Assessment Schedule – 2005

Physics: Demonstrate understanding of atoms and radioactivity (90256)

Evidence Statement

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	Thomson's and Rutherford's models both: • contain (negative) electrons • involve subatomic particles • involve atoms with smaller particles inside • contain positive charges • contain negative charges • contain (balanced) positive and negative charges • atoms are neutral overall. Accept any one of these – an answer that involves **protons** in both models **cannot** be **accepted.**	Correct statement of similarity.		
1(b)	Thomson's model consisted of negative electrons embedded in a sphere of positiveness / accept "solid"; but Rutherford's electrons were in orbit around a (small) positive nucleus.	Thomson's model described and **either** • electrons in orbit • (small) positive nucleus / mass in centre of Rutherford's model explained (neutron mentioned in answer does not negate answer).	Both Thomson's model described and **both** of • electrons in orbit • (small) positive nucleus / mass in centre of Rutherford's model explained (neutron mentioned in answer does not negate answer).	
2	1. Only a few alpha particles bounced back because the nucleus is so small / atom is mostly empty space that few collided with the nucleus. 2. If they bounced back it was because both alpha particle and nucleus are positive: repulsion 3. If they bounced back it was because nucleus is massive / dense so alpha particles rebound.	One correct reason (any from 3) but no explanation.	Correct Reason 1 (atoms are mostly space etc.) with explanation **OR** correct Reason 2 with explanation (repulsion because of like charges etc). (Reason 3 not accepted as answer but if used does not negate.)	Correct Reason 1 with explanation **AND** correct Reason 2 with explanation. (Reason 3 not accepted as answer but if used does not negate.)

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(a)	Alpha / α Gamma / γ Beta / β If candidate gives Name and symbol: If Name correct but accompanying symbol incorrect, accept answer as correct. If Name incorrect but accompanying symbol correct do NOT accept answer.	All correctly named.		
3(b)	Downwards particle's mass is much less than the other particle because it is an electron whereas the other particle consists of a helium nucleus (or 2 protons + 2 neutrons).	Mass is less / charge to mass ratio is greater.	Achievement ***plus*** reason for smaller deflection.	
4	*X* are beta particles / β. *Y* is gamma radiation / γ. If candidate gives Name and symbol: If Name correct but accompanying symbol incorrect, accept answer as correct. If Name incorrect but accompanying symbol correct do NOT accept answer.	Correct identification of both types of radioactivity.		
5	$a = 1$, $b = 1$, *X* = proton or hydrogen.	Correct values for *a* and *b*.	Achievement ***plus*** correct identification of *X*.	
6	Ionisation occurs when **radiation**: • causes **atoms** to become positively or negatively **charged** **OR** • electrons lost or gained from at**oms** **OR** • changes **atoms** into **ions.**	Correct answer involving radiation.		

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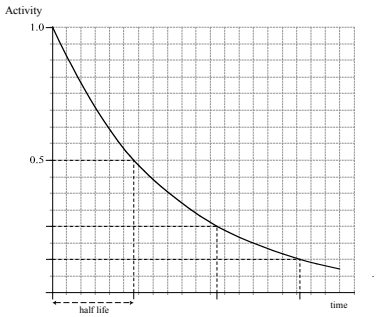
7(a)	Exponential graph drawn on axes. Graph starts at y-axis and never reaches x-axis. Axes labelled *Activity / Counts per second / Number of radioactive atoms* against *time / Half life* (units not required). Point at half maximum activity drawn across to graph line with line dropped onto time axis and labelled half-life (but can only accepts if Graph starts at y-axis) . **OR** A value on y-axis chosen and interpolated, half the value chosen interpolated – difference in time is half-life.  	Exponential graph drawn. (Graph starts at / close to y-axis and never reaches x-axis.)	Achievement ***plus*** both axes suitably labelled.	Merit ***plus*** construction lines shown enabling half-to be correctly calculated.
7(b)	The half-life of a radioactive material is the time taken for the activity of the sample to decrease to half of its original value (or other correct definition).	The time taken for half a radioactive sample to decay into something else / The time for the activity of a radioactive sample to halve.		

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8(a)	$^{241}_{95}\text{Am} \rightarrow {}^{4}_{2}\alpha + {}^{237}_{93}\text{Np}$ (Americium and alpha particle must be on opposite sides of arrow) **OR** Equivalent equation (including numbers) showing Americium minus alpha particle goes to Np. Accept He as replacement for α.	Correct answer including Np.		
8(b)	• Alpha particles cause more ionisation then beta or gamma because they are more massive particles.	Alpha particles cause greater ionisation.		.
	• The range of alpha particles is much less than that of beta or gamma so an alpha source is safer to use.	Alpha particles have a shorter range.	Achievement ***plus*** benefit of shorter range.	
8(c)	A long half-life means that the source would last longer / not need replacing / activity of source roughly constant.	Correct answer.		
9	10 g of a living sample has an activity of 234.5 cpm. To drop to a count of 25 cpm, the activity has halved a little more than three times. 3 × half-life = 3 × 5 730 = 17 190 Hence approximate age = 18 000 years.	Conversion of one of the two activities, so dealing with equivalent mass: 250 cpm per 100 gram of tree trunk **OR** 23.45 cpm for 10 g of living tree **OR** other conversion such as both to cpm per g (unit not required).	Correct number of half-lives. (actual = 3.22, accept 3 – 4.)	Correct answer of Approximately 18000 years (actual = 18451 years – accept range from 17190 – 22920) (unit not required).

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
SIX opportunities answered at Achievement level or higher. 6 × A	TEN opportunities answered with FOUR at Merit/Excellence level, and SIX at Achievement level. 4 × M / E *plus* 6 × A	TWELVE opportunities answered with TWO at Excellence level and FOUR at Merit/Excellence level and SIX at Achievement level. 2 × E *plus* 4 × M / E *plus* 6 × A