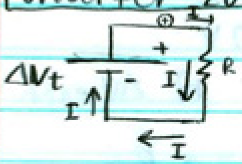
College Prep Physics II – Video Lecture Notes – Chapter 20

Video Lecture #1 – Chapter 20.1 - Introduction to Circuit Diagrams and Current Direction

Thank You, Puja Patel, for these notes.

chapter 20

chapter 20.1-20.3 – circuits & Resistors



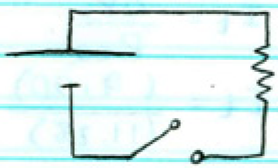
ΔV_t = terminal voltage

emf = ε ideal voltage

resistance of wires = 0!!!

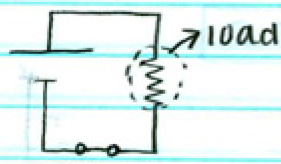
*current goes clockwise

Video Lecture #2 – Chapter 20.1 - Open, Closed and Short Circuits using an Incandescent Light Bulb



open circuit

-no current flow



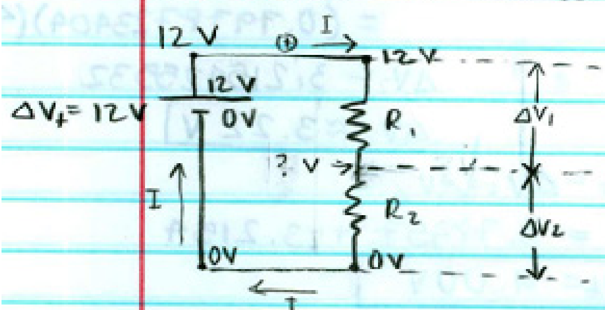
closed circuit

- current flow

Short circuit = a circuit with very low resistance, bypassing the load.

Video Lecture #3 – Chapter 20.2 - Derivation of the Equivalent Resistance of Resistors in Series

2 resistors in series



$\Delta V_t = \Delta V_1 + \Delta V_2$

$\frac{I_t R_{eq} = I_1 R_1 + I_2 R_2}{I}$

$R_{eq} = R_1 + R_2$

$I_t = I_1 = I_2$

R series $= R_1 + R_2 + R_3 \ldots$

$I_t = I_1 = I_2$

$\Delta V_t = \Delta V_1 + \Delta V_2 + \ldots$

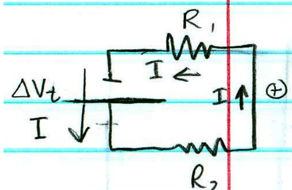
Req = equivalent resistance of the load

page 739 #4 Finding Equivalent Resistance and Electric Potential Difference in a Circuit with Resistors in Series

in series

p.739 #4 $R_1 = 7.25\ \Omega$ $\Delta V_t = 9.00\text{ V}$

$R_2 = 4.03\ \Omega$ a) $R_{eq} = ?$ b) $\Delta V_{each} = ??$



a)

$R_{eq} = R_1 + R_2$

$R_{eq} = (7.25\ \Omega)(4.03\ \Omega)$

$\boxed{R_{eq} = 11.28\ \Omega}$

b)

$\frac{\Delta V_t}{R_{eq}} = \frac{I_t R_{eq}}{R_{eq}}$

$I_t = \frac{\Delta V_t}{R_{eq}}$

$I_t = \frac{(9.00)}{(11.28)}$

$I_t = 0.7978723404\text{ A}$

$= I_1 = I_2$

$\Delta V_1 = I_1 R_1$

$= (0.7978723404)(7.25)$

$\Delta V_1 = 5.784574468$

$\boxed{\Delta V_1 \approx 5.78\text{ V}}$

$\Delta V_2 = I_2 R_2$

$= (0.7978723404)(4.03)$

$\Delta V_2 = 3.215425532$

$\boxed{\Delta V_2 \approx 3.22\text{ V}}$

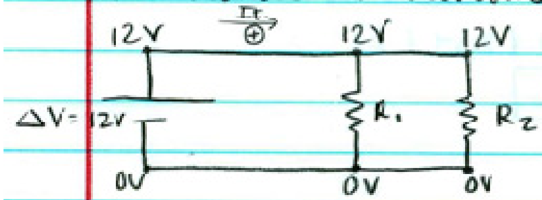
$\Delta V_t = \Delta V_1 + \Delta V_2$

$= 5.78457 + 3.2154$

$\boxed{\Delta V_t = 9.00\text{ V}}$

Video Lecture #5 – Chapter 20.2 - Derivation of the Equivalent Resistance of Resistors in Parallel

2 resistors in parallel



$\Delta V_t = \Delta V_1 = \Delta V_2$

$I_t = I_1 + I_2$

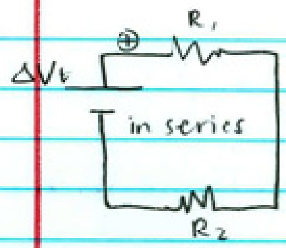
$\Delta V = IR \Rightarrow I = \frac{\Delta V}{R}$

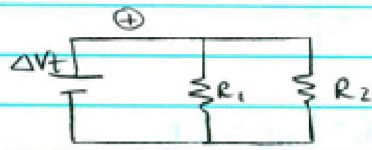
$\frac{\Delta V_t}{R_{eq}} = \frac{\Delta V_1}{R_1} + \frac{\Delta V_2}{R_2}$

$$R_{eq} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \ldots\right)^{-1}$$

$\Delta V_t = \Delta V_1 = \Delta V_2$

$I_t = I_1 + I_2$

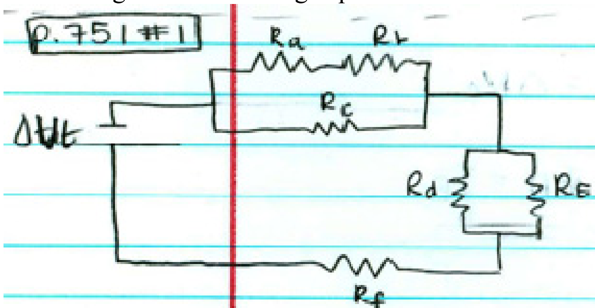




Video Lecture #6 – Chapter 20.3

Page 751 #1 Finding Equivalent Resistance and Electric Power in a Circuit with Resistors in Series and Parallel

p.751 #1



$R_a = 5.0\ \Omega$ $R_b = 7.0\ \Omega$ $R_c = 4.0\ \Omega$

$R_d = R_e$ $R_f = 2.0\ \Omega$ $\Delta V_t = 14.0\ V$

$P_a = ? = I_a \Delta V_a = I_a^2 R_a = \frac{\Delta V_a^2}{R_a}$

$R_{ab} = R_a + R_b$

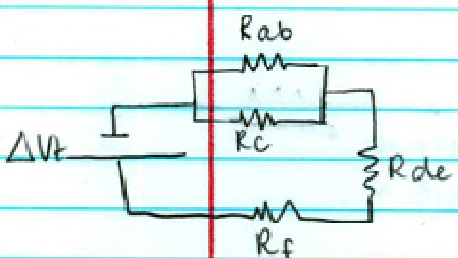
$= 5 + 7$

$= 12\ \Omega$

$R_{de} = \left(\frac{1}{R_d} + \frac{1}{R_e}\right)^{-1}$

$= \left(\frac{1}{4} + \frac{1}{4}\right)^{-1}$

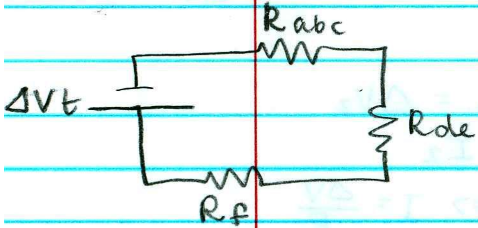
$R_{de} = 2\ \Omega$



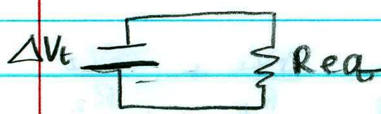
$R_{abc} = \left(\frac{1}{R_{AB}} + \frac{1}{R_C}\right)^{-1}$

$= \left(\frac{1}{12} + \frac{1}{4}\right)^{-1}$

$R_{abc} = 3$



$R_{eq} = R_{abc} + R_{de} + R_f$
$= (3) + (2) + (2)$
$R_{eq} = 7\ \Omega$



$\Delta V = IR$
$\Delta V_t = I_t R_{eq}$
$I_t = \frac{\Delta V_t}{R_{eq}} = \frac{14}{7}$

$I_t = 2\ A = I_{ABC} = I_{DE} = I_f$

$\Delta V_{abc} = I_{abc} \cdot R_{abc}$
$\Delta V_{abc} = (2)(3) = 6V = \Delta V_{ab} = \Delta V_c$

$I_{ab} = \frac{\Delta V_{ab}}{R_{ab}} = \frac{6}{12} = 0.5\ A = I_A = I_B$

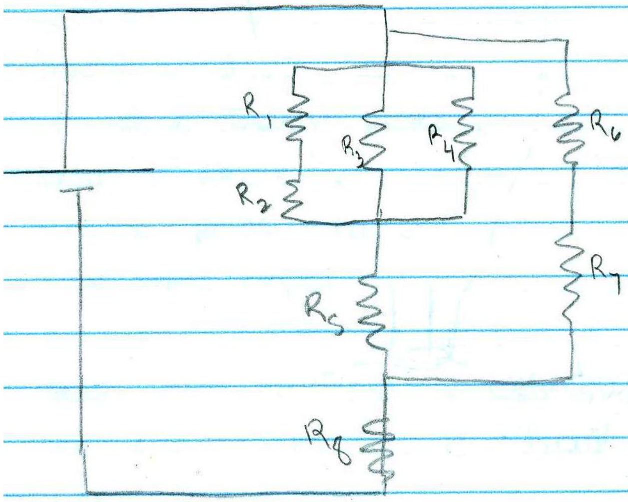
$P_a = I_a^2 R_a$
$= (0.5)^2 (5)$
$= 1.25$
$P_a \approx 1.2$ watts

* resistors in series = total will increase *
* resistors in parallel = total will decrease *

Video Lecture #7 – Chapter 20.3

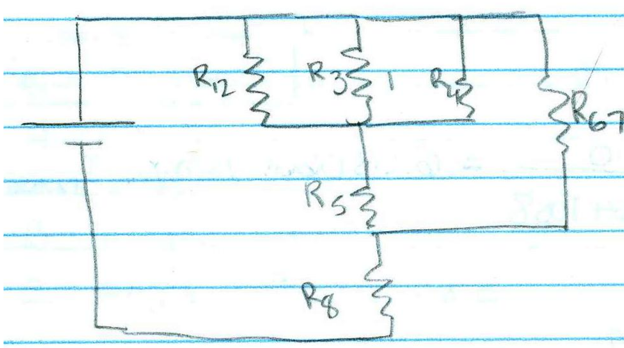
A Complex Resistor Circuit: Part a) Drawing the Circuit Diagram and Finding Equivalent Resistance

Thank You, Sangini Tolia, for these notes.



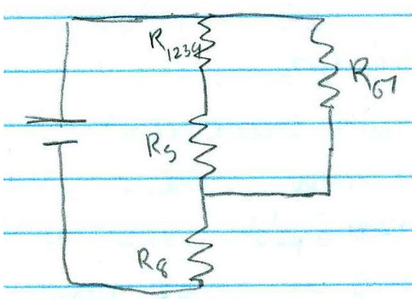
$R_{12} = R_1 + R_2 = 4\ \Omega$

$R_{67} = R_6 + R_7 = 4\ \Omega$



$R_{1234} = \left(\frac{1}{R_{12}} + \frac{1}{R_3} + \frac{1}{4}\right)^{-1}$

$= 0.8\ \Omega$



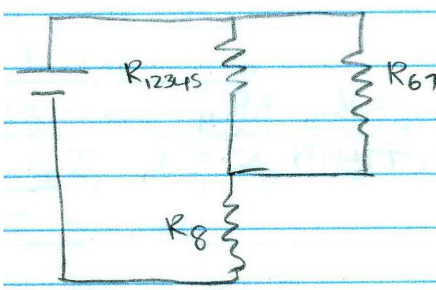
$R_{12345} = R_{1234} + R_5$

$= 0.8 + 2$

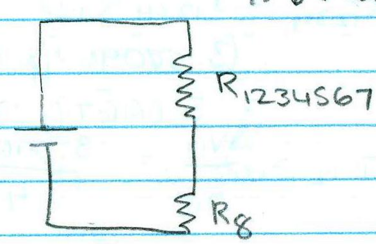
$= 2.8\ \Omega$

$R_{1234567} = \left(\frac{1}{R_{12345}} + \frac{1}{R_{67}}\right)^{-1}$

$= 1.647058\ \Omega$



⇒



$R_{eq} = R_{1234567} + R_8$

$= 1.647058 + 2$

$= 3.647058$

$\boxed{= 3.65\ \Omega}$

$P = I\Delta V = I^2 R = \frac{\Delta V_1^2}{R_1}$

$\Delta V_t = 24.0\ V$

$R_{eq} = 3.647058$

$I_t = \frac{\Delta V_t}{R_{eq}} = \frac{24.0}{3.647058} = 6.580661\ \text{Amps} = I_{1234567} = I_8$

$\Delta V_{1234567} = I_{1234567} R_{1234567}$

$= 6.580661(1.647058)$

$= 10.83871\ V = \Delta V_{12345} = \Delta V_{67}$

$\Delta V_{12345} = I_{12345} R_{12345}$

$10.83871 = I_{12345}(2.8)$

$3.870967\ \text{Amps}\ I_{12345} = I_{1234} = I_5$

$$\Delta V_{1234} = I_{1234} R_{1234} = (3.870967)(0.8) = 3.09677\Omega = \Delta V_{12} = \Delta V_3 = \Delta V_4$$

$I_{12} = \frac{\Delta V_{12}}{R_{12}} = \frac{3.0967}{4} = 0.77419\ A = I_1 = I_2$

$P_1 = I_1^2 R_1$

$= (0.77419)(2)$

$= 1.12\ W$ (Power dissipated by R_1)