EL 110 Parallel R Problems (Homework) Solutions

1. (a) 2, 3 and 4 are in parallel (b) 2 and 3 are in parallel
(c) 1 and 4 are in parallel, 2 and 3 are in series

2. (a) NO elements are in parallel (b) R6 and R7 are in series (obvious?), and R1 and R3 are in series IF you redraw the circuit (the same electron passing through R1 must also pass through R3; this is NOT obvious)
(c) R6 and R7 make a ***BRANCH***. A branch is a path between two nodes, and a branch can have one, or two, or any number of elements **IN SERIES**. So, the R6-R7 branch is in **parallel** with R5.

12. (a) Each 60-W bulb has a current of 60W/120V = 0.5 A. Ten 60-W bulbs use 5.0 A.
The washer has a current of 400W/120V = 3.333 A. TV has 360W/120V = 3 A.

(b) Total current = 5 A + 3.333 A + 3 A = 11.333 A. Since 20 A > 11.333 A, the circuit breaker will NOT trip.
(c) Rtotal = V/I_{total} = 120V/(11.333 A) = 10.6 Ω
(d) Ptotal = $V(I_{total})$=120V(11.333 A) = 1360 W
NOTE that 10(60W) + 400W + 360W = 1360 W also

3. (a) $R_{TOTAL} = 1/((1/R1) + (1/R2)) = 1/((1/9Ω) + (1/18Ω)) = (9^{-1} + 18^{-1})^{-1}$ = **6 Ω**
$G_{TOTAL} = (1/R1) + (1/R2) = (1/9Ω) + (1/18Ω) = 0.16666$ S (unit is Siemen)
(b) R_{TOTAL} = 1 k Ω G_{TOTAL} = 1 mS NOTE: G = 1/R = 1/(1 k Ω) = 1 mS
(c) R_{TOTAL} = 2.076 k Ω G_{TOTAL} = 0.4816 mS
(d) R_{TOTAL} = 1.333 Ω G_{TOTAL} = 0.75 S
(e) R_{TOTAL} = 9.948 Ω G_{TOTAL} = 0.1005 S
(f) R_{TOTAL} = 0.6889 Ω G_{TOTAL} = 1.4515 S

4. (a) $G_{TOTAL} = (1/4Ω) + (1/R) + (1/6Ω) = 0.55$ S (1/R) = 0.55 – (1/4) – (1/6) = 0.13333 S
R = 1/(0.13333 S) = 7.5 Ω

(b) $G_{TOTAL} = (1/5kΩ) + (1/8kΩ) + (1/R) = 0.45$ mS ; similarly, R = (0.125 mS) = 8 kΩ

11. (a) I = V/R = 120V/1.8kΩ = 66.666 mA (b) R_{TOTAL} = R/N = (1.8 k Ω)/8 = 225 Ω
(c) $P = V^2/R = (120V)^2/1800Ω$ = 8 watts (d) If one bulb burns out, NO EFFECT on the remaining bulbs (all 7 remaining bulbs are across 120 V, and light up normally)

5. (a) $G_{TOTAL} = (1/18Ω) + (1/R) + (1/18Ω) = (1/6Ω) = 0.1666$ S
(1/R) = 0.1666 – (1/18) – (1/18) = 0.0555 S R = 1/(0.0555 S) = 18 Ω
(b) R1 = 24 Ω

6. $G_{TOTAL} = 1/ R_{TOTAL} = 1/(20Ω) = (1/R1) + (1/5R1) + (1/0.5R1) = 16/(5R1)$ R1 = 64Ω

7. NOTE: all resistors are in parallel!
$G_{TOTAL} = 1/(10Ω) = 0.1$ S = (1/24Ω) + (1/R1) + (1/24Ω)+ (1/120Ω) , solve for R1
R1 = 120 Ω

9. (a) $G_{TOTAL} = 1/(3\Omega) + 1/(6\Omega) + 1/(1.5\Omega) = 1.1666$ S, $R_{TOTAL} = 1/G_{TOTAL} = 0.8571\ \Omega$

(b) $Is = 0.9V/(R_{TOTAL}) = 0.9V/(0.8571\Omega) = 1.05$ A

(c) $I_{R1} = 0.9V/R1 = 0.9V/3\Omega = 0.3$ A

$I_{R2} = 0.9V/R2 = 0.9V/6\Omega = 0.15$ A

$I_{R3} = 0.9V/R3 = 0.9V/1.5\Omega = 0.6$ A

$Is = I_{R1} + I_{R2} + I_{R3} = 1.05$ A So, YES, sum of parallel branch currents = Isource

(d) $P_{R1} = 0.9V(0.3A) = 0.27$ W

$P_{R2} = 0.9V(0.15A) = 0.135$ W

$P_{R3} = 0.9V(0.6A) = 0.54$ W

Total power dissipated by resistors is $Ptotal = P_{R1} + P_{R2} + P_{R3} = 0.945$ W

Total power "delivered" by the source is $Ps = V(I) = (0.9\ V)(1.05A) = 0.945$ W

(e) R1 had better be a ½ Watt resistor; R2 had better be a ¼ watt resistor;
R3 ought to be a 1 Watt resistor. If they are not these ratings (or more), they will become SERs (smoke-emitting resistors)