

# Photoelectric Effect Homework

Date: \_\_\_\_\_

1. What four observations of the photoelectric effect tell us that light behaves like a particle as well as a wave?

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2. What is the work function of a metal?

A. The minimum energy required to eject an electron

B. The minimum frequency required to eject an atom

C. The minimum wavelength required to eject an electron

D. The minimum energy required to eject a proton

3. What is the difference between threshold frequency and work function?

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4. Using the idea of Conservation of Energy, explain why the MAX value of kinetic energy is the difference between the photon energy and the work function.

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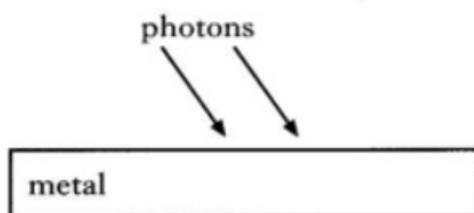
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2. To explain the photoelectric effect, light can be considered as consisting of tiny bundles of energy. These bundles of energy are called photons.

(a) Sketch a graph to show the relationship between photon energy and frequency. 1

(b) Photons of frequency  $6.1 \times 10^{14}$  Hz are incident on the surface of a metal.



This releases photoelectrons from the surface of the metal.

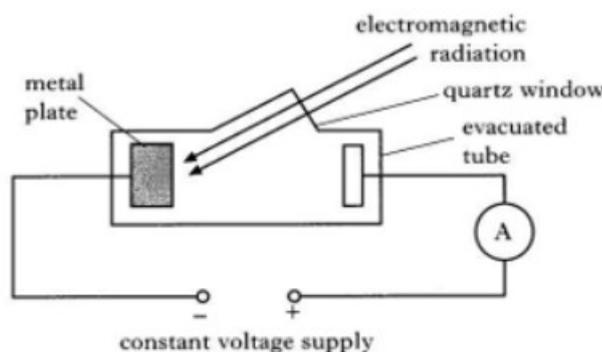
The maximum kinetic energy of any of these photoelectrons is  $6.0 \times 10^{-20}$  J.

Calculate the work function of the metal. 3

(c) The irradiance due to these photons on the surface of the metal is now reduced.

Explain why the maximum kinetic energy of each photoelectron is unchanged. 1

3. A metal plate emits electrons when certain wavelengths of electromagnetic radiation are incident on it.



When light of wavelength 605 nm is incident on the metal plate, electrons are released with zero kinetic energy.

(a) Show that the work function of this metal is  $3.29 \times 10^{-19}$  J. 5

(b) The wavelength of the incident radiation is now altered. Photons of energy  $5.12 \times 10^{-19}$  J are incident on the metal plate.

(i) Calculate the maximum kinetic energy of the electrons just as they leave the metal plate. 1

(ii) The irradiance of this radiation on the metal plate is now decreased. State the effect this has on the ammeter reading. Justify your answer. 2

When light of a certain frequency greater than the threshold frequency of a metal is directed at the metal, photoelectrons are emitted from the surface.

The power of the light incident on the metal surface is doubled.

Which row shows the effect on the maximum kinetic energy and the number of photoelectrons emitted per second?

	Maximum kinetic energy	Number of photoelectrons emitted per second	
<b>A</b>	remains unchanged	remains unchanged	
<b>B</b>	doubles	remains unchanged	
<b>C</b>	remains unchanged	doubles	
<b>D</b>	doubles	doubles	

(Total 1 mark)

Line **X** on the graphs below shows how the maximum kinetic energy of emitted photoelectrons varies with the frequency of incident radiation for a particular metal.

Which graph shows the results for a metal **Y** that has a higher work function than **X**?

