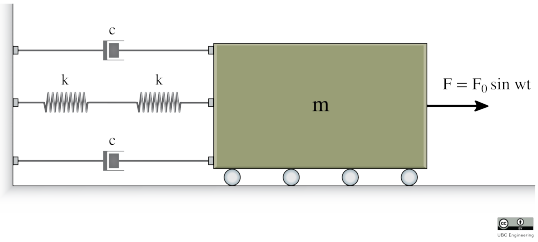
# 22-R-VIB-JL-47




A mass of $m = 27$ kg is supported by rollers and has a periodic force of $F = 4 \sin 5t$ N applied to it. Two springs in series, each with stiffness $k = 42$ N/m and two dampers in parallel, each with a damping constant $c = 9$ N·s/m attached to the wall keep the block in steady-state vibration.

Find the equivalent values for mass **m**, stiffness **k**, and damping **c** if there was only one of each component in the circuit, and select their proportionality to inductance **L**, resistance **R**, and capacitance **C** respectively.

Select the circuit diagram that represents the damped forced system's electrical equivalent.

## Solution

Calculating the mass, spring stiffness and damping equivalent we have:

$m_{eq} = m = 27$ [kg]

$k_{eq} = \left(\frac{1}{k} + \frac{1}{k}\right)^{-1} = \frac{k}{2} = 21$ [N/m]

$c_{eq} = c + c = 2c = 18$ [N·s/m]

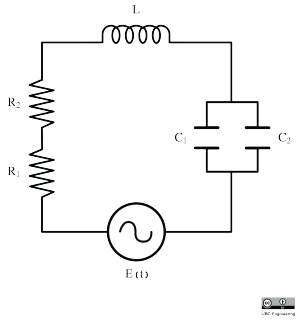
Then inductance L, resistance R, and capacitance C of the equivalent electrical analog system is given by:

$L = m$ in units of [H]

$C = \frac{1}{k_{eq}}$ in units of [F]

$R = c_{eq}$ in units of [Ω]

Lastly creating the equivalent circuit, the equivalent inductance is a single inductor with inductance $L = m$. The equivalent resistance is 2 resistors in series each with resistance $R = c$ for an equivalent resistance of $R_{eq} = 2R = 2c$. And the equivalent capacitance is 2 capacitors in parallel each with capacitance $C = \frac{1}{k}$ for an equivalent capacitance $C_{eq} = 2C = \frac{2}{k}$ (shown below).




| Device | Equivalent Series Connection | Equivalent Parallel Connection |
|---|---|---|
| Resistors | $R_{eq} = R_1 + R_2 + \cdots + R_N$ | $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N}$ |
| Capacitors | $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_N}$ | $C_{eq} = C_1 + C_2 + \cdots + C_N$ |
| Inductors | $L_{eq} = L_1 + L_2 + \cdots + L_N$ | $\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + \cdots + \frac{1}{L_N}$ |