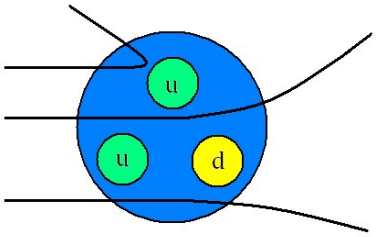
Quarks

Rutherford

Rutherford fired a beam of alpha particles at a thin gold foil. If the atom had no inner structure the alpha particles would only be deflected by very small angles. Some of the alpha particles were scattered at large angles by the nuclei of the atoms. From this Rutherford deduced that the atom was mostly empty space with the majority of the mass situated in the centre. Atoms were made from smaller particles.

Smaller Scattering

In 1968 Physicists conducted a similar experiment to Rutherford's but they fired a beam of high energy electrons at nucleons (protons and neutrons). The results they obtained were very similar to Rutherford's; some of the electrons were deflected by large angles. If the nucleons had no inner structure the electrons would only be deflected by small angles. These results showed that protons and neutrons were made of three smaller particles, each with a fractional charge.



Quarks

These smaller particles were named quarks and are thought to be fundamental particles (not made of anything smaller). There are six different quarks and each one has its own antiparticle.
We need to know about the three below as we will be looking at how larger particles are made from different combinations of quarks and antiquarks.

Quark	Charge (Q)	Baryon Number (B)	Strangeness (S)
d	-⅓	+⅓	0
u	+⅔	+⅓	0
s	-⅓	+⅓	-1

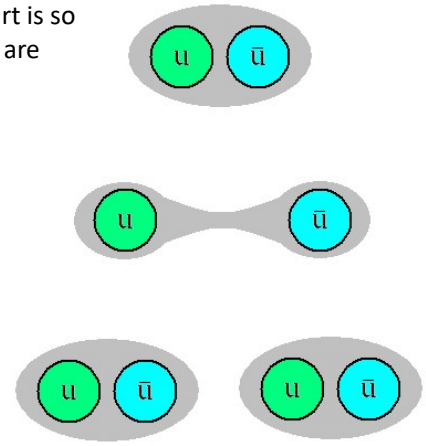
Anti Quark	Charge (Q)	Baryon Number (B)	Strangeness (S)
$\bar{d}$	+⅓	-⅓	0
$\bar{u}$	-⅔	-⅓	0
$\bar{s}$	+⅓	-⅓	+1

The other three are Charm, Bottom and Top. You will not be asked about these three

Quark	Charge	Baryon No.	Strangeness	Charmness	Bottomness	Topness
d	-⅓	+⅓	0	0	0	0
u	+⅔	+⅓	0	0	0	0
s	-⅓	+⅓	-1	0	0	0
c	+⅔	+⅓	0	+1	0	0
b	-⅓	+⅓	0	0	-1	0
t	+⅔	+⅓	0	0	0	+1

Quark pairs

Quarks never appear on their own. The energy required to pull two quarks apart is so massive that it is enough to make two new particles. A quark and an antiquark are created, an example of pair production.
A particle called a neutral pion is made from an up quark and an antiup quark. Moving these apart creates another up quark and an antiup quark. We now have two pairs of quarks.
Trying to separate two quarks made two more quarks.



Particle Classification

Now that we know that quarks are the smallest building blocks we can separate all other particles into two groups, those made from quarks and those that aren't made from quarks.
Hadrons – Heavy and made from smaller particles
Leptons – Light and not divisible into smaller particles