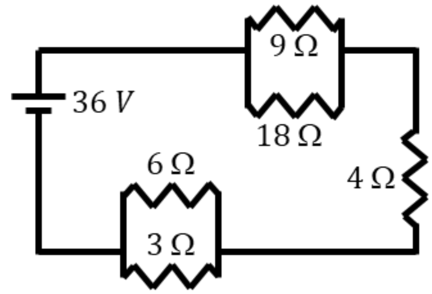
APPC, E & M: Unit B HW 4

Name: ______________________________
Hr: ___ Due at beg of hr on: __________

UB, HW4, P1
Reference Video: "Review of Unit on DC Circuits (Part I)"
YouTube, lasseviren1, DC CIRCUITS playlist

Answer Parts A-C WITHOUT DOING ANY CALCULATIONS.



A. Which resistor has the most current?

B. Explain your Part A answer.

C. What fraction (or percentage) of the current that flows through the battery…flows through each resistor?

3 Ω: ________ 6 Ω: ________
4 Ω: ________ 9 Ω: ________ 18 Ω: ________

D. Complete the Circuit Sudoku, i.e., the VIRP (rhymes with 'Burp!') chart. Include units.

E. For energy to be conserved, what must be true with regard to the values that make up the rightmost column of your chart?

	V	I	R	P
Batt.	**36 V**			
			3 Ω	
			4 Ω	
			6 Ω	
			9 Ω	
			18 Ω	

F. Show the calculation that verifies/demonstrates the validity of your Part E answer.

UB, HW4, P2

Reference Video: "Review of Unit on DC Circuits (Part I)"
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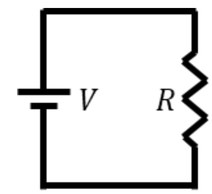
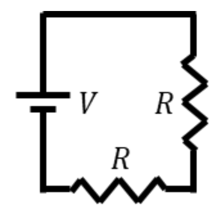


A. Consider the figure at right, containing a single battery and one resistor. In terms of ONLY V and R, write algebraic expressions for…

$I_{battery}$ = __________ $I_{resistor}$ = __________ $P_{battery}$ = __________ $P_{resistor}$ = __________

B. How do the two current expressions from Part A compare, and why?

C. How do the two power expressions from Part A compare, and why?

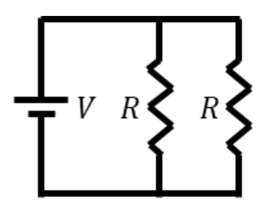


D. The next figure shows that we have now added a second resistor, identical to the first, in series with the first resistor. Again, in terms of only V and R, write algebraic expressions for…

$I_{battery}$ = __________ $I_{each\ resistor}$ = __________ $P_{battery}$ = __________ $P_{each\ resistor}$ = __________

E. How do the two current expressions from Part D compare, and why?

F. How do the two power expressions from Part D compare, and why?



G. The final figure shows that we have again added a second resistor, identical to the first, but this time in parallel with the first. Again, in terms of only V and R, write algebraic expressions for…

$I_{battery}$ = __________ $I_{each\ resistor}$ = __________ $P_{battery}$ = __________ $P_{each\ resistor}$ = __________

H. How do the two current expressions from Part G compare, and why?

I. How do the two power expressions from Part G compare, and why?

J. Summarize your findings: (Circle your answers.)

Greatest battery current?	one R	two Rs in series	two Rs in parallel
Greatest total resistance?	one R	two Rs in series	two Rs in parallel
Greatest power usage?	one R	two Rs in series	two Rs in parallel

UB, HW4, P3

Reference Video: "Review of Unit on DC Circuits (Part II)"
YouTube, lasseviren1, DC CIRCUITS playlist

A. By definition, current is an amount of charge passing a fixed point in a given amount of time. Write the equation expressing this definition, i.e., I = ?

B. Modify the right side of your Part A answer for the case where a VERY TINY amount of charge passes a fixed point in a VERY TINY amount of time, i.e., I = ?

C. Suppose the amount of charge passing a fixed point as a function of time conforms to the equation:

$$Q(t) = \alpha t^2 + \beta t + \gamma$$

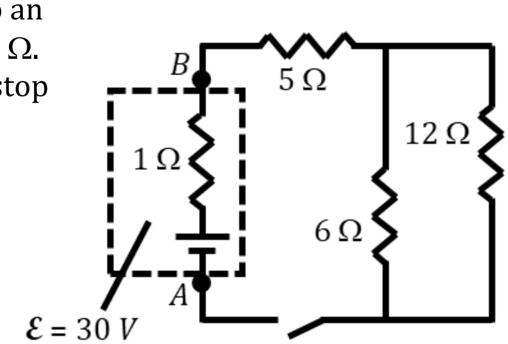
What must be the units on…?

α ________ β ________ γ ________

D. Based on the equation given in Part C, and in conformity with your Part B answer, write the equation that shows how the current would vary with time, i.e., $I(t)$ = ?

E. Suppose now that a current is known to vary with time according to the function: $I(t) = \sigma t^2 + \varphi t + \theta$
Write the equation that would be the starting point for determining the amount of charge that has passed a fixed point during any given time interval, i.e., $Q(t)$ = ?

The figure at right shows a circuit with a real emf device (as opposed to an ideal emf device) that has an emf of 30 V and an internal resistance of 1 Ω. Note the switch at the bottom of the figure, which allows us to start or stop the flow of current through the circuit.



F. When the switch is open, what will be the voltage measured across Points A and B?

G. The switch is now thrown (i.e., closed). Determine the quantities at right:

R_{tot} = ________ I_{batt} = ________

$I_{5\,\Omega}$ = ________ $I_{6\,\Omega}$ = ________ $I_{12\,\Omega}$ = ________

$V_{5\,\Omega}$ = ________ $V_{6\,\Omega}$ = ________ $V_{12\,\Omega}$ = ________

H. For a real emf device, there will also be a voltage drop across the internal resistance of the battery. Determine this voltage drop. $V_{1\,\Omega\text{ internal battery resistance}}$ = ________

I. Taking into account your Part H answer, what voltage would a voltmeter measure across the Points A and B when the circuit is closed and current is running through it?

UB, HW4, P4

Reference Video: “Review of Unit on DC Circuits (Part II)”
YouTube, lasseviren1, DC CIRCUITS playlist

A. Set up (and solve) a system of equations to find the currents in each resistor of the circuit shown here. Also, circle the arrow that shows the direction of each current.

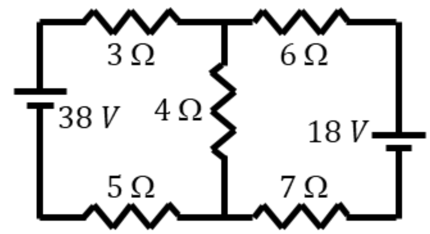
$I_{3\Omega}$ = ________ ← →

$I_{4\Omega}$ = ________ ↑ ↓

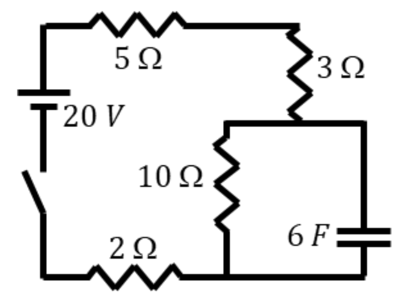
$I_{5\Omega}$ = ________ ← →

$I_{6\Omega}$ = ________ ← →

$I_{7\Omega}$ = ________ ← →



For Parts B-I, refer to the figure at right, which shows a circuit having a battery, a switch, four resistors, and a capacitor.



B. How does the capacitor behave at the instant the switch is thrown, i.e., at $t = 0$?

C. Based on your Part B answer…Which resistor is effectively NOT a part of the circuit at $t = 0$?

D. Based on your Part C answer, what is the total resistance of the circuit at $t = 0$?

E. Based on your Part D answer, determine the following, at $t = 0$:

$I_{2\Omega}$ = ________ $I_{3\Omega}$ = ________ $I_{5\Omega}$ = ________ $I_{10\Omega}$ = ________

$V_{2\Omega}$ = ________ $V_{3\Omega}$ = ________ $V_{5\Omega}$ = ________ $V_{10\Omega}$ = ________ $V_{capacitor}$ = ________

F. How does the capacitor behave a long time after the switch has been thrown, i.e., at $t = \infty$?

G. Based on your Part F answer, what is the total resistance of the circuit at $t = \infty$?

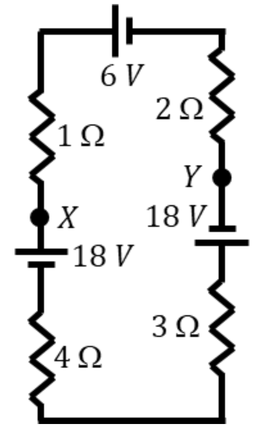
H. Based on your Part G answer, determine the following, at $t = \infty$:

$I_{2\Omega}$ = ________ $I_{3\Omega}$ = ________ $I_{5\Omega}$ = ________ $I_{10\Omega}$ = ________

$V_{2\Omega}$ = ________ $V_{3\Omega}$ = ________ $V_{5\Omega}$ = ________ $V_{10\Omega}$ = ________ $V_{capacitor}$ = ________

I. At $t = \infty$, the capacitor is now fully charged. Use the definition of capacitance (which is an equation), some information from the figure, and some part of your Part H answer to determine the charge on the capacitor plates at $t = \infty$.

UB, HW4, P5
Reference Video: "Review of Unit on DC Circuits (Part III)"
YouTube, lasseviren1, DC CIRCUITS playlist



The figure at right shows a circuit having three ideal emf sources and four resistors. Also specified are two points, *X* and *Y*.

A. Your first task is to write (but yet NOT solve) one Kirchhoff's Loop Rule equation that applies to the circuit shown in the figure. Begin this process by clearly indicating in the figure your starting/ending point, as well as the direction you will proceed as you traverse the circuit.

B. Now write (but do NOT solve) your Kirchhoff's Loop Rule equation, in conformity with your work in Part A. Do NOT combine terms or simplify. (I want to see all terms.)

C. Solve your Part B response to obtain a numerical answer (with units, duh…) for the current flowing in the circuit.

D. Which point has the higher potential? (circle) Point *X* Point *Y*

E. What is the name of the instrument you'd use if you wanted to measure the potential difference between Points *X* and *Y*?

F. What kind of resistance does the instrument of Part E have? (circle) high resistance low resistance

G. What numerical value would the Part E instrument measure between Points *X* and *Y*?