

A-Level Physics

Name: _____ Score: _____

1. Most α -particles passing straight through the gold foil showed that the atom is:

- ☐ entirely negative
- ☐ mostly empty space
- ☐ made only of nuclei
- ☐ a solid ball of charge

2. An α -particle is:

- ☐ a helium nucleus (2 protons + 2 neutrons)
- ☐ a single proton
- ☐ a fast electron
- ☐ a high-energy photon

3. What is the charge on an up quark?

- ☐ $+\frac{2}{3}e$
- ☐ 0
- ☐ $+1e$
- ☐ $-\frac{1}{3}e$

4. Almost all of an atom's mass is in its nucleus.

- ☐ True ☐ False

5. Of the three, α radiation is the most strongly ionising.

- ☐ True ☐ False

6. A proton is made of which quarks?

- ☐ u u u
- ☐ d d d
- ☐ u u d
- ☐ u d d

7. Protons and neutrons together are called _____.

8. The positron is the _____ of the electron.

9. A neutron is u d d. What is its total charge, in units of e ?

10. How many neutrons are in ${}^1_6\text{C}$?

A-Level Physics

1. **mostly empty space**

If most go straight through, there is little in the way – the atom is mostly empty, with the mass and charge concentrated in a tiny nucleus.

2. **a helium nucleus (2 protons + 2 neutrons)**

An α -particle is ${}^4_2\alpha$ – a helium-4 nucleus with charge $+2e$.

3. $+\frac{2}{3}e$

Up-type quarks (up, charm, top) carry $+\frac{2}{3}e$; down-type (down, strange, bottom) carry $-\frac{1}{3}e$.

4. **True**

Protons and neutrons are ~ 1 u each; electrons are $\sim 1/1836$ u, so the nucleus holds nearly all the mass.

5. **True**

Yes – α is the strongest ioniser (and so the least penetrating); γ is the weakest ioniser (and most penetrating).

6. **u u d**

Proton = u u d, giving charge $\frac{2}{3} + \frac{2}{3} - \frac{1}{3} = +1$.

7. **nucleons**

The nucleon number A counts the protons plus neutrons in the nucleus.

8. **antiparticle**

An antiparticle has the same mass but opposite charge – the positron is $+e$ to the electron's $-e$.

9. **0**

$\frac{2}{3} - \frac{1}{3} - \frac{1}{3} = 0$ – the neutron is uncharged.

10. **8**

$N = A - Z = 14 - 6 = 8$ neutrons.