PHYSICS 12

NAME: Key

Electric Circuits

1. What is the current in a circuit if 12 C of charge pass a point in 1.5 s? 8.0 A $I = \frac{Q}{t} = \frac{12C}{1.5s}$

2. What is the voltage between the ends of a resistor if 360 J of energy is expended as heat for every 6.0 C of charge that pass through the resistor? $E = P \cdot t = V \cdot I \cdot t = V \cdot \frac{Q}{t} t$ 60. V $= V \cdot Q$ $V = \frac{E}{Q} = \frac{360}{6} = 60\,V$

3. What is the resistance of a resistor if a current of 1.50 mA exists in the resistor when a potential difference of 45.0 V is applied to the ends of the resistor? $V = IR$, $R = \frac{V}{I}$ 30kΩ $= \frac{45}{.0015} = 30\,000\,\Omega$

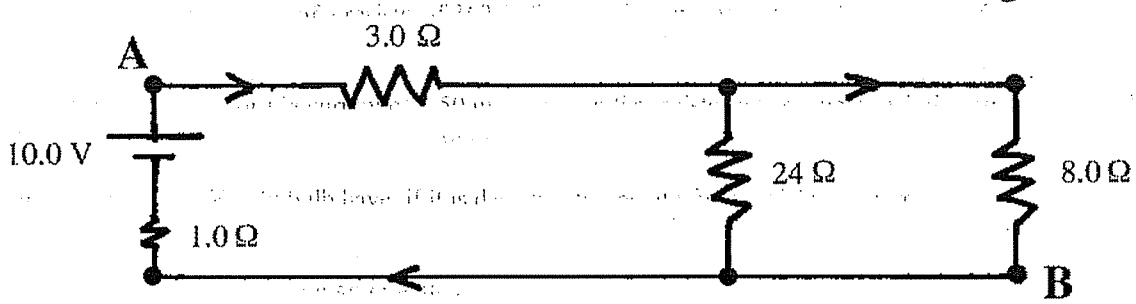
4. What resistance must a 60.0 W light bulb have, if it is designed to operate from a 120.0 V source? $P = V \cdot I = V\left(\frac{V}{R}\right) = \frac{V^2}{R}$ $R = \frac{V^2}{P}$ 240 Ω $= \frac{120^2}{60}$

5. A battery with an internal resistance of 0.50 Ω delivers 1.50 A to a light bulb of resistance 3.0 Ω. What is the EMF of the battery? 5.25 V

$R_T = 3.5\,\Omega$
$I = 1.5\,A$
$V = IR$

6. Three resistors are connected in series with a 24.0 V battery. If the resistors are 2.0 Ω, 4.0 Ω and 6.0 Ω, what is the potential difference across the 4.0 Ω resistor? $R_T = 12\,\Omega$ 8.0 V $I_T = 2\,A$ $V_4 = (2)(4) = 8\,V$

7. Three resistors are in parallel, and a current of 36.0 A enters the parallel network. If the resistors have resistances of 2.0 Ω, 3.0 Ω and 6.0 Ω, what current exists in the 3.0 Ω resistor? $R_T = 1\,\Omega$ $V_T = 36\,V$ $I = \frac{V}{R} = \frac{36}{3} = 12\,A$
12 A

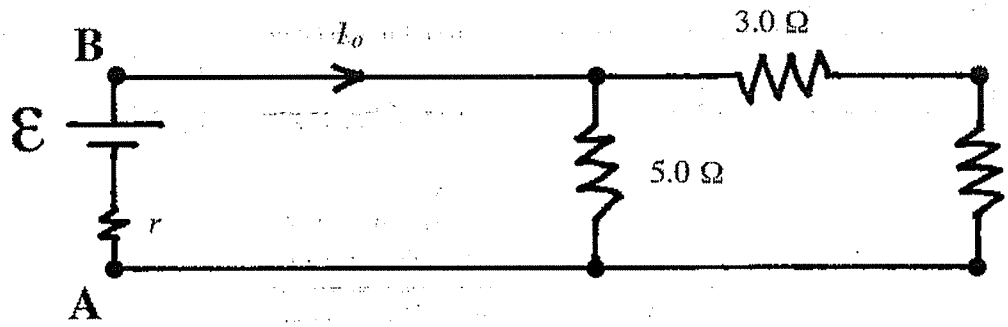


8. (a) What is the equivalent resistance of the above circuit? $\frac{1}{24} + \frac{1}{8} \rightarrow 6\,\Omega + 4\,\Omega$ 10.0 Ω

   (b) What current exists at A? $\frac{V}{R} = \frac{10}{10} = 1$ 1.0 A

   (c) What current exists at B? 6.0 V $V_3 = 3\,V$ $V_1 = 1\,V$ so $V = 6\,V$

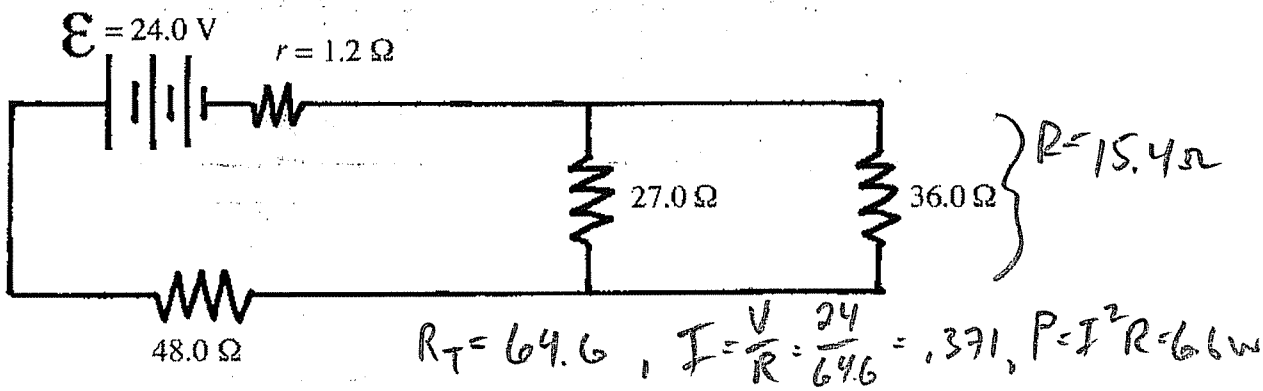
   (d) What current exists at B? $I = \frac{V}{R} = \frac{6}{8} = .75\,A$ 0.75 A



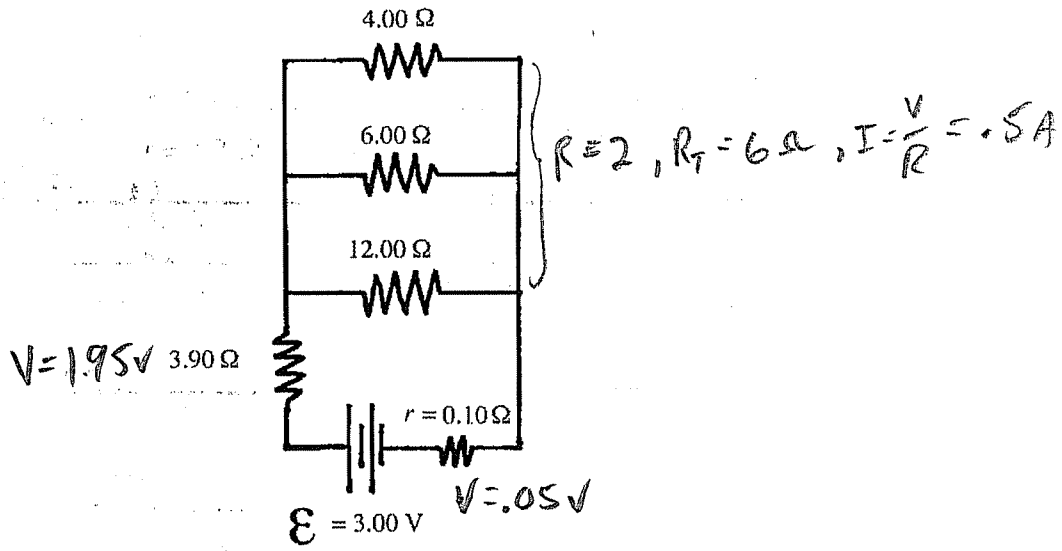
$R_T = 3.3\,\Omega$
$I = \frac{V_T}{R} = \frac{9.6}{3.3}$

9. The EMF of the battery above is 6.00 V, and the terminal voltage V_{AB} is 4.60 V. $= 1.38\,A$

(a) What is the total current I_o? 1.38 A
(b) What is the internal resistance r? $V = \mathcal{E} - Ir$, $6.0 - 4.6 = (1.38)r$ 1.01 Ω



10. If the EMF of the battery above is 24.0 V and its internal resistance r is 1.2 Ω, what power is dissipated in the 48.0 Ω resistor?
6.6 W

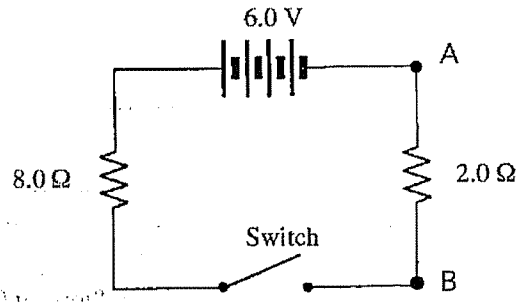


11. (a) What is the voltage across the 6.0 Ω resistor? $3 - 2 = 1.0V$ 1.0 V
(b) What current exists in the 12 Ω resistor? 0.083 A $I = \frac{V}{R} = \frac{1}{12}$

12. A dry cell has an EMF of 1.500 V. When it is connected in series with a 1.20 Ω resistor, the current through it is 0.750 A. What is the internal resistance of the dry cell? 0.800 Ω $R_T = \frac{V}{I} = \frac{1.5}{.75} = 2\Omega - 1.2\Omega = .8\Omega$

13. Three 60-W light bulbs are connected in parallel with a 120 V source. What total current must the source supply to the three light bulbs? 1.5 A $P = 180W = IV$ $I = \frac{180W}{120V} = 1.5A$

14.

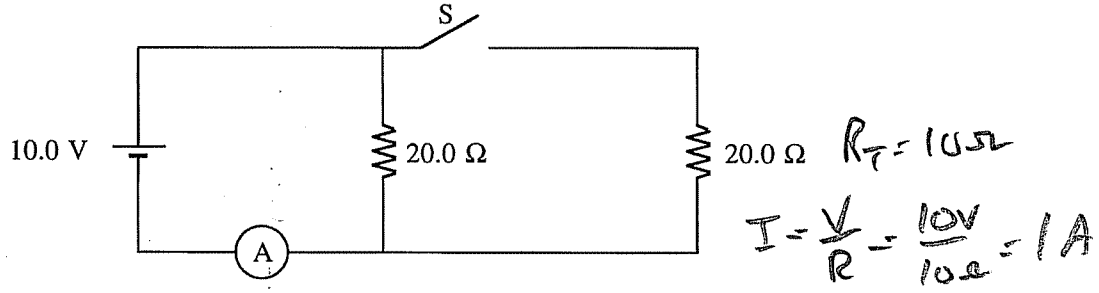


0V

The switch in the above diagram is open. What is the potential difference V_{AB} across the 2.0 Ω resistor? 0 V

Assignment

Multiple Choice



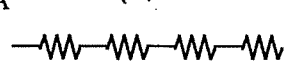
$R_T = 10\Omega$

$I = \frac{V}{R} = \frac{10V}{10\Omega} = 1A$

1. The current through **A** is 0.50 A when the switch S is open. What will the current through **A** be when the switch S is closed?
   A. 0 A
   B. 0.25 A
   C. 0.50 A
   D. 1.0 A

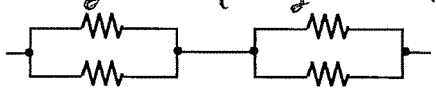
2. Which one of the following arrangements of four identical resistors will have the least resistance?

A



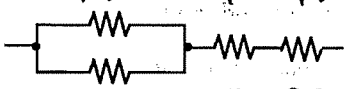
4r

B



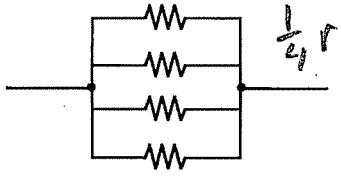
$\frac{1}{2}r + \frac{1}{2}r = 1r$

C

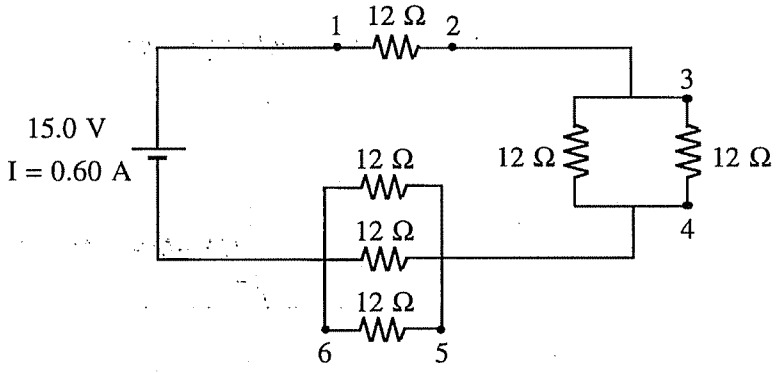


$\frac{1}{2}r + r + r = 2.5r$

D



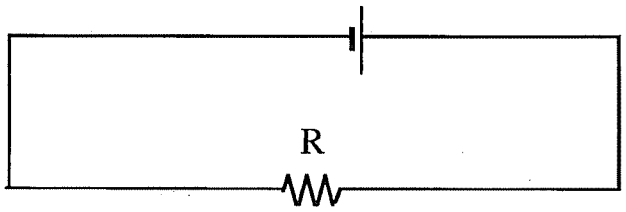
$\frac{1}{4}r$



3. Where is the most power dissipated in this circuit?
   A. Between 1 and 2.
   B. Between 3 and 4.
   C. Between 5 and 6.
   D. Power dissipated is the same in all three situations.

$P = I^2R$

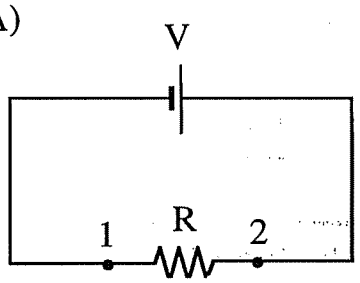
I is greatest between 1 & 2



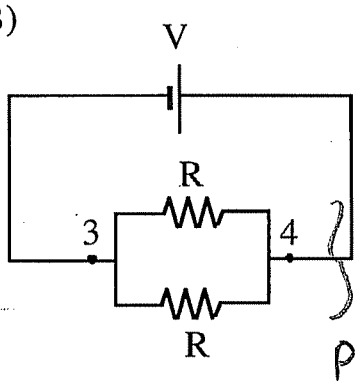
4. In this circuit, if you wish to measure the current through resistor *R* and the voltage between the ends of resistor *R*, where should the ammeter and voltmeter be placed?

	ammeter	voltmeter
A	in series ✓	in series
B	in series ✓	in parallel ✓
C	in parallel	in parallel ✓
D	in parallel	in series

(A)



(B)

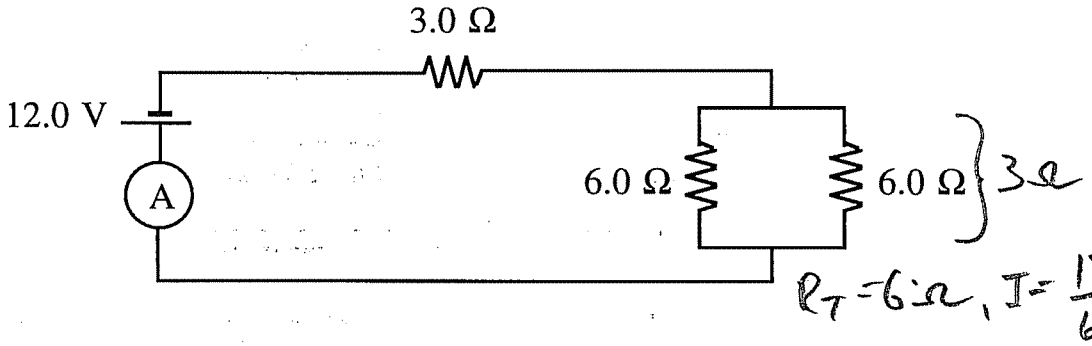


$R_T = R_2$ so
I_T is double so
$P = V \cdot I$ is double

5. The power dissipated in circuit **(A)** in resistor *R* between 1 and 2 is *P*. In circuit **(B)** the same source voltage is used, but an identical resistor *R* is added in parallel with the first resistor. How much power will be dissipated between 3 and 4?

A. ¼ *P* B. ½ *P* C. *P* D. 2 *P* E. 4 *P*

Open-Ended Questions



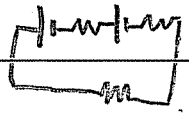
3Ω

$R_T = 6\,\Omega$, $I = \frac{12}{6} = 2A$

6. What is the current in the ammeter **A**?

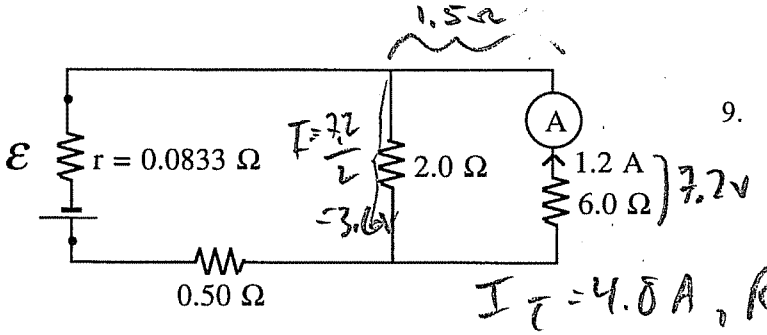
7. A 1500 W kettle is connected to a 110 V source. What is the resistance of the kettle element? $P = V \cdot I = \frac{V^2}{R}$, $R = \frac{V^2}{P}$

8. A flashlight contains a battery of two cells in series, with a bulb of resistance 12.0 Ω. The internal resistance of each cell is 0.260 Ω. If the potential difference across the bulb is 2.88 V, what is the EMF of *each* cell?



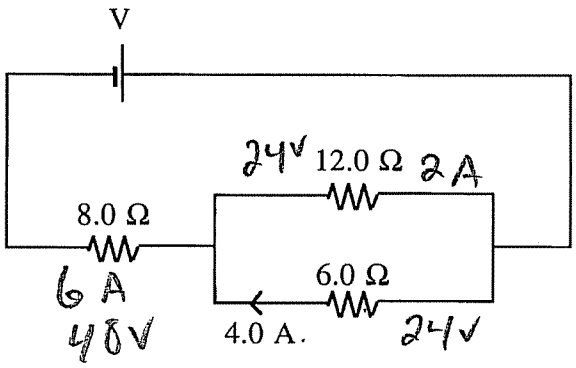
$R_T = 12.52\,\Omega$, $I = \frac{V}{R} = \frac{2.88}{12} = .24A$ $V_T = (.24)(12.52) = 3.00V \div 2$

1.5V



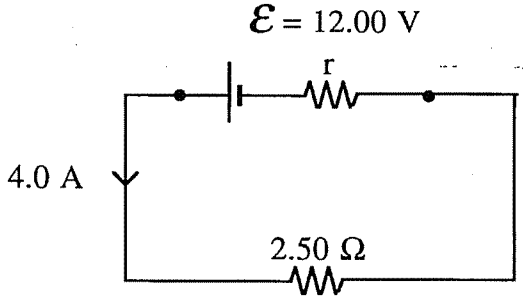
9. What is the EMF of the battery if the current in **A** is 1.2 A, and the internal resistance of the battery is 0.0833 Ω?

$I_T = 4.8\,A$, $R_T = 2.083\,\Omega$, $V_T = IR = 10\,V$



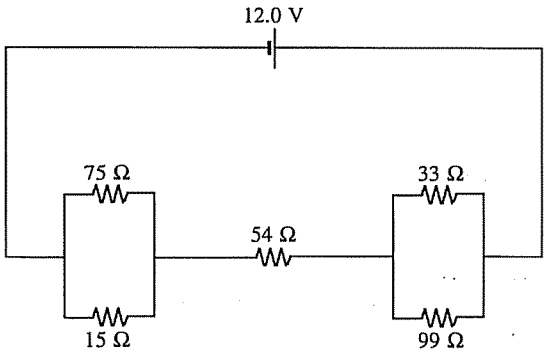
10. What is the voltage V of the power supply?

$48 + 24 = 72\,V$



11. What is the internal resistance of the battery?

$R_T = \frac{V_T}{I_T} = \frac{12}{4} = 3\,\Omega$, $r = .5\,\Omega$

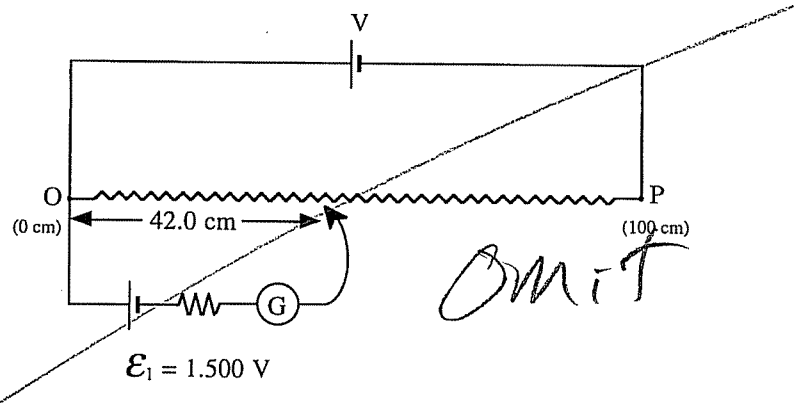


12. (a) What is the equivalent resistance of this circuit?
(b) What is the current through the 54 Ω resistor?
(c) How much power is dissipated in the 54 Ω resistor?

$12.5\,\Omega + 54\,\Omega + 24.75 = 91.25\,\Omega$

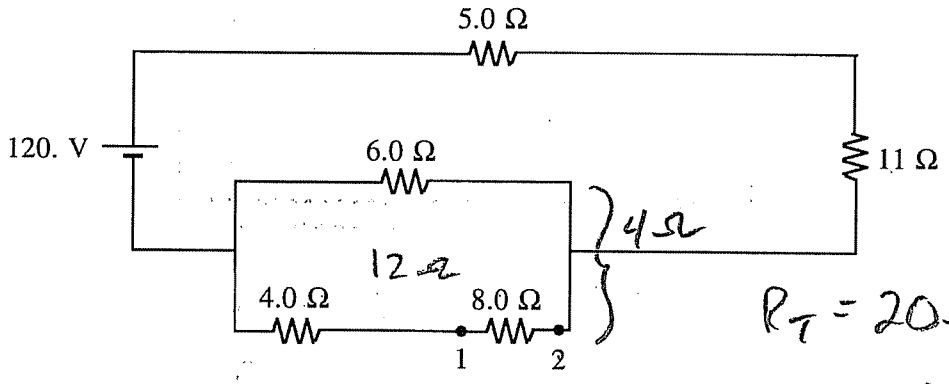
$I = \frac{V}{R} = \frac{12}{91} = .13\,A$

$P = I^2R = (.13)^2 54\,\Omega = .93\,W$



Omit

13. A potentiometer with a standard cell of EMF $\mathcal{E}_1 = 1.500$ V is 'balanced' when the contact is 42.0 cm from **O**. When $\mathcal{E}_1$ is replaced with a second cell with EMF $\mathcal{E}_2$, balance is achieved at 48.0 cm from **O**. What is the magnitude of EMF $\mathcal{E}_2$?



14. (a) What is the voltage across the 8.0 Ω resistor (between 1 and 2)?
(b) How much power is dissipated in the 5.0 Ω resistor?

$R_T = 20\Omega$, $I_T = \frac{120}{20} = 6A$

$V_{11} = IR$
$= (6)(4) = 24V$

$I_{1\&2} = \frac{V}{R} = \frac{24V}{12} = 2A$

$V_{1\&2} = IR$
$= (2A)(8) = 16V$

$P = I^2R$
$= 6^2 \cdot 5$
$= 180W$

1. D 2. D 3. A 4. B 5. D
6. 2.0 A
7. 8.1 Ω
8. 1.50 V
9. 10.0 V
10. 72 V
11. 0.50 Ω
12. (a) 91 Ω
(b) 0.13 A
(c) 0.93 W
13. 1.71 V
14. (a) 16 V
(b) 1.8×10^2 W