DC circuits

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Electricity

chemical potential E
⇒ Electric E

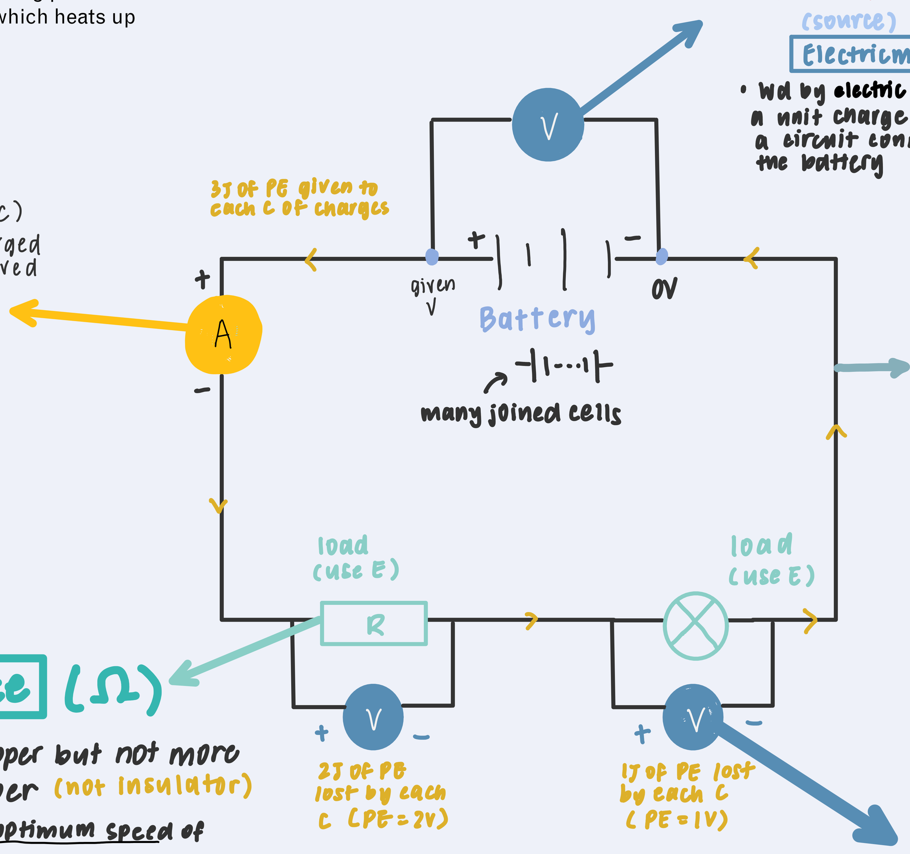
static E	current of electricity			power	
Q	I	V	R	P	E
charge	current	voltage	resistance	power	electricity
C	(A)	(V)	(Ω)	(W)	(J)

Symbols

- dry cell
- battery
- wire
- voltmeter
- Ammeter
- bulb
- resistor
- closed switch
- switch open

Circuits

Parts of a circuit



Ammeter

measure of electric current

___ C of charge flowing through every part of the circuit in 1s

0 resistance

(-) current = flow in opp direction

Charge moving produces "friction" which heats up

produces heating
Current: rate of flow of electric charge (e^-) — how much charge is moving

(current)
Brightness depends on power
$P = VI = \frac{V^2}{R} = I^2R$
highest voltage : highest current

$I = \frac{Q}{t}$ — (C) charged moved; current (A)

Voltmeter

DONT DRAW AT CORNER EG.

has ∞ resistance so current does not flow through

$(1JC^{-1})$ (energy given to e^- by battery)

(source) type of PD (JC^{-1})

Electromotive force

- wd by electric source in driving a unit charge (C) through a circuit connected to the battery

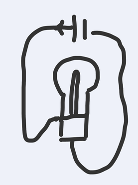
$V = \frac{W}{Q}$ — W: J; Q: C; V: Emf / pd (V)

resistance

Copper wire

e^- exists in wire due to delocalized electrons

charges moving produce "friction" which heat up...



bulb: another wire

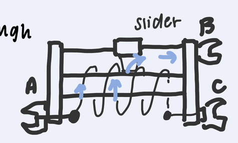
chemical → heat, light

Resistance (Ω)

- any metal but copper but not more reactive than copper (not insulator)
  - ↳ slows e^- to ensure optimum speed of current → too much current
- dependent on material properties and physical dimensions

1) length (long > short)
2) cross sec area (thin > thick)
3) material
4) temperature (temp ↑ res ↑)
   - particles move quicker
   - harder for (-) to pass through

(variable resistors)
Rheostats
- used to vary current



- vary strength

slide control

$R = \frac{\rho L}{A}$

$R = \frac{V}{I}$ — V: potential difference; I: current

$R = \frac{\rho l}{A}$ — ρ: resistivity; l: length; A: area

Potential difference $(V = JC^{-1})$

- wd to drive a unit charge through the component
- between 2 points
- can be used for bulbs

Pd across open switch = EMF

pd of closed switch = 0

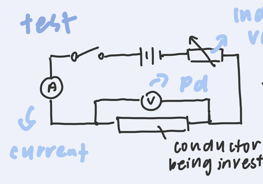
Potential

- At a single point in a circuit

Ohm's Law

current passing through a ~~metallic conductor~~ is directly proportional to the potential difference across it

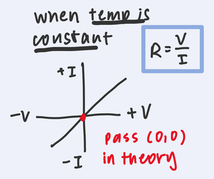
test



independent variable
- get 6 sets of values
- plot best fit line → find slope

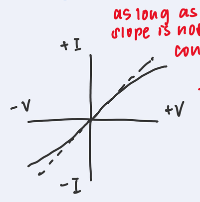
OBEY	DOES NOT OBEY
Ohmic conductor	non ohmic conductor

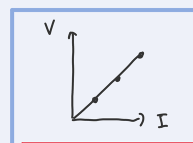
Ohmic conductor:
- constant res when temp is constant
- $R = \frac{V}{I}$



- only resistors

Non ohmic conductor: as long as slope is not a constant





$R \neq \text{slope} \neq \frac{\Delta V}{\Delta I}$

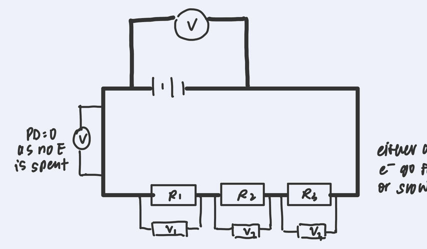
$R = \frac{V_a}{I_a} = \frac{V_b}{I_b} = \frac{V_c}{I_c}$

- NEVER ALLOWED TO LEAVE SWITCH ON
  ↳ fixed resistor

open: carry exp
close: take reading

Types of circuits

Series circuits



Characteristics
1) Only 1 path for current to flow
2) Components are connected 1 after another

▲ Current in a series circuit is always the same

① $R_{eff} = R_1 + R_2 + R_3$

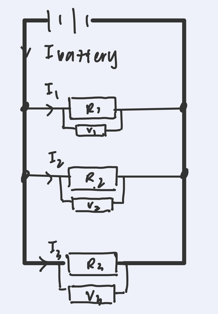
② $I_1 = I_2 = I_3$ → does not matter where ammeter is placed

1 path only → current (amt of charge per s is unchanged)

③ $V_1 + V_2 + V_3 = EMF$ shared

same current but dif res so can't be the same
split in proportion of resistivity

Parallel circuits



→ can argue that bulb is in parallel with power supply, as $P = \frac{V^2}{R}$ it has the highest power dissipated

Replace 3 guys with 1 guy

1) Components connected in multiple loops
2) several paths which electric current can flow through

↗ derived from $I = \frac{V}{R}$ and ③

① $R_{eff} = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)^{-1}$ → $R_{eff} < R_{min}$

② $I_{battery} = I_1 + I_2 + I_3$ — Sum of current of each branch is equal to current in main path (current splits)

③ $V_1 = V_2 = V_3 = EMF$ — $V = \frac{W}{Q}$ how much per charge

All spent
more resistors: run out of E faster

Pd across whole circuit is equal to the pd across each resistor

$I = \frac{V}{R}$
V is constant
↳ larger res → less current
smaller res → more current
the current "splits" depending on the resistance

Power

↳ Job done by appliance

Electrical power

$P = \frac{W}{t} = \frac{E}{t}$ rate at which E is transformed / changed

$P = VI = I^2R = \frac{V^2}{R}$ } usually for power lost

Power rating

for bulb, directly proportional to brightness

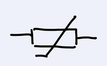
240V 2000W
give me 240V, I'll work at 2000W and give a brightness of

when optimal PD is used, bulb will dissipate E at the rate of ___ W and shine at "normal brightness"

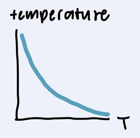
E bill in kWh
kilowatt / hr

Input trandncers

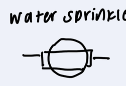
- R changes with physical changes



thermistor



T ↑ R ↓
more free e^- are produced so R ↓
water sprinkler



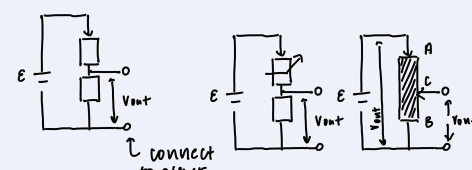
LDR

L ↑ R ↓
automatic light sensor

can be used with vr and pd

Potential Divider circuits

line of resistors connected in series used to provide a fraction of the voltage source to another part of the circuit

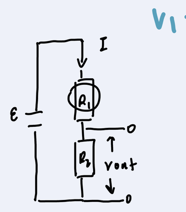


connect to other parts (wont show in qn)

C can adjust the resistance across ~~AB~~ for both sides

for series circuits,

$V_1 = \left(\frac{R_1}{R_1 + R_2}\right) emf$ — connected to voltmeter



$V_{out} = \left(\frac{R_2}{R_1 + R_2}\right) \times V_E$

During day
Light ↑ R ↓

During night
Light ↓ R ↑
V_{out} → turn on light