Hw 1 solution

1.7) given $i(t) = 3\mu A$ for all t.

Find $q(t)$?

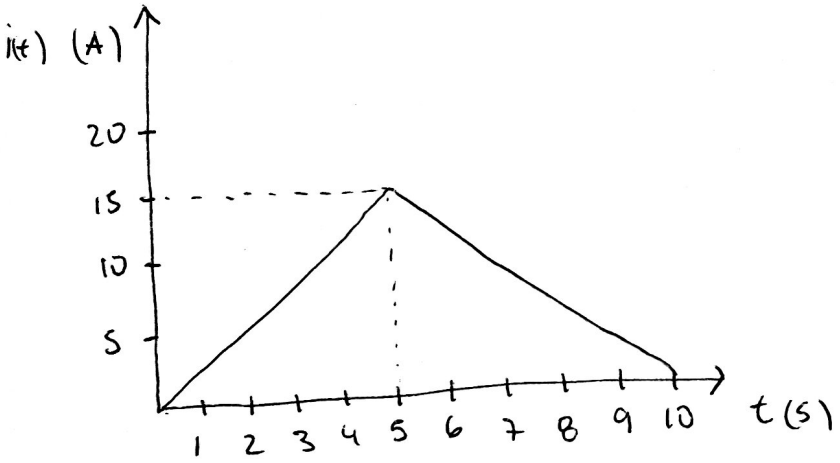
$$q(t) = \int_{t_1}^{t_2} i(t)\,dt = \int_0^{500ms} 30\mu A\,dt = (30\mu A)(500ms)$$

$$= 15000 \cdot 10^{-6} \cdot 10^{-3} C$$

$$= 15\mu C$$

1.12)

$$i(t) = \begin{cases} 3t \text{ A} & 0 \le t \le 5s \\ 30 - 3t \text{ A} & 5 < t \le 10s \\ 0 \text{ A} & t > 10s \end{cases}$$



$$q_T = \int_0^5 3t\,dt + \int_5^{10} 30 - 3t\,dt$$

$$= \frac{3}{2}t^2\Big|_0^5 + \left(30t - \frac{3}{2}t^2\right)\Big|_5^{10}$$

$$= \frac{3}{2}(5^2) + 30(10) - \frac{3}{2}(10)^2 - 30(5) + \frac{3}{2}(5)^2$$

$$= \frac{3}{2}(25) + 300 - 150 - 150 + \frac{3}{2}(25)$$

$$= 75\ C$$

1.15)

$$i(t) = \begin{cases} 0A & t < 0 \\ 5e^{-3t} & t \geq 0 \end{cases}$$

$$q(t) = \int_0^t 5e^{-3t_1} dt_1 = -\frac{5}{3} e^{-3t_1} \Big|_0^t = -\frac{5}{3}\left(e^{-3t} - e^{-3(0)}\right)$$

$$= \frac{5}{3}\left(1 - e^{-3t}\right)$$

1.22) Recall that $P = V \cdot i$

Device	Power	Absorbing / delivering
1	$(15)(-1) = -15$	delivering
2	$(5)(1) = 5$	Absorbing
3	$(10)(2) = 20$	Absorbing
4	$(-10)(-1) = 10$	Absorbing
5	$(20)(-3) = -60$	Delivering
6	$(20)(2) = 40$	Absorbing

Power balance:

$$P_1 + P_2 + \ldots + P_6 = -15 + 5 + 20 + 10 - 60 + 40$$

$$= 0W$$

2.6) It is given $G = 0.05\,mS$, Then $R = \frac{1}{0.05 \times 10^{-3}\,S}$

$R = 20\,K\Omega$

Recall that $i = \frac{V}{R}$, where $V = 1.5\,V$

Then, $i = \frac{1.5\,V}{20\,K\Omega} = 0.075\,mA$

2.9) By the color code, the resistor should be:

$= 33 \times 10^3 \pm 5\%\ \Omega$

or $= 33 \times 10^3 \pm 1.65 \times 10^3\ \Omega$

$= 33\,K\Omega \pm 1.65\,K\Omega$

Therefore, the resistor is not properly coded.

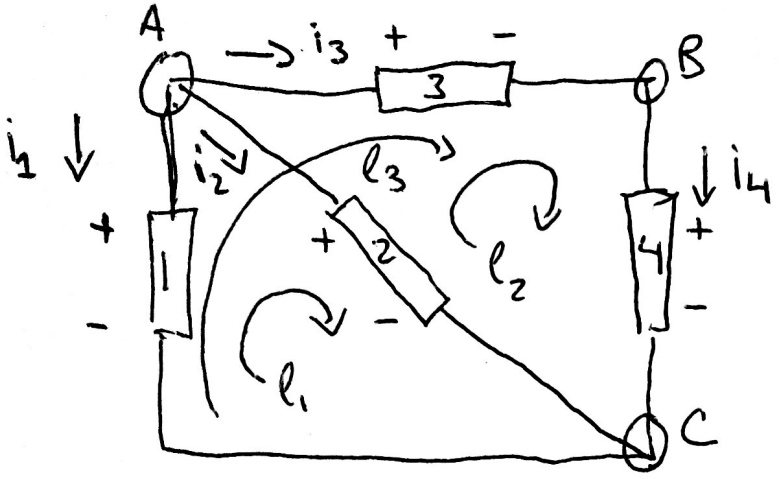
2.15) It is given $i_2 = -6A$ and $i_3 = 2A$

Using KCL we have:

$-i_1 - i_2 = 0 \Rightarrow i_1 = -i_2 = 6A$

$i_2 + i_3 = i_4 \Rightarrow i_4 = -4A$

2.17)



a) Nodes: A, B, C

loops: l_1, l_2, l_3

b) Elements in series: 3 with 4

Elements in parallel: 1 with 2

c) KCL:

$$i_1 + i_2 + i_3 = 0$$

$$i_3 = i_4$$

$$i_4 + i_2 + i_1 = 0$$

KVL:

$$-V_1 + V_2 = 0$$

$$-V_2 + V_3 + V_4 = 0$$

$$-V_1 + V_3 + V_4 = 0$$

2.23) There are not elements in series nor parallel

We are given: $V_2 = 10V$, $V_4 = 10V$, $V_5 = 5V$

Find V_1, V_3, V_6

KVL:

* $-V_1 + V_2 + V_4 + V_5 = 0 \Rightarrow V_1 = V_2 + V_4 + V_5$

$V_1 = 10V + 10V + 5V$

$V_1 = 25V$

* $-V_1 + V_2 + V_3 = 0 \Rightarrow V_3 = V_1 - V_2$

$V_3 = 25V - 10V$

$V_3 = 15V$

* $V_6 - V_4 - V_2 = 0 \Rightarrow V_6 = V_2 + V_4$

$V_6 = 10V + 10V$

$V_6 = 20V$

2.27)