The current in a 20 mH inductor is

$i = 40\ mA \quad t \leq 0$

$i = A_1 e^{-10,000t} + A_2 e^{-40,000t}$ Amps $\quad t \geq 0$

$V_L = 28\ V \ @\ t = 0$

a) Find V_L for $t > 0$

$$V_L = L\frac{di_L}{dt} = (0.02)(-10,000A_1 e^{-10,000t} - 40,000A_2 e^{-40,000t})$$

$@t = 0,\ V_L = 28 = (-200A_1 - 800A_2)$

$@t = 0\ i_L = 0.04 = A_1 + A_2$

Solving, $A_1 = 0.1$, $A_2 = -0.06$

$$\boxed{\begin{aligned} V_L(t) &= -20e^{-10,000t} + 48e^{-40,000t} \quad V \\ i_L(t) &= 0.1e^{-10,000t} - .06e^{-40,000t} \quad A \end{aligned}}$$

b) Find the time greater than 0 when $P_L = 0$

Power = 0 when V or I = 0

assume $I = 0$: $0 = .1e^{-10,000t} - .06e^{-40,000t}$

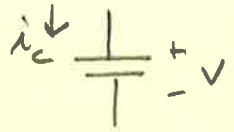
Solving for t: $t = -17.03\ \mu s$ ✱ not possible

assume $V = 0$: $0 = -20e^{-10,000t} + 48e^{-40,000t}$

Solving for t: $\boxed{t = 29.18\ \mu s}$

$v_c = 500t\,e^{-2500t}$ V for $t > 0$

$C = 5\,\mu F$



a) Find i_c for $t > 0$

$$i = C\frac{dv_c}{dt} = c\left(500t\left(-2500\,e^{-2500t}\right) + e^{-2500t}(500)\right)$$

$$\boxed{i_c = 2.5\times10^{-3}\,e^{-2500t}\left[-2500t + 1\right]\ A}$$

b) Find Power when $t = 100\,\mu s$

$$P_c = V_c I_c\Big|_{t=100\mu s} = (0.03894)(0.00146)$$

$$\boxed{P_c = 56.86\,\mu W}$$

c) is the Cap (absorbing) or delivering power @ $t = 100\,\mu s$?

d) Find the energy stored @ $t = 100\,\mu s$

$e = \frac{1}{2}CV^2$ where $V(100\,\mu s) = 0.03894$ V

$e = \frac{1}{2}(5\,\mu F)(.03894)^2 = \boxed{3.79\,nJ}$

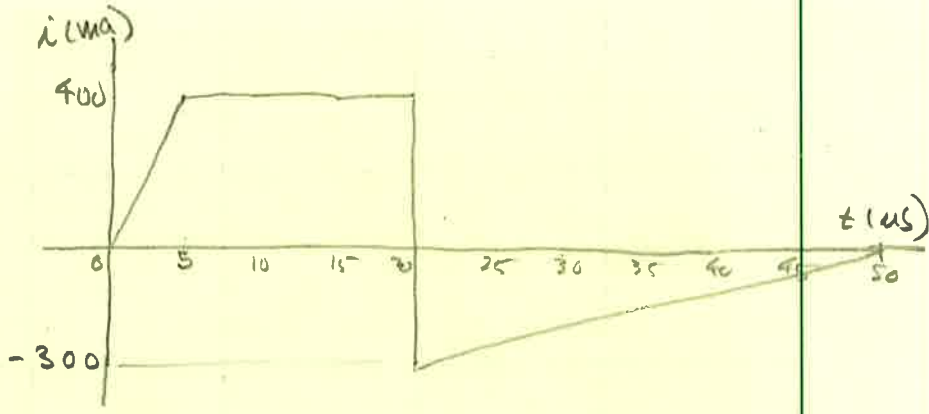
e) Find the maximum energy stored + the time it occurs

the energy is max when V_c is max

$\frac{dV_c}{dt} = 0$ when $-2500t + 1 = 0$ or $\boxed{t = 0.4\,ms}$

$V_c\,(t = 5ms) = 73.58\,mV$

$e = \frac{1}{2}CV^2 = \boxed{13.53\,nJ}$



the current is applied to a 0.25 uF capacitor with $V_0 = 0$

a) Find Charge @ $t = 30\,us$

$0 \le t \le 5ms$; $i = \frac{400\,mA}{5us} t = 80 \times 10^3 t$

$5 \le t \le 20ms$

$i = 400\,mA$

$20 \le t \le 50\,us$

$i = \frac{300mA}{30\,us} t - 0.5$

$$q = \int i\,dt$$

$$q(30\,us) = \int_0^{5us} 80\times10^3 t\,dt + \int_{5us}^{20us} .4\,dt + \int_{20us}^{30us} (10\times10^3 t - .5)\,dt$$

$$= 1\,uC + 6\,us - 2.5\,uC$$

$$\boxed{q(15us) = 9.5\,uC}$$

b) Find V_{cap} @ $t = 50\,us$

$$V = \frac{1}{C}\int i_c\,dt$$

$$V = 4\times10^6 \left[\int_0^{5us} 80\times10^3 t\,dt + \int_{5us}^{15us} .4\,dt + \int_{20us}^{50us} (10^4 t - .5)\,dt \right]$$

$$\boxed{V(50\,us) = 10\,V}$$

c) Find energy stored in Cap.

$V(50us) = 10\,V$

$$\boxed{W = \frac{1}{2}CV^2 = 12.5\,uJ}$$

The current in an inductor ($L = 50\,mH$) is

$$i = 120\,mA \quad t \le 0$$
$$i = A_1 e^{-500t} + A_2 e^{-2000t}\,A \quad t \ge 0$$

$$V_L(0) = -18\,V$$

a) Find i_L and V_L for $t \ge 0$

① $i_L(0) = 120\,mA = A_1 + A_2$

$V_L = L\frac{di}{dt} = (.05)(-500A_1 e^{-500t}) + A_2(-2000)e^{-2000t}$ (.05)

② $V_L(0) = -18 = -25A_1 - 100A_2$

$A_1 = -.08$

$A_2 = 0.20$

$$i_L = -.08e^{-500t} + 0.20e^{-2000t}\,A$$

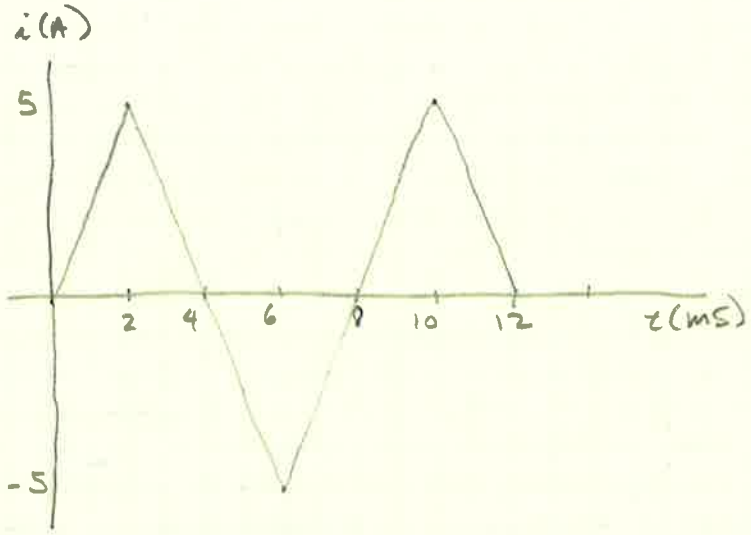
$$V_L = 2e^{-500t} - 20e^{-2000t}\,V$$

b) Specify the time intervals when the inductor is storing energy and when it is delivering energy.

inductor stores energy when power > 0

" delivers " " " < 0

The current shown is applied to a 2 uf capacitor. $v_c(0) = 0$



a) find charge on capacitor at t=6ms

$$i = \frac{dQ}{dt} \Rightarrow Q = \int i\,dt$$

$0 \le t \le 2ms$: $i = \frac{5}{.002}t = 2500t$

$2 \le t \le 6ms$: $i = -\frac{10}{.004}t + 10 = -2500t + 10$

$6 \le t \le 10ms$: $i = \frac{10}{.004}t - 20 = 2500t - 20$

$10 \le t \le 12ms$: $i = \frac{-10}{.004}t + 30 = -2500t + 30$

$$Q = \int_0^{.002} 2500t\,dt + \int_{.002}^{.006} (-2500t + 10)\,dt = .005 + (.015 - .015) = 5mC$$

$$\boxed{Q_{6ms} = 5mC}$$

b) find V_{cap} @ t = 10ms

$$i_c = C\frac{dv_c}{dt} \Rightarrow v_c = \frac{1}{C}\int i_c\,dt$$

$$V_{10ms} = \frac{1}{2\times10^{-6}}\int_0^{.002} 2500t\,dt + \frac{1}{C}\int_{.002}^{.006} (-2500t + 10)\,dt + \int_{.006}^{.010} (2500t - 20)\,dt$$

$$\boxed{V_{10ms} = 2500V}$$

c) How much energy is stored by this capacitor?

$$v_{12ms} = v_{10ms} + \frac{1}{C}\int_{10}^{12} (-2500t + 30)\,dt = 5000V$$

$$\boxed{w = \frac{1}{2}CV^2 = 25J}$$