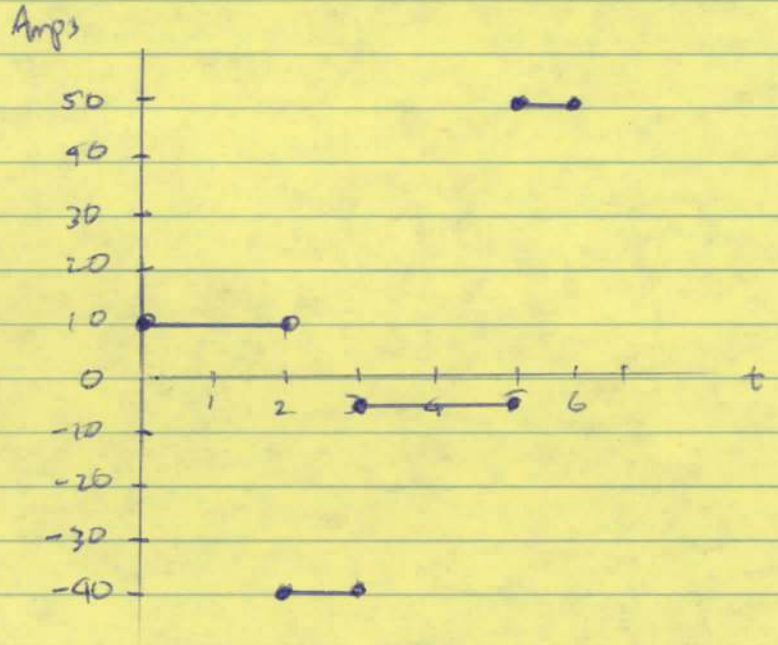
MAE 140 HW #1

1-9

We have that $I = \frac{dq}{dt}$, so we get the following graph (+5)

$$I(t) = \begin{cases} 10A & 0 \le t \le 2 \\ -40A & 2 \le t \le 3 \\ -5A & 3 \le t \le 5 \\ 50A. & 5 \le t \le 6 \end{cases}$$



(+5)

NOTE: SUBTRACT 0.5 POINTS WHEN THERE IS NO UNIT GIVEN OR UNIT IS INCORRECT.

1.11

A cellphone charger outputs 9.6V and is protected by a 50mA fuse. A 2W cellphone is connected to it. Will the fuse blow?

$P = VI$

$I = \frac{P}{V} = \frac{2}{9.6} = 0.2083 \text{ amps}$

$= \underline{208.3 \text{ mA}}$ (+8) Calculating current.

Since 208.3mA exceeds 50mA, the fuse will blow. (+2) Stating that fuse will blow.

1.14

12V automobile battery has an output capacity of 100Ah when connected to a lamp that absorbs 200W of power.

(a) Find the current supplied by the battery and determine how long the battery can power the headlight for.

$P = VI,$

$I = \frac{P}{V} = \frac{200}{12} = \underline{16.67 \text{ A}}$ (+3)

To find how long battery can power the lamp.

$t = \frac{100}{(200/12)} = \underline{\underline{6 \text{ hours}}}$ (+3)

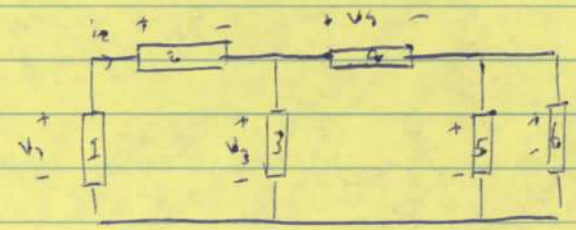
(b) A 100W device is connected through the utility port. How long can the battery power both the device and the headlight?

$P_{tot} = 200 + 100 = 300W$

$I = \frac{300}{12} = \underline{25 \text{ A}}$

$t = \frac{100}{25} = \underline{4 \text{ hours}}$ (+4)

1.23



Use the power balance to find V_4 when $v_1 = 20V$, $i_1 = -2A$, $P_2 = 20W$, $P_3 = 10W$, $i_4 = 1A$, $P_5 = P_6 = 2.5W$

$P_1 = -40W$

$P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 0$

$\Rightarrow P_4 = \underline{5W}$ } As $P_4 > 0$, it is absorbing power. (+2)

$P = VI$

$\Rightarrow V_4 = \underline{5V}$ (+8)

2.7

$V = 15V$, $P_x = 25mW$. Find R_x

$P = VI$, $V = IR$,

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

$\Rightarrow P = \frac{V^2}{R}$, $R = \frac{V^2}{P} = \frac{15^2}{25m} = \underline{9000\,\Omega}$ (+10)

2.81

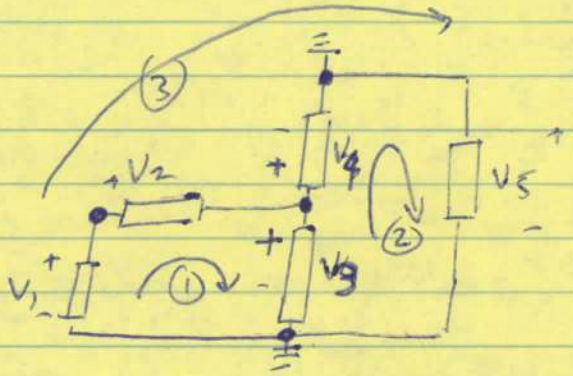
$I = 10mA$, $V = 100V$, Find R_x and the power supplied by the source

$P = VI = 100 \times 10m = 1W$ (+5)

$R = \frac{V}{I} = \frac{100}{10m} = 10000\ \Omega$ (+5)

2.16

Determine which elements are in series or parallel or neither, How many different nodes and loops are there in the circuit? If $V_2 = 3V$, and $V_3 = 5V$, find V_1, V_4 and V_5.



- Elements V_1 & V_2 are in series. (+1)
- Elements V_3 & V_4 are in parallel with eachother. (+1)

- There are 3 loops (indicated) (+1)
- There are 4 nodes (indicated by circles) (+1)

$-V_1 + V_2 + V_3 = 0$,

$V_5 = 0$ (Connected between two grounds)

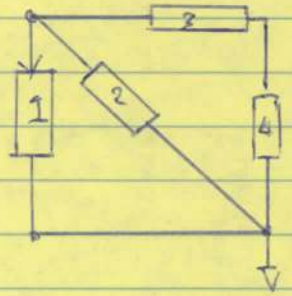
$V_3 = +V_4$

$V_5 = 0V$ (+2)

$V_4 = +5V$ (+2)

$V_1 = 8V$ (+2)

2.18]



$i_2 = -30mA$, $i_4 = 20mA$, find i_1 & i_3.

$i_3 = i_4 \Rightarrow i_3 = 20mA$ (+4)

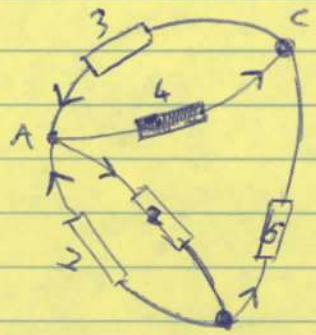
$i_1 + i_2 + i_3 = 0$

$i_1 = -i_2 - i_3$

$= 30m - 20m$

$= \underline{\underline{10m}}$

2.24]



Are any of the elements in series or parallel? $i_1 = -3mA$, $i_2 = 10mA$, $i_3 = -15mA$, identify i_4 and i_5.

3 & 4 and 1 & 2 are in parallel. (+2)

Perform a nodal analysis at point A

$i_1 + i_3 = i_2 + i_4$

$i_4 = i_1 + i_3 - i_2$

$= -3m - 15m - 10m$

$= \underline{\underline{-30mA}}$ (+4)

Perform a nodal analysis at point C

$i_4 + i_5 = i_3$

$i_5 = i_3 - i_4$

$= -15m + 30m$

$= \underline{\underline{15mA}}$ (+4)

2.26

+5

If a wire is connected across (B) and (C) then $V_5 = 0$, so the voltage across elements 1, 2, 3, 4 will all be the same

+3