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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Physics, 2009

90256 Demonstrate understanding of atoms and radioactivity

Credits: Two
2.00 pm Tuesday 17 November 2009

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: MODELS OF THE ATOM

(a) Around 1800, James Dalton proposed a modern atomic model, based on experimentation rather than pure reason.

Describe one aspect of Dalton's model of the atom.

(b) Thomson's model is commonly referred to as the "Plum Pudding Model".

Describe Thomson's model of the atom.

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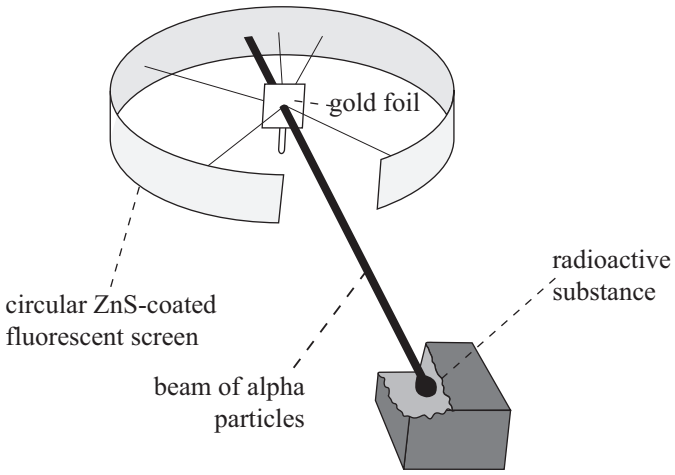
(c) A diagram of Rutherford's gold foil experiment, which he performed with Geiger and Marsden, is shown below. The whole apparatus was in an evacuated chamber, that is in a vacuum.



Give the purposes of the following in the experimental setup:

(i) **zinc sulfide (ZnS) fluorescent coating** on the circular screen

(ii) **circular shape** of screen

(iii) **evacuated** chamber

QUESTION TWO: RUTHERFORD AND RADIOACTIVITY

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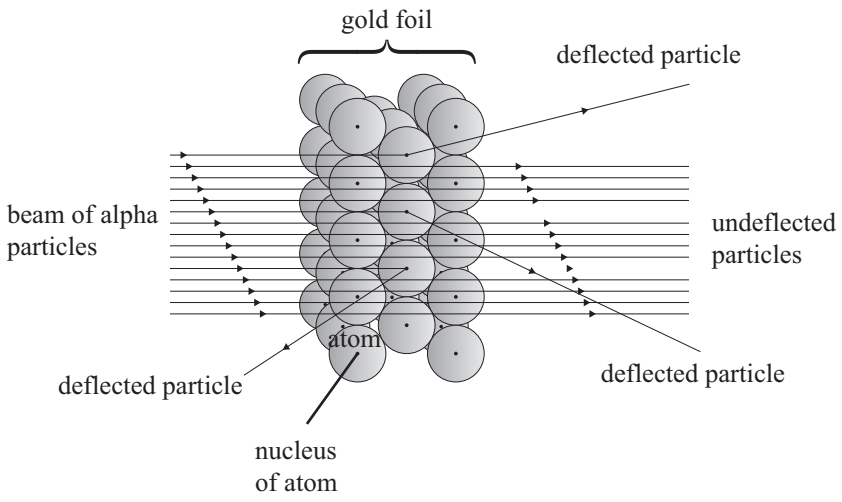
The observations that Rutherford made are shown in the diagram below:



Based on his observations, Rutherford came to certain conclusions about the structure of the atom.

(a) Explain Rutherford's THREE **main** conclusions about the structure of the atom.

(1) _____

_____

_____

(2) _____

_____

_____

(3) _____

_____

_____

One of the first artificial nuclear reactions was carried out by Rutherford when he fired alpha particles into a jar of nitrogen gas $^{14}_{7}N$. He discovered that the products were oxygen $^{17}_{8}O$, and one other particle.

(b) Write a nuclear equation for the reaction.

_____

(c) Name the other particle that was produced as a result of this nuclear reaction.

_____

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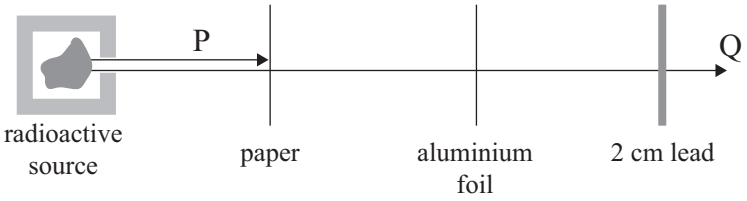
(d) State the TWO conservation laws that you used in order to write the equation in (b).

(1) _____

(2) _____

(e) The type of radiation emitted from a source can be determined using absorbers. The diagram below shows an example.



Identify the radioactive emissions labelled P and Q in the diagram above, giving reasons.

P: _____

_____

_____

Q: _____

_____

_____

QUESTION THREE: HALF-LIFE

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$_{89}Ac$	$_{90}Th$	$_{91}Pa$	$_{92}U$	$_{93}Np$	$_{94}Pu$	$_{95}Am$	$_{96}Cm$	$_{97}Bk$	$_{98}Cf$

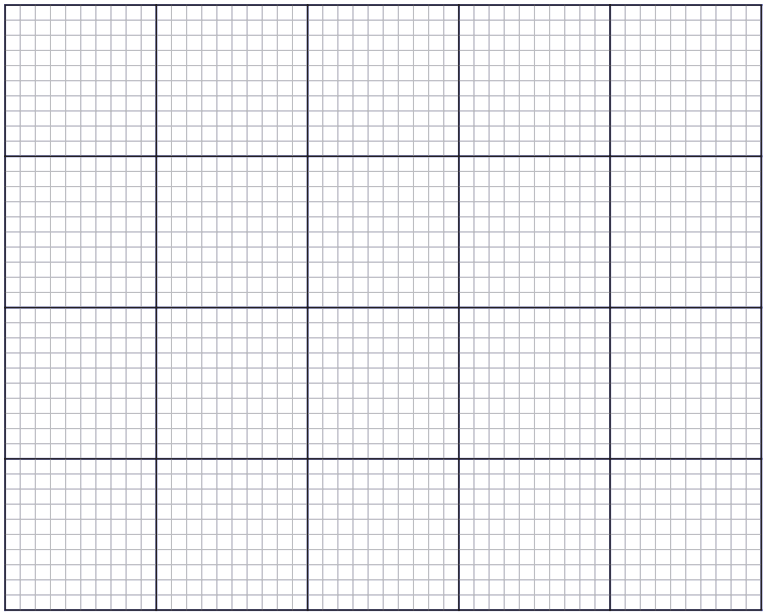
Plutonium-241 ($^{241}_{94}Pu$), which has a half-life of 14 years, is a typical product from a nuclear reactor. Plutonium-241 decays to americium-241($^{241}_{95}Am$).

(a) Write a nuclear equation for the decay of plutonium-241 to americium-241.

_____

(b) Draw a graph to show the decay of 32 g of plutonium-241. Use the graph to find the mass of plutonium-241 after 20 years.

Mass (g)



Time (years)

Mass of plutonium-241 after 20 years = _____

Americium-241 has a half-life of 432 years and is widely used in smoke detectors. Americium-241 emits alpha particles and gamma radiation.

(c) Describe and explain the changes inside the nucleus of Am-241 when it emits an **alpha particle and a gamma ray**.

_____

_____

_____

_____

(d) Write a nuclear equation for the decay of Am-241 when it emits an alpha particle.

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

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Question number	

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