A Level Physics Online

AQA Physics - 7408

Module 8: Particle Physics

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
8.1 Radioactivity				
8.1.1 Rutherford Scattering				
Qualitative study of Rutherford scattering.				
Appreciation of how knowledge and understanding of the structure of the nucleus has changed over time.				
8.1.2 α, β and γ Radiation				
Their properties and experimental identification using simple absorption experiments; applications eg to relative hazards of exposure to humans.				
Applications also include thickness measurements of aluminium foil paper and steel.				
Inverse-square law for γ radiation: $I = k / x^2$				
Experimental verification of inverse-square law.				
Applications eg to safe handling of radioactive sources.				
Background radiation; examples of its origins and experimental elimination from calculations.				
Appreciation of balance between risk and benefits in the uses of radiation in medicine.				
8.1.3 Radioactive Decay				
Random nature of radioactive decay; constant decay probability of a given nucleus: $\Delta N / \Delta t = -\lambda N$				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
$N = N_0 e^{-\lambda t}$				
Use of activity: $A = \lambda N$				
Modelling with constant decay probability.				
Questions may be set which require students to use: $A = A_0 e^{-\lambda t}$				
Questions may also involve use of molar mass or the Avogadro constant.				
Half-life equation: $T_{½} = ln2 / \lambda$				
Determination of half-life from graphical decay data including decay curves and log graphs.				
Applications eg relevance to storage of radioactive waste, radioactive dating etc.				
8.1.4 Nuclear Instability				
Graph of N against Z for stable nuclei.				
Possible decay modes of unstable nuclei including α, β^+ , β^- and electron capture.				
Changes in N and Z caused by radioactive decay and representation in simple decay equations.				
Questions may use nuclear energy level diagrams.				
Existence of nuclear excited states; γ ray emission; application eg use of technetium-99m as a γ source in medical diagnosis.				
8.1.5 Nuclear Radius				
Estimate of radius from closest approach of alpha particles and determination of radius from electron diffraction.				
Knowledge of typical values for nuclear radius.				
Students will need to be familiar with the Coulomb equation for the closest approach estimate.				

You should be able to demonstrate and show your understanding of:	Progress and understanding: 1	2	3	4
Dependence of radius on nucleon number: $R = R_0 A^{1/3}$ derived from experimental data				
Interpretation of equation as evidence for constant density of nuclear material.				
Calculation of nuclear density.				
Students should be familiar with the graph of intensity against angle for electron diffraction by a nucleus.				
8.1.6 Mass and Energy				
Appreciation that $E = mc^2$ applies to all energy changes.				
Simple calculations involving mass difference and binding energy.				
Atomic mass unit, u.				
Conversion of units; 1 u = 931.5 MeV.				
Fission and fusion processes.				
Simple calculations from nuclear masses of energy released in fission and fusion reactions.				
Graph of average binding energy per nucleon against nucleon number.				
Students may be expected to identify, on the plot, the regions where nuclei will release energy when undergoing fission/fusion.				
Appreciation that knowledge of the physics of nuclear energy allows society to use science to inform decision making.				
8.1.7 Induced Fission				
Fission induced by thermal neutrons; possibility of a chain reaction; critical mass.				
The functions of the moderator, control rods, and coolant in a thermal nuclear reactor.				
Details of particular reactors are not required.				

You should be able to demonstrate and show your understanding of:	Progress and understanding:			
	1	2	3	4
Students should have studied a simple mechanical model of moderation by elastic collisions.				
Factors affecting the choice of materials for the moderator, control rods and coolant. Examples of materials used for these functions.				
8.1.8 Safety Aspects				
Fuel used, remote handling of fuel, shielding, emergency shut-down.				
Production, remote handling, and storage of radioactive waste materials.				
Appreciation of balance between risk and benefits in the development of nuclear power.				