Enhanced Guided Notes: Set 5

Voltage and Current

Topics:

A. Series Resistors/Circuits
B. Power Distribution in a Series Circuit
C. Voltage Sources in a Series Circuit
D. Kirchhoff's Voltage Law
E. Voltage Division in a Series Circuit
F. Voltage Regulation and the Internal Resistance of Voltage Sources

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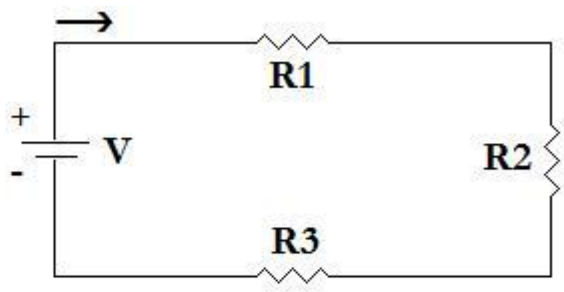
A. Series Resistors / Circuits

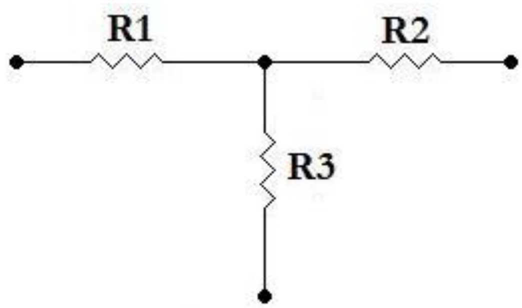


$I_{R1} = I_{R2} = I_{R3} =$

$I =$ ________________

$R_{TOTAL} = R_1 +$

In general, $R_T = R_1 + R_2 + R_3 + \ldots + R_N$



Are these resistors in series?

✵ Examples:

Discovered by Georg Simon Ohm

$\Delta T = O$ ↪ Double V ➔ Double I
Triple V ➔ Triple I

Conclusions

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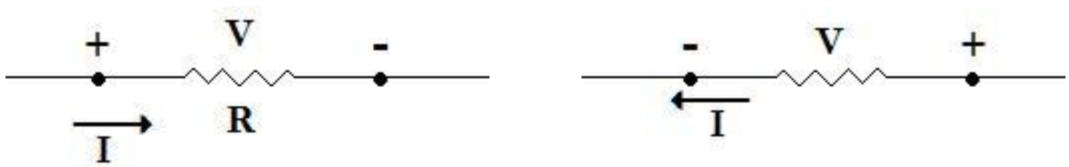
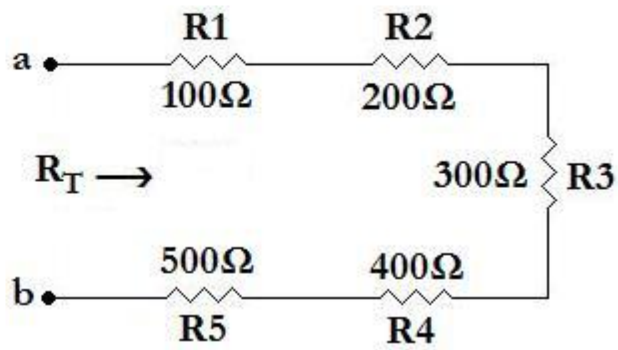
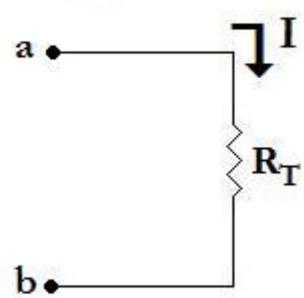
Now, we can say that $$\frac{V}{I} = R$$



✵ Examples:

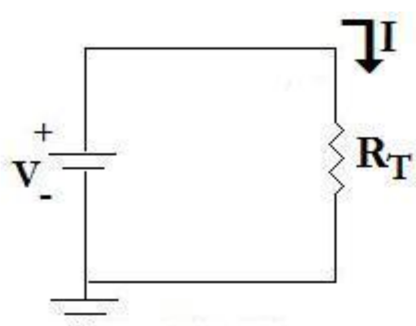


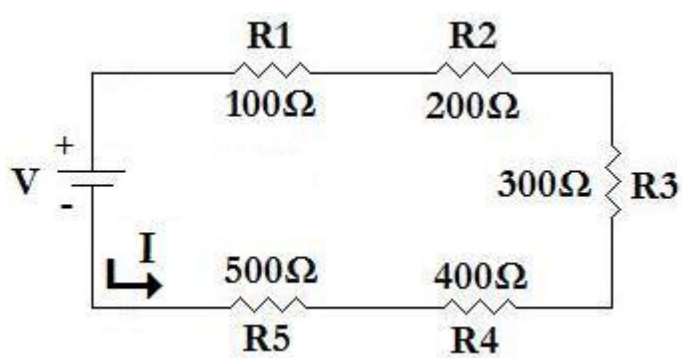
R_T =



If V_{ab} = 15V then I =

____

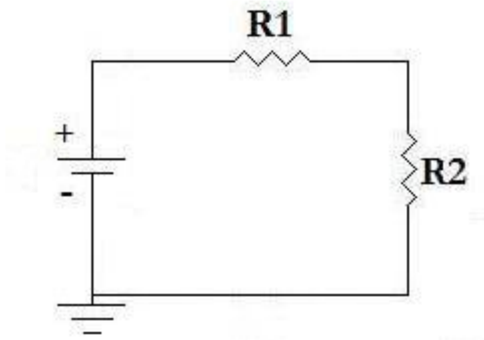




If V=15

I =

A 20k Ω resistor and a 15k Ω resistor are connected in series to a 140 V source. Find the voltage drop across the 15k Ω resistor.



How do we solve this problem?

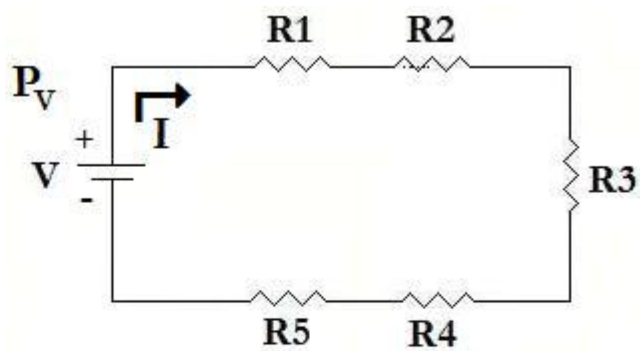
Why?

Conclusions?

B. Power Distribution in a Series Circuit

$$P_{applied} = P_{dissipated\ (absorbed)}$$

Let's consider this situation



$P_V = P_{R1} + P_{R2} + P_{R3} + P_{R4} + P_{R5}$

Let V = 15 V
R1 = 100Ω, R2 = 200Ω, R3 = 300Ω, R4 = 400Ω and R5 = 500Ω

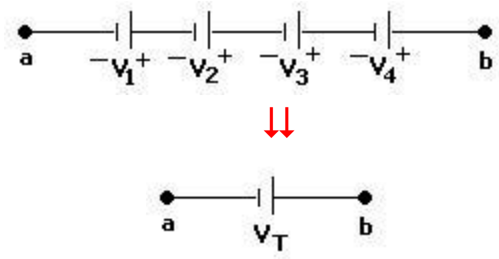
a. R_T =

b. I =

c. P_V =

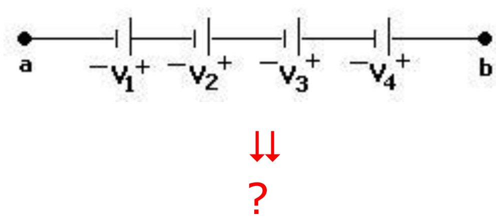
d. How do you calculate P_{R1}, P_{R2}, P_{R3}, P_{R4}, and P_{R5}?

C. Voltage Sources in a Series Circuit



V_T =

Now, what happens if we have the following arrangement of voltage sources?



Conclusions

- V
- I
- P

D. Kirchhoff's Voltage Law

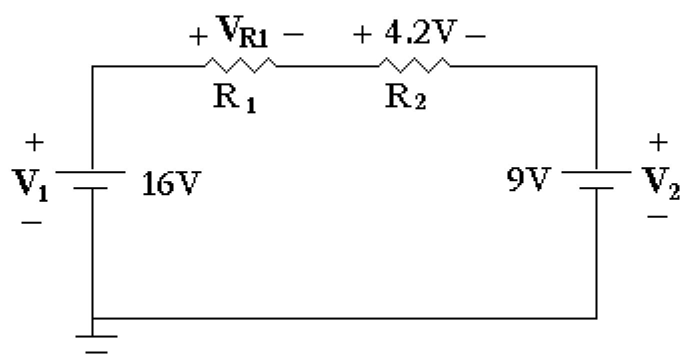
Kirchhoff's Voltage Law (KVL) was developed by Gustav Kirchhoff in the mid 1800s.

KVL requires ____

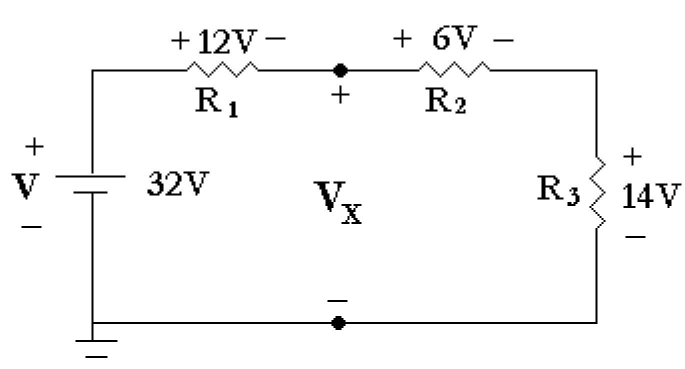
"The algebraic sum of the potential rises or drops around a closed loop is zero."

$$\therefore \Sigma_{\circlearrowleft} V = 0 \quad \rightarrow \quad \Sigma_{\circlearrowleft} V_{Rises} =$$

✵ Examples:



Use Kirchhoff's Vol. Law to determine V_{R1}

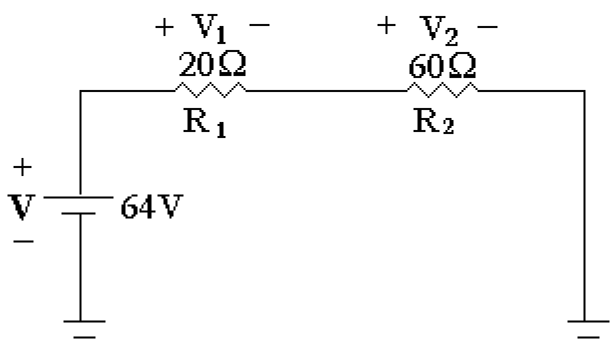


Use KVL to determine V_X

E. Voltage Division in a Series Circuit

From KVL, we know that $\therefore \Sigma V = 0$

How will a resistor's value affect the voltage across the resistor?

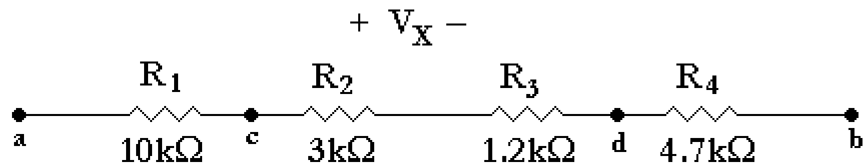


a. What can we say about the voltage across R_2 compared to that across R_1?

b. V_1 =

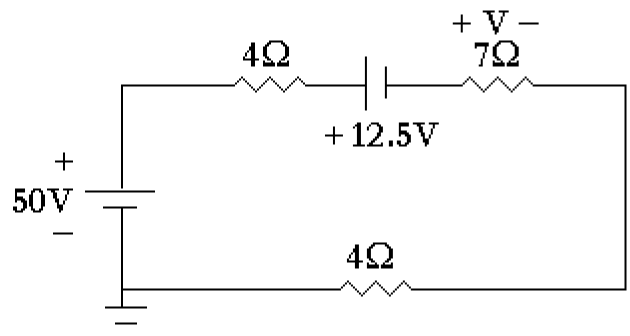
c. V_2 =

✵ Example:



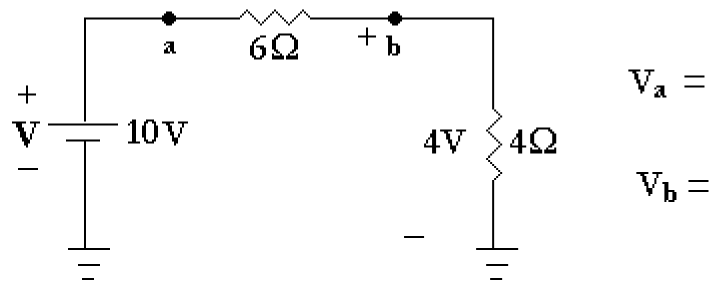
V_{cd} = 5.6 V
Find V_X

Find I and the voltage across the 7Ω resistor for the following network.

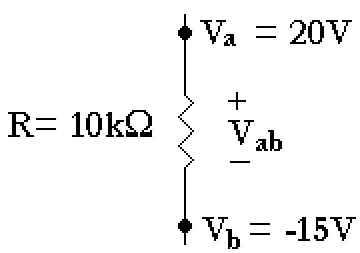


How do we solve this problem? Why?

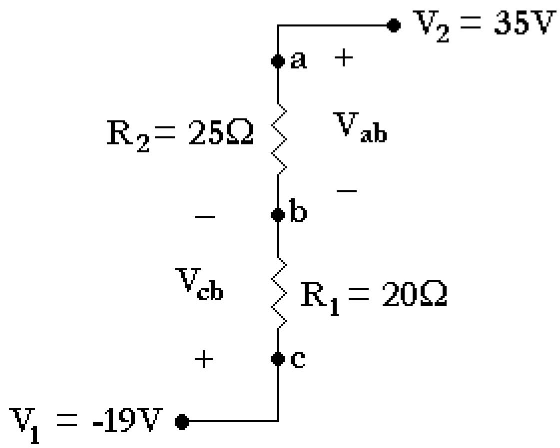
What is the difference between V_a and V_{ab}?



$V_{ab} = V_a - V_b$



V_{ab} =



Find Vab, Vcb and Vc

How do we approach this problem?

Redraw

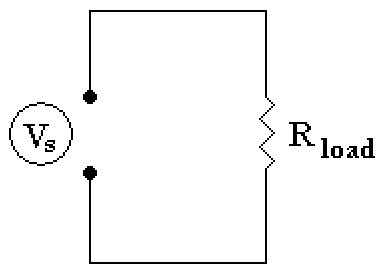
- I=

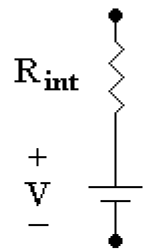
V_{ab} =

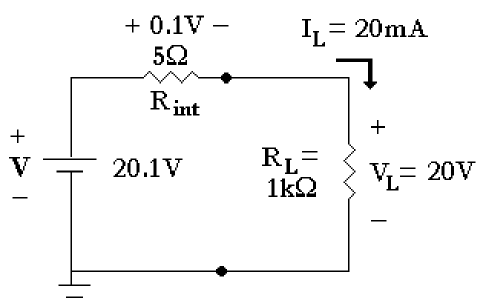
V_{cb} =

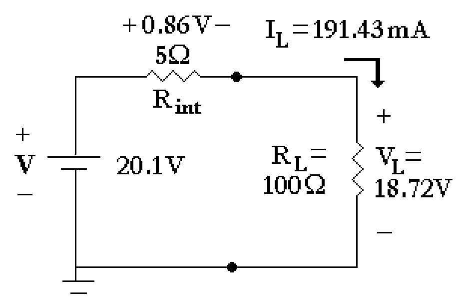
V_c =

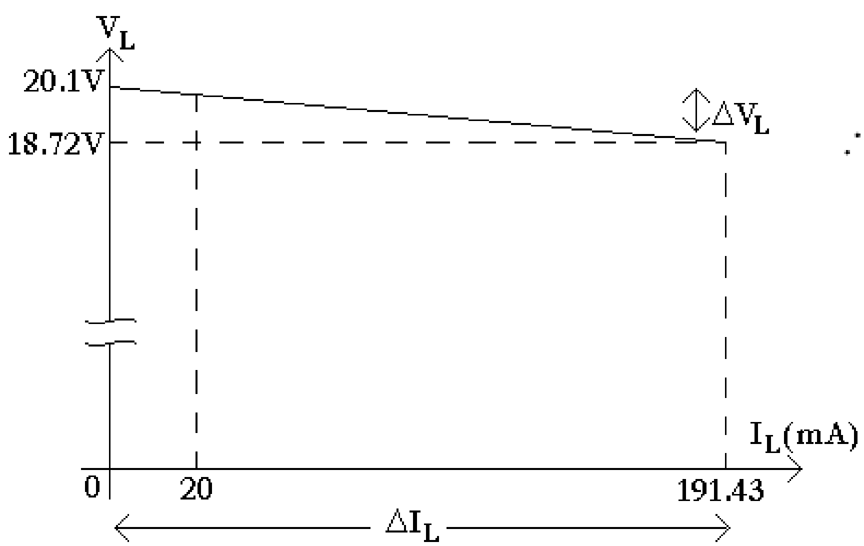
F. Voltage Regulation and the Internal Resistance of Voltage Source











$\therefore R_{int} =$

Voltage Regulation (VR) = Load Regulation

$$V_R = \frac{V_{NL} - V_{FL}}{V_{FL}} * 100\%$$

Conclusions: