

**Assessment Schedule – 2007****Physics: Demonstrate understanding of atoms and radioactivity (90256)****Evidence Statement**

<b>Q</b>	<b>Evidence</b>	<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
ONE (a)	<p>The Dalton model proposed that matter was made of <b>indivisible atoms</b> / <b>smallest building block of matter</b> (The Dalton model had no electrons or protons).</p> <p>The Thomson (“plum pudding”) model proposed that the atom was a <b>positive sphere</b> with negatively charged <b>electrons embedded in it</b>. The atom as whole was neutral. (The Thomson model did not have protons.)</p> <p>The Rutherford model proposed that the atom had a <b>central positive nucleus</b>. The negatively charged <b>electrons were in orbit</b> around the nucleus of the atom. The atom as whole was neutral. The <b>atom was mainly space</b>. (The Rutherford model had electrons and protons.)</p> <p>(Thomson and Rutherford BOTH predicted the atom was mainly space.)</p>	<p>Dalton model <b>OR</b> Thompson model <b>OR</b> 2 of 3 ideas from Rutherford model explained. (Neutron mentioned in Rutherford model does not negate answer.)</p>	<p><b>TWO</b> models correctly explained. (2 of 3 ideas from Rutherford model is sufficient.) (Neutron mentioned in Rutherford model does not negate answer.)</p>	<p><b>ALL</b> models correctly explained. (2 of 3 ideas from Rutherford model is sufficient.)  (Neutron mentioned in Rutherford model does not negate answer.)</p>
(b)	(Most of) the alpha particles would go straight through / alpha particles should only be deflected by small angles as they pass through / uniform scattering.	(Most of) the alpha particles would go straight through / alpha particles should only be deflected by small angles as they pass through / uniform scattering.		
(c)	<p>(Most of the) alpha particles went straight through.</p> <p>(Some of the) particles were deflected away.</p> <p>(A very few of the) particles were reflected right back / deflected through large angles.</p>	<b>TWO</b> correct observations.	<b>ALL THREE</b> correct observations.	

(d)	<p>If air were present in the chamber the alpha particles would not travel far (alpha particles can penetrate only 5cm in air) / be stopped / lose energy / path would change / be deviated <b>because</b> of collisions with air particles.</p> <p>The air (particles) would be ionised / become positively or negatively charged / lose electrons / change from atoms to ions <b>because</b> alpha particles are highly ionising and they would ionise the air as they passed through it.</p>	<p>Alpha particles would not travel far / be stopped / lose energy / path would change / be deviated (do not accept “affect”, “react”, “interfere”) / alpha becomes a helium atom</p> <p><b>OR</b></p> <p>Air would be ionised / become positively or negatively charged / lose electrons / change from atoms to ions (do not accept “react”).</p>	<p>Alpha particles would not travel far / be stopped / lose energy / path would change / be deviated (do not accept “affect”, “react”, “interfere”) / alpha becomes a helium atom.</p> <p><b>AND</b></p> <p>Air would be ionised / become positively or negatively charged / lose electrons / change from atoms to ions (do not accept “react”).</p>	
(e)	<p>Beta particles (which are more penetrating) would almost all go straight through the gold foil.</p> <p><b>OR</b></p> <p>Greater scattering effect so more Beta particles deflected through large angles (very few would be scattered through small angles)</p> <p><b>OR</b></p> <p>greater backscattering.</p>	<p>(Almost all) Beta particles would through the gold foil.</p> <p><b>OR</b></p> <p>More Beta particles scattered through large angles / greater backscattering.</p>		
TWO (a)	<p>Different number of neutrons / 3 more neutrons in Pt-195 / 3 less neutrons in Pt-192 / different mass number / Pt-195 has greater mass.</p> <p>(They have the same number of protons.)</p>	<p>One correct difference (don't accept nucleons).</p>		
(b)	<p>The 78 represents the atomic number / number of protons.</p> <p>The 195 represents the mass number / number of nucleons / number of protons and neutrons / relative atomic mass (not “atomic mass”).</p>	<p>Both identified correctly (don't accept number of electron instead of protons).</p>		
(c)	<p><math>{}^{192}_{77}\text{Ir} \rightarrow {}^{192}_{78}\text{Pt} + {}^0_{-1}\text{e}</math></p> <p>Particle is Beta particle / <math>\beta</math> or electron <math>\text{e}^-</math></p>	<p>Correct equation – accept <math>\beta</math> instead of e (If <math>\gamma</math> as well, ignore. Irrelevant whether numbers to left or right – but not diagonals).</p> <p><b>OR</b></p> <p>Beta particle / electron produced (must be stated not inferred from equation). Don't accept: b, B.</p>	<p>Correct equation – accept <math>\beta</math> instead of e (If <math>\gamma</math> as well, ignore. Irrelevant whether numbers to left or right – but not diagonals).</p> <p><b>AND</b></p> <p>Beta particle / electron produced (must be stated not inferred from equation). Don't accept: b, B.</p>	

(d)	Conservation of mass / mass number / nucleon number. <b>AND</b> Conservation of atomic number / charge number / charge.	Both correct.		
(e)	Half life should be long enough in order for the doctors to be able scan the patients (assuming being used as tracer). Half life should not be too long in the patient as radioactivity could harm the patient.	One correct reason.	Both correct reasons.	
(f)	Alpha particles are highly ionising and could harm cells in the human body. Gamma radiation has very low ionising ability and hence is safer for use.	Alpha particles are highly <b>ionising</b> . <b>OR</b> Gamma rays are poor <b>ionisers</b> (do not accept gamma rays do NOT ionise).	Alpha particles are highly ionising as <b>compared</b> with gamma rays. <b>AND</b> human cells could be harmed by ionisation / cause cancer.	
(g)	(i) For alpha decay, the atomic number reduces by 2 and the mass number reduces by 4. An alpha particle consists of two neutrons and two protons. (ii) For beta decay, the atomic number increases by one, but the mass number remains the same. A beta particle is a fast-moving electron. It is emitted when a neutron changes to a proton and an electron.	ONE of THREE from: For alpha decay, the atomic number reduces by 2 and the mass number reduces by 4. <b>OR</b> For beta decay, the atomic number increases by one, but the mass number remains the same. <b>OR</b> ONE of: (During beta decay, a beta particle is emitted when a neutron changes to a proton and an electron / beta particle. <b>OR</b> An alpha particle is emitted consisting of two neutrons and two protons.)	TWO of THREE from: For alpha decay, the atomic number reduces by 2 and the mass number reduces by 4. <b>OR</b> For beta decay, the atomic number increases by one, but the mass number remains the same. <b>OR</b> ONE of: (During beta decay, a beta particle is emitted when a neutron changes to a proton and an electron / beta particle. <b>OR</b> An alpha particle is emitted consisting of two neutrons and two protons.)	THREE of THREE from: For alpha decay, the atomic number reduces by 2 and the mass number reduces by 4. <b>AND</b> For beta decay, the atomic number increases by one, but the mass number remains the same. <b>AND</b> ONE of: (During beta decay, a beta particle is emitted when a neutron changes to a proton and an electron / beta particle. <b>OR</b> An alpha particle is emitted consisting of two neutrons and two protons.)

(h)	<p>By calculation:</p> <p>One half-life is 8 days (since the rate falls to <math>\frac{1}{4}</math> after 16 days). 28 days is 3.5 half-lives.</p> $\text{Rate} = 600 \times \left(\frac{1}{2}\right)^{3.5}$ <p>Rate = 53</p> <p>By graphing:</p> <p>After 1 half-life, count rate  <math>= \frac{600}{2} = 300</math></p> <p>After 2 half-lives, count rate  <math>= \frac{300}{2} = 150</math></p> <p>After 3 half-lives, count rate <math>= \frac{150}{2} = 75</math></p> <p>After 4 half-lives, count rate  <math>= \frac{75}{2} = 37.5</math></p> <p>From graph, decay rate after 28 days is about 50 counts per second.</p>	<p>Correct number of half-lives calculated to be 8 days</p> <p><b>OR</b></p> <p>Points plotted on graph:        8 days = 300        16 days = 150        24 days = 75        32 days = 37.5</p> <p>If BOTH methods used, award highest grade from either method.</p>	<p>Half-life calculated to be 8 days <b>and</b> 28 days is 3.5 half-lives</p> <p><b>OR</b></p> <p>Points plotted on graph:        8 days = 300        16 days = 150        24 days = 75        32 days = 37.5</p> <p><b>AND</b>  <b>Accurate</b> exponential curve drawn (do not accept joining the dots with a ruled line).</p>	<p>Half-life calculated to be 8 days <b>and</b> 28 days is 3.5 half-lives <b>and</b> use of 3 half-lives = 75 and 4 half-lives = 37.5 / calculation of <math>1 / 2^{3.5}</math> to arrive at answer of 53</p> <p><b>OR</b></p> <p>Points plotted on graph:        8 days = 300        16 days = 150        24 days = 75        32 days = 37.5</p> <p><b>AND</b>  <b>Accurate</b> exponential curve drawn (do not accept joining the dots with a ruled line).  <b>AND</b>        Answer <b>matches graph</b> (construction lines preferred but not required).</p>
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### Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
$6 \times \text{A/M/E}$	$9 \times \text{A/M/E}$ inc $4 \times \text{M/E}$	$11 \times \text{A/M/E}$ inc $(3 \times \text{M/E}$ and $2 \times \text{E})$