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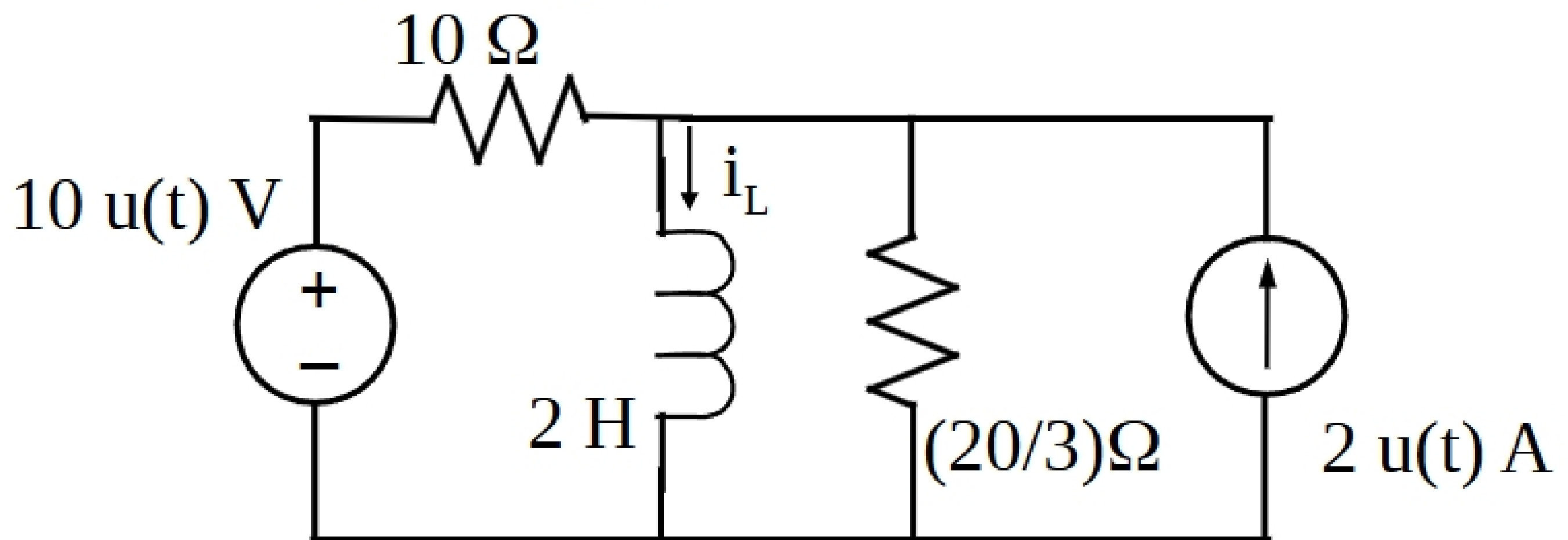
## Linearity, superposition, response classifications

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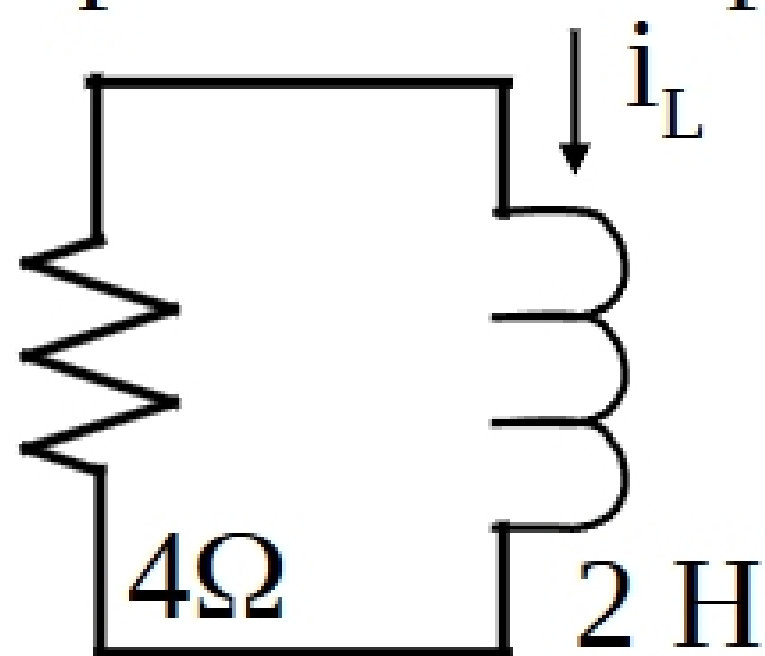
Superposition can be applied to RL or RC circuits with voltage or current sources (excitations). When applying superposition:

- 1) Find response due to each excitation without initial conditions.
- 2) Find response due to initial conditions (one at a time) when all independent sources are deactivated.
- 3) Sum all responses.

**Example:** Using superposition, determine  $i_L(t)$  for  $t \geq 0$  given  $i_L(0^-) = -1$  A.



Step 1: Find response due to initial conditions.

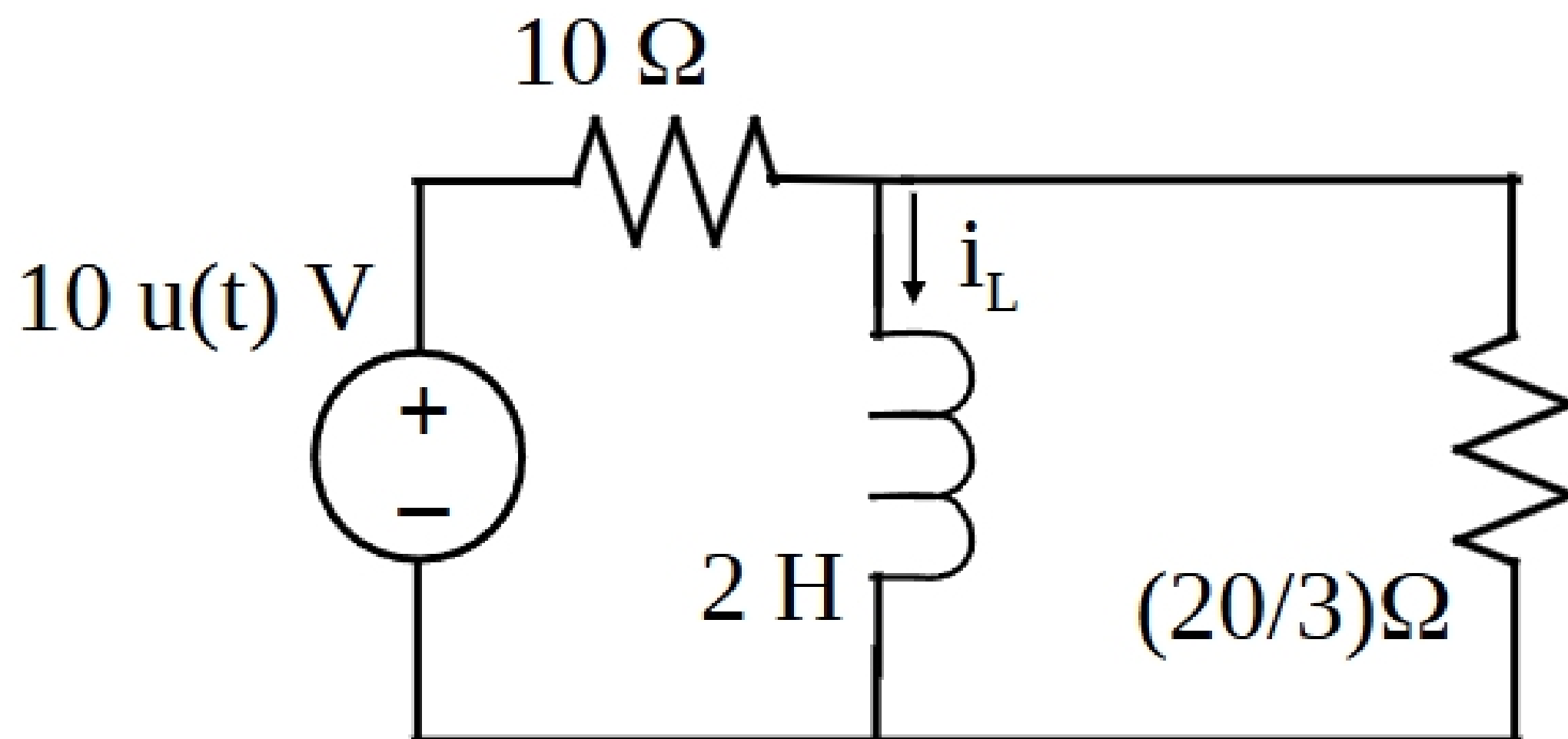


$$\frac{d i_L(t)}{dt} + \frac{R_{TH}}{L} i_L(t) = 0$$

$$\left( \frac{R_{TH}}{L} \right) = 2 \text{ s}^{-1}$$

$$i_{L1}(t) = [e^{-(R/L)(t-t_0)}] i_L(t_0) = -e^{-2t} \text{ A}$$

Step 2: Find response from voltage source.



$$i_{L2}(0^+) = 0; \quad i_{L2}(\infty) = 1 \text{ A}$$

$$R_{\text{TH}} = 4 \Omega; \quad R_{\text{TH}}/L = 2 \text{ s}^{-1}$$

$$i_{L2}(t) = i_{L2}(\infty) + [i_{L2}(t_0^+) - i_{L2}(\infty)]e^{-(R_{\text{TH}}/L)(t-t_0)}$$

$$i_{L2}(t) = (1 - e^{-2t}) \text{ A}$$