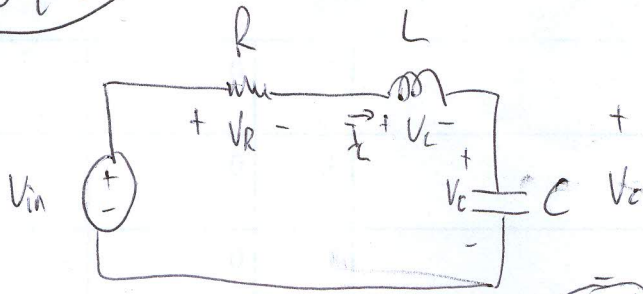


20 point

①



$$V_{in} = V_R + V_L + V_C$$

2 point

$$V_{in} = R I_L + L \frac{dI_L}{dt} + V_C$$

1 point

1 point

②

$$\frac{dI_L}{dt} = \frac{V_{in}}{L} - \frac{R}{L} I_L - \frac{V_C}{L}$$

2 point

$$C \frac{dV_C}{dt} = I_L$$

$$\frac{dV_C}{dt} = \frac{I_L}{C}$$

①

4 point

Take derivative of ② put ① inside

$$\frac{d^2 I_L}{dt^2} = \frac{1}{L} \frac{dV_{in}}{dt} - \frac{R}{L} \frac{dI_L}{dt} - \frac{1}{L} \frac{dV_C}{dt}$$

2 point

3 point

$$\frac{d^2 I_L}{dt^2} + \frac{R}{L} \frac{dI_L}{dt} = \frac{1}{L} \frac{dV_{in}}{dt} - \frac{1}{L} \frac{I_L}{C}$$

$$\frac{d^2 I_L}{dt^2} + \frac{R}{L} \frac{dI_L}{dt} + \frac{1}{LC} I_L = \frac{1}{L} \frac{dV_{in}}{dt}$$

Take derivative of ① put ② inside

$$\frac{d^2 V_C}{dt^2} = \frac{1}{C} \frac{dI_L}{dt} = \frac{1}{C} \left[ \frac{V_{in}}{L} - \frac{R}{L} I_L - \frac{1}{L} V_C \right]$$

2 point

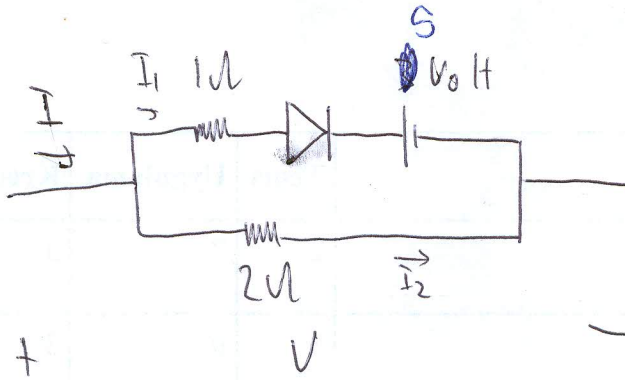
$$\frac{d^2 V_C}{dt^2} + \frac{1}{LC} V_C + \frac{R}{CL} I_L = \frac{V_{in}}{LC}$$

$$C \frac{dV_C}{dt} = I_L$$

$$\frac{d^2 V_C}{dt^2} + \frac{R}{L} \frac{dV_C}{dt} + \frac{1}{LC} V_C = \frac{1}{LC} V_{in}$$

3 point

(2)



if ~~current~~  $V > \mathcal{E} \rightarrow I_1 \checkmark$   
 $\rightarrow I_2 \checkmark$

if  $V < \mathcal{E} \rightarrow I_1 \times$   
 $\rightarrow I_2 \checkmark$

$$I = I_1 + I_2 \leq \frac{V - \mathcal{E}}{1} + \frac{V}{2}$$

$$= \frac{3V - 6}{2}$$

2 point

$$I = I_1 + I_2 = I_2 = \frac{V}{2}$$

0

3 point

