Isotopes

Isotope - An atom with the same number of protons but a different number of neutrons.

Radioisotope - An isotope that is radioactive and sometimes unstable. They
decay.

Formulas

W1= q ∆V1

(J)..(.c)..(v)

Power - rate of doing work

P= w/t (joules/seconds)

Power w/t = q∆v/t

P=i∆v

Unit of energy

w=pt

(joules) = Watt*Sec

New energy unit = kWh

Electrical Energy

1kWh ≡ 1000*3600

1kWh ≡ 3.6*10^6J

resistance

R_T → total resistance
I_T → total current
V_T → total voltage
P_T → total power

$$R_T = \frac{V_T}{I_T}$$

$$R_T = \frac{V_T^2}{P_T} \quad R_T = \frac{P_T}{I_T^2}$$

1/Rt = 1/R1 + 1/R2 + ...+1/Rn if in parallel.

Electrical energy and power

Electrical energy (Joules) = potential drop (volts) x current (amps) x times (seconds) E=VIt

P=E/t were one watt = 1 joule per second

E/t = VIT/t or P= VI

Power (watts) = voltage (volts) x current (amps)

P=VI

How much energy does a 100W light bulb use in half an hour?

P=100W and t=0.5h

So E=100W x 0.5h = 50Wh or 0.05kWh

To find power used Volts times Amps

Resistance

$$R = \frac{pL}{A}$$

p = resistivity of a material
L = length of the wire
A = cross sectional area of wire

Ohm's law: ∆V=iR or V=Amps*Ohms

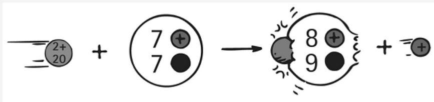
A charge q moving through a potential difference ∆V will lose potential energy: ∆U=qV

Electric field

The electric field in any region of space is defined as the electric force per unit charge: E = F/q

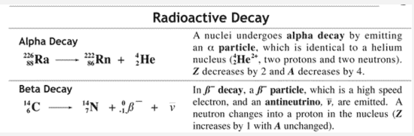
the force on a charge of q in an electric field is given by F= qE

Neutron Bombardment



$${}^4_2He + {}^{14}_7N \rightarrow {}^{17}_8O + {}^1_1H$$

Decay



Radioactive Decay

Alpha Decay $^{226}_{88}Ra \longrightarrow ^{222}_{86}Rn + ^{4}_{2}He$	A nuclei undergoes **alpha decay** by emitting an α **particle**, which is identical to a helium nucleus ($^{4}_{2}He^{2+}$, two protons and two neutrons). *Z* decreases by 2 and *A* decreases by 4.
Beta Decay $^{14}_{6}C \longrightarrow ^{14}_{7}N + ^{0}_{-1}\beta^{-} + \bar{\nu}$	In β^- **decay**, a β^- **particle**, which is a high speed electron, and an **antineutrino**, $\bar{\nu}$, are emitted. A neutron changes into a proton in the nucleus (*Z* increases by 1 with *A* unchanged).

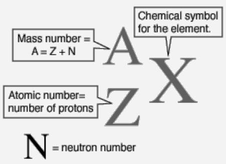
Radiaiton

Alpha radiation - Helium nucleus (2 protons and 2 neutrons), highly ionising, charge of 2+, heavy.
Beta radiation - fast moving electron, negatively charged electron, not as high ionising capabilities, charge of -1.
Gamma radiation - electromagnetic radiation, less ionising then alpha or beta.
Detecting radiation - Geiger-Muller tube counts ions that are produced inside it, these create an electrical signal.
Radiation in the body - Ionising radiation can damage or kill the cells, dna can replicate in the damaged form, cancers can form.

Ionising Radiation

Ionising means that the radiation rips off electrons from nearby atoms that it passes.
Three types of radiation: Alpha, Beta and Gamma
Alpha passes through paper.
Beta passes through thin metal.
Gamma passes through thick metal.
Alpha radiation is most ionising, so it loses it's energy very quickly.

Atomic Notation



Half life

Half-life - the time taken for the radioactivity of a specified isotope to fall to half its original value.

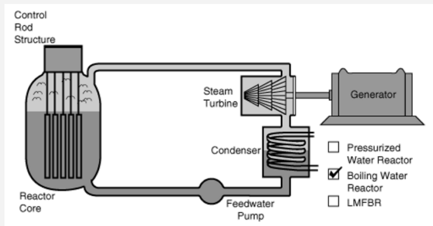
Nuclear fission/fusion

Fission- When a nucleus splits into two or more pieces usually after bombardment by neutrons.
Fusion- A process taking place inside stars in which small nuclei are forced together to make larger nuclei. Energy is released in the process.
Chain reaction - A series of nuclear fissions that may or may not be controlled. The neutrons that are released cause the reaction.

Nuclear Fission Reactors

Used to harness energy from Fission reactions.
Neutrons released from Uranium-235 when it undergoes fission are travelling at high speeds, this leads to a chain reaction which causes an explosion.
The heat generated from the fission process is used to make steam which drives the turbine.
Fuel rods- long, thin rods containing pellets of enriched uranium
moderator- material that slows neutrons.
control rods- rods made of a material that absorbs neutrons
coolant- a liquid or gas to absorb the heat energy

Nuclear Reactor



Electric charge

Conductors: All metals, especially silver, gold, copper aluminium and any ionic solution.
Moderate conductors: Water and earth.
Semi-conductors: Silicon, Germanium and skin.
Insulators: Plastics, polystyrene, dry air, glass, porcelain, cloth (dry)
Moderate insulators: wood, paper, damp air, ice and snow.

Electrical forces and fields

$$F = \frac{kq_1q_2}{r^2}$$

For the forces between two charges q1 and q2 at a distance of r
k= 9.0 x 10^9 N m^2 x C^2

Electric Current

Electric current is the rate of transfer of charge: I=q/t
where q is the charge transferred and t is the time taken.
1 ampere (A) = 1 coulomb per second (C*s^{-1})
So 1 coulomb (C) = 1 ampere second (A*s)
1 volt = 1 joule per coulomb (1V = 1JC^{-1})
1 ohm = 1 volt per ampere (1ohm = 1VA^{-1})

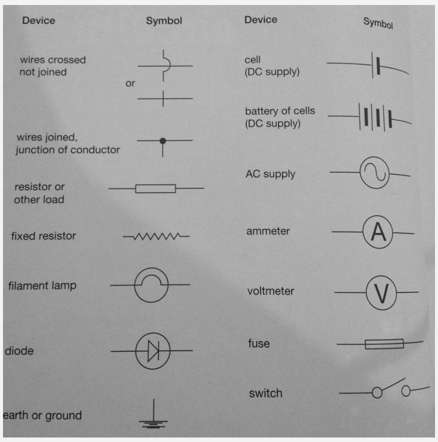
Resistance

∆VBattery=i Rtotal
∆vBattery=∆V1+∆V2
Therefore i*Rtotal = ∆V1+ ∆V2=iR1+iR2
Rtotal = R1 + R2
R= V/I or V = IR

Electric Circuits

In any electric circuit the sum of all currents flowing into any point is equal to the sum flowing out of it.
The total potential drop around a closed circuit must be equal to the total EMF (electromotive force, the energy provided by the cell)

Symbols and devices



Formulas

Two loops
Junction law
Current in = current out
at(a) itotal = i1 +i2
Parallel arrangement
∆V1= ∆V2
iTotal = ∆VBattery/Rtotal
iTotal = i1 +i2
∆VBattery/Rtotal=∆V1/R1+∆V2/R2
1/Rtotal = 1/R1 + 1/R2
Rtotal = (1/R1 +1/R2)
R1=R2 =10Ohms
1/Rt = 1/10 + 1/10
= 2/10 = 1/5
RT= 5 ohms
Voltage loop law
One loop
∆Vbattery = ∆1+∆2
Voltage drop of battery must equal
Sum of voltage drops around one loop.