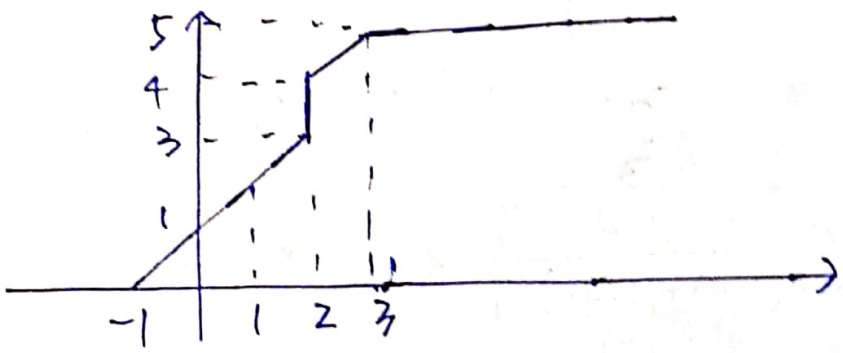
Quiz 3 Solutions.

Problem #1.

(1)



(2) $\int_{-\infty}^{+\infty} f(5)\,\delta(t-5)\,dt = f'(5)$

$f'(t) = u(t+1) + \delta(t-2) - u(t-3)$

$f'(5) = 0$ (or from the curve, $f'(5) = 0$

Thus. $\int_{-\infty}^{+\infty} f(5)\,\delta(t-5)\,dt = 0$

Problem #2.

(1) Charging process: the switch is turned on (—o ↓ o—), it performs as an R-L circuit and the inductor stores charges.

(2) Ignition process: the switch is turned off (—o ↑ o—) in a short time, which means the voltage variance is large during the short time period. Then, it can make the air breakdown and the ignition happens.

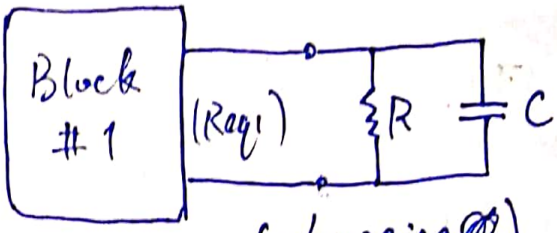
(2) $|U_s| = L\frac{di}{dt} = L\frac{\Delta I}{\Delta t}$ (suppose Δt is small)

since

$$\Delta t = \frac{L\Delta I}{|U_s|} = \frac{L\frac{U}{R}}{U_s} = \frac{LU}{RU_s}.$$

Problem #3.

Step #1:

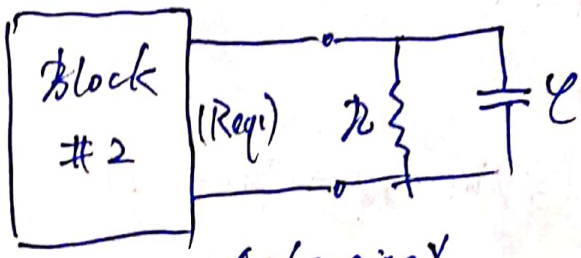


$$R_{eq} = R \,//\, R_{eq1} = \frac{R\cdot R_{eq1}}{R+R_{eq1}}$$

$$C_{eq} = C.$$

Measure the (charging/discharging) time (the time interval between starting and the readout of current meter is ~~zero~~ not change) as t_1 ($t_1 \approx 5\tau_1$)

Step #2



$$R_{eq} = \frac{R\cdot R_{eq2}}{R+R_{eq2}}$$

$$C_{eq} = C$$

Measure the (charging/discharging) time as t_2 ($t_2 \approx 5\tau_2$)

$$T_1 \approx 5\tau_1 = 5\cdot\frac{R\cdot R_{eq1}}{R+R_{eq1}}\cdot C \qquad T_2 = 5\tau_2 = 5\frac{R\cdot R_{eq2}}{R+R_{eq2}}\cdot C$$

$$\frac{\frac{R\cdot R_{eq1}}{R+R_{eq1}}}{\frac{R\cdot R_{eq2}}{R+R_{eq2}}} = \frac{T_1}{T_2} \Rightarrow R = \frac{R_{eq1}R_{eq2}(T_1-T_2)}{R_{eq1}T_2 - R_{eq2}T_1} \qquad C = \frac{T_1T_2(R_{eq1}-R_{eq2})}{5R_{eq1}R_{eq2}(T_1-T_2)}$$