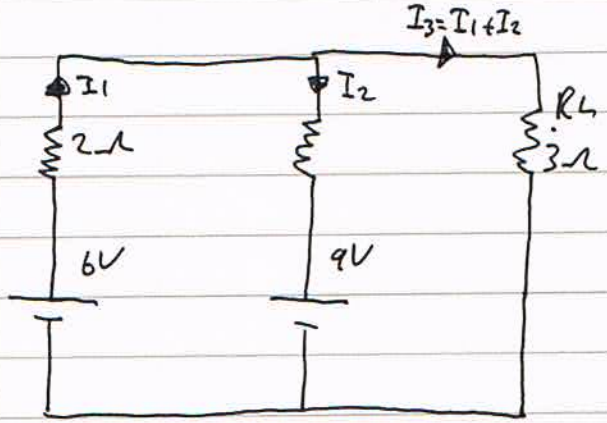
IEL-400 Assignment 1

Q1



$$I_1 = \frac{U_1}{R_1}$$
$$= \frac{6}{2}$$
$$= 3A$$

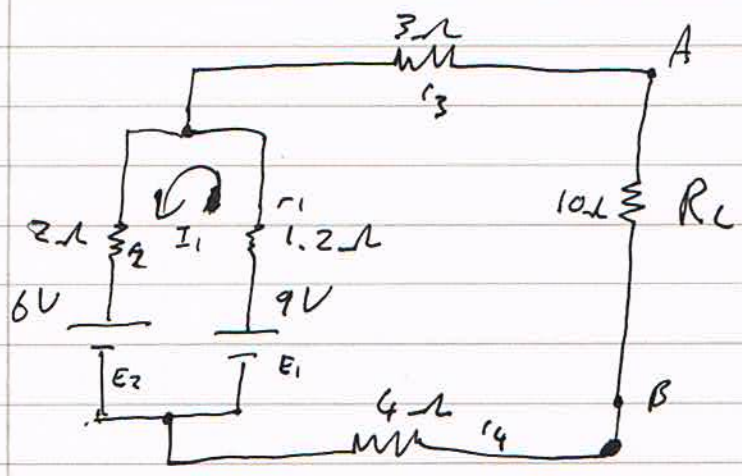
$$I_2 = \frac{U_2}{R_2}$$
$$= \frac{9}{4}$$
$$= 2.25A$$

$$I_3 = I_1 + I_2$$

$$= 3 + 225$$

$$= 5.25A$$

Q2



i) $I_1 = \frac{9-6}{2+1.2}$

$= 0.9375\ A$

P.D across AB

$E = E_1 - I_1 r_1$

$= 9 - (0.9375)(1.2)$

$= 7.875\ V$

ii) Remove emf sources:

$r = \frac{r_1 \times r_2}{r_1 + r_2} + r_3 + r_4$

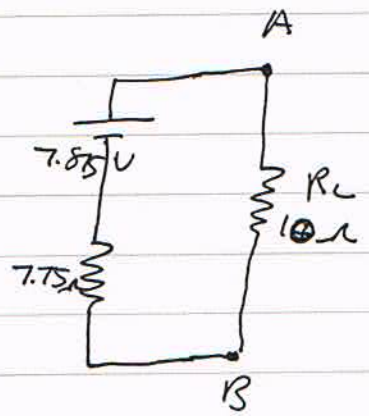
$= \frac{(1.2)(2)}{1.2+2} + 3 + 4$

$= 7.75\ \Omega$

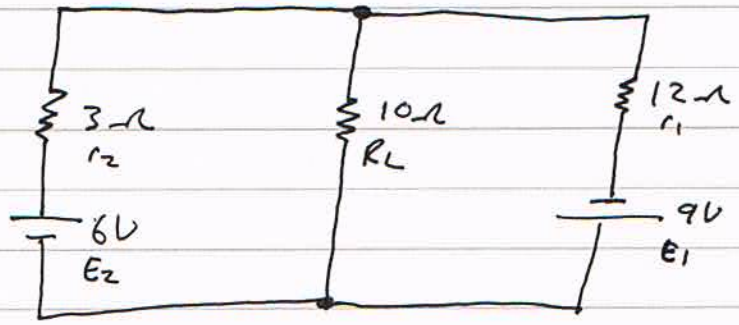
iii) $I = \frac{E}{r+R} = \frac{7.875}{7.75+10}$

$= 0.463\ A$

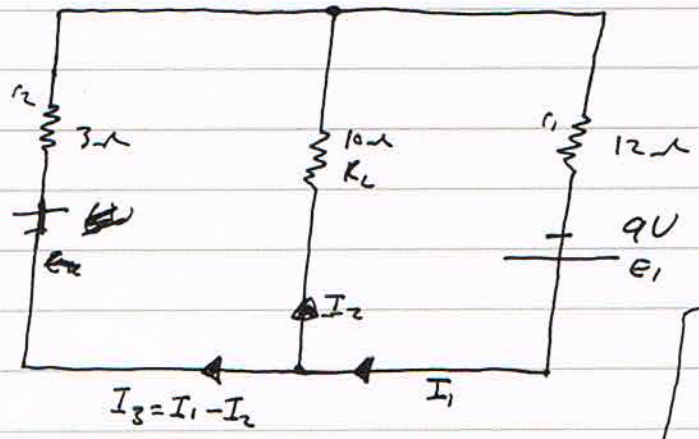
Equivalent circuit:



Q3



i)



Remove E_2

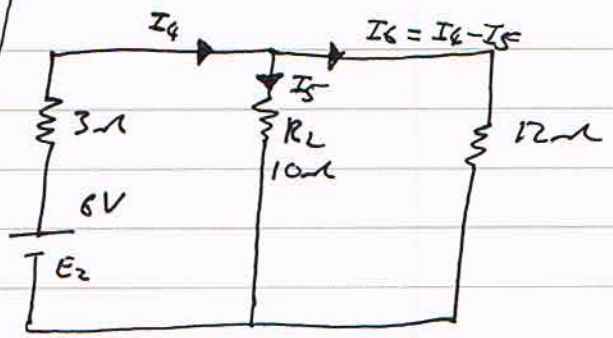
$$R_{//} = \frac{3 \times 10}{3+10} = 2.308\,\Omega$$

$$I_1 = \frac{9}{12 + 2.308} = 0.629\ A$$

$$I_2 = \left(\frac{10}{10+3}\right) I_1 = \frac{10}{13}(0.629) = 0.4838\ A$$

$$I_3 = 0.629 - 0.483 = 0.146\ A$$

ii) Remove E_1



$$R_{//} = \frac{10 \times 12}{10+12} = 5.455\,\Omega$$

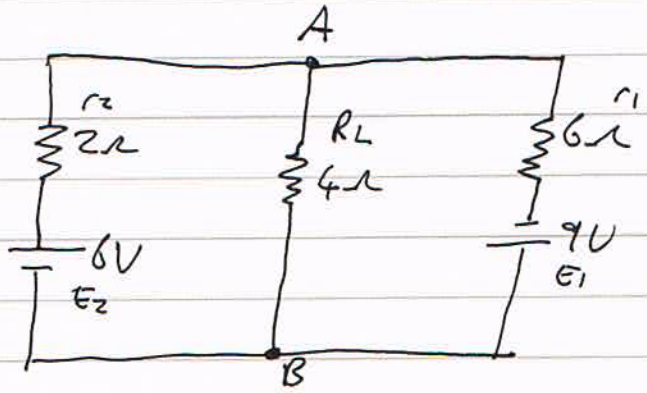
$$I_4 = \frac{6}{3 + 5.455} = 0.709\ A$$

$$I_5 = \left(\frac{10}{10+12}\right) I_4 = 0.322\ A$$

$$I_6 = 0.709 - 0.322 = 0.387\ A$$

$$\therefore I_{RL} = 0.387 - 0.146 = 0.241\ A$$

Q4



i) $I = \frac{6+9}{2+6}$

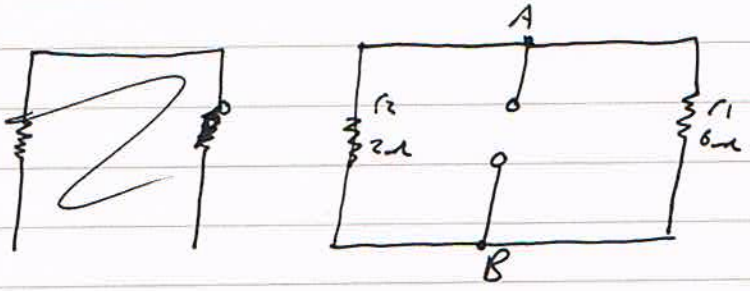
$= 1.875A$

P.D. across AB:

$E = 6 - (1.875)2$

$= 2.25V$

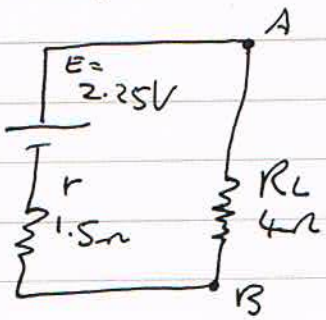
ii) Remove emf sources



$r = \frac{2 \times 6}{2+6}$

$= 1.5\Omega$

iii) Th. equivalent

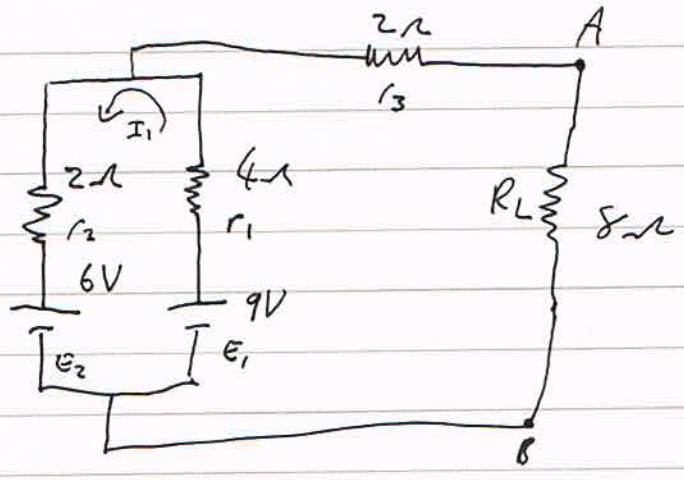


$I_{RL} = \frac{E}{r+R}$

$= \frac{2.25}{1.5+4}$

$= 0.409\ A$

Q5



i) $I_1 = \frac{\mathcal{E}_1 - \mathcal{E}_2}{r_1 + r_2}$

$= \frac{9-6}{4+2}$

$= 0.5\,A$

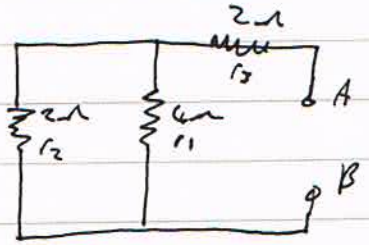
P.D. across AB:

$\mathcal{E} = \mathcal{E}_1 - I_1 r_1$

$= 9 - (0.5 \times 4)$

$= 7\,V$

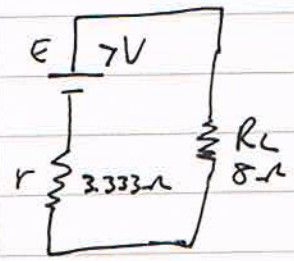
ii) Remove emf sources:



$R_T = \frac{(2 \times 4)}{2+4} + 2$

$= 3.333\,\Omega$

iii) Th. equiv circuit

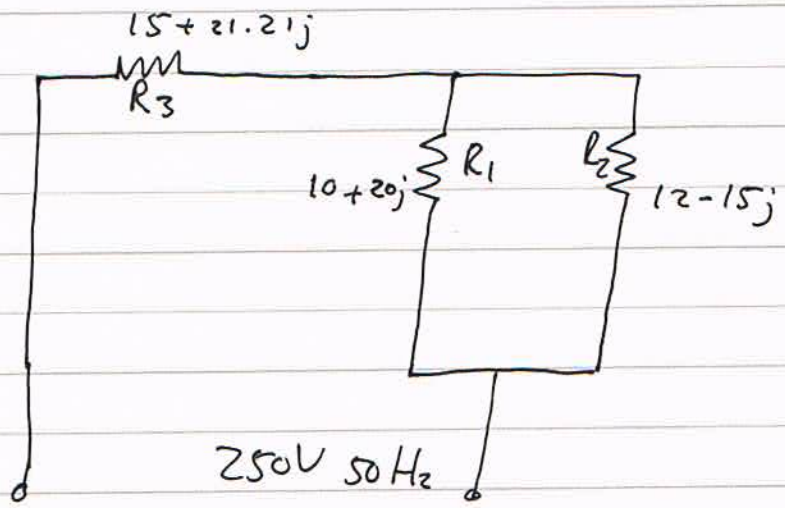


$I = \frac{\mathcal{E}}{r + R_L}$

$= \frac{7}{3.333 + 8}$

$= 0.617\,A$

Q6



$$R_{II} = \frac{R_1 \times R_2}{R_1 + R_2}$$

i) $R_1 \times R_2$

$= (10 + 20j)(12 - 15j)$

$= 120 + 240j - 150j - 300j^2$

$= 120 + 90j + 300$

$= 420 + 90j$

ii) $R_1 + R_2$

$= (10 + 20j) + (12 - 15j)$

$= 22 + 5j$

iii) $\frac{420 + 90j}{22 + 5j}$

$= \frac{420 + 90j}{22 + 5j} \times \frac{22 - 5j}{22 - 5j}$

$= \frac{9240 + 1980j - 2100j - 450j^2}{22}$

$= \frac{9690 - 120j}{22}$

$= \frac{4845}{11} - \frac{60}{11}j$

iv) $R_{II} + R_3 = R_T$

$\therefore \left(\frac{4845}{11} - \frac{60}{11}j\right) + (15 + 21.21j)$

$Z = \frac{5010}{11} + 15.755j$

$I = \frac{V_T}{RZ}$

$= \frac{250}{\frac{5010}{11} + 15.755j}$

$= 0.548 - 0.019j$

pg 6/R

1) $f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$

$= \frac{1}{2\pi}\sqrt{\frac{1}{(125\times10^{-3} \times 0.20264\times10^{-6})} - \frac{5^2}{125\times10^{-3}}}$

$= 1000.003\ Hz$

2) $X_L = 2\pi fL$

$= 2\pi(1000)(125\times10^{-3})$

$= 785.398\ \Omega$

$Z = \sqrt{R^2 + X_L^2}$

$= \sqrt{5^2 + 785.398^2}$

$= 785.416\ \Omega$

$I_{LR} = \frac{V}{Z_t} = \frac{20}{785.416}$

$= 0.0255A$

$= 25.464\ mA$

3) $X_C = \frac{1}{2\pi fC}$

$= \frac{1}{2\pi(1000\times0.20264\times10^{-6})}$

$= 785.407\ \Omega$

$I_C = \frac{V}{X_C} = \frac{20}{785.407}$

$= 0.0255A$

$= 25.464\ mA$ (90°)

Q7 (Contd)

4) $Z = \frac{L}{CR}$ (Dyn imp)

$= \frac{125 \times 10^{-3}}{0.20264 \times 10^{-6} \times 5}$

$= 123371.696\ \Omega$

$= 123.371\ k\Omega$

5) $\theta = \tan^{-1} \frac{X_L}{R} = \tan^{-1} \frac{785.398}{5}$

$\theta = 89.635^\circ$ lagging

$I_{LR} \cos 89.635$

$= 25.466 \times 10^{-3} \cos 89.635$

$\doteq 162.216\ \mu A$

$I_T = \frac{V_T}{Z + R}$

$= \frac{20}{785.398 + 5}$

$= 0.0253\ A$

$= 25.303\ mA$

Q7 (contd)

6) $\theta = \tan^{-1} \frac{X_L}{R}$

$= \tan^{-1} \frac{785.398}{5}$

$\theta = 89.635°$ lagging

$I_{LR} \cos 89.635$ (Horizontal comp)

$= 25.464 \cos 89.635$

$= 162.216 \mu A$

$-I_{LR} \sin 89.635$ (vert. comp)

$= -25.464 \sin 89.635$

$= -25.463 A$

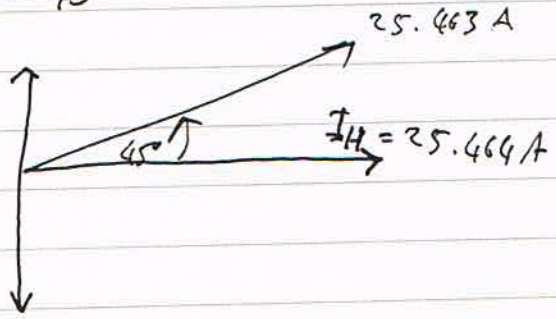
Vert comp of I_C

$I_C \sin 90 = 25.464 \sin 90$

$= 25.464 A$

$\theta = \tan^{-1} \left(\frac{25.464}{25.463}\right)$

$= 45°$



pg 9/12

Q8

a) $R_T = \frac{100 \times 120}{100 + 120} + 0$

$= 54.545\ \Omega$

b) $P = \frac{V^2}{R}$

$= \frac{6^2}{54.545}$

$= 0.66\ W$

b) $R_T = 54.545 + 50$

$= 104.545$

$\therefore P = \frac{6^2}{104.545}$

$= 0.3443\ W$

c) 0.3 ; conducts

d) positive

e) junction diode

f) 8.9 - 9.1 V

g) minimum ; R

h) V_R ; maximum

Q9

a) Impedance is the combination of resistances in a RL, RC, or RLC circuit. It can also be said to be the ratio applied voltage to current.

b) The Q-factor is the amount by which V_L and V_C are magnified. It gives an indication of how many times V_L or V_C is greater than V_T

c) maximum; minimum

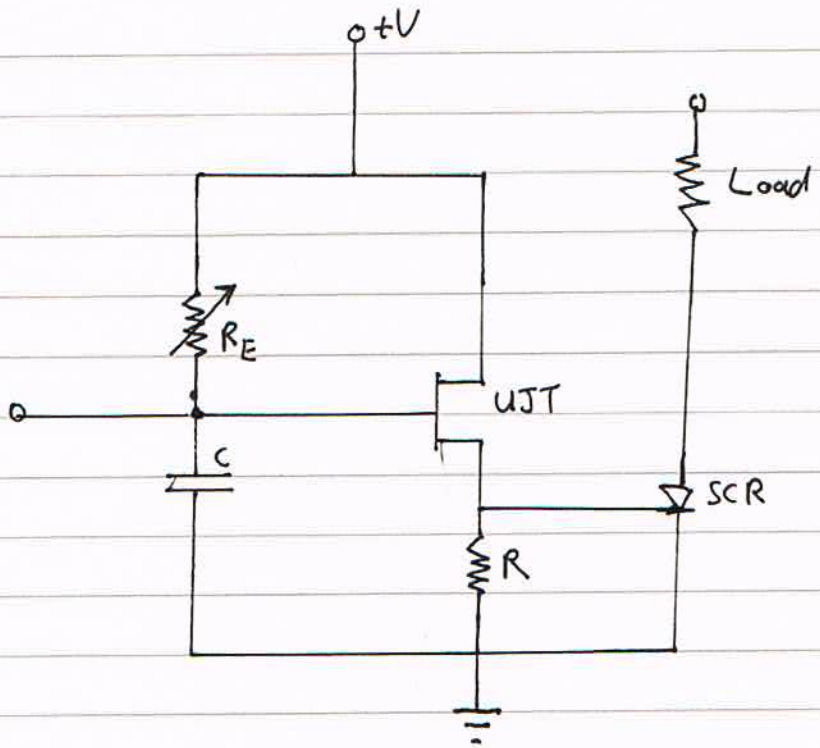
d) ~~a series~~ both series & parallel

e) acceptor

f) rejector

g) 1

Q10



The resistor R_E is chosen so that the load line is determined by R_E passes through the device characteristic in the negative resistance region.

The capacitor determines the time interval between triggering pulses and the time duration of each pulse.

By varying R_E, the time constant $R_E C$ alters the point at which the UJT fires thus allowing the control of the conduction angle of the SCR, controlling the control of the load.

pg 12/1