Atomic Physics

Alpha: $X \rightarrow {}^{4}_{2}\alpha + Y$ Stopped by skin

Beta: $X \rightarrow {}^{0}_{-1}\beta + Y$ Stopped by Al Foil

Gamma: $X \rightarrow {}^{0}_{0}\gamma + Y$ Stopped by Lead

1 Bq = 1 Disintegration per second.

Absorbed Dose= $\frac{energy(J)}{Mass(kg)}$ measured in Grays(gy)

Dose Equivlent = Gy x Quality factor
Measured in sieverts (sv)

Alpha Particles	20
Neutrons	10
Beta Particles	1
Gamma Rays	1
X rays	1

Effective dose(sv) = dose Equivalent x Weighting

Ovaries/Testes	0.2
Bone Marrow	0.12
Colon	0.12
Lung	0.12
Stomach	0.12
Bladder	0.05
Breast	0.05
Liver	0.05
Oesophagus	0.05
Thyroid	0.05
Rest of body	0.07
Total	1

Genetic Effects when sex cells are damaged

Somantic Effects any cells in the body are damaged (not sex cells)

Whole body dose (Sv)	Symptom
<1	Non fatal, only minor symptoms such as nausea white blood cell level drops
2	Death unlikely, radiation sickness ie nausea vomiting and diarrhoea, skin rashes, hair loss and bone marrow damage
4	50% chance of death in two months, severe radiation sickness, high chance of leukaemis and tumors
8	Almost certain death within 1-2 Acute Radiation sickness – convulsions, lethargy

Mass	Charge	Typical Energy	Range (air)	Penertration	Ionisation
Heavy 4	Plus 2	~5 MeV	cm	little	very
Light e	Minus 1	~1 MeV	1-2 metre	more	some
none	none	~0.1MeV	Many m	most	none

Joules and Electron volts

1 Ev = 1.6×10^{-19} J 1 J = $\frac{1}{1.6\times10^{-19}}$ ev

E = MC squared

$E(joules) = m(kg) \times (3.0\times10^{8})^{2}$ e = m x speed of light squared

Tokamak doughnut shape magnetic field to contain super hot plasma. The heat is taken from the reactor by lithium and water

Inertial confinement Pallet of fusion fuel is struck by high intensity lase creating the high temperatures required for fusion.

H/He fusion in the sun

$${}^{1}_{1}H + {}^{1}_{1}H \rightarrow {}^{2}_{1}H + {}^{0}_{+1}e + {}^{0}_{0}v$$

$${}^{1}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}He + {}^{0}_{0}gamma$$

$${}^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + {}^{1}_{1}H + {}^{1}_{1}H$$

H/He fusion in reactors

$${}^{1}_{1}H + {}^{1}_{1}H \rightarrow {}^{3}_{2}He + {}^{1}_{0}n$$

$${}^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{1}H + {}^{1}_{1}H$$

$${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$$

Electricity

Charge physical property of matter (positive or neg)
Coloumb is one mole of fundamental charges

Energy ability to do work
Joule work done by a force of one newton when its point of application moves one meter.

Power energy being moved/used/transformed over time
Watt measurement of power in Joules per second

P = VI $P=I^2$ $P=\frac{V^2}{R}$

Ampere = Charge transfer/second
Volt = 1 Coloumb given 1 Joule of energy
Resistance = one volt/one amp
Siemens/mhos/conductance = 1/Resistance

Ampere hours measure of capacity of charge (can supply a certain amount of Coloumbs for an hour)

Batteries in series double voltage, same capacity
Batteries in parallel same voltage, double capacity

Earth Leakage/RCD Detects a difference between the amount of current between the active and neutral wires, most likely caused by leakage into the earth.

Safety in Electricity Factors in fatality

- current is the main killer. Voltage is indirectly related through ohms law
- Duration
- Pathway (through heart)
- Voltage (if over 600V)

Causality

- Voltage is the cause of current
- Current can affect resistance in a non-ohmic conductor
- and otherwise resistance affects current in an ohmic conductor.

Force between charges

$$F=\frac{9.0\times10^{9}\,Mn^{2}C^{-2}\times q_1\times q_2}{r^{2}}$$

r is in metres, q are point charges
Force on charge q in field E
F = qE
Force in Newtons, q in Coloumbs E in N/C

Charge on an electron 1.6×10^{-19}
Electrons in a coloumb 6.2×10^{18}
Terminal voltage = EMF – I x internal resistance
Watt-hour = 3600 J
Kilowatt-hour = 3 600 000 MJ

Kirchoff's laws
The total potential drop around a closed circuit must be equal to the total EMF in the circuit.

In any electric circuit the sum of all currents flowing into any point is equal to the sum of the currents flowing out of it .

Multiple cells or batteries in a circuit then just add or subtract the voltages given the orientation.

Circuit diagrams

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Wire colours
Active: Brown/Red Neutral: Blue/Black
Earth: Green and yellow/Green

Resistor colours
First two bands are numbers, third is a multiplier with 10^(colour number). Forth indicates tolerance (gold 5% silver 10%)

Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

Prefixes

Giga (G)	10^9	1 000 000 000	Billion
Mega (M)	10^6	1 000 000	Million
Kilo (k)	10^3	1 000	Thousand
Hecto (h)	10^2	100	Hundred
Deca (da)	10^1	10	Ten
		1	One
Deci (d)	10^-1	0.1	Tenth
Cent (c)	10^-2	0.01	Hundredth
Milli (m)	10^-3	0.001 .	thousandth
Micro (μ)	10^-6	0.000 001	Millionth
Nano (n)	10^-9	0.000 000 001	Billionth
Pico (p)	10^-12	0.000 000 000 001	Trillionth

RMS or root mean square is basically average. Of a sin wave it is amplitude divided by square root of 2

Peak to Peak is the difference between peak and trough ie in a sine with 1 amplitude peak to peak is 2

Voltage Divider $\frac{R_2\times Vin}{R_1+R_2}=Vout$ where R2 is the resistor between the two **V***out* wires