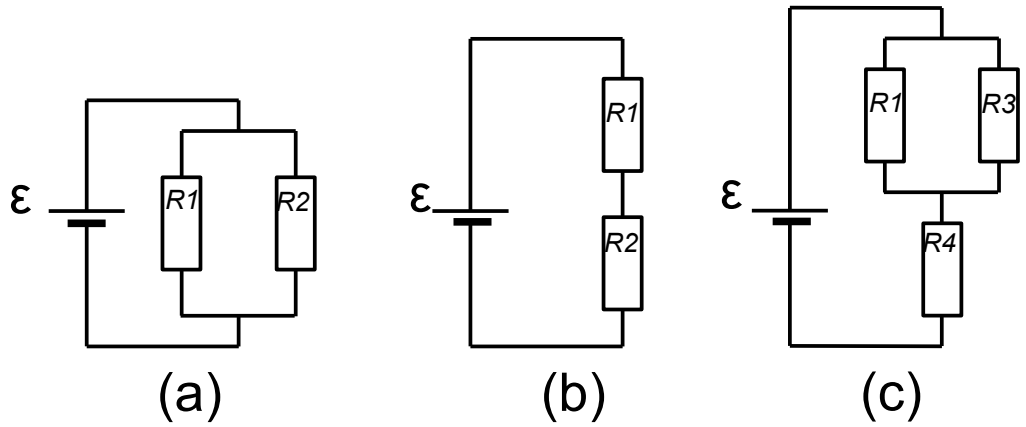
Electric Circuits,
SOLUTIONS to na_week1

Q1) Consider the three circuits (a), (b), and (c) shown in the figure below.



(i) Calculate the equivalent resistance in each circuit if R1=10Ω, R2=20Ω, R3=15Ω and R4 =5Ω and ε=10 V.
The equivalent resistance in each of the 3 cases is:
(a) $1/R= (1/R1 + 1/R2)= (1/10+1/20)= 0.1 +0.05=0.15\Omega^{-1}$
$R= 1/0.15= 6.67\Omega$
(b) $R= R1 + R2 = 10 + 20 = 30\Omega$

(c) $R= R4 + 1/(1/R1 + 1/R3)= 5 + 1/(1/10+1/15)=5+6=11\Omega$

(ii) What is the dissipated electric power in each circuit?
(You may neglect the internal resistance of the power supply ε.)

The dissipated power P= ε^2/R

(a) P= 100/6.7=15 W
(b) P= 100/30= 3.3 W
(c) P= 100/11=9.1 W

Q2) Husband and wife disagree about how to light their Christmas tree with 20 identical bulbs with R=1Ω, using a battery of 20V. The husband wishes to connect the bulbs in series, while the wife argues that the bulbs will be brighter if connected in parallel. Who is right and what is the difference in dissipated energy between the two options.
The wife is right.

If the bulbs are connected in series the total resistance is 20Ω,
the current *I*=20V/20Ω= 1A and the dissipated power is P=ε*I*=ε^2/R =400/20=20W
If the bulbs are connected in parallel the total resistance is 1/20=0.05Ω, the current *I*=20V/0.05Ω= 400A and the dissipated power is P=ε*I*=ε^2/R =400/0.05=8000W