# 5. Nuclear physics

**Starter Quiz · 课前小测**

IGCSE Physics Name: _____ Score: _____

1. Where is almost all of an atom's mass?

   ☐ in the empty space

   ☐ in the electrons

   ☐ spread evenly through the atom

   ☐ in the tiny central nucleus

2. Nuclear fission is when:

   ☐ two light nuclei join together, releasing energy

   ☐ a heavy nucleus splits into two smaller nuclei, releasing neutrons and energy

   ☐ a nucleus gives out a gamma ray and nothing else

   ☐ an atom gains an electron and becomes an ion

3. Radioactive decay is spontaneous and random. This means:

   ☐ it only happens in a laboratory

   ☐ you cannot predict when a particular nucleus will decay, or speed it up

   ☐ every nucleus decays at the same instant

   ☐ it can be sped up by heating

4. The half-life of a radioactive isotope is the time taken for:

   ☐ the sample to double

   ☐ half the unstable nuclei in a sample to decay

   ☐ the radiation to travel 1 metre

   ☐ all the nuclei to decay

5. An atom that loses an electron becomes a positive ion.

   ☐ True ☐ False

6. Nuclear fusion is when:

   ☐ two light nuclei join to make a heavier one, releasing energy

   ☐ a neutron turns into a proton and an electron

   ☐ electrons jump between orbits, giving out light

   ☐ a heavy nucleus splits into two smaller ones

7. A source reads 250 counts/min. The background is 30 counts/min. What is the corrected count rate, in counts/min?

   _____ counts/min

8. A source reads 800 counts/min and has a half-life of 3 hours. What is the count rate after 6 hours, in counts/min?

   _____ counts/min

9. How many neutrons are in a nucleus of ${}^{14}_{6}\mathrm{C}$?

   _____

10. In ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{141}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + x\,{}^{1}_{0}\mathrm{n}$, how many neutrons $x$ are released?

    _____

# 5. Nuclear physics

**Answers · 答案**

IGCSE Physics

1. **in the tiny central nucleus**

   Almost all the mass is concentrated in the tiny, dense nucleus; the rest of the atom is mostly empty space.

2. **a heavy nucleus splits into two smaller nuclei, releasing neutrons and energy**

   Fission = splitting a heavy nucleus (after it absorbs a neutron) into two smaller nuclei, plus 2–3 neutrons and energy.

3. **you cannot predict when a particular nucleus will decay, or speed it up**

   Spontaneous = not triggered and not controllable; random = you cannot say which nucleus decays next or exactly when.

4. **half the unstable nuclei in a sample to decay**

   Each half-life, half of the remaining unstable nuclei decay, so the count rate halves.

5. **True**

   Losing a negative electron leaves the atom with more positive charge – a positive ion.

6. **two light nuclei join to make a heavier one, releasing energy**

   Fusion = joining two light nuclei into a heavier one, releasing energy. It powers the Sun.

7. **220 counts/min**

   Corrected = measured − background = $250 - 30 = 220$ counts/min.

8. **200 counts/min**

   6 hours is two half-lives: $800 \to 400 \to 200$ counts/min.

9. **8**

   Neutrons = $A - Z = 14 - 6 = 8$.

10. **3**

    Nucleon numbers must balance: $235 + 1 = 141 + 92 + x$, so $236 = 233 + x$ and $x = 3$.