

Name of the Student: _____

Max. Marks : 17 Marks

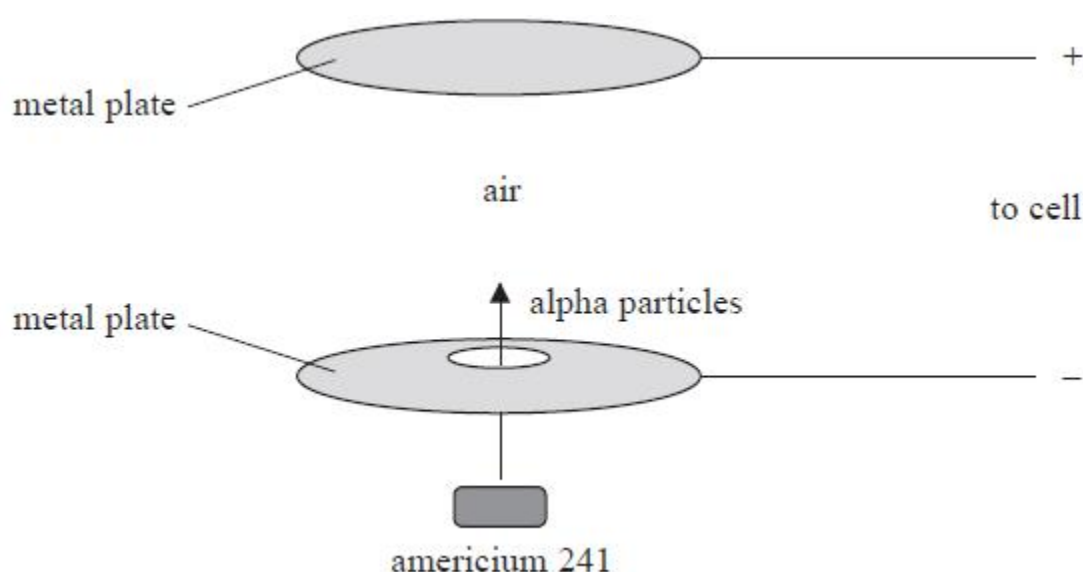
Time : 17 Minutes

Q1.

Some types of smoke detector contain a radioactive isotope of americium, ^{241}Am . The nuclei of ^{241}Am decay by emitting an alpha particle.

The diagram shows part of a smoke detector.

The detectors use a small amount of ^{241}Am to make the air between two metal plates conduct charge.



(a) (i) Explain why a stream of alpha particles will cause charge to flow between the metal plates.

(2)

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(ii) Suggest how smoke particles entering the space between the plates will cause the current to decrease.

(1)

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(b) (i) The decay of ^{241}Am is said to be random and spontaneous. State what is meant by random and spontaneous.

(2)

Random

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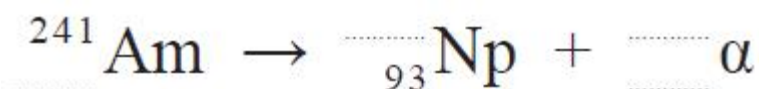
Spontaneous

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(ii) Complete the equation for the decay of ^{241}Am .

(2)



(Total for question = 7 marks)

Q2.

The photograph shows a vase made of uranium glass. Uranium glass is radioactive.



Uranium glass usually contains a maximum of 2% uranium. Uranium glass made in the early part of the 20th century can contain up to 25% uranium.

A uranium nucleus decays to thorium by emission of an alpha particle.

It can be assumed that all the energy of the decay is transferred to kinetic energy of the alpha particle.

Calculate the speed of the emitted alpha particle.

mass of uranium nucleus = 238.0003 u

mass of thorium nucleus = 233.9942 u

mass of alpha particle = 4.0015 u

(5)

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Speed of alpha particle = ...

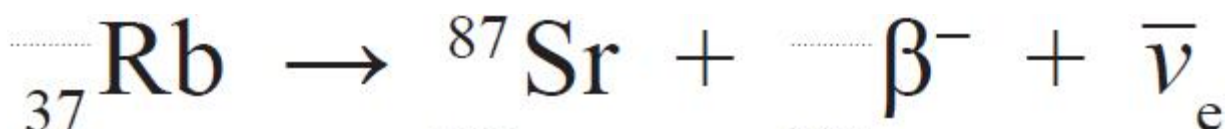
(Total for question = 5 marks)

Q3.

A hundred years ago, a method to determine the age of certain rocks was developed. An unstable isotope of rubidium is present in some rocks when they form. Over time the rubidium decays to a stable isotope of strontium.

Rubidium decays to strontium via β^- decay. Complete the nuclear equation representing the decay.

(2)



(Total for question = 2 marks)

Q4.

A student used a Geiger-Müller (GM) tube to determine the activity of a radium source. Radium emits α , β , and γ radiation.

He positioned the source 20 cm from the GM tube, as shown, and recorded the count for 1 minute. He repeated the measurement and calculated a mean count.



The student recorded the following results.

Count 1	Count 2	Mean count
183	178	181

Criticise the student's method for determining the count at this position.

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(Total for question = 3 marks)