The Photoelectric Effect

Have a go at the following exam questions.

OCR, G482, JUNE 2009

7 In 1905 Einstein presented a theory to explain the photoelectric effect using the concept of quantisation of radiation proposed by Planck in 1900.

(a) Show, with the aid of a suitably labelled diagram, the arrangement of apparatus that could be used to demonstrate the photoelectric effect. Describe how you would use the apparatus and what would be observed.

In your answer you should make clear how your observations provide evidence for the photoelectric effect.

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..... **[5]**

(b) Describe how the photoelectric effect can be explained in terms of the physics of quantum behaviour.

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..... **[5]**

[Total: 10]

5. The work function of calcium is 4.60×10^{-19} J.

(a) (i) State what is meant by the work function of a metal. [1]

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(ii) Calculate the lowest frequency of radiation for which Einstein's photoelectric equation applies to a calcium surface. [1]

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(iii) Explain, in physical terms, why the equation does not apply for frequencies lower than this. [2]

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(b) Calculate the frequency of radiation needed to eject electrons of maximum kinetic energy 2.30×10^{-19} J from the calcium surface. [2]

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(c) A mercury vapour lamp emits ultraviolet radiation of frequencies 8.2×10^{14} Hz and 11.8×10^{14} Hz.

(i) Calculate the **maximum** kinetic energy of electrons ejected from a calcium surface when the lamp is placed near the surface. Explain your reasoning. [2]

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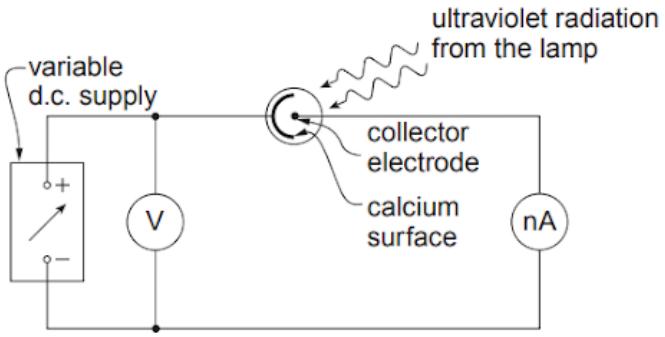
(ii) Calculate the potential difference needed to stop electrons reaching the collector electrode in the circuit shown. [1]



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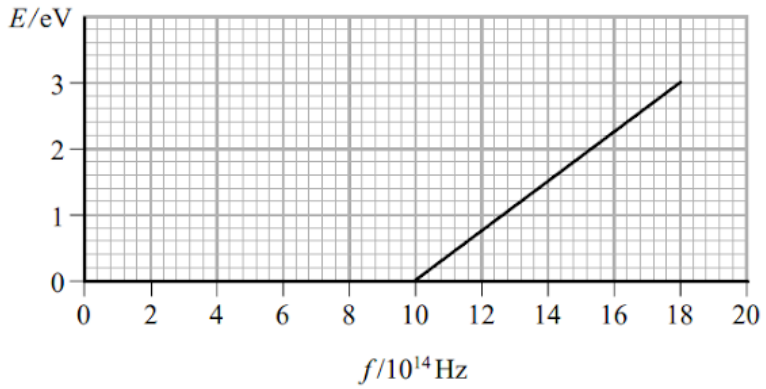
EDEXCEL, 6PH02/01, JUNE 2010

17 The graph shows how the maximum kinetic energy E of photoelectrons emitted from the surface of aluminium varies with the frequency f of the incident radiation.



(a) Explain why no photoelectrons are emitted below a frequency of 10×10^{14} Hz.

(1)

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(b) Calculate the work function of aluminium in electron volts.

(3)

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Work function = ...

(c) State the quantity represented by the gradient of the graph.

(1)

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(d) Add a second line to the graph to show how E varies with f for a metal which has a work function less than aluminium.

(2)

(Total for Question 17 = 7 marks)

EDEXCEL, 6PH02/01, JANUARY 2011

18 Ultraviolet radiation incident on a zinc plate releases electrons from the zinc's surface. The energy of each incident photon is 5.4 eV. Zinc has a work function of 4.3 eV.

(a) (i) State the name given to this effect.

(1)

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(ii) State the speed of the photons.

(1)

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(iii) What is meant by the work function of a metal?

(1)

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(b) An electron is emitted from the surface of the zinc.

(i) Calculate the maximum kinetic energy of the electron in joules.

(3)

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Maximum kinetic energy = ...

(ii) Calculate the maximum speed of the electron.

(2)

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Maximum speed = ...

(c) The intensity of the ultraviolet radiation is doubled.

State what happens to the maximum speed of an electron emitted from the zinc.

(1)

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(Total for Question 18 = 9 marks)