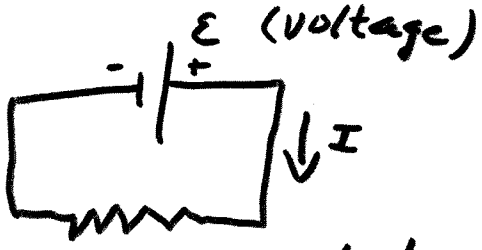
Read 13.4

O2L group problems updated

Group tomorrow - circuits

Review

Current $I = \frac{Q}{t}$ (Amps)

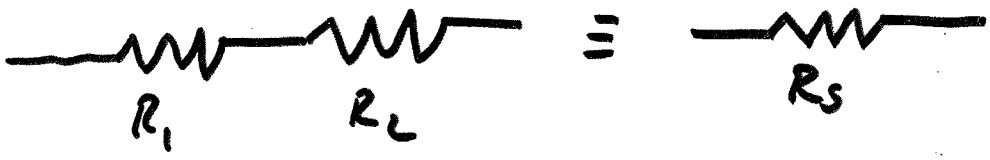


Resistor (ohms Ω)

Ohm's Law $\Delta V = IR$

loop rule: around any closed loop sum of voltage rises = sum of voltage drops

Resistors in series

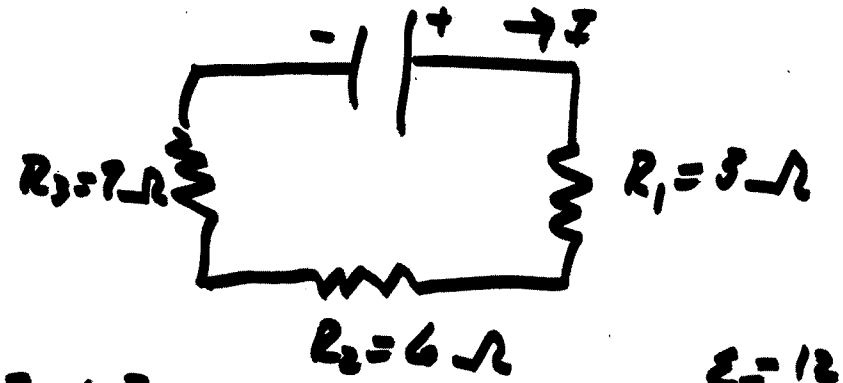


$R_s = R_1 + R_2$

same current flowing through them

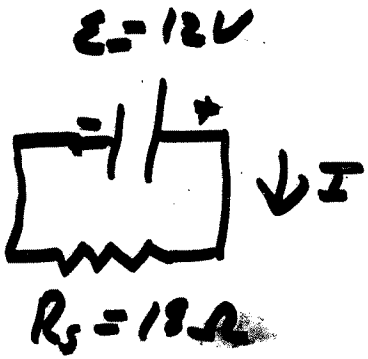
Problem: A 3Ω, a 6Ω, and a 9Ω resistor are placed in series and connected to a 12 V battery?

(a) What is the current flowing through each resistor?



$R_S = R_1 + R_2 + R_3$

$= 3\,\Omega + 6\,\Omega + 9\,\Omega = 18\,\Omega$



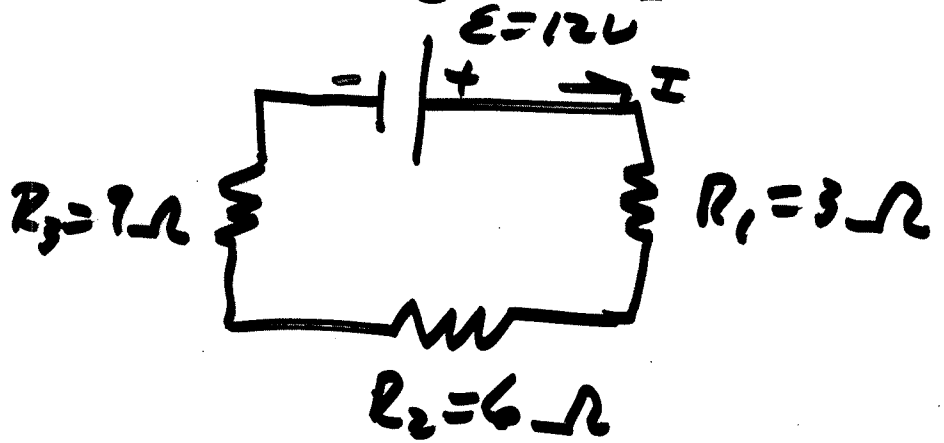
$\mathcal{E} = IR$

$I = \frac{\mathcal{E}}{R_S} = \frac{12\,V}{18\,\Omega} = .67\,A$

all have same current

Problem: A 3Ω, a 6Ω, and a 9Ω resistor are placed in series and connected to a 12 V battery?

(b) What is the voltage drop across each resistor?



$I_1 = I_2 = I_3 = I$

$\Delta V_1 = I_1 R_1 = (.67A)(3\Omega) = 2V$

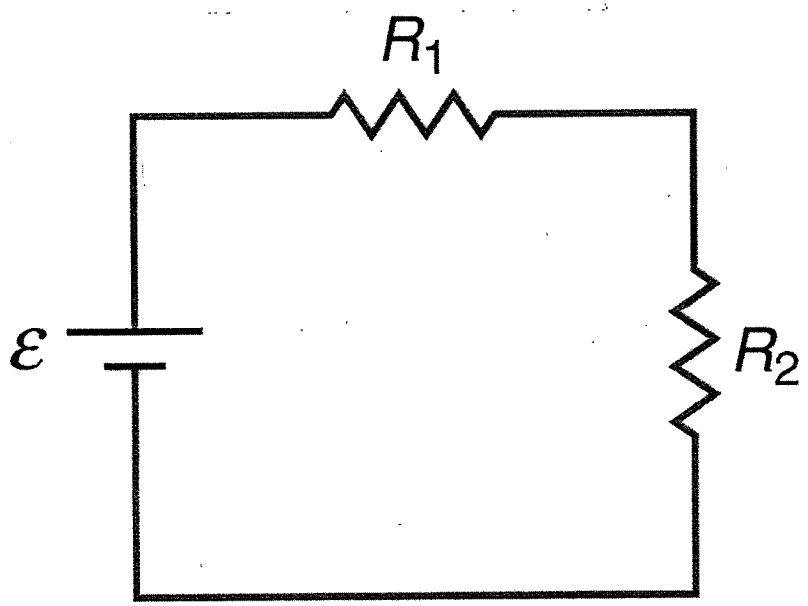
$\Delta V_2 = I_2 R_2 = (.67A)(6\Omega) = 4V$

$\Delta V_3 = I_3 R_3 = (.67A)(7\Omega) = 4V$

$\Delta V_1 + \Delta V_2 + \Delta V_3 = 12V$

Interactive Question

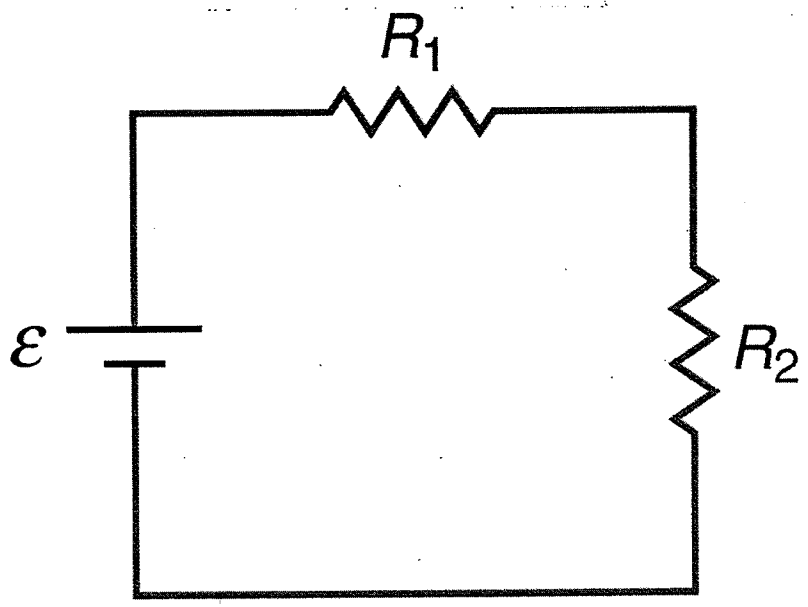
Two resistors are connected in series with a battery as shown. R_1 is less than R_2. Which of the two resistors has the greater current flowing through it?



A) R_1
B) R_2
C) They have the same current
D) More information is needed

Interactive Question

Two resistors are connected in series with a battery as shown. R_1 is less than R_2. Which of the two resistors has the greatest voltage difference across it?



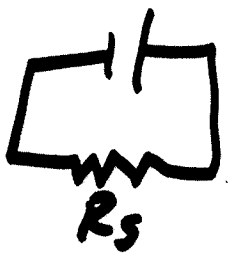
A) R_1
B) R_2
C) They have the same voltage difference
D) More information is needed

Problem: An ideal battery has a voltage of 9.0 volts and is attached to a 20 Ω external resistor. The battery has an internal resistance of 1 Ω.

A) What current is flowing through the circuit?

B) What is the terminal voltage of the battery?

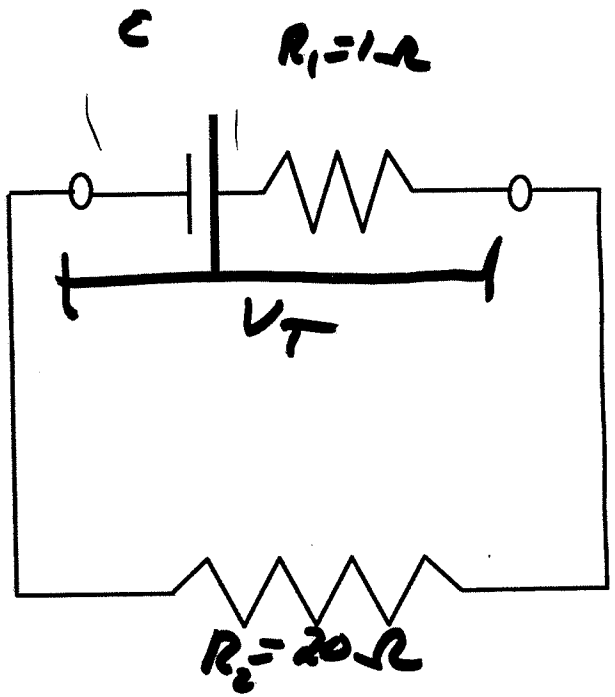
1) $R_s = R_1 + R_2 = 1\Omega + 20\Omega = 21\Omega$



$\mathcal{E} = IR$

$I = \frac{\mathcal{E}}{R} = \frac{9V}{21\Omega}$

$= .429A$



B) $V_T = \mathcal{E} - IR_1$

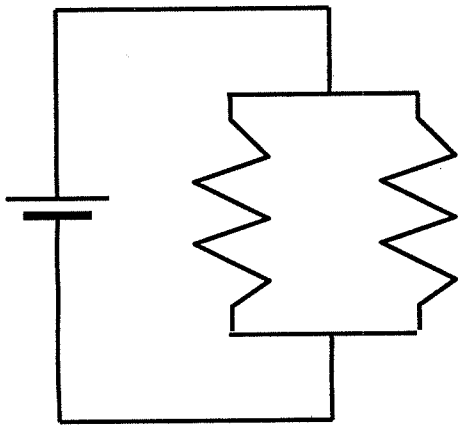
$9V - (.429A)(1\Omega)$

$8.571V \sim 8.6V$

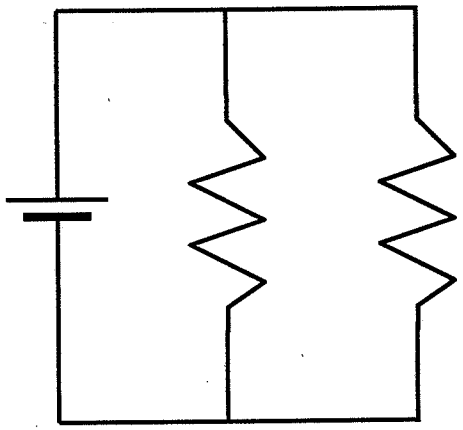
Interactive Question

D

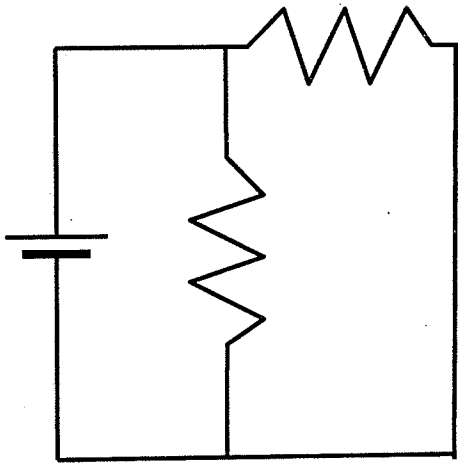
Which of the following circuits are identical?



(A)



(B)

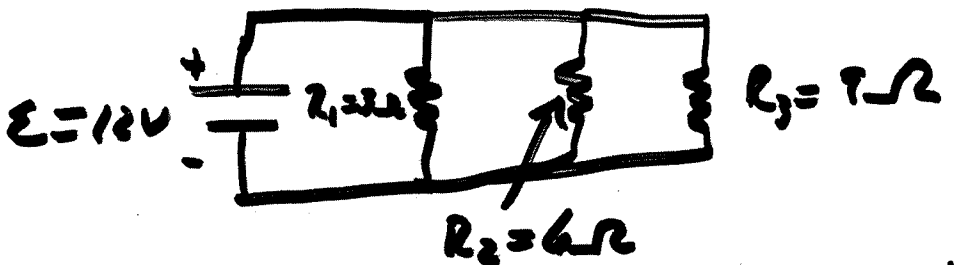


(C)

A) (A) and (B) only
B) (B) and (C) only
C) (A) and (C) only
D) (A), (B), and (C)
E) None of the above

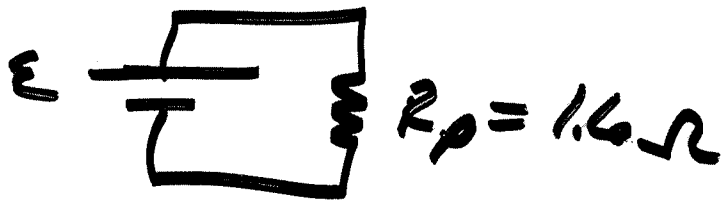
Problem: A 3 Ω, a 6 Ω, and a 9 Ω resistor are placed in parallel and connected to a 12 V battery?

(a) What is the total current flowing through the system?



$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{3\Omega} + \frac{1}{6\Omega} + \frac{1}{9\Omega} = \frac{6}{18\Omega} + \frac{3}{18\Omega} + \frac{2}{18\Omega}$$

$$\frac{1}{R_p} = \frac{11}{18\Omega} \qquad R_p = \frac{18\Omega}{11} = 1.6\Omega$$



$$I = \frac{\varepsilon}{R_p}$$

$$= \frac{12V}{1.6\Omega} = \underline{\underline{7.3A}}$$

Problem: A 3 Ω, a 6 Ω, and a 9 Ω resistor are placed in parallel and connected to a 12 V battery?
(b) What is the current in each resistor? ?

$$I_1 = \frac{\Delta V_1}{R_1} = \frac{12\,V}{3\,\Omega} = 4\,A$$

$$I_2 = \frac{\Delta V_2}{R_2} = \frac{12\,V}{6\,\Omega} = 2\,A$$

$$I_3 = \frac{\Delta V_3}{R_3} = \frac{12\,V}{9\,\Omega} = 1.3\,A$$

$$I_1 + I_2 + I_3 = \underline{7.3\,A}$$

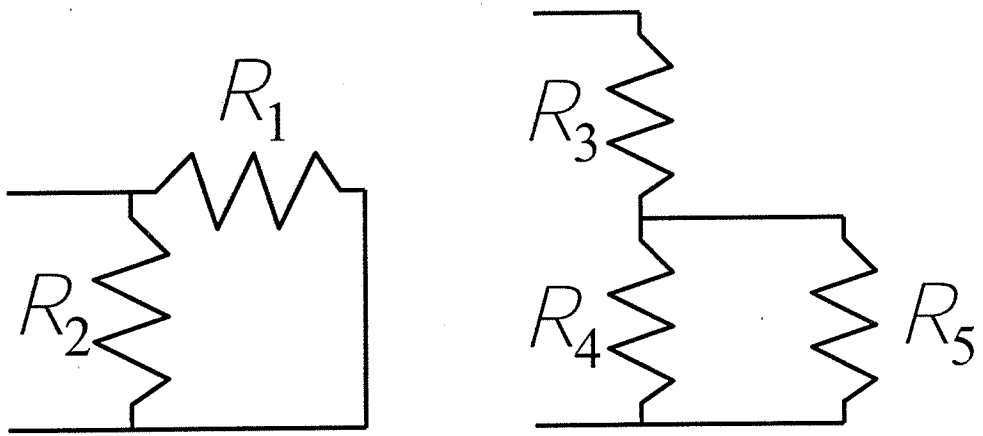
note

$$\Delta V_1 = \Delta V_2 = \Delta V_3 = \mathcal{E}$$

Interactive Question

D

Consider the two circuits on the right. Which of the following statements is true?



A) R_1 and R_2 are in parallel. R_3 and R_4 are in series.
B) R_4 and R_5 are in parallel. R_3 and R_4 are in series.
C) R_1 and R_2 are in series. R_3 and R_4 are in series.
D) R_1 and R_2 are in parallel. R_4 and R_5 are in parallel.
E) R_1 and R_2 are in series. R_4 and R_5 are in parallel.