Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Particle And Radiation

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Name of the Student:_____

Max. Marks : 22 Marks   **Time : 22 Minutes**

Q1.

A common type of smoke detector contains a very small amount of americium-241, $^{241}_{95}Am$

(a)   Determine the number of each type of nucleon in one americium-241 nucleus.

type of nucleon _____ number _____

type of nucleon _____ number _____

                                                                                        (2)

(b)   Americium-241 is produced in nuclear reactors through the decay of plutonium, $^{241}_{94}Pu$

State the decay process responsible for the production of americium-241. Explain your answer.

_____

_____

_____

                                                                                        (2)

(c)   An americium-241 nucleus decays into nuclide X by emitting an alpha particle.

Write an equation for the decay of the nucleus and determine the proton number and nucleon number of X.

nucleon number _____

proton number _____

                                                                                        (3)

(d)   The alpha radiation produced by americium-241 causes the ionisation of nitrogen and oxygen molecules in the smoke detector.

State what is meant by ionisation.

_____

_____

_____

(1)

(e)   A friend who has not studied physics suggests that a smoke detector containing radioactive material should not be sold.

Use your knowledge of physics to explain why a smoke detector containing americium-241 does not provide any risk to the user.
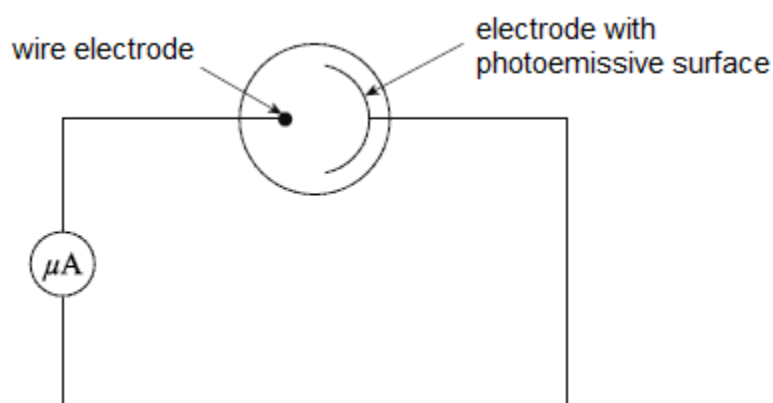
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_____

(2)
(Total 10 marks)

Q2.

Figure 1 shows a photocell which uses the photoelectric effect to provide a current in an external circuit.

Figure 1

(a)   Electromagnetic radiation is incident on the photoemissive surface.

Explain why there is a current only if the frequency of the electromagnetic radiation is above a certain value.

_____

_____

_____

_____

_____

_____

(3)

(b)　State and explain the effect on the current when the intensity of the electromagnetic radiation is increased.

_____

_____

_____

_____

(2)

(c)　A student investigates the properties of the photocell. The student uses a source of electromagnetic radiation of fixed frequency and observes that there is a current in the external circuit.

The student then connects a variable voltage supply so the positive terminal is connected to the electrode with a photoemissive surface and the negative terminal is connected to the wire electrode. As the student increases the supply voltage, the current decreases and eventually becomes zero. The minimum voltage at which this happens is called the stopping potential. The student's new circuit is shown in **Figure 2**.

Figure 2
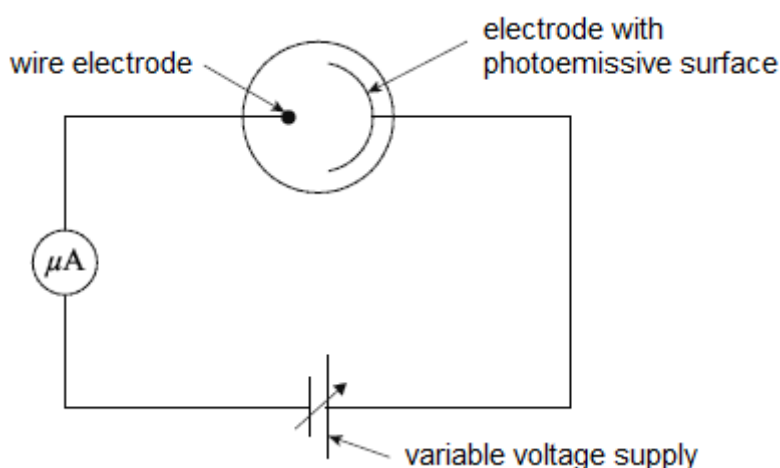
The photoemissive surface has a work function of 2.1 eV. The frequency of the electromagnetic radiation the student uses is 7.23×10^{14} Hz.

Calculate the maximum kinetic energy, in J, of the electrons emitted from the photoemissive surface.

maximum kinetic energy = _____ J

(3)

(d)   Use your answer from **part (c)** to calculate the stopping potential for the photoemissive surface.

stopping potential = _____ V

(1)

(e)   The student increases the frequency of the electromagnetic radiation.

Explain the effect this has on the stopping potential.

_____

_____

_____

_____

_____

_____

(3)
(Total 12 marks)