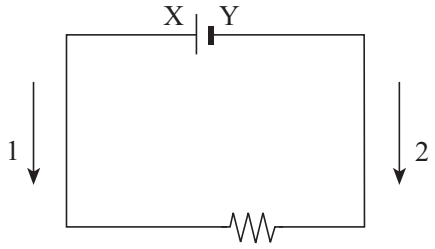
1. A 9.0 V battery was recharged with a current of 1.2 A in 1.8×10^4 s. How much charge was transferred during that time?

$I = \frac{q}{t}$ $q = I \cdot t = (1.2A)(1.8\times10^4 s)$

$= 2.2\times10^4 C$

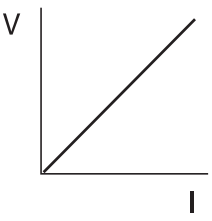
A. 1.1×10^1 C
B. 2.2×10^4 C
C. 1.6×10^5 C
D. 1.9×10^5 C

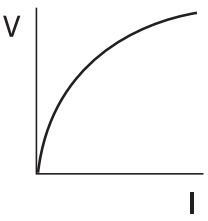
2. Which of the following correctly labels arrows 1 and 2 and polarities X and Y in the circuit below?

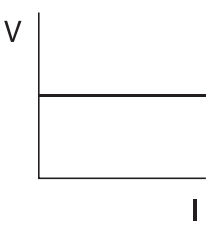


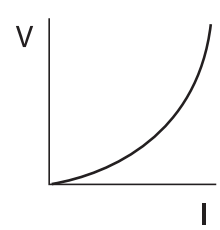
	ARROW 1	ARROW 2	POLARITY X	POLARITY Y
A.	Electron Flow	Conventional Current	Positive	Negative
B.	Electron Flow	Conventional Current	Negative	Positive
C.	Conventional Current	Electron Flow	Positive	Negative
D.	Conventional Current	Electron Flow	Negative	Positive

3. Which of the following graphs illustrates Ohm's law?

A. 

B. 

C. 

D. 

$V = IR$

$\therefore$ linear!

4. Current is a measure of

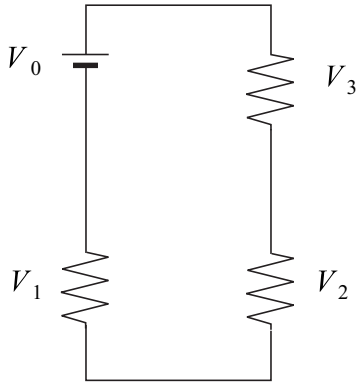
$I = \frac{q}{t}$

A. the number of charges stored in a cell.
B. the amount of energy given to a charged object.
C. the charge passing a point in a circuit in a given time.
D. the resistance to the flow of charged particles in a circuit.

5. Which of the following relationships correctly applies to the circuit shown below?

Series:

$V_0 = V_1 + V_2 + V_3$



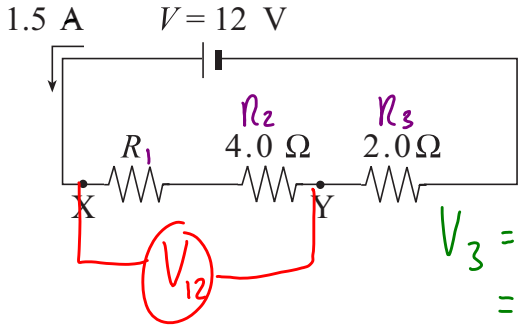
A. $V_0 = V_1 + V_2 + V_3$

B. $V_0 + V_1 = V_2 + V_3$

C. $V_0 = V_1 = V_2 = V_3$

D. $\frac{1}{V_0} = \frac{1}{V_1} + \frac{1}{V_2} + \frac{1}{V_3}$

6. In the following circuit, what is the magnitude of the potential difference between **X** and **Y** ?



A. 3.0 V
B. 6.0 V
C. 9.0 V
D. 12 V

$V_3 = I_3 R_3$
$= (1.5A)(2.0\Omega)$
$= 3.0V$

$V_{12} = V_T - V_3$
$= 12 - 3 = 9.0V$

7. A potential difference of 12 V causes 0.35 C of electric charge to pass through a resistor in 2.6 s. What power does the resistor dissipate?

A. 1.6 W
B. 4.2 W
C. 11 W
D. 89 W

$I = \frac{q}{t} = \frac{0.35C}{2.6s} = 0.1346A$

$P = IV = (0.1346A)(12V) = 1.62W$

8. The headlights in a car use 95 W of power. A driver parks her car but leaves the lights on. The 12 V battery has 3.4×10^5 C of stored charge. How long does it take for the battery to lose its charge?

A. 1.1×10^3 s
B. 3.6×10^3 s
C. 4.3×10^4 s
D. 2.7×10^6 s

$P = IV$

$I = \frac{P}{V} = \frac{95W}{12V} = 7.92A$

$I = \frac{q}{t}$

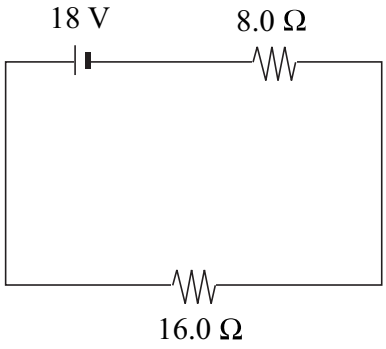
$t = \frac{q}{I} = \frac{3.4 \times 10^5 C}{7.92A} = 42900s$

9. Which of the following household electrical appliances has the greatest rate of energy consumption?

	ITEM	VOLTAGE	CURRENT
A.	Video Camera	6.0 V	1.6 A
B.	Radio	4.5 V	0.45 A
C.	Cassette Recorder	6.0 V	2.2 A
D.	Ghetto Blaster	12 V	1.4 A

$P = IV$
$= 9.6W$
$= 2.0W$
$= 13.2W$
$= 16.8W$

10. Calculate the power dissipated by the 8.0 Ω resistor in the circuit below.



A. 4.5 W
B. 6.0 W
C. 10 W
D. 41 W

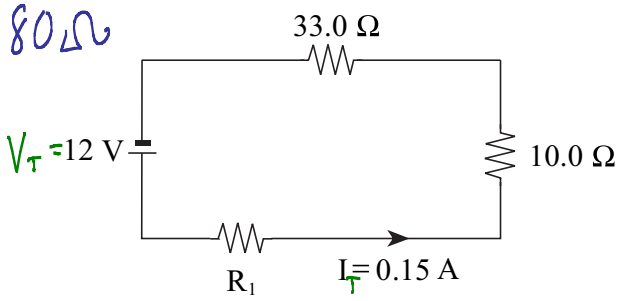
$I_T = \frac{V_T}{R_T} = \frac{18V}{24\Omega} = 0.75A$

$P = I^2R = (0.75)^2(8.0) = 4.5W$

11. What is the power dissipated in resistor R_1 in the circuit shown in the diagram below?

$R_T = \frac{V_T}{I_T} = \frac{12\text{ V}}{0.15\text{ A}} = 80\,\Omega$

$R_1 = 80 - 33 - 10 = 37\,\Omega$



$*P = IV$

$P = I^2R$

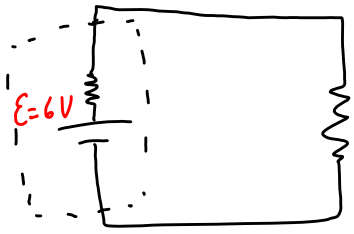
$P = \frac{V^2}{R}$

A. 0.83 W
B. 0.97 W
C. 1.8 W
D. 2.8 W

$P = I^2R$
$= (0.15\text{ A})^2(37\,\Omega)$
$= 0.83\text{ W}$

12. A battery whose emf is 6.0 V is connected to a 2.0 Ω resistor. The voltage drop across the 2.0 Ω resistor is 5.0 V. What is its internal resistance?

A. 0.40 Ω
B. 1.7 Ω
C. 2.4 Ω
D. 2.5 Ω



$V = 5.0\text{V} = V_{Term}$

$R = 2.0\,\Omega$

$I = \frac{V}{R} = \frac{5}{2} = 2.5\text{A}$

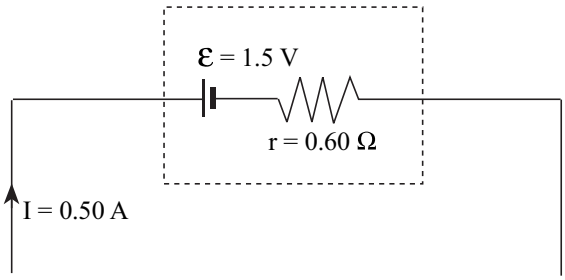
$V_{Term} = \mathcal{E} - Ir$

$r = \frac{\mathcal{E} - V_{Term}}{I}$

$= \frac{6-5}{2.5} = 0.4\,\Omega$

13. A cell whose emf is 1.5 V and internal resistance is 0.60 Ω is charged by supplying a 0.50 A current in the direction shown.

special case!



$V_{Term} = \mathcal{E} + Ir$

$= 1.5 + (0.5)(0.6)$

$= 1.8\text{V}$

What is the terminal voltage of the cell while being charged?

A. 0.30 V
B. 1.2 V
C. 1.5 V
D. 1.8 V

none of these make sense anyway!

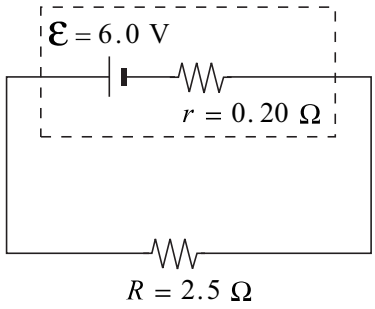
14. The terminal voltage of a battery is always less than the emf of a battery when supplying current in a circuit because of a voltage drop due to

A. the terminal connections.
B. the battery's internal resistance.
C. heating of resistors in the circuit.
D. heating of the wires in the circuit.

15. What is the terminal voltage of the battery in the circuit shown in the diagram?

$V_{Term} = \mathcal{E} - Ir$
$= 6\text{ V} - (2.22\text{ A})(0.20\ \Omega)$
$= 5.6\text{ V}$

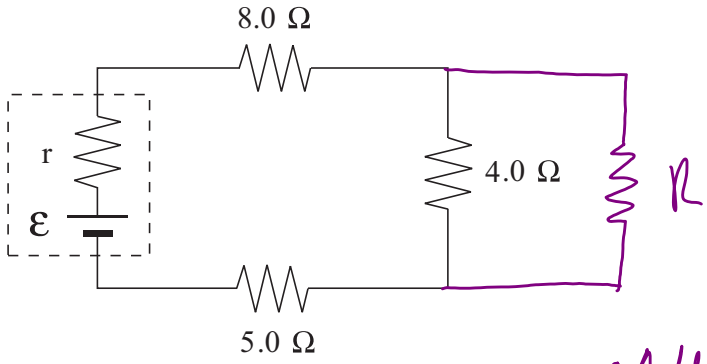
$I_T = \frac{\mathcal{E}}{R_T} = \frac{6\text{ V}}{2.7\ \Omega} = 2.22$



$V = IR$
$= (2.22)(2.5)$
$= 5.6\text{ V}$

A. 0.44 V
B. 5.6 V
C. 6.0 V
D. 6.4 V

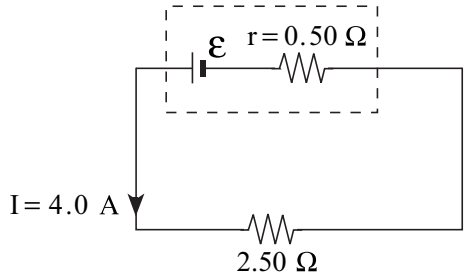
16. When a resistor is added in parallel with the 4.0 Ω resistor in the circuit shown below, what happens to the voltage across the 5.0 Ω resistor and to the terminal voltage of the battery?



	Voltage Across 5.0 Ω	Terminal Voltage
A.	increases	decreases
B.	increases	increases
C.	decreases	decreases
D.	decreases	increases

- Adding R in parallel decreases total resistance
- ∴ total current increases
- ∴ Voltage across R = 5 Ω increases due to $V = IR$ (↑ ↑ const)
- ∴ V_{Term} decreases due to $V_{Term} = \mathcal{E} - Ir$ (↓ ↑)

17. What is the emf of the battery shown?



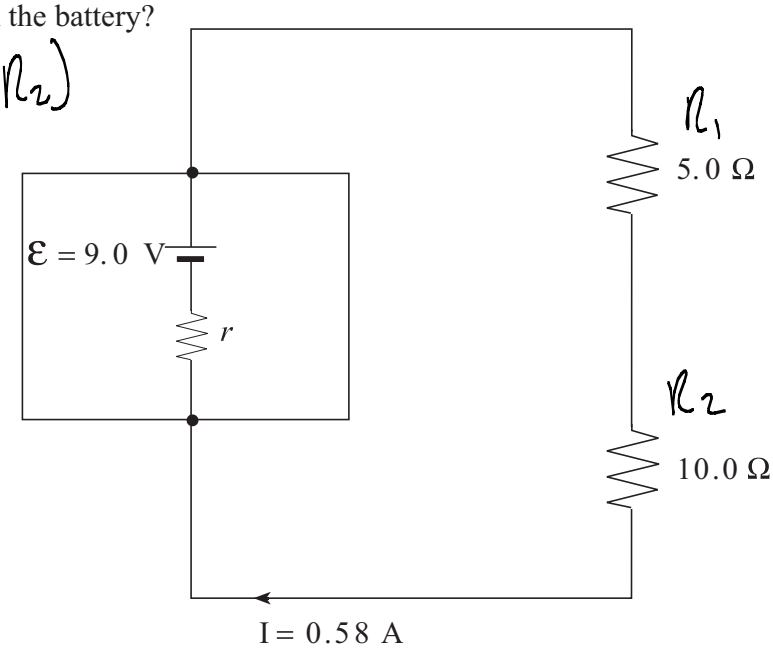
A. 2.0 V
B. 8.0 V
C. 10 V
D. 12 V

$\mathcal{E} = I_T R_T$
$= (4.0A)(2.5+0.5) = 12V$

18. In the following circuit, what is the power loss in the battery?

A. 0 W
B. 0.17 W
C. 5.0 W
D. 5.2 W

$V_{Term} = I(R_1 + R_2)$
$= 8.7V$



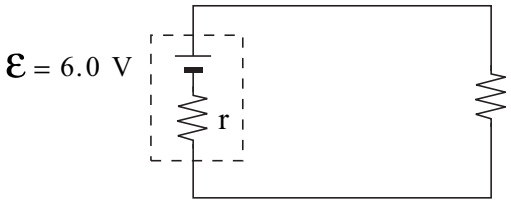
$V_{Term} = \mathcal{E} - Ir$

$r = \frac{\mathcal{E} - V_{Term}}{I} = 0.52\Omega$

$P = IV = (0.58A)(0.3)$
$= 0.17W$

19. A battery provides 3.20 W of power to an external resistance. What power is dissipated as heat by the internal resistance within the battery?

$P = I^2R \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{3.20W}{10.0\Omega}} = 0.566A$



$V = IR = (0.566)(10) = 5.66V$ (V_{Term})

A. 0.19 W
B. 3.4 W
C. 3.6 W
D. 60 W

$V_{Term} = \mathcal{E} - Ir$

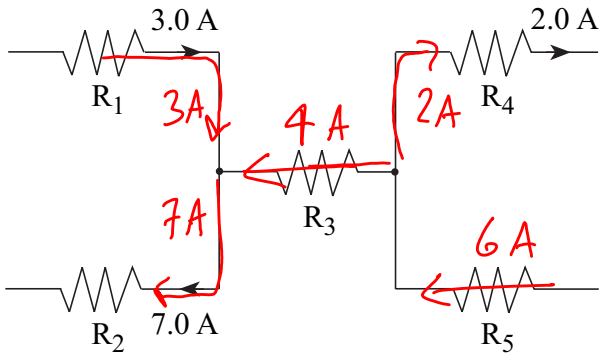
$r = \frac{\mathcal{E} - V_{Term}}{I} = \frac{6 - 5.66}{0.566} = 0.607\Omega$

Alternate Solution: $P_T = P_{Ext} + P_{int}$

$P_{int} = P_T - P_{Ext} = (6.00)(0.566) - 3.20$
$= 0.19W$

$P_{internal} = I^2 r = (0.566)^2(0.607) = 0.19W$

20. The diagram below shows part of an electrical circuit.



What are the magnitude and direction of the current passing through resistor R_5 ?

A. 6.0 A towards the left
B. 12.0 A towards the left
C. 2.0 A towards the right
D. 8.0 A towards the right

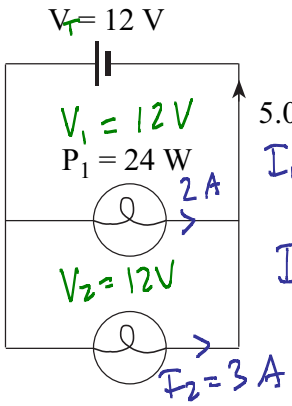
21. What happens to the total resistance of a circuit as one more resistor is added in parallel?

A. The total resistance decreases.
B. The total resistance increases.
C. The total resistance becomes zero.
D. The total resistance does not change.

22. A 12 V battery supplies a 5.0 A current to two light bulbs as shown below.

$P = IV$

$P_T = I_T V_T$
$= (5A)(12V)$
$= 60\ W$



$I_1 = \frac{P_1}{V_1} = \frac{24W}{12V} = 2.0A$

$I_T = I_1 + I_2$

$P_2 = I_2 V_2 = (3A)(12V) = 36\ W$

$P_2 = P_T - P_1$
$= 36\ W$

The power output of one of the bulbs is $P_1 = 24$ W. What is the power output of the other bulb?

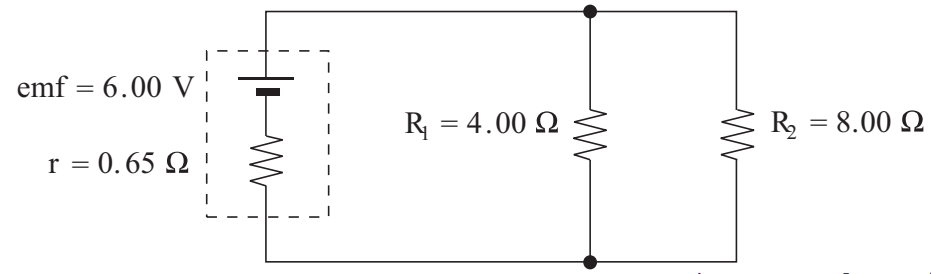
A. 14 W
B. 24 W
C. 36 W
D. 60 W

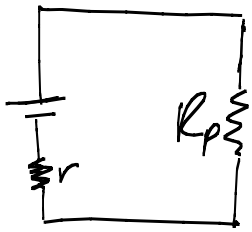
23. What current flows through the 4.00 Ω resistor in the following circuit?

$\mathcal{E} = I_T R_T$

$I_T = \frac{\mathcal{E}}{R_T}$

$= 1.8\ A$





A. 0.47 A
B. 1.2 A
C. 1.3 A
D. 1.5 A

$V_{Term} = \mathcal{E} - Ir$

$= 6V - (1.8A)(0.65\Omega)$

$= 4.8\ V$

$I_1 = \frac{V_1}{R_1}$

$= \frac{4.8V}{4.0\Omega}$

$= 1.2\ A$

$R_p = (R_1^{-1} + R_2^{-1})^{-1}$

$= 2.667\Omega$

$R_T = R_p + r$

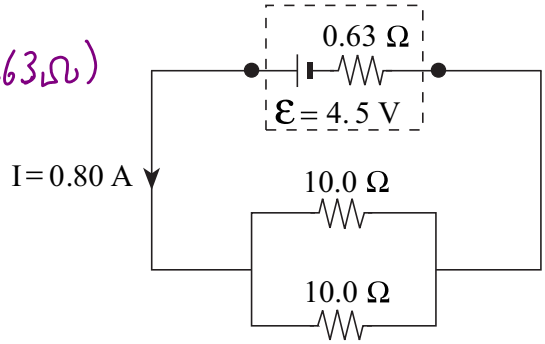
$= 3.32\Omega$

24. What is the terminal voltage of the cell in the circuit shown in the diagram below?

$V_{Term} = \mathcal{E} - Ir$

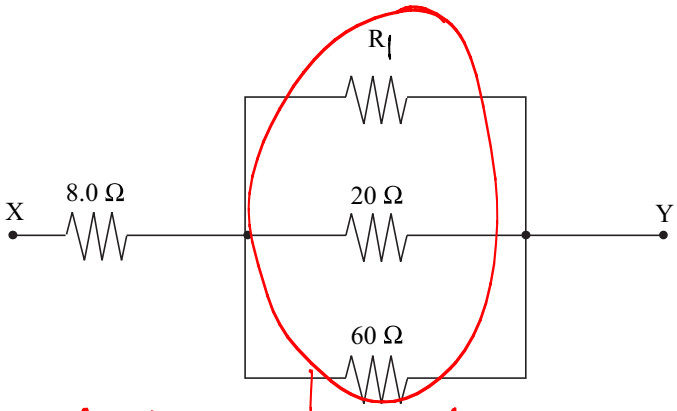
$= 4.5V - (0.80A)(0.63\Omega)$

$= 4.0V$



A. 0.50 V
B. 3.5 V
C. 4.0 V
D. 4.5 V

25. The total resistance between points X and Y is 14.0 Ω. What is the value of R?



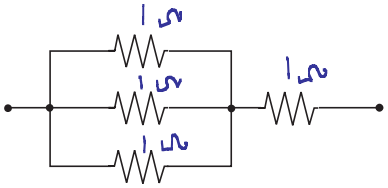
$R_1 = 8.0\Omega$ $R_p = 6.0\Omega$

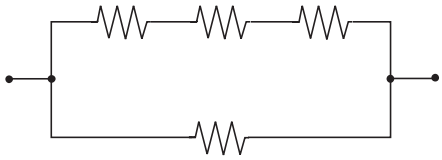
A. 6.0 Ω
B. 8.3 Ω
C. 10 Ω
D. 210 Ω

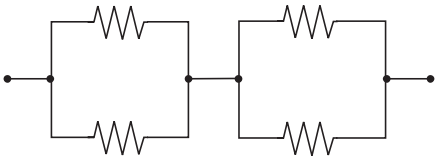
$\frac{1}{6} = \frac{1}{R_1} + \frac{1}{20} + \frac{1}{60}$ $\frac{1}{R_1} = \frac{1}{6} - \frac{1}{20} - \frac{1}{60}$

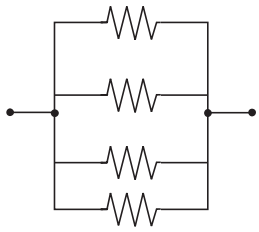
$R_1 = 10\Omega$

26. Which of the following arrangements would draw the smallest current when connected to a potential difference? All resistors have the same value.

A. 

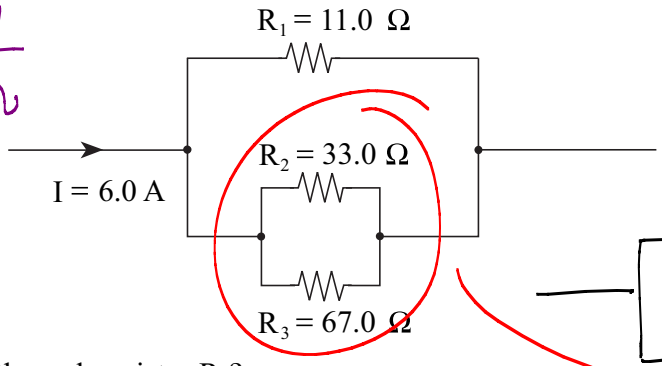
B. 

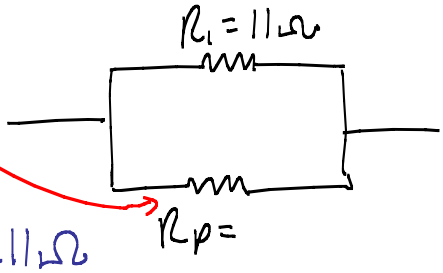
C. 

D. 

27. The diagram below shows part of an electrical circuit.

$I_1 = \frac{V_1}{R_1} = \frac{44\text{ V}}{11\ \Omega} = 4.0\text{ A}$





What is the current through resistor R_1?

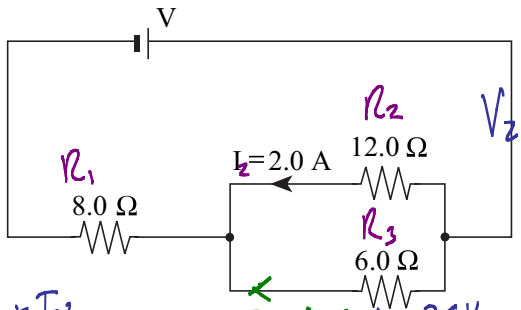
A. 2.0 A
B. 3.0 A
C. 4.0 A
D. 6.0 A

$R_p = (R_2^{-1} + R_3^{-1})^{-1} = 22.11\ \Omega$

$R_T = (R_1^{-1} + R_p^{-1})^{-1} = 7.35\ \Omega$

$V_T = I_T R_T = (6.0\text{A})(7.35\ \Omega) = 44\text{ V}$

28. What is the voltage, V, of the power supply shown in the circuit?



$V_2 = I_2 R_2 = (2.0\text{A})(12\ \Omega) = 24\text{ V}$

$I_3 = \frac{V_3}{R_3} = \frac{24\text{ V}}{6\ \Omega} = 4.0\text{ A}$

$I_T = I_2 + I_3 = 2 + 4 = 6\text{ A} = I_1$

A. 24 V
B. 52 V
C. 72 V
D. 96 V

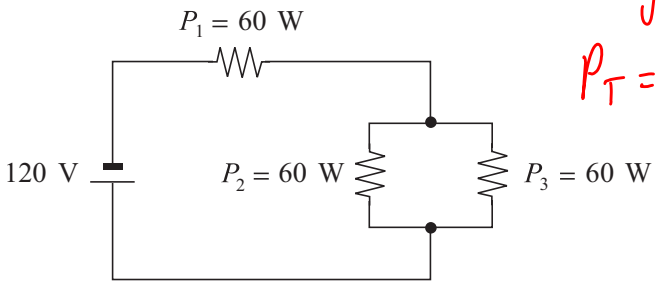
$V_1 = I_1 R_1 = (6\text{A})(8\ \Omega) = 48\text{ V}$

$V_T = 72\text{ V}$

29.. What is the current leaving the battery in the circuit below?

Energy is conserved so:

$P_T = P_1 + P_2 + P_3$



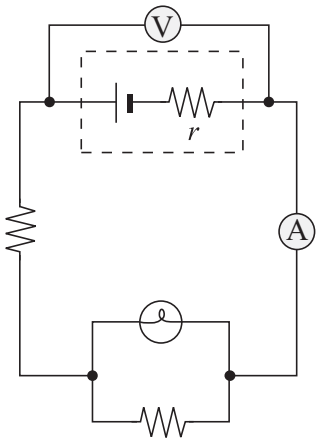
A. 1.3 A
B. 1.5 A
C. 2.0 A
D. 4.0 A

$P_T = I_T V_T$

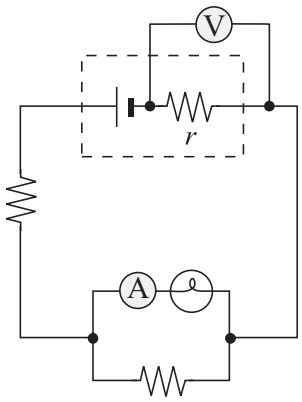
$I_T = \frac{P_T}{V_T} = \frac{180W}{120V} = 1.5A$

30. In which of the following circuits is the voltmeter placed correctly to measure the terminal voltage of the battery, and the ammeter placed correctly to measure the current through the light bulb (⊖) ?

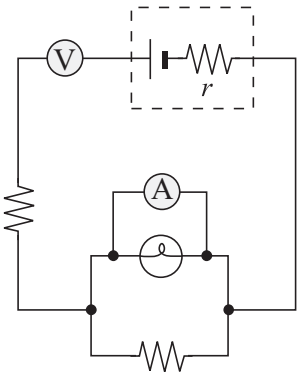
A.



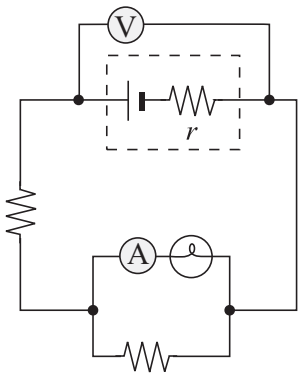
B.



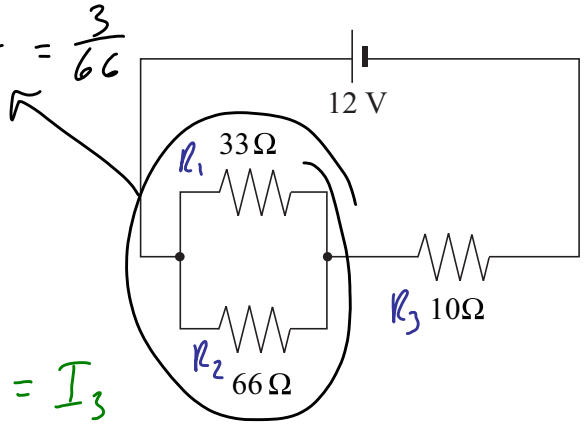
C.



D.



31. What is the current through the 10Ω resistor in the circuit shown below?



$\frac{1}{R_p} = \frac{1}{33} + \frac{1}{66} = \frac{3}{66}$

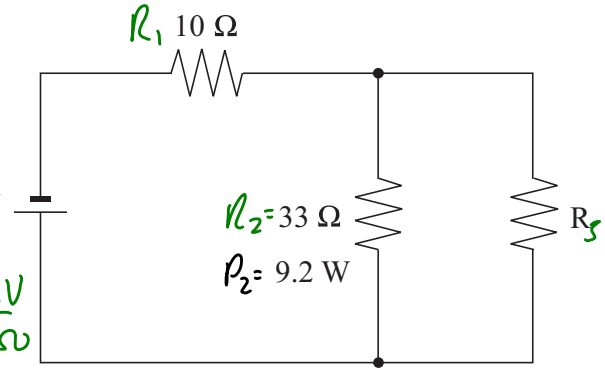
$R_p = 22\Omega$

$R_T = R_p + R_3 = 32\Omega$

$I_T = \frac{V_T}{R_T} = \frac{12V}{32\Omega} = 0.37A = I_3$

A. 0.11 A
B. 0.37 A
C. 1.2 A
D. 1.7 A

32. What is the total power dissipated by the three resistors in the circuit shown below?



$P_2 = \frac{V_2^2}{R_2}$ $\quad V_2 = \sqrt{P_2 R_2}$

$= \sqrt{(9.2W)(33\Omega)}$

$= 17.4V$

$V_T = V_1 + V_2$

$V_1 = V_T - V_2$

$= 24 - 17.4 = 6.6V$

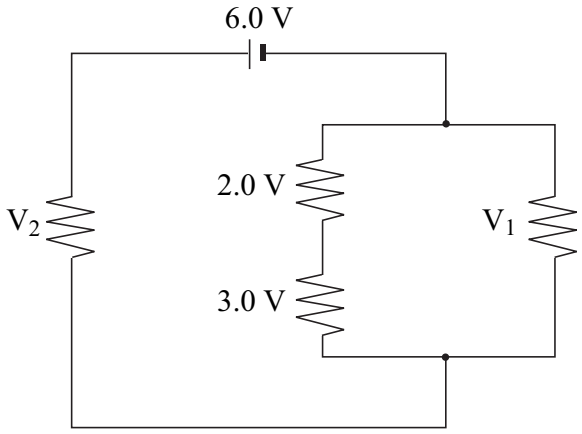
$I_1 = \frac{V_1}{R_1} = \frac{6.6V}{10\Omega}$

$= 0.66A$

$P_T = V_T I_T = (24V)(0.66A) = 16W$

A. 12 W
B. 16 W
C. 23 W
D. 30 W

33. What are the potential differences, V_1 and V_2, in the circuit shown below?



	Potential Difference V_1	Potential Difference V_2
A.	1.0 V	5.0 V
B.	1.0 V	6.0 V
C.	5.0 V	1.0 V
D.	5.0 V	5.0 V

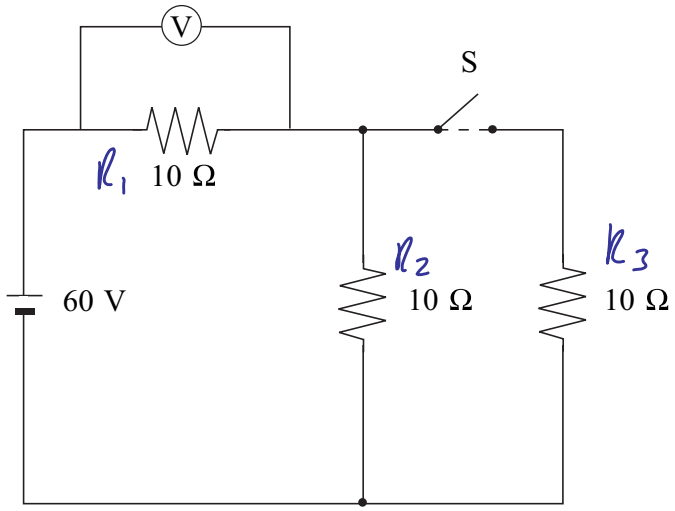
$V_p = V_1 = 2 + 3 = 5.0V$

$V_T = V_p + V_2$

$V_2 = V_T - V_p = 6.0 - 5.0$

$= 1.0V$

34. In the circuit shown below, voltmeter readings are taken when switch S is closed and open.



Open:

$R_T = R_1 + R_2 = 20\,\Omega$

$I_T = \frac{V_T}{R_T} = \frac{60\,V}{20\,\Omega} = 3.0\,A$

$V_1 = I_1 R_1 = (3.0)(10) = 30\,V$

Which of the following is correct?

	VOLTMETER READINGS	
	SWITCH CLOSED	SWITCH OPEN
A.	20 V	30 V
B.	30 V	30 V
C.	40 V	20 V
(D.)	40 V	30 V

Closed

$R_T = R_1 + (R_2^{-1} + R_3^{-1})^{-1} = 15\,\Omega$

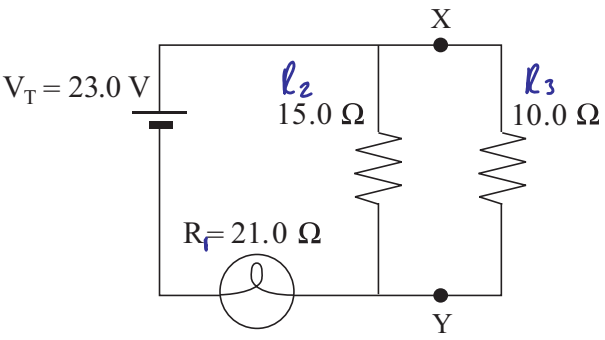
$I_T = \frac{V_T}{R_T} = \frac{60\,V}{15\,\Omega} = 4.0\,A$

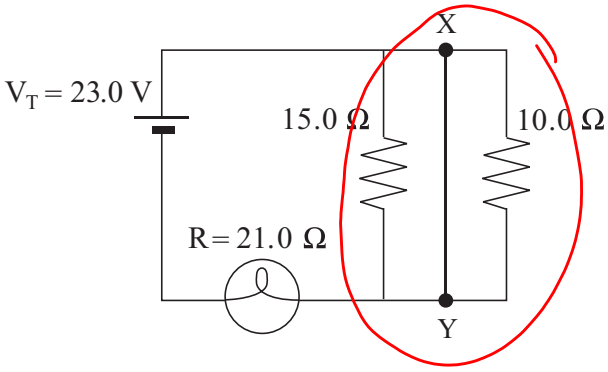
$V_1 = I_1 R_1 = (4.0)(10) = 40\,V$

35. A circuit is made from two resistors and a light bulb as shown on the left. A short time later a copper wire is connected across points X and Y as shown on the right diagram.

$R \simeq 0\,\Omega$

Essentially $R_p \to 0$





What is the current through the light bulb and what happens to the brightness of the bulb when the wire is connected?

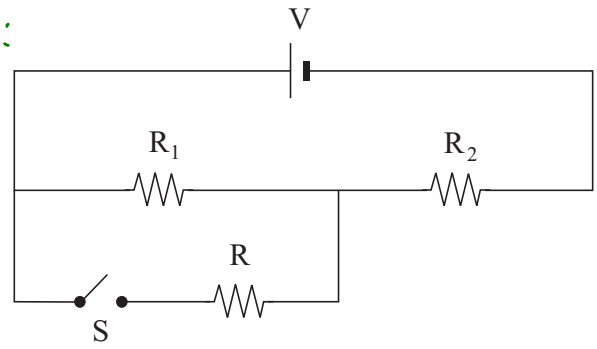
	CURRENT	BRIGHTNESS OF BULB
A.	0.64 A	dimmer
B.	0.64 A	brighter
C.	1.10 A	dimmer
(D.)	1.10 A	brighter

$\therefore R_T = R_1 = 21\,\Omega$

$I_T = \frac{V_T}{R_T} = \frac{23\,V}{21\,\Omega} = 1.1\,A$

36. Switch S is originally open as shown in the circuit below.

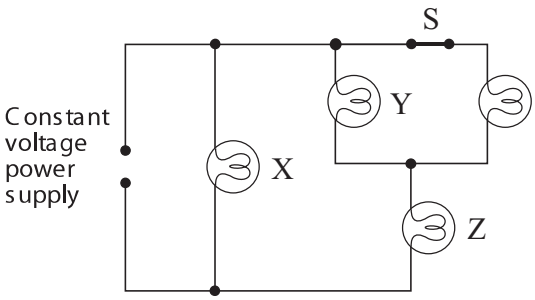
When switch closes:
- R_T ↓
- I_T ↑
- I_1 ↓

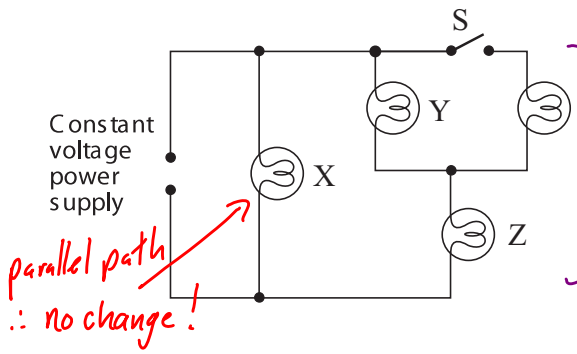


How does the current through resistors R_1 and R_2 change when switch S is closed?

	CURRENT THROUGH R_1	CURRENT THROUGH R_2
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

37. If switch S is opened, how does the brightness of each bulb (X, Y, and Z) compare to the situation when the switch was closed?





	BULB X	BULB Y	BULB Z
A.	same	same	same
B.	same	dimmer	brighter
C.	same	brighter	dimmer
D.	dimmer	dimmer	dimmer