

**Science: GCSE Atomic Structure and Radiation**

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| 1. Structure of the atom | | | | | |
|  | **Key word** | | **Definition** | | |
| 1 | Atom | | The smallest possible piece of an element. Has a radius of 0.1nm (or 1x10-10m) | | |
| 2 | Nucleus | | The centre of an atom. Contains protons and neutrons | | |
| 3 | Proton | | A positively charged particle found in the nucleus | | |
| 4 | Neutron | | A neutral particle found in the nucleus. Has no charge | | |
| 5 | Electron | | A negatively charged particle found in energy levels (shells) around the nucleus | | |
| **Sub-atomic particle** | | **Relative atomic mass** | | **Charge** | 5  2  3  4 |
| Proton | | 1 | | +1 |
| Neutron | | 1 | | 0 |
| Electron | | ~0 | | -1 |

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| 1. Key Words | |
| Atomic number | Number of protons in the nucleus of an atom |
| Atomic mass | Total number of protons **and** neutrons in the nucleus of an atom |
| Isotope | Different forms of the same element with the same number of protons, but different numbers of neutrons |

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| 1. Discovery of the Atomic Model | | |
|  | Model | Discovery |
| 1 | Solid sphere | Dalton stated that the atom was the smallest particle and it could not be broken up further |
| 2 | Plum Pudding  Discovery of the electron | JJ Thompson stated that the atom was a cloud of positive charge with negatively charged electrons randomly dotted around the cloud. |
| 3 | Nuclear model  Discovery of a positively charged nucleus | Rutherford conducted experiments with gold foil that proved that the atom contained a positively charged nucleus with the electrons randomly around the outside of the nucleus |
| 4 | Planetary Model (Bohr)  Discovery that electrons orbit the nucleus on energy levels called ‘shells’ | Bohr stated that electrons orbited around the nucleus like planets around the sun and that there were different numbers of shells in different elements |
| 5 | Quantum Model  Discovered that electrons are found in clouds of probability called orbitals | Schrodinger stated that electrons do not orbit the nucleus but move around in waves and it is impossible to know the exact location of an electron. |
| 6 | Modern Atomic Model  Discovery of the neutron | Chadwick discovered the neutron in the nucleus which helped to explain the atomic mass of an atom. |
| 1 2 3 4 5 6 | | |

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| Challenge Questions | |
| 1 | What needs to be taken before the count rate can be measured? |
| 2 | What safety precautions should a teacher take when demonstrating radioactive sources to the class? |
| 3 | Explain why isotopes of large elements are generally radioactive. |
| 4 | Explain why a radioactive source with a short half-life is used as tracers in the body? |



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| 1. Radiactivity Key Words | |
| Background radiation | Radiation that is found in the environment such as from rocks, cosmic rays and fallout from nuclear weapons testing |
| Becquerel (Bq) | Units for measuring the radioactivity of a source |
| Count rate | The speed at which a radioactive source decays (gives out radiation) |
| Unstable atom | An atom that a very large nucleus with a high neutron to proton ration meaning that radiation is emitted from the nucleus |
| Geiger counter | Instrument used to measure radioactivity of a substance |

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| 1. Types of Radiation | | | | |
| Type of radiation | Symbol | Structure and charge | Range and penetration | Ionising power |
| Alpha | α | 2 protons and 2 neutrons from the nucleus  Charge = +2 | Travels up to 5cm in air, blocked by paper and skin | High |
| Beta | β | Fast moving electron from the nucleus  Charge = -1 | Most travel up to 15cm in air, blocked by a thin sheet of aluminium | Medium |
| Gamma | γ | High energy wave  Charge = 0 | Can travel at the speed of light so can travel vast distances. Stopped by 1m thick concrete or thick lead plates | Low |

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| 1. Half-Life | |
| The half-life of a radioactive source is the time it takes for the count rate to decrease by half. | |
|  | 1. The starting count rate is 300, so half of that is 150. 2. You find 150 on the y-axis and read across to the line. 3. Then read down from the line to calculate the time.     So for this graph, the half-life is 15 days.  This means that every 15 days the count rate will decrease by half.  In 60 days the count rate will be 18.75Bq |

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| 1. Half-life Equations (HT) | |
| Alpha decay | When an alpha particle is emitted from the nucleus 2 protons and 2 neutrons are given out. This means the atomic number will decrease by 2 and the atomic mass will decrease by 4. |
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| beta decay | When a beta particle is emitted from an atom, 1 neutron changes into a proton. This means the atomic number will increase by 1 and the atomic mass will stay the same. |
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