

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

- ☐ in the tiny central nucleus
- ☐ spread evenly through the atom
- ☐ in the electrons
- ☐ in the empty space

2. Nuclear fission is when:

- ☐ a heavy nucleus splits into two smaller nuclei, releasing neutrons and energy
- ☐ two light nuclei join together
- ☐ an atom gains an electron
- ☐ a nucleus gives out a gamma ray only

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

- ☐ you cannot predict when a particular nucleus will decay, or speed it up
- ☐ it can be sped up by heating
- ☐ every nucleus decays at the same instant
- ☐ it only happens in a laboratory

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

- ☐ half the unstable nuclei in a sample to decay
- ☐ all the nuclei to decay
- ☐ the sample to double
- ☐ the radiation to travel 1 metre

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 heavy nucleus splits
- ☐ a neutron turns into a proton
- ☐ electrons jump between orbits

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. What fraction of the unstable nuclei remain after 3 half-lives? (Give a decimal.)

10. In ${}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow {}_{56}^{141}\text{Ba} + {}_{36}^{92}\text{Kr} + x {}_0^1\text{n}$, how many neutrons x are released?

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: $800 \rightarrow 400 \rightarrow 200$ counts/min.

9. 0.125

Each half-life halves the number: $\left(\frac{1}{2}\right)^3 = \frac{1}{8} = 0.125$.

10. 3

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