SPH3U0 **Electricity Quest** Name:_____

Knowledge: _____/ 20 marks Application: _____/ 20 marks

Useful Formulas:

$I = \frac{Q}{\Delta t}$ $V = \frac{E}{Q}$ $E = VI\Delta t$ $R_s = R_1 + R_2 + R_3 + \cdots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots\ldots$

$P = IV = I^2R = \frac{V^2}{R}$

Part A: Multiple Choice [6 marks]

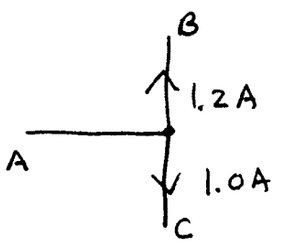
1	2	3	4	5	6
A	C	C	B	D	C

Part B: Knowledge Short Answer [14 marks]

1.What is Kirchoff's Current Law and what does it tell you about the current in branch A and the junction shown below? [2]

The total current in Branch A, is equal to the sum of the current in branches B + C.

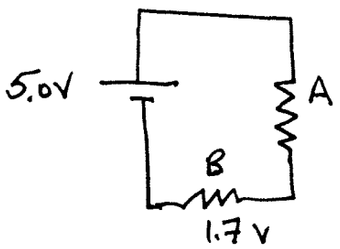
$I_A = I_B + I_C = 1.2 + 1.0 = 2.2\,A$



2. What is Kirchoff's Voltage Law and what does it tell you about the voltage across load A in the circuit below? [2]

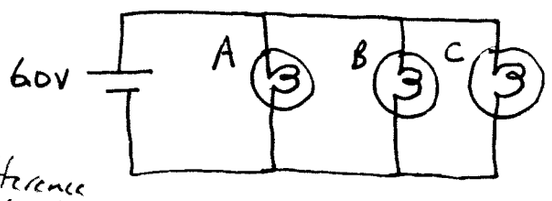
The sum of the voltage drops around the circuit is equal to the total voltage gains.

$\therefore V_T = V_A + V_B$ OR $V_A = V_T - V_B$ $\quad V_A = 5.0V - 1.7V = 3.3V$



3. What is/are the voltage(s) across Light Bulbs A, B and C in the circuit below? Explain your answer. [2]

The bulbs A, B and C are all in parallel with the battery. They all see the same potential difference of 6.0V.



4. How much energy does a 1.5 V battery give 2.0 Coloumbs of charge if the current is 1.5 A? [3]

$V = 1.5V$ $\quad Q = 2.0C$ $\quad I = 1.5A$ $\quad E = ?$

$E = V \cdot Q$
$= (1.5V)(2.0C)$
$= 3.0\,\frac{J}{C} \cdot C$
$= 3.0\,J$

$\therefore$ the total energy transferred is 3.0J.

5. A current of 540 mA flows through a flashlight bulb with a potential difference of 6.0 V across it. How much electrical energy is converted by the bulb in a time of 20.0 seconds. [5]

$I = 0.540\,A$ $\quad V = 6.0V$ $\quad \Delta t = 20.0s$ $\quad E = ?$

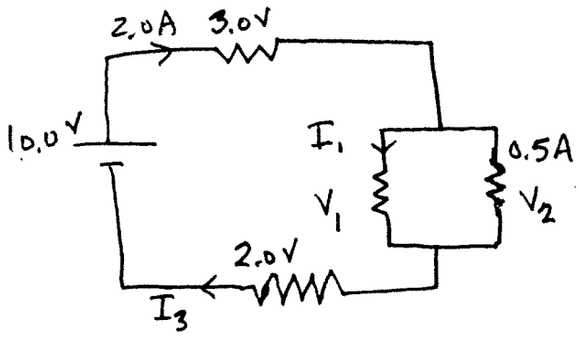
$E = VI\Delta t$
$= (6.0V)(0.540A)(20.0s)$
$= 64.8J.$
$\sim 65\,J$

$\therefore$ 65 J of electrical energy is converted by the bulb.

Part B: Application Questions [20 marks]

1. Use Kirchoff's Current and Voltage Laws to determine all unknown currents and voltages in the following circuits. Show your work in the space beside the diagram.

a) $I_1 =$ 1.5A $V_1 =$ 5.0V $V_2 =$ 5.0V $I_3 =$ 2.0A [4]



$I_1 = 2.0A - 0.5A = 1.5A$

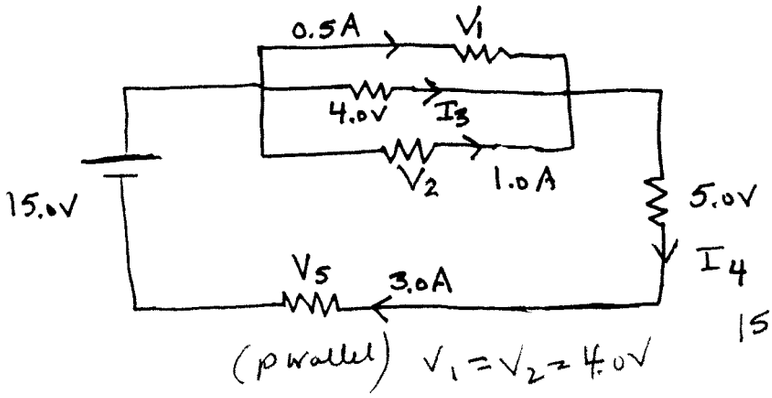
$V_T = 3.0V + V_1 + 2.0V$

$10.0V = 5.0V + V_1 \rightarrow V_1 = 10.0V - 5.0V = 5.0V$

$V_2 = V_1 = 5.0V$ (parallel)

$I_3 = 2.0A$

b) $V_1 =$ 4.0V $V_2 =$ 4.0V $I_3 =$ 1.5A $I_4 =$ 3.0A $V_5 =$ 6.0V [5]



$3.0A = 0.5A + I_3 + 1.0A$

$3.0A = 1.5A + I_3 \rightarrow I_3 = 1.5A$

$I_4 = 3.0A$

$15.0V = 4.0V + 5.0V + V_5$

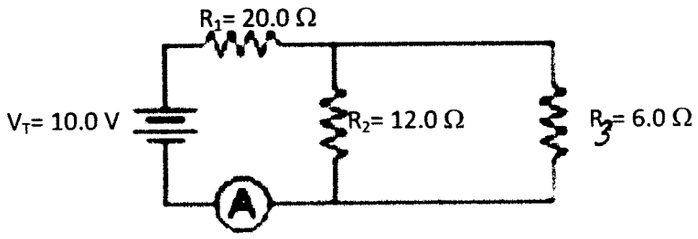
$15.0V = 9.0V + V_5$

$15.0V - 9.0V = V_5$

$6.0V = V_5$

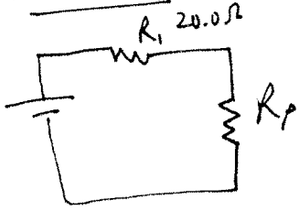
(parallel) $V_1 = V_2 = 4.0V$

2. Consider the circuit shown below:



a) Solve for the total equivalent resistance in the circuit below: [4]

Find R_p:



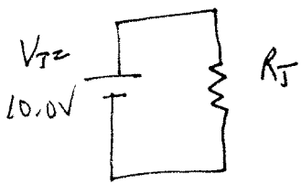
$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_p} = \frac{1}{12} + \frac{1}{6.0}$

$\frac{1}{R_p} = \frac{3}{12.0}$

$R_p = 4.0\Omega$

Find R_T:



$R_T = R_1 + R_p$

$= 20.0\Omega + 4.0\Omega$

$= 24.0\Omega$

∴ the total equivalent resistance is 24.0Ω [2]

b) Find the total current flowing through the ammeter.

$V_T = 10.0V$

$R_T = 24.0\Omega$

$I_T = ?$

$I_T = \frac{V_T}{R_T} = \frac{10.0V}{24.0\Omega} = 0.42A$

∴ the current is 0.42A.

c) Find the voltage across resistor R_1 and the power consumed by resistor R_1. [2]

$I_T = 0.417A$

$R_1 = 20.0\Omega$

$V_1 = ?$ $P_1 = ?$

$V_1 = I_T R_1$

$= (0.417A)(20.0\Omega)$

$= 8.3V$

$P_1 = I_T V_1$

$= (0.417A)(8.3V)$

$= 3.475W$

$\sim 3.5W$

d) Find the voltage across resistor R_2 and the power consumed by resistor R_2. [3]

$V_3 = ?$

$P_2 = ?$

in equivalent circuit #1:

$V_T = V_1 + V_{R_p}$

$V_{R_p} = V_T - V_1 = 10.0V - 8.3V$

$= 1.7V$

$\therefore V_2 = V_3 = 1.66V$

$P_2 = \frac{V_2^2}{R} = \frac{(1.66V)^2}{12.0\Omega} = 0.23W$