Physics 25 Practice Problems Chapters 19-20

1. Two 4-ohm resistors are connected in series. (a) What is the equivalent resistance of this combination? (b) What would be the equivalent resistance if they were connected in parallel?

2. Prove that the equivalent resistance of two resistors R connected in parallel is R/2, then show that the equivalent resistance of three resistors R connected in parallel is R/3.

3. A battery is connected to a single resistor. The power output of the battery is 30 watts. What would be the power output if the battery emf (voltage) were doubled?

4. An incandescent light bulb designed for use with a 110-volt power supply is marked as 75 W. What is the bulb's filament resistance?

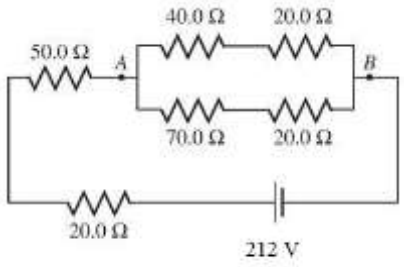
5. If the power consumed by a resistor is 200 W, what would be the power consumed if the current through the resistor were tripled?

6. Six amperes approach the branch point of a pair of equal resistors. The total power consumed by the pair is 54 W. What is the resistance of each resistor?

7. A 12-volt battery is in series with a 4-ohm resistor and a 2-ohm resistor. What is the power consumed by each resistor?

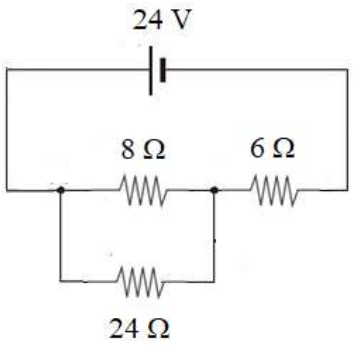
8. A 3-Ω resistor is connected in parallel with a 6-Ω resistor, and the combination is attached to the terminals of a 10-volt battery. What is the total power consumed by the two resistors, in watts?

9. What is the power output of the battery in the circuit below?



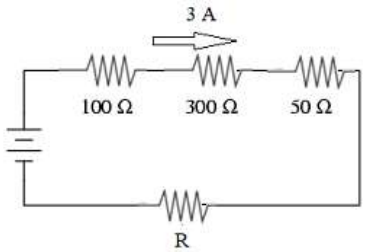
10. Two identical resistors are connected in parallel. Across the branch points of this parallel combination is connected a 40-volt battery. What would have to be the resistance of each resistor in order that the output power of the battery be 100 watts?

11. What is the power (in watts) consumed by the 8-ohm resistor in the circuit below?



12. The output power of the battery in the circuit below is 5400 W.

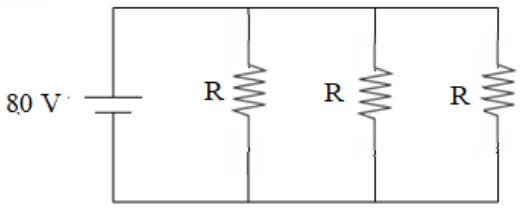
What is the resistance R?



13.

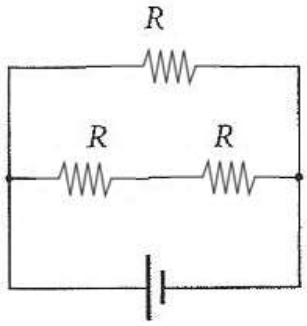
The power output of the battery in the circuit below is 300 watts.

What is R?

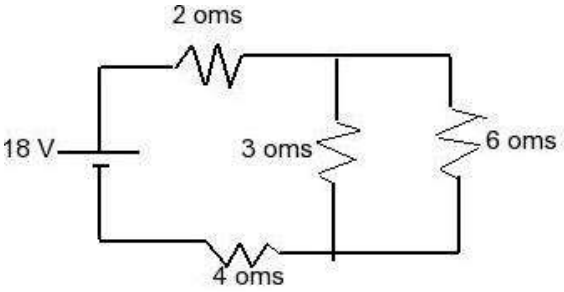


14. In the circuit below the current through the top branch is 4.0 A, and the current through the bottom branch is 2.0 A. The power output of the battery is 400 watts.

What is R?

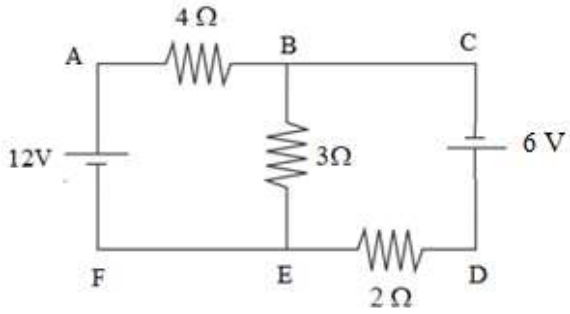


15. What is the power consumed by the 6-ohm resistor in the circuit below?



16. A current of 18 amperes approaches a branch point of three parallel-connected resistors. The three resistances are 2 ohms, 3 ohms, and 6 ohms. What is the current through each resistor?

17. What is the current through the 3-ohm resistor?



Problem Solutions

1. (a) 8 Ω (b) 2 Ω	**2.** Replace two of the resistors in parallel with $R^2/2R = R/2$ What remains is R/2 in parallel with the third R: $(\frac{1}{2} R)(R) / (\frac{1}{2} R + R) = (\frac{1}{2} R^2 / 2) / (3R/2)$ $= R/3$	**4.** $P = \varepsilon^2/R$ $75 = 110^2/R$ $R = 161\ \Omega$
3. $P_1 = \varepsilon_1^2/R$ $= 30$ watts $\varepsilon_2 = 2\ \varepsilon_1$ $P_2 = \varepsilon_2^2/R$ $= (2\ \varepsilon_1)^2/R$ $= 4\ \varepsilon_1^2/R$ $= 4\ (30)$ $= 120$ watts Faster: $(2)^2\ 30 = 120$ watts		**5.** $P_1 = I_1^2R$ $= 200$ $P_2 = (3I_1)^2\ R$ $= 9\ I_1^2R$ $= 9(200)$ $= 1800$ W Faster: $(3)^2\ (200) = 1800$

6.

Equal resistances in parallel receive the same current, and therefore they each consume ½ the total: 27 W.

$3^2 R = 27$
$R = 3\ \Omega$

7.

$R = 4 + 2$
$= 6\ \Omega$

$I = 12/6$
$= 2$ A

4 Ω power: $2^2 4 = 16$ W

2 Ω power: $2^2 2 = 8$ W

8.

$(3)(6)/(3 + 6) = 2\ \Omega$

$I = 10/2$
$= 5$ A

$P = 5(10)$
$= 50$ W
= power produced
= power consumed

Together, the two resistors consume 50 W of power.

9.

60 and 90 in parallel:

$60(90)/(60 + 90) = 36\ \Omega$

36 in series with 50 + 20:

$36 + 50 + 20 = 106\ \Omega$

$212/106 = 2$ A

$P = 212\ (2)$
$= 424$ W

10.

Need 2.5 A out of the battery in order that the power output be 100 W.

Required equivalent resistance is 16 Ω.

$R(R)/(R+R) = 16$
$R = 32\ \Omega$

11.

Equivalent of
8 and 24 in parallel: 6 Ω

Now there is 6 Ω in series with 6 Ω, for a total of 12 Ω.

$I = 24/12$
$= 2$ A

Current in 8 Ω:

$I = (24/32)\ 2$
$= 1.5$ A

$P = (1.5)^2\ 8$
$= 18$ W

12.

$5400 = 3^2\ (100 + 300 + 50 + R)$
$R = 150\ \Omega$

13.
Equivalent resistance = R/3 (See Problem 2)

$300 = 80^2\ /(R/3)$
$R = 64\ \Omega$

14. $400 = 4^2 R + 2^2 R + 2^2 R$
$R = 16.67\ \Omega$

15.
3 Ω and 6 Ω in parallel: 2 Ω
2 Ω in series with 2 Ω and 4 Ω: 8 Ω

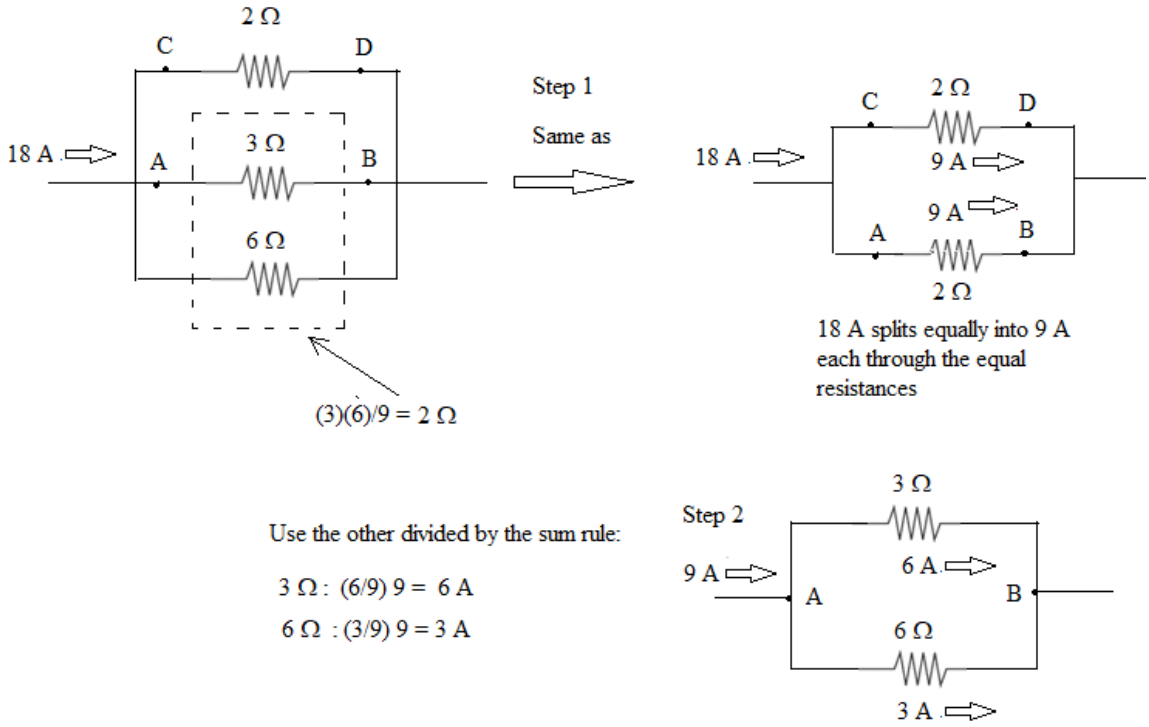
$I = \varepsilon/R$
$=18/8$
$= 2.25$ A

Current through 6 Ω:

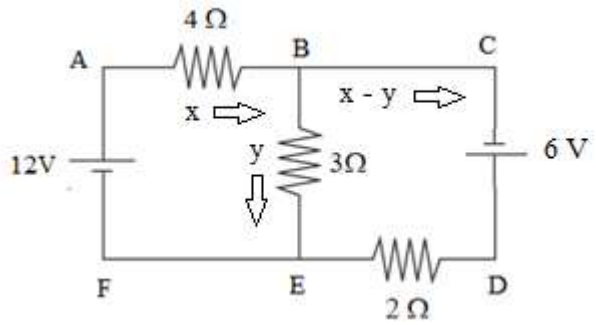
$(3/9)\ 2.25 = 0.75$ A

$P = 0.75^2\,(6)$
$= 3.38$ W

16.



17.



ABEFA: $-4x - 3y + 12 = 0$

BCDEB: $6 - 2(x - y) + 3y = 0$

Solve: $x = 3$ A
$y = 0$