Physics Year 11

Electrical Circuits

Voltmeters & Ammeters

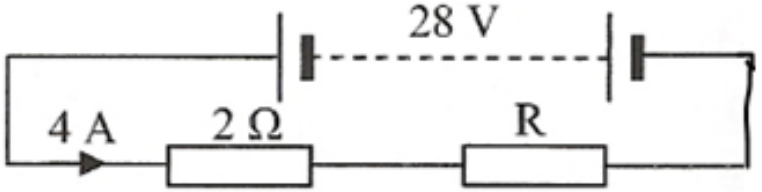
- Voltmeter –measures PD between 2 points
- Connected in parallel to the component it is measuring the PD across
- High resistance instruments (little I diverted)
- Ammeter measures I at a point
- Connected in series
- Very low resistance (little effect on I)
- Polarities – right way round

Series Circuits

- Resistors connected end to end = series
- Resistors connected in series V is shared among resistors
- V = $V_1 + V_2 + V_3$
- Same I goes through all
- Total resistance is the sum of the individuals

Worked Example

A 2 Ω resistor is connected in series with an unknown resistor R and a battery supplying 28 V. The current in the circuit was measured at 4A. Calculate



a) *The value of R*

Total resistance = V/I = 28/4 = 7 Ω so R = 5 Ω

b) *The voltages across each of the two resistors*

$V_1 = IR_1 = 4 \times 2 = 8$ V $V_2 = IR_2 = 4 \times 5 = 20$ V

Disadvantages of Series Circuits

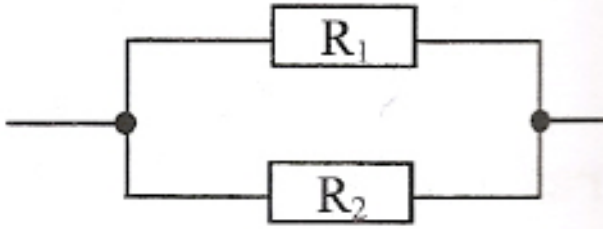
- Series circuits have two disadvantages when compared with parallel circuits.

- The first disadvantage is that, if one component in a series circuit fails, then all the components in the circuit fail because the circuit has been broken.

- The second disadvantage is that the more components there are in a series circuit, the greater the circuit's resistance.

Parallel Circuits

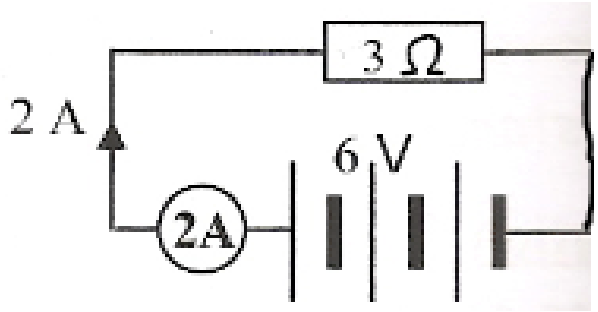
- In parallel means placing it by the side of another
- If R_1 is connected as



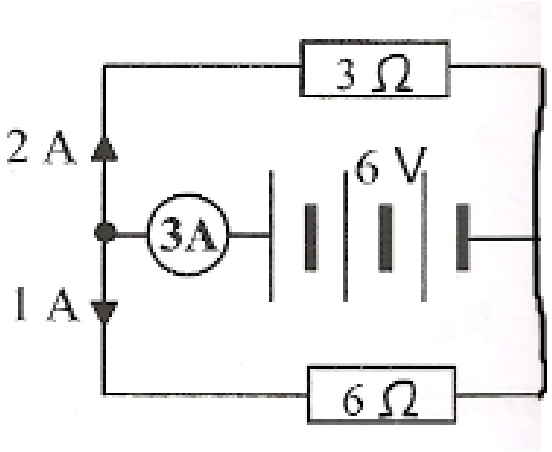
- Then amount of I flowing in the circuit increases
- Reason = R_2 allows I to flow in another pathway
- I is shared among resistors
- Same V across each
- Total resistance is less than

Parallel Circuits continued

- 3 ohmn resistor & 6 V cell
- I flowing = 6/3 = 2A

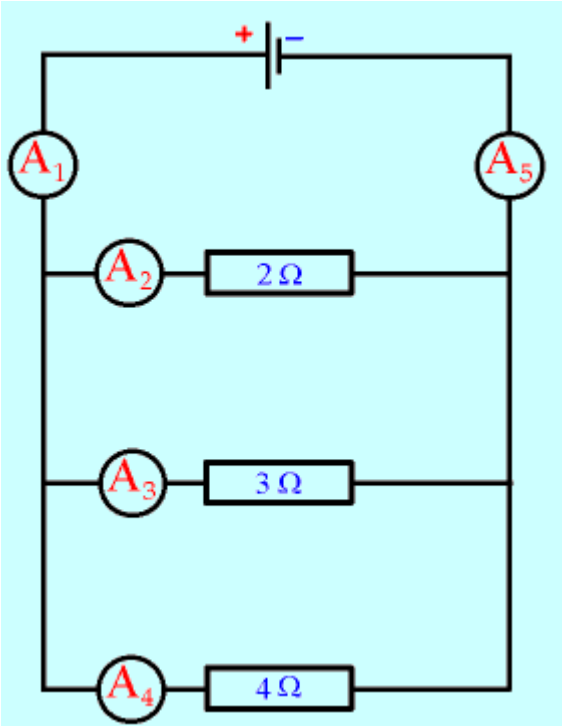


- Another resistor of 6 ohmns
- Forms separate circuit
- I = 6/6 = 1A
- Total I flowing from cell =2+1A
- Total R= V/I = 6/3 = 2 ohmns



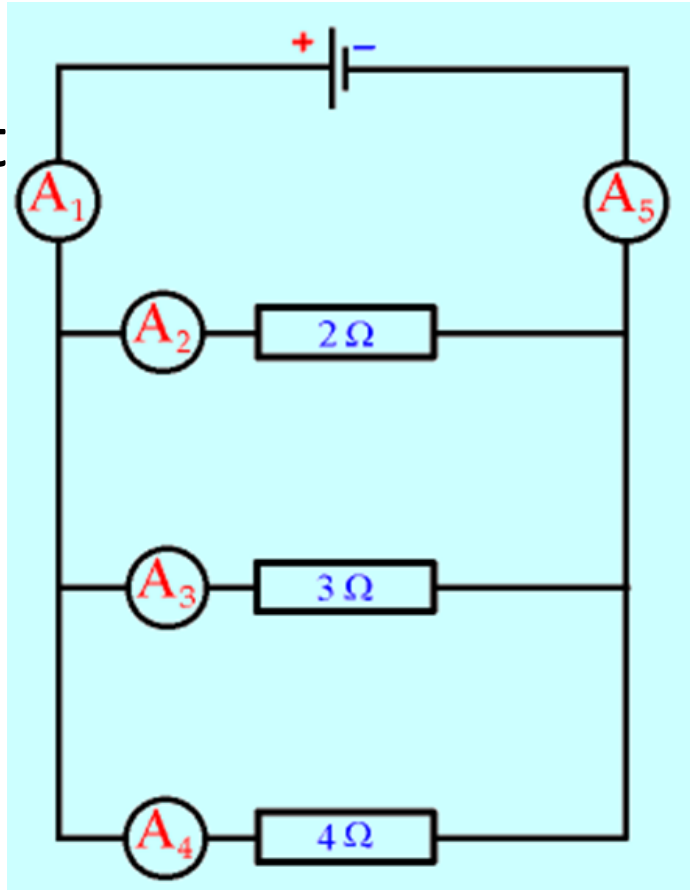
Rules for a Parallel Circuit.

- Current in a Parallel Circuit.
- The current in a parallel circuit depends on the resistance of the branch.
- The total current flowing in to the branches is equal to the total current flowing out of the branches.
- A1 = A5



Current in a Parallel Circuit.

- The current at A2 flowing through the 2 Ohm resistor can be found using V = I x R
- If the supply voltage is 12 Volt
- I = V / R
- = 12 / 2
- = 6 Amps.

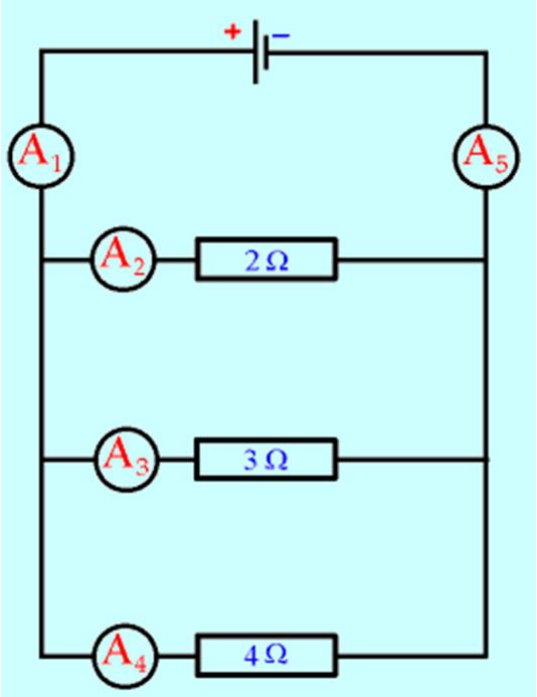


Parallel Notes

- For parallel circuits, each component behaves as if it is connected independently to the cell, and is unaware of the other components
- If an identical cell (battery) is placed in parallel with the original cell the current stays the same because the total voltage of the circuit is the same.
- The two cells together provide electricity for twice as long before they both run out.

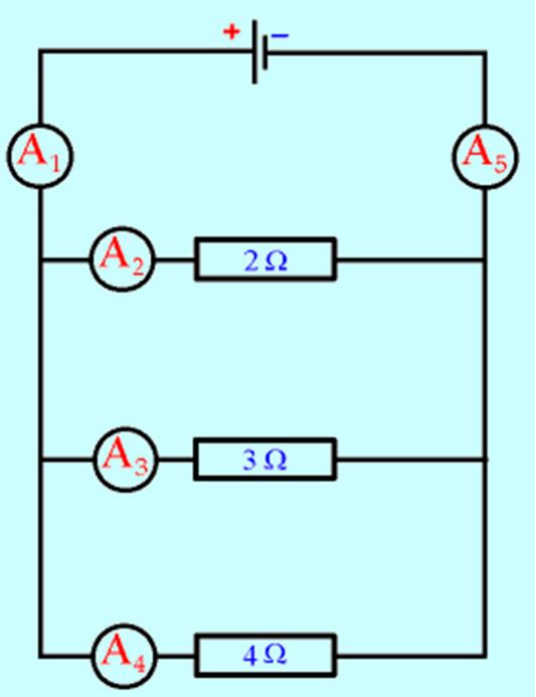
Current in a Parallel Circuit (continued).

- The current A2 flowing through the 2 Ohm resistor is 6 Amps.
- The current A3 flowing through the 3 Ohm resistor is
- I = V / R
- = 12 / 3
- = 4 Amps.
- The current A4 flowing through
- the 4 Ohm resistor is
- I = V / R = 12 / 4
- = 3 Amps.
- Notice that the bigger the resistance, the smaller the current.



Current in a Parallel Circuit (continued)

- The total current A1 or A5 is found by adding up the current in each branch.
- A1 = A2 + A3 + A4
- = 6 + 4 + 3
- = 13 Amps.

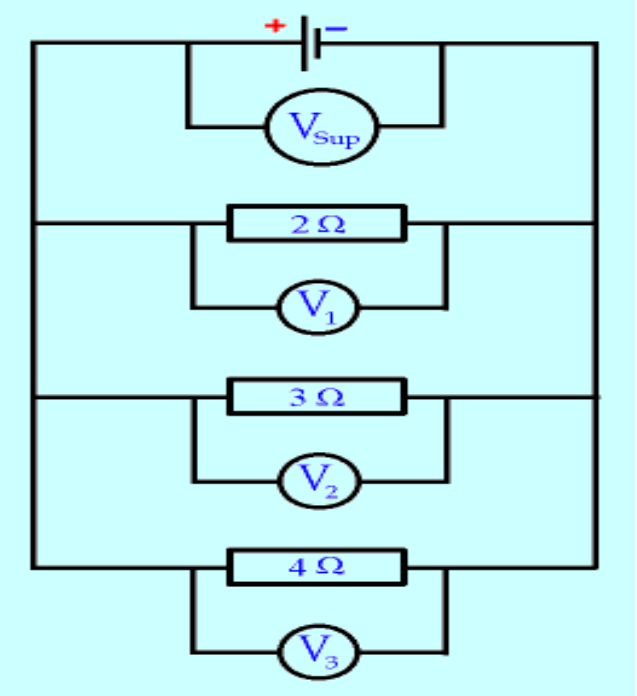


- This is much larger than the current of 1·333 Amps which flows through a series circuit with the same resistors and supply voltage

Voltage in a Parallel Circuit.

- The voltage in a parallel circuit is the same for all branches.
- V1 = V2 = V3.
- The voltage for each branch is the same as the supply voltage.

- V1 = V2 = V3= Vsup.



- If an identical cell (battery) is placed in parallel with the original cell the voltage stays the same.
- The two cells together provide electricity for twice as long before they run out.

Resistance in a Parallel Circuit.

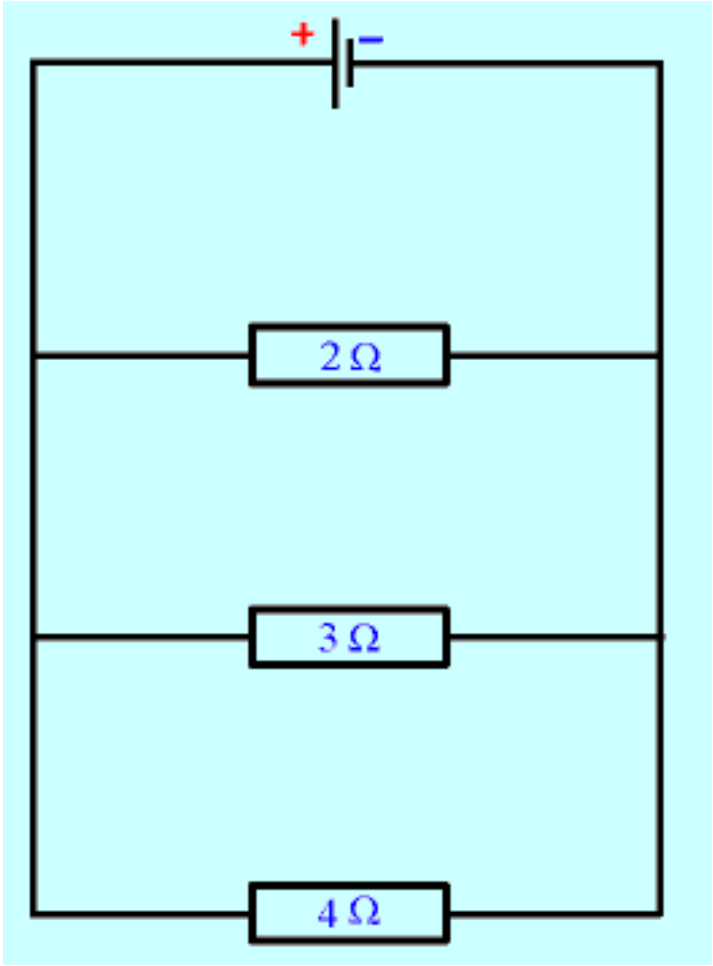
- The total resistance of a parallel circuit is calculated using the formula

- $1/R = 1/R1 + 1/R2 + 1/R3 \cdots$

Worked Example

- $1/R = 1/2 + 1/3 + 1/4$
- $= 6/12 + 4/12 + 3/12$
- $= 13/12$
-
- (You want R not 1/R so flip both
- Sides of the equal sign to give you R)

- $R = 12/13$
- $= 0{\cdot}92$ Ohms.



Parallel Resistance Notes

- Notice that this is a much smaller resistance than you get in the series circuit using the same resistors.

- It is even smaller than the smallest resistor in the parallel circuit, which is 2 Ohms.
- Putting more resistors in the parallel circuit decreases the total resistance because the electricity has additional branches to flow along and so the total current flowing increases.