

Lecture Two: Part I

Circuits: An Introduction

Homework

Sealy (the bed company) is having a problem. The problem is that people are so happy to get into their comfy Sealy beds that they jump on them. Jumping so high and because the beds are so springy they are flung off the bed onto the ground and sue the company.

To combat this problem Sealy wants to design a new bed that will keep the average adult (weighing between 55kg and 110kg) on their beds (but still provide the softest possible landing). Can you help choose the damping and spring constants for the bed assuming the bed is very thin (think trampoline like), it is 30cm off the ground and the average height (at it's peak) of someone's jump is 120 cm.

Charge

- Measured in Coulombs (C), **CHARGE** is a quantized source of physical force carried by electrons (-ve) and protons (+ve).
- One Coulomb is the amount of charge in 6.2×10^{18} charged particles.

Current

- Current measured in Amperes (A) is the flow of charge
- One coulomb of charge per second equals 1 A
- Generally Charge is very hard to measure so engineers tend to work with current

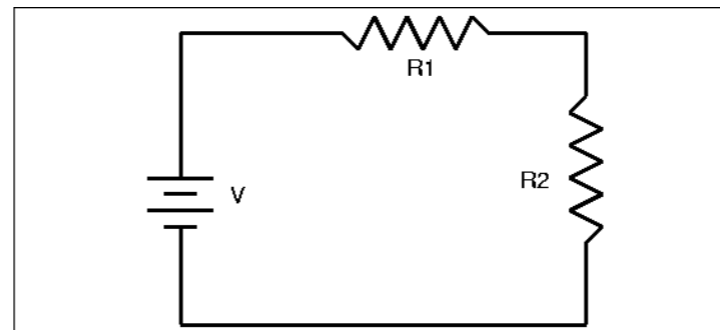
Electrical Resistance

Measured in Ohms (Ω), Electrical resistance is the amount to which the flow of charge (current) in circuit is impeded by a circuit element.

Total Resistance:

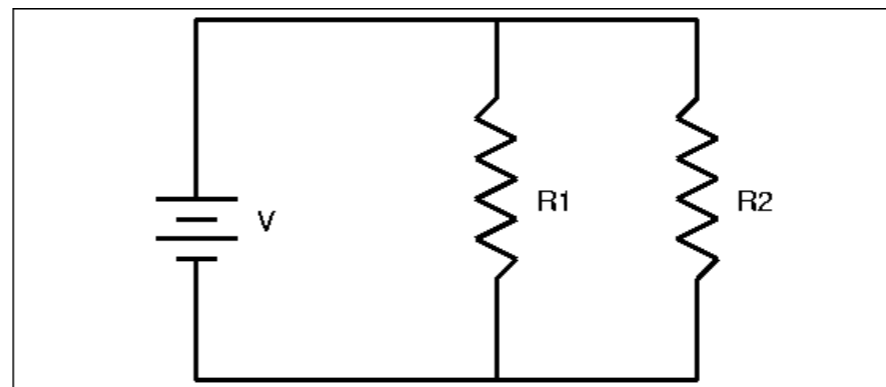
In Series: They Just Sum

$$R_t = R_1 + R_2$$



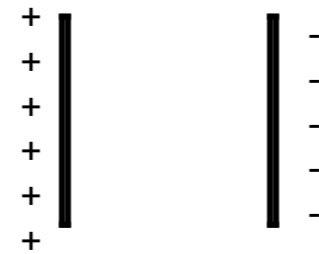
In Parallel: The inverse of the total equals the sum of the inverses.

$$1/R_t = 1/R_1 + 1/R_2$$



Voltage

Measured in Volts (V), voltage is the potential difference between two points in an electrical field.

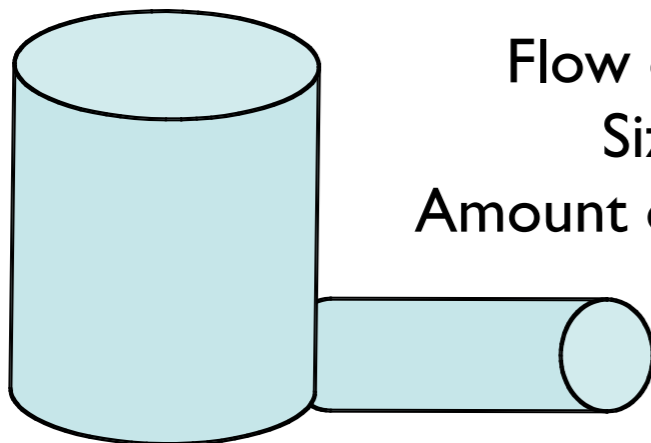


Analogy: Water flow

Flow of water in pipe ~ current

Size of pipe ~ resistance

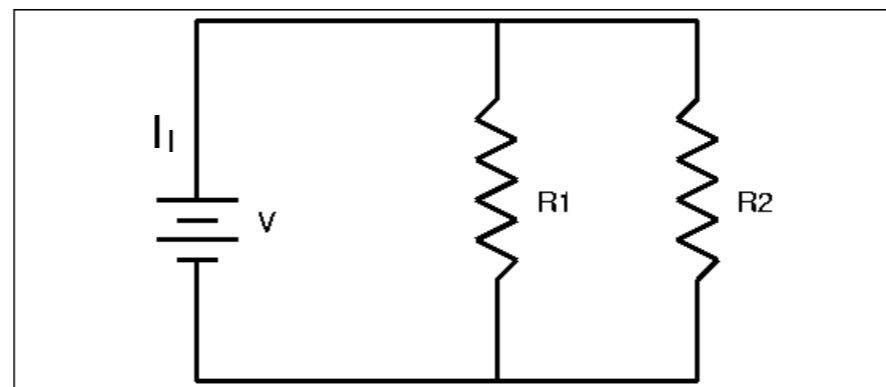
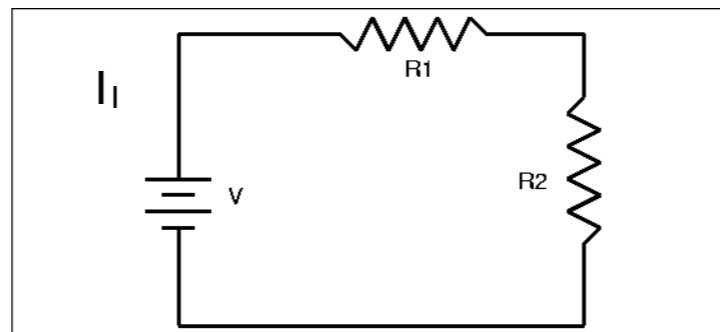
Amount of water in the tank ~ voltage



Relation Between V, I, and R

$$V = IR \text{ (Ohm's Law)}$$

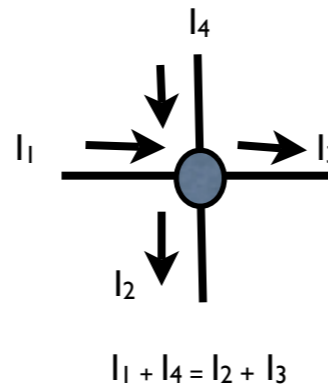
Exercise: Given $V = 3$, $R_1 = 2$ and $R_2 = 1$ Find I_1



Kirchoff's Laws

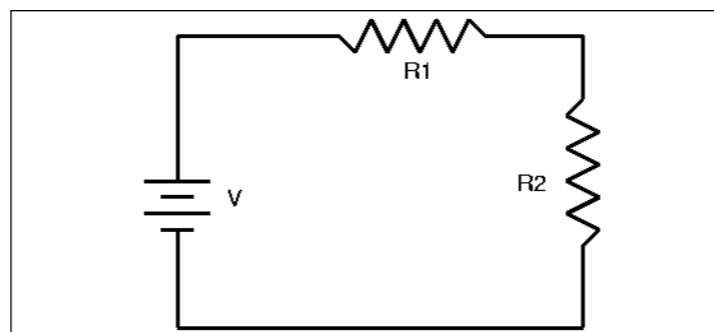
KCL : Kirchoff's Current Law

Sum of current into a node equals the sum out of a node

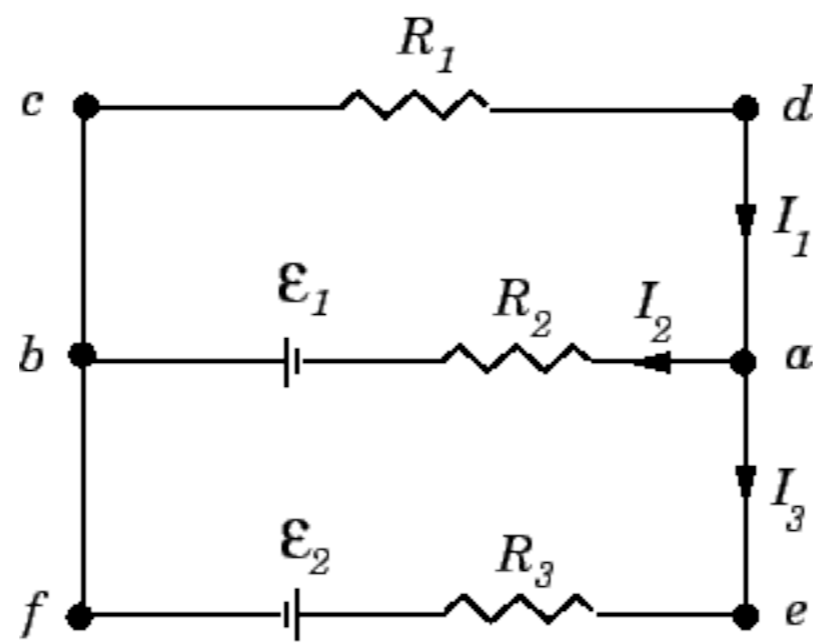


KVL : Kirchoff's Voltage Law

The Sum of the voltages in a loop is zero



Example



Homework

Make up (and solve) your own example circuit that minimally requires the solving of three equations and three unknowns.