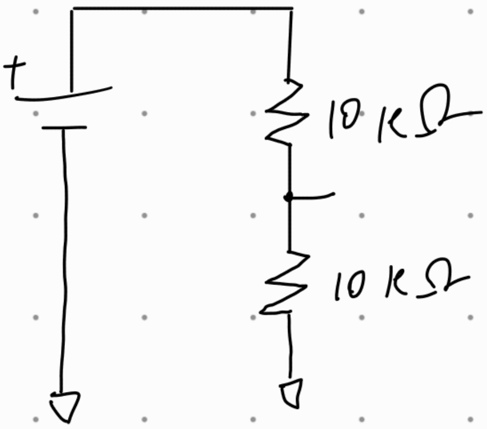
1.

a



$$V_{out} = \frac{R_2}{R_1+R_2} V_{in}$$

$$9V \cancel{\frac{10 k\Omega}{20 k\Omega}}$$

$$\boxed{V_{out} = 4.5 V}$$

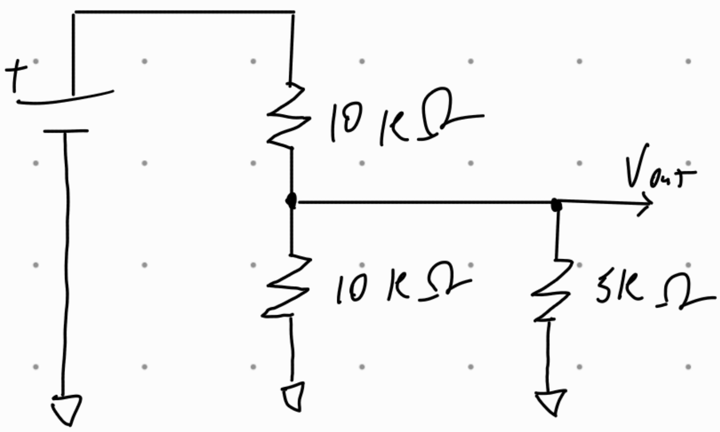
$V = IR$

$9V = I \, 20 k\Omega$

$$\frac{9 V}{20 k\Omega} = I = 4.5 E{-}4 A$$

or $\boxed{0.45 mA}$

b.



$$\frac{1}{R_T} = \frac{1}{5 k\Omega} + \frac{1}{10 k\Omega}$$

$$\frac{1}{R_T} = \frac{3}{10 k\Omega}$$

$$R_T = \frac{10}{3} k\Omega$$

$$R_T = 3.\bar{3} k\Omega$$

$$V_{out} = V_{in} \frac{R_T}{R_T + R_1}$$

$$= 9V \frac{3.\bar{3} k\Omega}{13.\bar{3} k\Omega}$$

$$\boxed{V_{out} = 2.25 V}$$

$V = IR$

$\frac{V}{R} = I$

$$\frac{9 V}{13.3 k\Omega} = \boxed{0.675 mA}$$

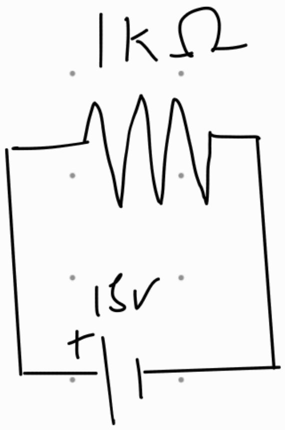
$I_{R_3} R_3 = 2.25\ V$

$I_{R_3} = \dfrac{2.25\ V}{5 k\Omega} = 0.45\ mA$ @ $2.25V$

$\boxed{= 1.0125\ mW}$

power dissipated by R_3

2.



max current config

$V = I R$

$15V = I\ 1000\ \Omega$

$\dfrac{15\ V}{1000\ \Omega} = 0.015\ A$ @ $15V$

$= 0.225\ W < 0.25\ W$

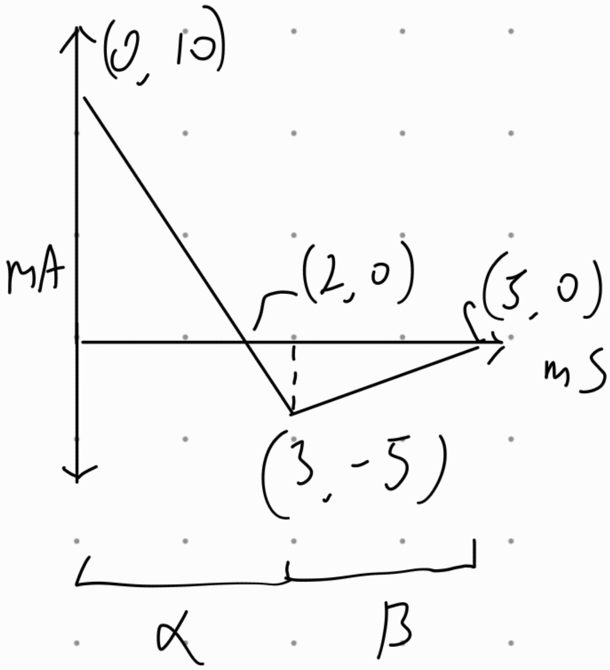
3.

$i(t) = C \dfrac{dv}{dt}$

$i(t)\,dt = C\,dv$

$\int i(t)\,dt = \int C\,dv$

$= CV$



α : $i(t) = 10 - 5t$

$$\frac{1}{C}\int 10-5t \; dt = V$$

$$\frac{1}{C}\left(10t - \frac{5}{2}t^2\right) = V$$

$$\frac{10ma}{1\mu f}t - \frac{5ma}{1\mu f(2)}t^2 = V$$

$$\frac{10E-3}{1E-6}t - \frac{5E-3}{2E-6}t^2 = V$$

$$1E4(t) - 2.5E3(t^2) = V$$

from $0 < t < 3E-3$

β

$$i(t) = -5 + \frac{5}{2}t$$

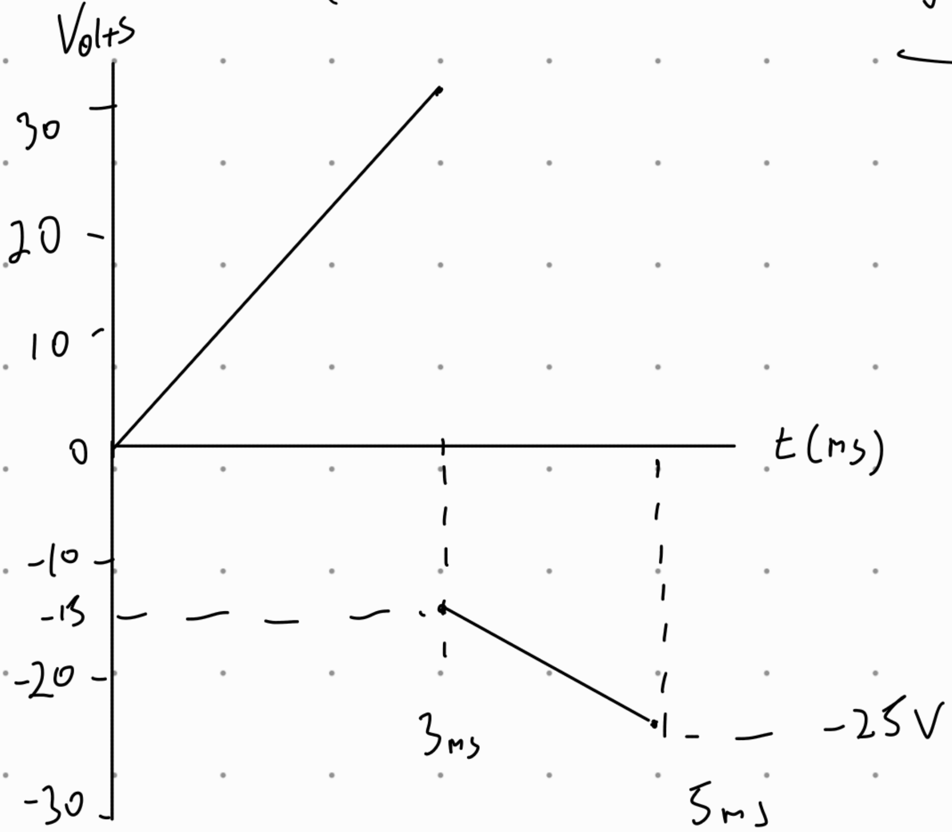
$$\frac{1}{C}\int -5+\frac{5}{2}t \; dt = V$$

$$\frac{1}{C}\left(-5t + \frac{5}{4}t^2\right) = V$$

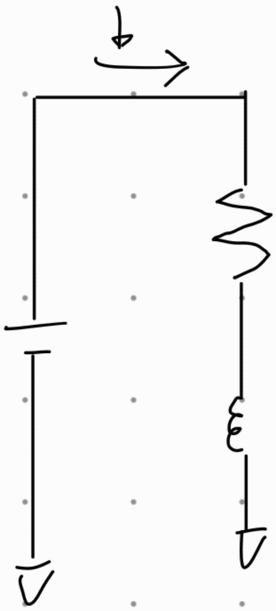
$$\frac{-5E-3}{1E-6}t + \frac{5E-3}{4E-6}t^2 = V$$

$$-5E3(t) + 1.25E3 = V$$

from $3E-3 < t < 5E-3$



4. $I = 5e^{-2t}$



$R_4 \quad 4\Omega \qquad V_R = IR$

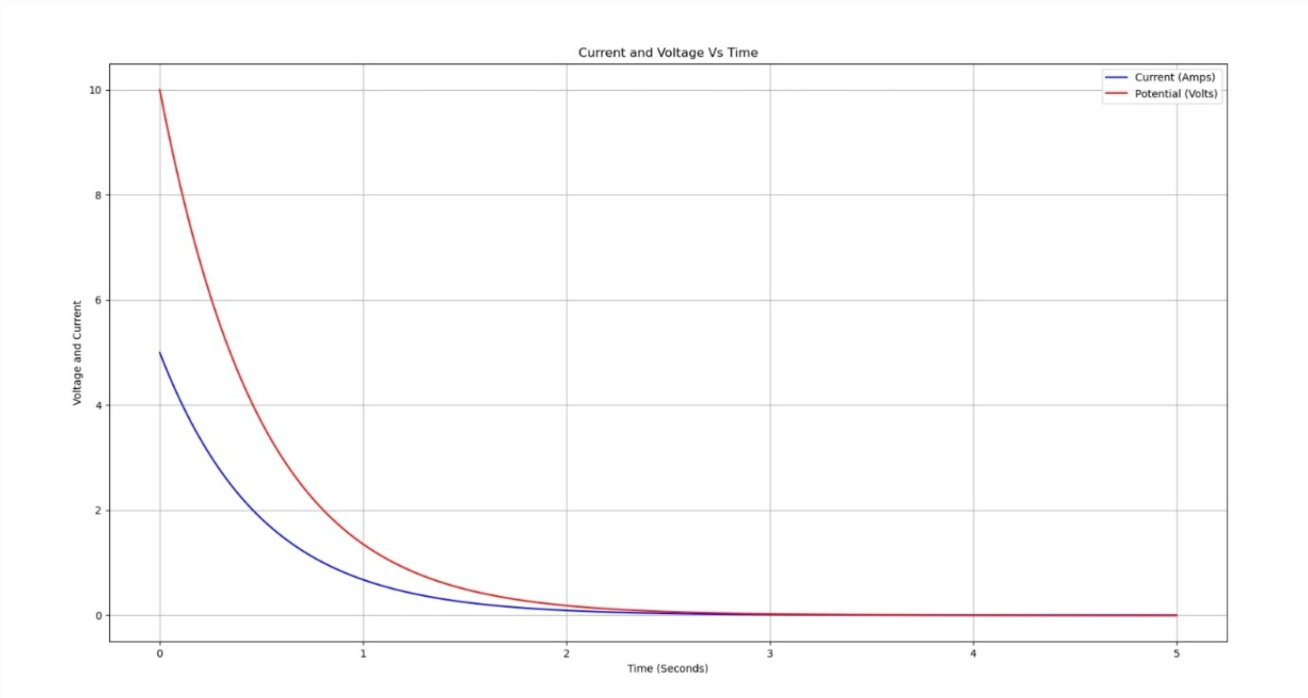
$L_1 \quad 1H \qquad V_L = L\dfrac{di}{dt}$

$$V_T(t) = IR + L\frac{dI}{dt}$$

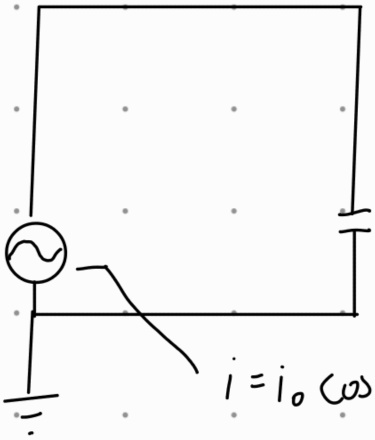
$$V_T(t) = 5e^{-2t}R - 10e^{-2t}L$$

$$= 20e^{-2t} - 10e^{-2t}$$

$$V_T(t) = 10e^{-2t}$$



5.



$i = i_0 \cos(\omega t)$

$\varphi = 90^\circ$

$P = VI$

$= V_m \sin(\omega t)\, I_m \cancel{\sin(\omega t + 90^\circ)}$ $\cos(\omega t)$

$P = V_m I_m \sin(2\omega t)$

1 cycle: $0 \to \frac{2\pi}{\omega}$

$P_{cycle} = \int_0^{2\pi/\omega} V_m I_m \sin(2\omega t)$

$P_{cycle} = V_m I_m \left[-\frac{1}{2\omega} \cos(2\omega t) \right] \Big|_0^{2\pi/\omega}$

$\cos(\frac{2\pi}{\cancel{\omega}} \cdot 2\cancel{\omega})$

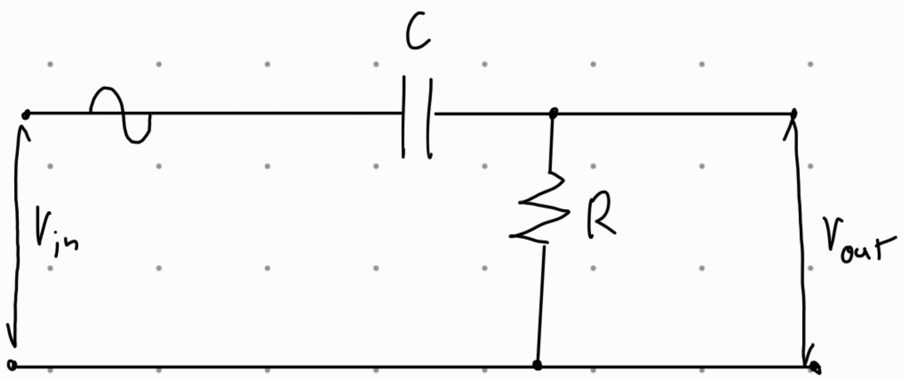
$= 0 \qquad - 0$

$P_{cycle} = V_m I_m [0]$

$= 0$

6.

a. Build a high-pass passive filter:



b. $V_{out} = V_{in} \dfrac{1}{\sqrt{1 + 1/(\omega RC)^2}}$

$$A_v = \frac{V_{out}}{V_{in}} = \frac{R}{\sqrt{R^2 + X_c^2}} \cdot \frac{\frac{1}{R}}{\frac{1}{R}} = \frac{1}{\sqrt{R^2}}$$

$$= \frac{R/R = 1}{\dfrac{\sqrt{R^2 + X_c^2}}{\cancel{\sqrt{R^2}}\ 1}} = \frac{1}{\sqrt{1 + \frac{X_c^2}{R^2}}}$$

$$\frac{V_{out}}{V_{in}} = \frac{1}{\sqrt{1 + 1/(\omega RC)^2}}$$ ✓

c. if $R = 1K\Omega$ & $f = 10^6$ Hz

cut-off freq given by

$$f_c = \frac{1}{2\pi RC}$$

$$10^6 = \frac{1}{2\pi(1000\,\Omega)\,C}$$

$$2000\pi \cdot 10^6 = \frac{1}{C}$$

$$6.283E4 = \frac{1}{C}$$

$$\underline{C \approx 6.283E-9}$$

The capacitor should be around 6.28 nF to produce the desired cutoff frequency