Assessment Schedule – 2008

Physics: Demonstrate understanding of atoms and radioactivity (90256)

Evidence Statement

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Italics indicate replacement evidence.

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	Helium nucleus / He^{2+} / Helium 2+ ion (but not Helium positive ion).	**Helium nucleus / He^{2+} / Helium 2+ ion** (but not Helium positive ion).		
(b)	Removing an electron from air / atom / molecule to produce a positive ion / atom / molecule.	**Removing** an **electron** from **air / atom / molecule.**	**Removing** an **electron** from **air / atom / molecule** to produce a **positive ion / atom / molecule.**	
(c)	Alpha particles are not very penetrating and could not pass through the case / alpha could only travel a few cms through air / alpha cannot pass through skin so would not be harmful.	Alpha particles are not **very penetrating / only travel a few cms through air** / alpha cannot **pass through skin**.		
(d)	**95** protons **146** neutrons	Both correct		
(e)	$$^{241}_{95}\text{Am} \rightarrow \, ^{237}_{93}\text{Np} + \, ^{4}_{2}\text{He}$$ A correct subtraction with Am minus alpha goes to Np (equation to follow) but must have + or – and → (don't accept =)	**Correct equation** accept He or He^{2+} or α (but not a or A).		
(f)	Conservation of charge.	Conservation of **charge** (references to conservation of mass are neutral).		

(g)	Graph drawn correctly. Intercept lines for 1.0 mg drawn correctly. Approx 610 years.	Graphical method: • **2 half life points drawn** correctly and **exponential curve** drawn OR • **Interpolation of graph** (**construction lines** or **visibly marked point**) – accept 1.0 (250 -290 based on graph) or 0.6 (590 – 630 based on graph) OR Mathematical method: **1.6(½)^n = 0.6** (accept 1.6(½)^n = 1.0) (If BOTH methods used, award highest grade from either method.)	Graphical method: • **2 half life points drawn** correctly and **exponential curve** drawn • **Interpolation of graph** (**construction lines** or **visibly marked point**) – accept 1.0 (250 -290 based on graph) or 0.6 (590 – 630 based on graph) OR Mathematical method: **1.6(½)^n = 0.6 so n = 1.41 half lifes** 1.6(½)^n = 1.0 so n = 0.68 half lifes (If BOTH methods used, award highest grade from either method.)	Graphical method: • **2 half life points drawn** correctly and **exponential curve** drawn • **Interpolation of graph** (**construction lines** or **visibly marked point**) using 0.6 (590 – 630 based on graph) • Correct **statement of answer based on graph** OR Mathematical method: 1.6(½)^n = 0.6 n = **609 – 611 years** (If BOTH methods used, award highest grade from either method.)
(h)	When the Americium decays, it doesn't disappear, but changes into a slightly smaller nucleus (Np). The Neptunium is still there so the **mass is virtually unchanged.**		Correct answer.	
(i)	**Out of the page** (not up).	Correct answer – accept circled answers (if both answers, they must match to be awarded grade).		

(j)	Diagram shows **Bends to the left**, **significantly greater curvature.** ends to the left because • the beta particle is **opposite (negative) charge** or use of the / **right hand slap / left hand rule** (no details required regarding digits etc). • Greater curvature because the beta particle has much less mass / smaller mass / lighter.(The fact that force on beta is less is not required).	Correct diagram OR Correct direction (but not sufficiently significant) with correct explanation for this.	Correct diagram and one explanation.	Correct diagram and both explanations.
TWO (a)	$^{60}_{27}\text{Co} \rightarrow\ ^{60}_{28}\text{Ni} +\ ^{0}_{-1}\beta$ OR A correct subtraction with Cobalt minus beta goes to Nickel (equation to follow) but must have + or – and $\rightarrow$ (don't accept =) Named particle: beta particle / electron accept β or e (but not b or B).	Beta correctly named OR Correct equation.	Beta correctly named AND Correct equation.	
(b)	A neutron has decayed into a proton and an electron. The electron (accept beta for emitted electron) is emitted.	A **neutron** has decayed into a **proton** and an **electron**.	A **neutron** has decayed into a **proton** and an **electron**. AND The **electron is emitted**. (Also accept – a neutron decays into a proton and releases an electron in the process)	
(c)	$^{99}_{43}\text{Tc} \rightarrow\ ^{99}_{43}\text{Tc} + \gamma$ Don't accept: λ, Y Accept: γ ,gamma, ɣ	Correct except for one error (eg omitting gamma completely, wrong gamma symbol, one wrong number)	**Correct equation**.	
(d)	Gamma rays are (high frequency or high energy) waves / photons (of electromagnetic radiation). (accept gamma are not particles) They have no mass number and no charge, so they do not change the number of protons or neutrons.	Gamma rays are (high frequency or high energy) **waves / photons** (of electromagnetic radiation). OR They have **no mass** and **no charge**	Gamma rays are (high frequency or high energy) **waves / photons** (of electromagnetic radiation). AND They have **no mass** and **no charge**	Gamma rays are (high frequency or high energy) **waves / photons** (of electromagnetic radiation). AND They have **no mass** and **no charge** AND so they do **not change the number of protons or neutrons** of Tc

THREE (a)	Some alpha particles **underwent large deflections** OR **bounced back**. (passed straight through is neutral).	Correct answer		
(b)	Atom is mainly **empty space**. **Tiny / dense / positive nucleus** at centre. **Surrounded** by (orbiting) **electrons**. (neutrons in model is neutral)	Two of three key ideas.		
		15	9	3

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
$7 \times A / M / E$	$10 \times A / M / E$ inc $4 \times M / E$	$12 \times A / M / E$ inc ($3 \times M / E$ and $2 \times E$)

Note: the grade awarded is the highest one that has been demonstrated in all achievement criteria up to and including that grade.