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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Physics, 2008

90256 Demonstrate understanding of atoms and radioactivity

Credits: Two
2.00 pm Tuesday 25 November 2008

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only	**Achievement Criteria**		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles.	Give descriptions or explanations in terms of phenomena, concepts, and / or principles.	Give concise explanations that show clear understanding in terms of phenomena, concepts, and / or principles.
Overall Level of Performance		

You are advised to spend 20 minutes answering the questions in this booklet.

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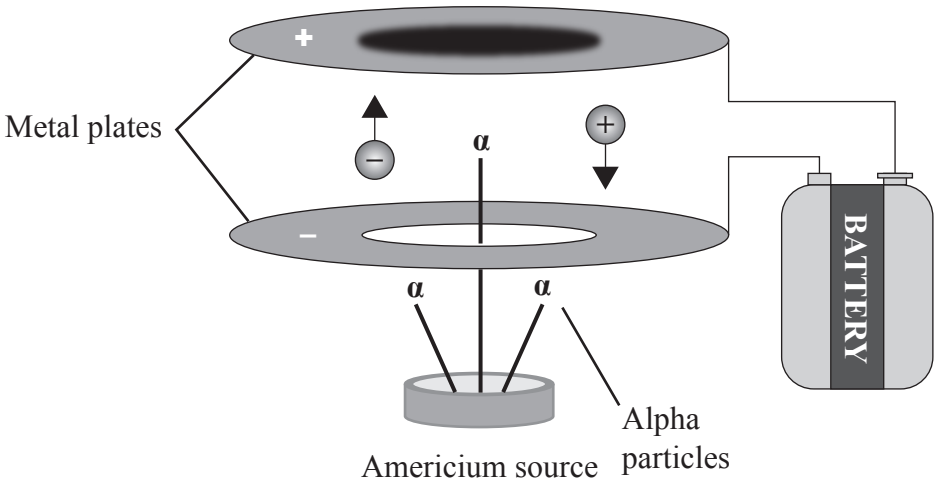
QUESTION ONE: THE SMOKE DETECTOR

Common smoke detectors contain a small amount of the radioactive isotope Americium 241. Americium 241 is an alpha emitter, and decays with a half life of 432 years. The alpha particles **ionise** the gases in the air between two metal plates.



(a) State **another** name for an alpha particle.

(b) Describe what is meant by the word "**ionise**" in this context.

(c) Describe why the radioactive source is **not** a health risk.

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(d) The symbol for Americium 241 is $^{241}_{95}Am$.

How many protons and neutrons are there in the nucleus?

Protons _____ Neutrons _____

(e) Americium 241 decays to Neptunium (Np).

Write the equation for the alpha decay of Americium 241.

_____

(f) Name the important physics principle that helped you work out the atomic number of Neptunium.

_____

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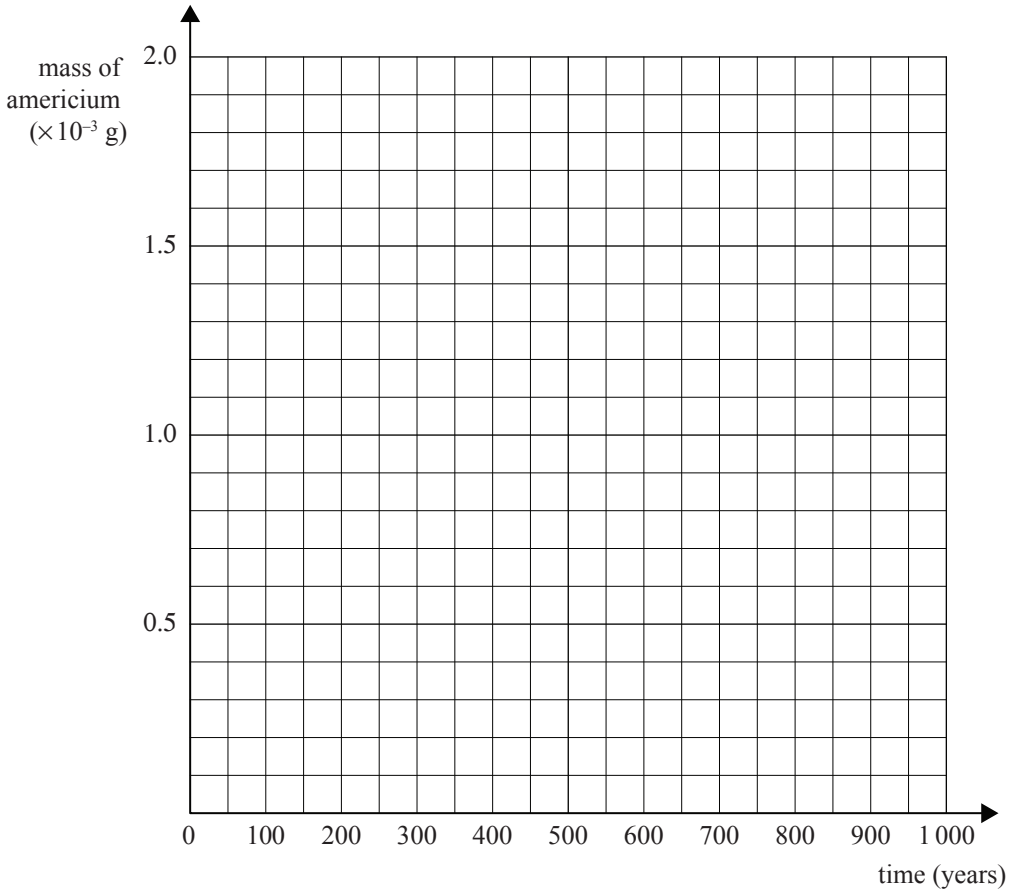
(g) One smoke detector has a radioactive source containing 1.6×10^{-3} g of the isotope Americium 241.

Use the graph axes below (or other method) to **show** how long it takes for 1.0×10^{-3} g of Americium from the original radioactive source to decay.
Americium 241 has a half-life of 432 years.



(h) Explain why the mass of the radioactive source is **not** 0.6×10^{-3} g after this time.

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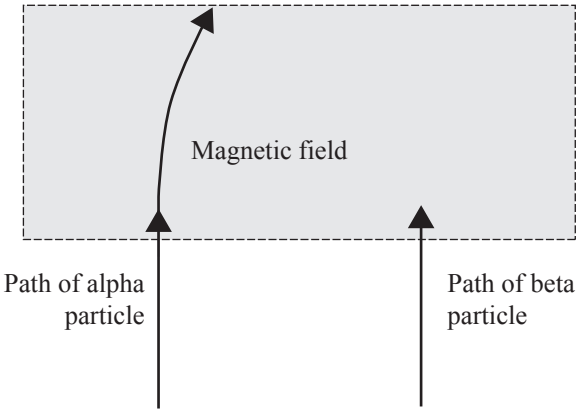
The diagram below shows an alpha particle travelling towards the top of the page and through a magnetic field.



(i) What is the direction of the magnetic field?

Choose your answer from:

towards the top of the page	*towards the bottom of the page*
left	*right*
into the page	*out of the page.*

(j) Complete the diagram above to show the path of a beta particle travelling at the same speed. Explain how you worked out your answer.

QUESTION TWO: NUCLEAR MEDICINE

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Cobalt 60 ($^{60}_{27}\text{Co}$) is used in hospitals. It decays into Nickel 60 ($^{60}_{28}\text{Ni}$).

(a) Write the radioactive decay equation for Cobalt 60, and name the particle produced.

(b) Describe what has happened inside the Cobalt nucleus to produce this radioactive decay.

Technetium 99 ($^{99}_{43}\text{Tc}$) is another common isotope used in hospitals for imaging. Technetium 99 emits gamma rays when it decays.

(c) Write the radioactive decay equation for Technetium 99.

(d) Describe what gamma rays are, and use your description to justify your answer to question (c) above.

QUESTION THREE: RUTHERFORD'S EXPERIMENT

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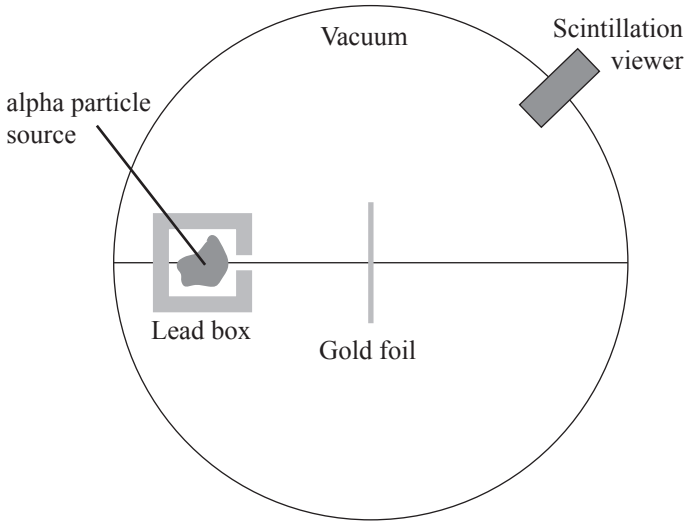
In 1910 Ernest Rutherford directed an experiment that involved firing alpha particles at a thin gold foil. From the results he developed a new model of the atom.



(a) What part of the results did he find surprising?

(b) Briefly describe the model Rutherford developed.

Extra paper for continuation of answers if required.
Clearly number the question.

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Question number