SP6: **Radioactivity** (Paper 1)

Lesson	Objectives Tracker Sheet	Date covered	I know this well	I need to do more work on this
SP6a Atomic models	P6.1 Describe an atom as a positively charged nucleus, consisting of protons and neutrons, surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus			
	P6.2 Recall the typical size (order of magnitude) of atoms and small molecules.			
	P6.17 Describe how and why the atomic model has changed over time including reference to the plum pudding model and Rutherford alpha particle scattering leading to the Bohr model.			
SP6b Inside atoms	P6.3 Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass (nucleon) number and using symbols in the format 13 6C			
	P6.4 Recall that the nucleus of each element has a characteristic positive charge, but that elements differ in mass by having different numbers of neutrons			
	P6.5 Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons.			
	P6.6 Recall that in an atom the number of protons equals the number of electrons and is therefore neutral.			
SP6c Electrons and orbits	P6.7 Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus.			
	P6.8 Explain that electrons change orbit when there is absorption or emission of electromagnetic radiation.			
	P6.9 Explain how atoms may form positive ions by losing outer electrons.			
	P6.17 Describe how and why the atomic model has changed over time including reference to the plum pudding model and Rutherford alpha particle scattering leading to the Bohr model.			
SP6d Background radiation	P6.12 Explain what is meant by background radiation.			
	P6.13 Describe the origins of background radiation from Earth and space.			
	P6.14 Describe methods for measuring and detecting radioactivity limited to photographic film and a Geiger–Müller tube			
SP6e Types of radiation	P6.5 Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons			

	P6.10 Recall that alpha, β- (beta minus), β+ (positron), gamma rays and neutron radiation are emitted from unstable nuclei in a random process.			
	P6.11 Recall that alpha, β- (beta minus), β+ (positron) and gamma rays are ionising radiations.			
	P6.15 Recall that an alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation.			
	P6.16 Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise.			
SP6f Radioactive decay	P6.18 Describe the process of β – decay (a neutron becomes a proton plus an electron).			
	P6.19 Describe the process of β + decay (a proton becomes a neutron plus a positron).			
	P6.20 Explain the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays (α, β, γ and neutron emission).			
	P6.21 Recall that nuclei that have undergone radioactive decay often undergo nuclear rearrangement with a loss of energy as gamma radiation			
	P6.22 Use given data to balance nuclear equations in terms of mass and charge.			
SP6g Half-life	P6.23 Describe how the activity of a radioactive source decreases over a period of time.			
	P6.24 Recall that the unit of activity of a radioactive isotope is the Becquerel, Bq			
	P6.25 Explain that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay or the activity of a source to decay by half.			
	P6.26 Explain that it cannot be predicted when a particular nucleus will decay but half-life enables the activity of a very large number of nuclei to be predicted during the decay process.			
	P6.27 Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations			
SP6h Using radioactivity	P6.28P Describe uses of radioactivity, including: a household fire (smoke) alarms b irradiating food c sterilisation of equipment d tracing and gauging thicknesses e diagnosis and treatment of cancer.			
SP6i Dangers of radioactivity	P6.29 Describe the dangers of ionising radiation in terms of tissue damage and possible mutations and relate this to the precautions needed.			
	P6.31 Explain the precautions taken to ensure the safety of people exposed to radiation, including			

	limiting the dose for patients and the risks to medical personnel.			
	P6.32 Describe the differences between contamination and irradiation effects and compare the hazards associated with these two.			
SP6j Radioactivity in medicine	P6.33P Compare and contrast the treatment of tumours using radiation applied internally or externally.			
	P6.34P Explain some of the uses of radioactive substances in diagnosis of medical conditions, including PET scanners and tracers.			
	P6.35P Explain why isotopes used in PET scanners have to be produced nearby.			
SP6k Nuclear energy	P6.36P Evaluate the advantages and disadvantages of nuclear power for generating electricity, including the lack of carbon dioxide emissions, risks, public perception, waste disposal and safety issues.			
	P6.37P Recall that nuclear reactions, including fission, fusion and radioactive decay, can be a source of energy.			
SP6l Nuclear fission	P6.38P Explain how the fission of U-235 produces two daughter nuclei and the emission of two or more neutrons, accompanied by a release of energy.			
	P6.39P Explain the principle of a controlled nuclear chain reaction.			
	P6.40P Explain how the chain reaction is controlled in a nuclear reactor including the action of moderators and control rods.			
	P6.41P Describe how thermal (heat) energy from the chain reaction is converted into electrical energy in a nuclear power station.			
	P6.42P Recall that the products of nuclear fission are radioactive.			
SP6m Nuclear fusion	P6.43P Describe nuclear fusion as the creation of larger nuclei resulting in a loss of mass from smaller nuclei, accompanied by a release of energy, and recognise fusion as the energy source for stars.			
	P6.44P Explain the difference between nuclear fusion and nuclear fission			
	P6.45P Explain why nuclear fusion does not happen at low temperatures and pressures, due to electrostatic repulsion of protons			
	P6.46P Relate the conditions for fusion to the difficulty of making a practical and economic form of power station.			