Particles

1 Constituents of the atom

Specific charge - The charge to mass ratio
Isotope - An atom with the same number of protons as an element but a different number of neutrons

2 Stable and unstable nuclei

2.1 The strong nuclear force

$0fm - 0.5fm$ - **Repulsion**
$0.5fm - 3fm$ - **Attraction**
$3fm+$ - **No force**

2.2 Alpha decay

An atom emits an alpha particle (Helium Nucleus/2 protons and 2 neutrons)
Reduces *Mass Number* by **4** and *proton number* by **2**

2.3 Beta decay

Neutron→Proton+Electron+Neutrino
The neutrino was hypothesised to conserve energy

3 Particles, antiparticles and photons

For every particle there is a corresponding antiparticle (can be itself)

Property	**Particle**	**Antiparticle**
Mass	x	x
Charge	x	-x
Rest Energy	x	x
Baryon Number	x	-x
Lepton Number	x	-x
Strangeness	x	-x

When a particle and antiparticle collide they annihilate each other
A particle-antiparticle pair can be produced from energy

4 Particle interactions

Fundamental interactions:

Force	**Affects**	**Gauge Boson**	**Range**
Gravitational	Mass	Graviton	Infinite
Electromagnetic	Charge	Photon	Infinite
Nuclear Strong	Quarks	Gluon(Pion)	10^{-15}m
Nuclear Weak	Leptons+Quarks	W^+, W^-, Z^0	10^{-18}m

The exchange particles provide the forces between elementary particles
Virtual photons are the exchange particle of the electromagnetic force
Examples of the weak interaction:

- β^+ Decay
- β^- Decay
- Electron capture
- Electron-proton collisions

5 Classification of particles

5.1 Hadrons

Hadrons are subject to the strong interaction
There are two types of hadrons:

- Baryon(3 Quarks)
- Meson (Quark-Antiquark pair)

The baryon number is conserved in an interaction
All baryons will eventually decay into protons
Kaons can decay into pions

5.2 Leptons

Types of lepton(All have a lepton number of 1):

- Electron
- Muon
- Electron Neutrino (Approximated to massless)
- Muon Neutrino (Approximated to massless)

Lepton number is conserved during an interaction
Muons decay into electrons

5.3 Strange particles

Produced through the strong interaction
Decay through the weak interaction

6 Quarks and antiquarks

6.1 Baryons

Proton	UUD
Neutron	DUD

6.2 Mesons

6.2.1 Pions(All 0 Strangeness)

π^0	$U\bar{U}$ or $D\bar{D}$
π^+	$U\bar{D}$
π^-	$D\bar{U}$

6.2.2 Kaons (All strange)

K^+	$U\bar{S}$
K^-	$\bar{U}S$
K^0	$D\bar{S}$
$\bar{K^0}$	$\bar{D}S$