Name : _____ Key

Electricity and Circuits

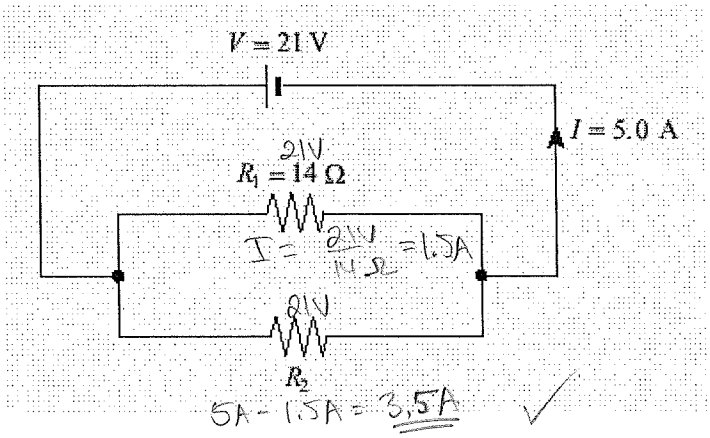
1. Which pair of values will cause the greatest deflection of an electron beam in a cathode ray tube?

	Accelerating Voltage	Deflection (Plate) Voltage
A.	400 V ✓	20 V
(B.)	400 V ✓	40 V ✓
C.	800 V	20 V
D.	800 V	40 V ✓

2. Electricity is transmitted at high potential to

A. Operate heavy equipment
B. Maximize current in the transmission
(C.) Minimize the energy lost as heat in the transmission lines
D. Produce alternating currents because they always require high voltages

3. Find the current flowing through resistor R_2 in the circuit shown below.



4. A cell has an internal resistance of 0.50Ω. It has a terminal voltage of 1.4V when connected to a 5.0Ω external resistance. What will its terminal voltage be if the 5.0Ω resistor is replaced by a 10.0Ω resistor?

$r = 0.5\Omega$
$V_{AB} = 1.4V$
$R = 5\Omega$

① $I = \frac{V_{AB}}{R} = \frac{1.4V}{5\Omega} = 0.28A$

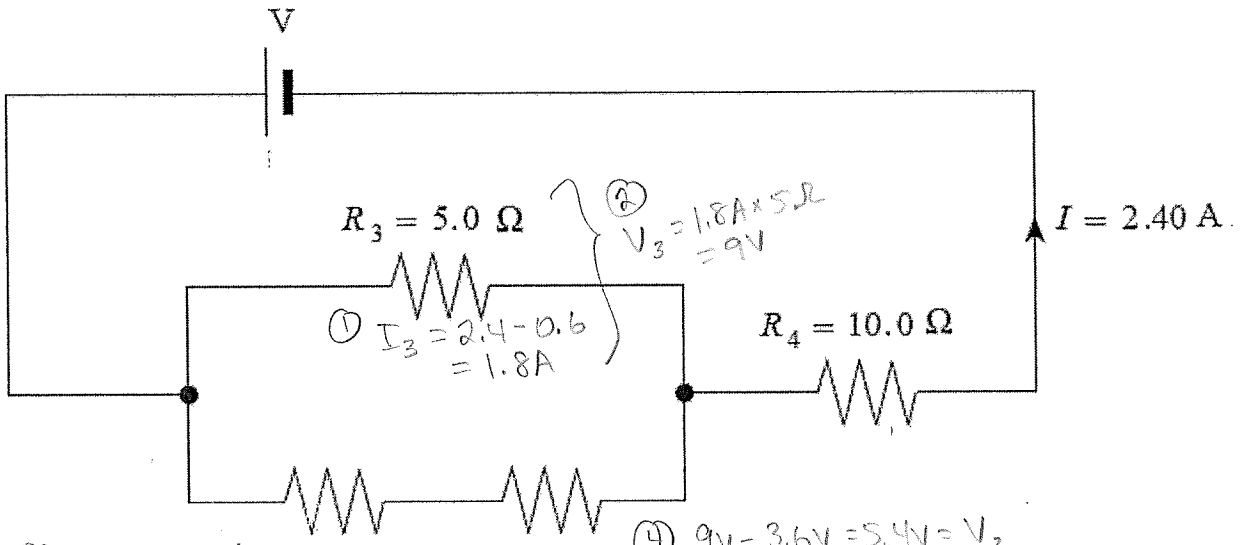
② $\mathcal{E} = V_{AB} + Ir$
$= 1.4V + (0.28A)(0.5\Omega)$
$= 1.54V = \mathcal{E}$ of battery (constant)

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

③ add new R, new $I = \frac{\mathcal{E}}{R+r} = \frac{1.54V}{10.5\Omega}$
$= 0.14\overline{6}A$

④ then $V_{AB} = \mathcal{E} - Ir$
$= 1.54 - (0.14\overline{6})(0.5)$
$= 1.47V$ ✓

5. A) Find the value of resistor R_2



② $V_3 = 1.8A \times 5\Omega = 9V$

① $I_3 = 2.4 - 0.6 = 1.8A$

③ $V_1 = 0.6A \times 6\Omega = 3.6V$

④ $9V - 3.6V = 5.4V = V_2$

⑤ $R_2 = \frac{V_2}{I_2} = \frac{5.4}{0.6} = 9\Omega$ ✓

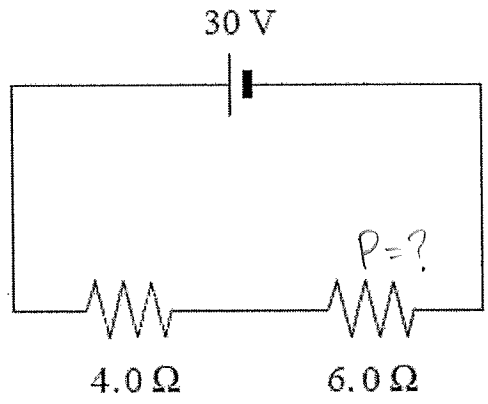
B) Find the potential difference of the power supply V

$V_p = 9V$ $V_4 = (2.4A)(10\Omega) = 24V$ $V = V_p + V_4 = 33V$ ✓

6. Which household electrical appliance consumes the least energy in a typical month?

A. Stove
B. Dryer
C. Clock
D. Refrigerator

7. What is the power output of the 6.0Ω resistor in the diagram?



① $R_T = 10\Omega$

② $I_T = \frac{30V}{10\Omega} = 3A$

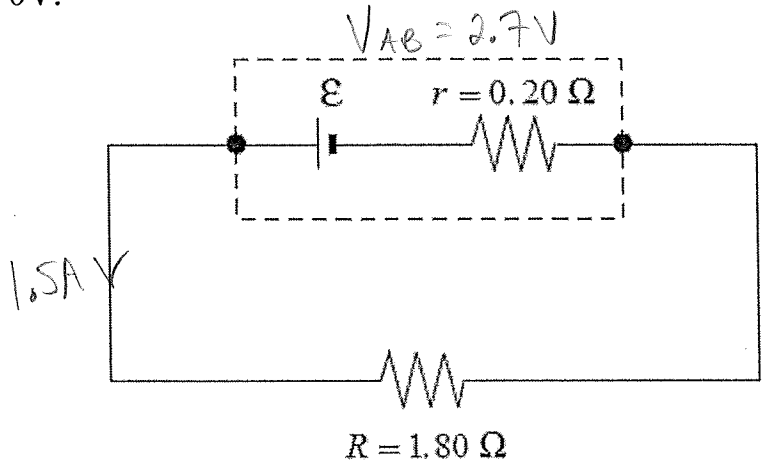
③ $P = I^2R = (3A)^2(6\Omega) = 54W$ ✓

8. A 12V power supply is connected to an 8.0Ω resistor for 50s. How much charge passes through the resistor?

① $I = \frac{12V}{8\Omega} = 1.5A$ $V = IR$

② $Q = It = (1.5A)(50s) = 75C$ ✓ $I = \frac{Q}{t}$

9. The cell shown delivers a 1.50A current to the external circuit and has a terminal voltage of 2.70V.

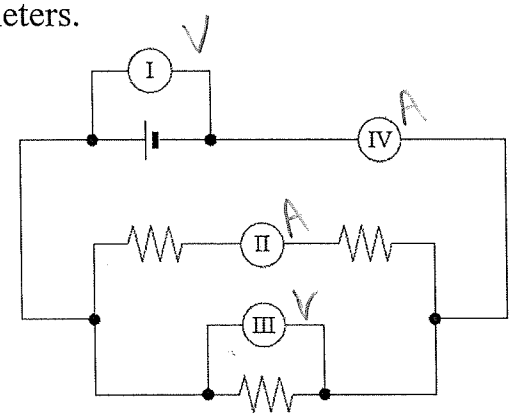


A) What is the emf of the cell? $V_{AB} = \mathcal{E} - Ir$ $\mathcal{E} = V_{AB} + Ir = 2.7V + 1.5(0.2) = 3.00V$ ✓

B) The 1.80Ω external resistance is replaced by other resistors and the current and terminal voltage are measured in each case. Using principles of physics, explain the relationship between terminal voltage $V_T = V_{AB}$ and current I as these resistors are changed?

$I = \frac{\mathcal{E}}{R+r}$; as $R \uparrow$, $I \downarrow$; then $V_{AB} = \mathcal{E} - Ir$; as $I \downarrow$, $V_{AB} \uparrow$

10. The circuit shown below includes two ammeters and two voltmeters. Identify the correct placement of these meters.



Ammeters in series IV, II
Voltmeters in parallel I, III

	AMMETERS	VOLTMETERS
A.	I, II	III, IV
B.	I, III	II, IV
(C.)	II, IV ✓	I, III ✓
D.	III, IV	I, II

✓

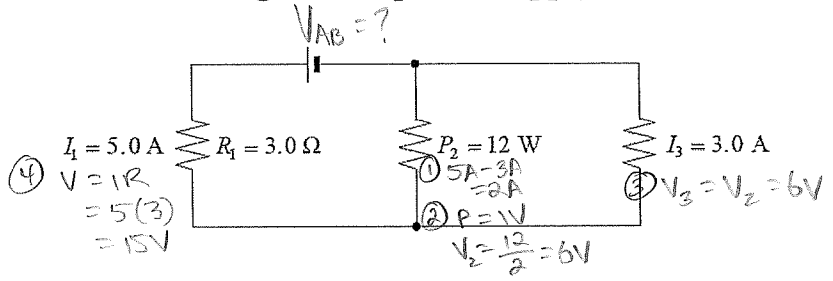
11. A 120V supply is connected to a heater of resistance 15Ω. What must the resistance of another heater be in order to produce the same power output when connected to a 240V supply?

$P = \frac{V^2}{R} = \frac{(120)^2}{15\Omega} = 960W$

$960W = \frac{(240)^2}{R_2}$

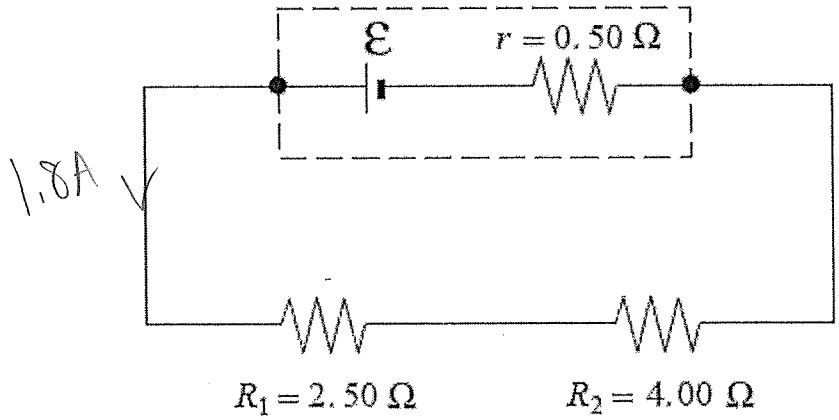
$R_2 = 60\Omega$ ✓

12. What is the voltage of the power supply shown in the diagram?



⑤ $V_{AB} = 15V + 6V = 21V$ ✓

13. The cell shown in the diagram supplies a 1.80A current to the resistors R_1 and R_2.

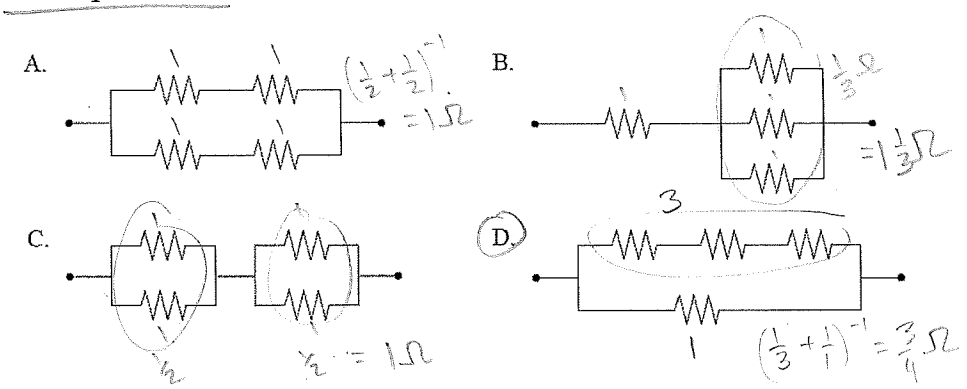


A) What is the terminal voltage of the cell? $V_{AB} = IR = (1.8)(2.5+4) = 11.7V$ ✓

B) What is the emf of the cell? $V_{AB} = \mathcal{E} - Ir$

$\mathcal{E} = V_{AB} + Ir = 11.7 + (1.8)(0.5) = 12.6V$ ✓

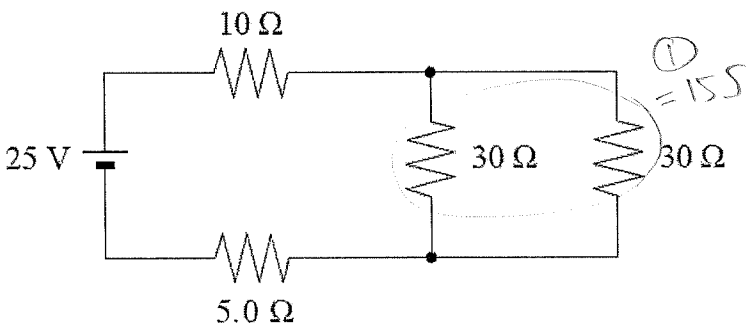
14. Which of the following arrangements would draw the largest current when connected to the same potential difference? All resistors have the same value ← smallest R since $I = \frac{V}{R}$



Find equivalent R assume R = 1

← lowest R so highest I ✓

15. What is the power dissipated by the 5.0Ω resistor in the following circuit?



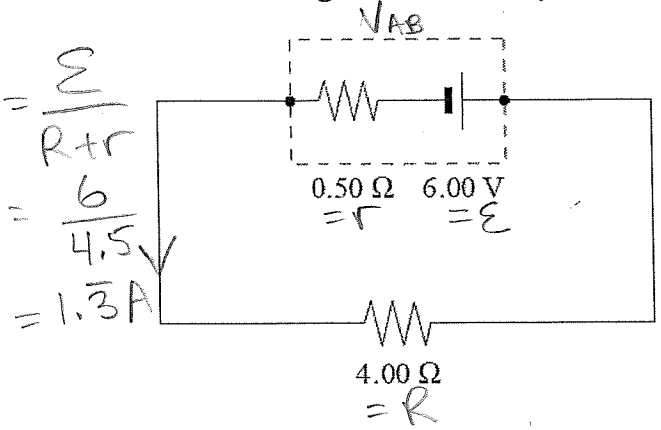
① = 15Ω

② $R_T = 10 + 15 + 5 = 30\Omega$

③ $I = \frac{25V}{30\Omega} = 0.83A$

④ $P = I^2R = (0.83)^2(5\Omega) = 3.5W$ ✓

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

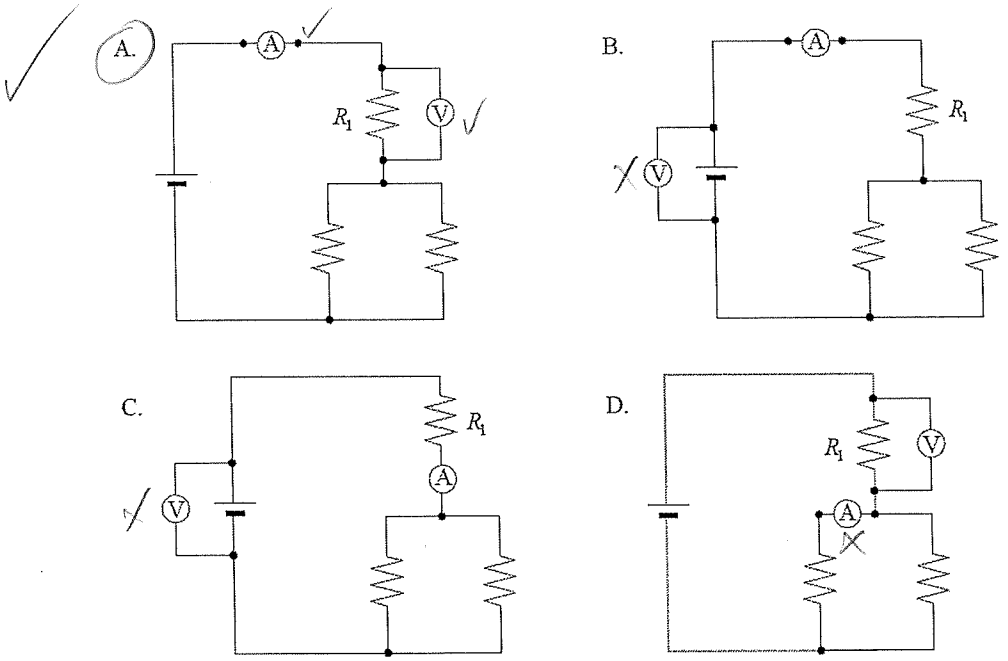


① $I = \frac{\varepsilon}{R+r} = \frac{6}{4.5} = 1.\overline{3}\,A$

② $V_{AB} = \varepsilon - Ir$
$= 6 - (1.\overline{3})(0.5)$
$= 5.3\,V$ ✓

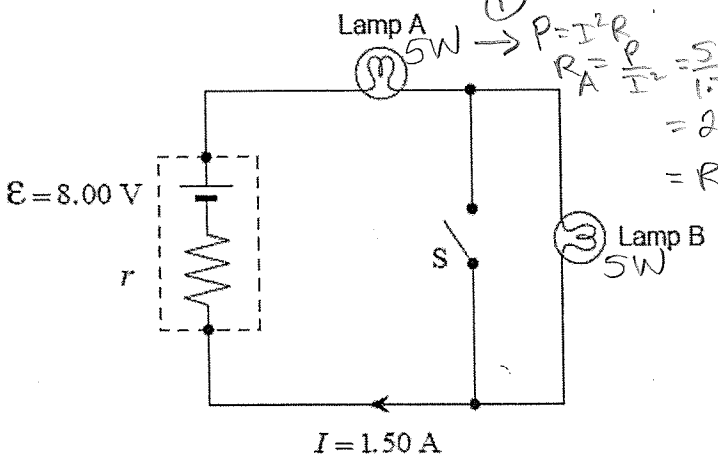
17. Which one of the following shows the correct placement of an ammeter and a voltmeter to determine the power output of resistor R_1?

series parallel



18. The circuit shown consists of an 8.00V battery and two light bulbs. Each light bulb dissipates 5.0W. Assume that the light bulbs have a constant resistance. Switch S is open. If current of 1.50A flows in the circuit what is the internal resistance r of the battery?

so series circuit



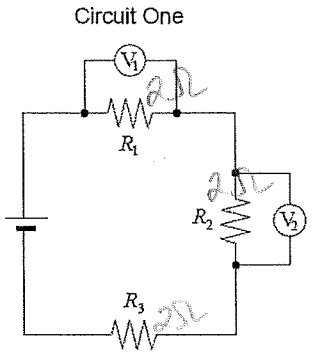
① $P = I^2R$
$R_A = \frac{P}{I^2} = \frac{5}{1.5^2} = 2.\overline{2}\,\Omega = R_B$

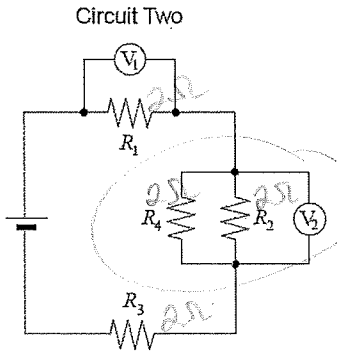
② $R_T = 2.\overline{2} + 2.\overline{2} = 4.\overline{4}\,\Omega$

③ $V_{AB} = IR_T = (1.5A)(4.\overline{4}\,\Omega) = 6.\overline{6}\,V$

④ $V_{AB} = \varepsilon - Ir$
$r = \frac{V_{AB} - \varepsilon}{-I}$
$= 0.89\,\Omega$ ✓

19. In circuit one, resistors and the voltmeters are connected as shown. In circuit two, an additional resistor R_4 is placed in parallel with resistor R_2

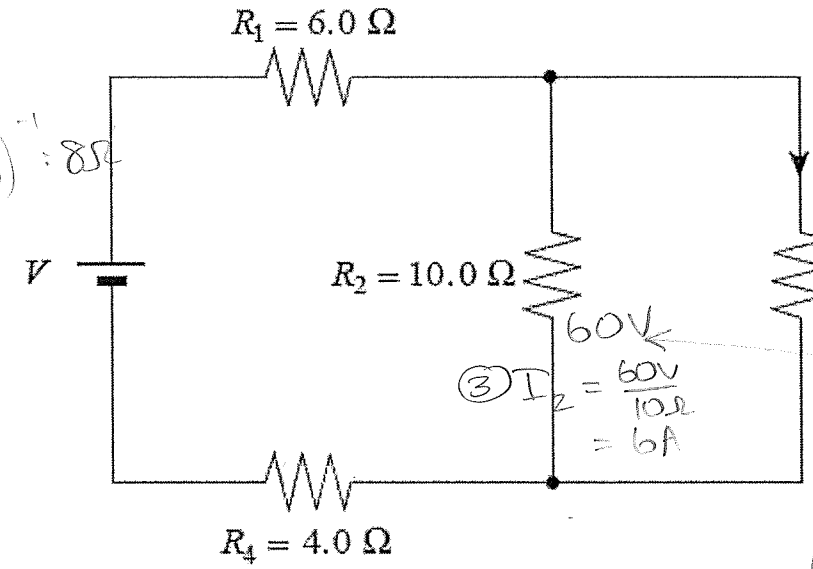




How have the values of V_1 and V_2 in circuit two changed compared to those in circuit one?

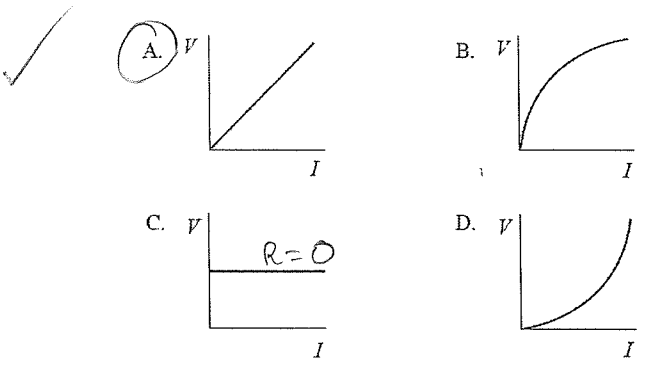
	V_1	V_2
A.	no change	decreased
B.	decreased	increased
C.	increased	decreased
D.	increased	no change

20. A current of 1.50A flows through the 40.0Ω resistor.



What is the potential difference of the power supply?

21. Which of the following graphs illustrate Ohm's law?

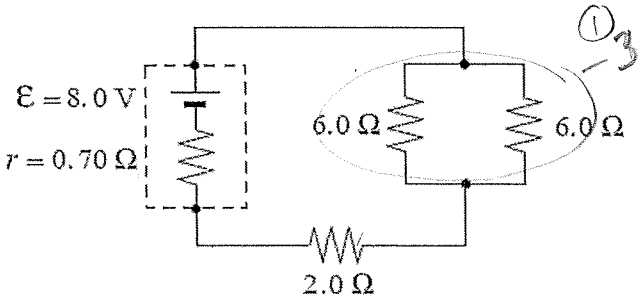


$V = IR$

$V = RI$

↑ slope (constant)

22. In the following circuit, what is the terminal voltage of the battery?



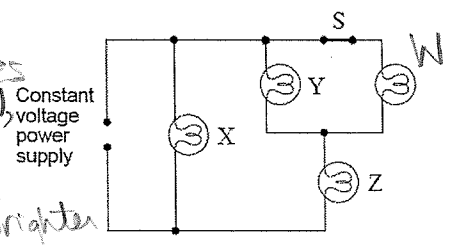
① 3Ω ② $R_T = 3\Omega + 2\Omega = 5\Omega$

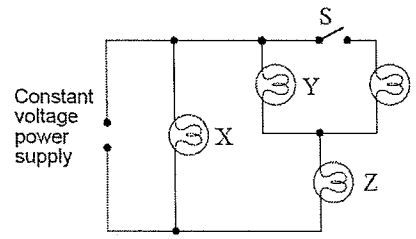
③ $I = \frac{\mathcal{E}}{R+r} = \frac{8}{5.7} = 1.404\ A$

④ $V_{AB} = \mathcal{E} - Ir = 8 - (1.404)(0.7) = 7.0V$ ✓

23. 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?

-When closed current divides btwn Y and W, when open Y gets more current so brighter





-When open, Y + Z is greater so less current chooses that path ⇒ Z would be dimmer

-Plus R_T (when open) is more so I_0 is less so X is same

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

✓

← only answer with Y brighter

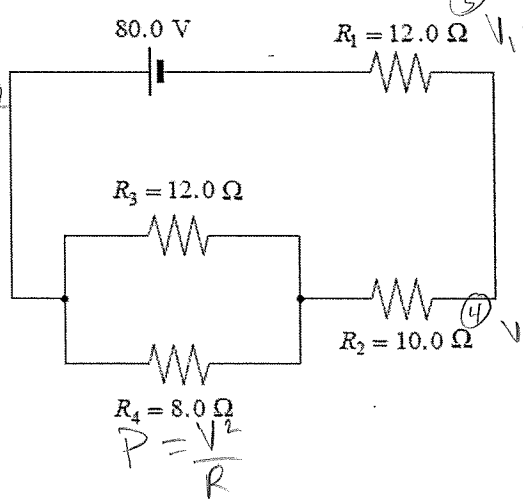
24. What is the power dissipated in the 8.0Ω resistor in the circuit as shown?

① R_T

$R_p = \left(\frac{1}{12} + \frac{1}{8}\right)^{-1} = 4.8\Omega$

$R_T = 12 + 10 + 4.8 = 26.8\Omega$

② $I_0 = \frac{V_0}{R_T} = \frac{80}{26.8} = 2.985\ A$



③ $V_1 = (2.985)(12) = 35.82V$

④ $V_2 = (2.985)(10) = 29.85V$

⑤ $80 - 35.82 - 29.85 = 14.33$ for parallel

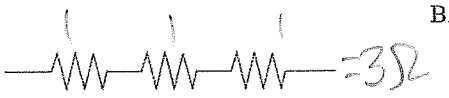
⑥ R_4

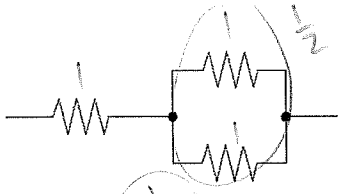
$P_4 = \frac{(14.33V)^2}{8\Omega} = 26W$ ✓

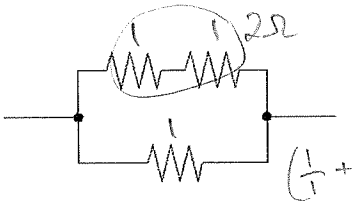
$P = \frac{V^2}{R}$

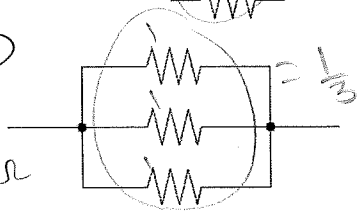
25. Which of the following combination of three identical resistors has the least equivalent resistance?

let each $R = 1\Omega$

A.  $= 3\Omega$

B.  $= 1.5\Omega$

C.  $\left(\frac{1}{1}+\frac{1}{2}\right)^{-1} = \frac{2}{3}\Omega$

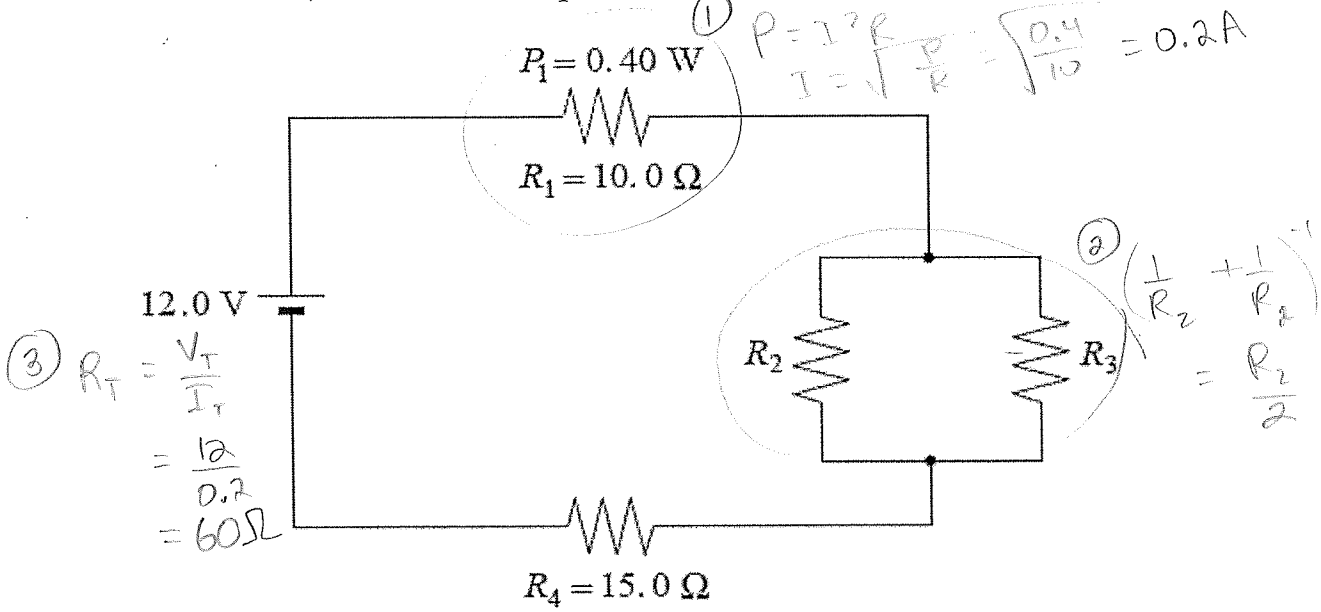
D.  $= \frac{1}{3}\Omega$ ✓

26. An electrical device with a constant resistance draws 0.75A when connected to a 4.8V source. What are the current and power for this device when it is connected to a 6.0V source?

$R = \frac{V}{I} = \frac{4.8V}{0.75A} = 6.4\Omega$ Then $I = \frac{V}{R} = \frac{6V}{6.4\Omega} = 0.94A$ ✓

$P = \frac{V^2}{R} = \frac{(6V)^2}{6.4\Omega} = 5.6W$ ✓

27. In the circuit below, resistor R_1 dissipates 0.40W. Resistors R_2 and R_3 are identical.



① $P = I^2R$, $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{0.4}{10}} = 0.2A$

② $\left(\frac{1}{R_2}+\frac{1}{R_3}\right)^{-1} = \frac{R_2}{2}$

③ $R_T = \frac{V_T}{I_T} = \frac{12}{0.2} = 60\Omega$

What is the resistance of R_2?

④ $60\Omega = 10\Omega + \frac{R_2}{2} + 15\Omega$

$35\Omega = \frac{R_2}{2}$

$70\Omega = R_2$ ✓