3055 BA SANGAM COLLEGE

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WORKSHEET 21

SCHOOL:BA SANGAM COLLEGE YEAR 12

SUBJECT: PHYSICS NAME OF STUDENT: _____

STRAND	*ATOMIC PHYSICS*
SUB-STRAND	*RADIOACTIVITY*
Content Learning Outcome	

PHOTOELECTRIC EFFECT

The photoelectric effect occurs when light above a certain frequency (the threshold frequency) is shone on metals like zinc, and this causes electrons to escape from the zinc. The escaping electrons are called photoelectrons.

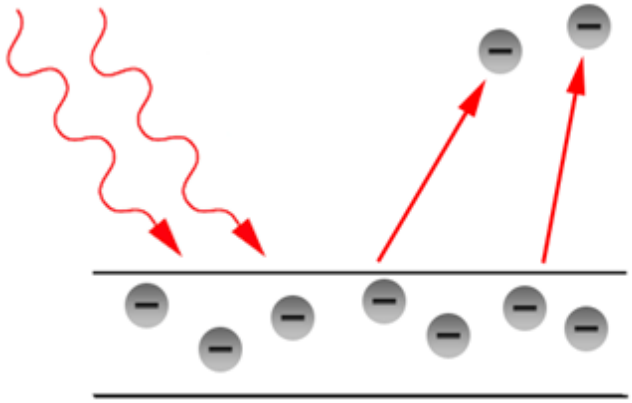
It was shown in experiments that;

-the frequency of the light needed to reach a particular minimum value (depending on the metal) for photoelectrons to start escaping the metal

-the maximum kinetic energy of the photoelectrons depended on the frequency of the light not the intensity of the light

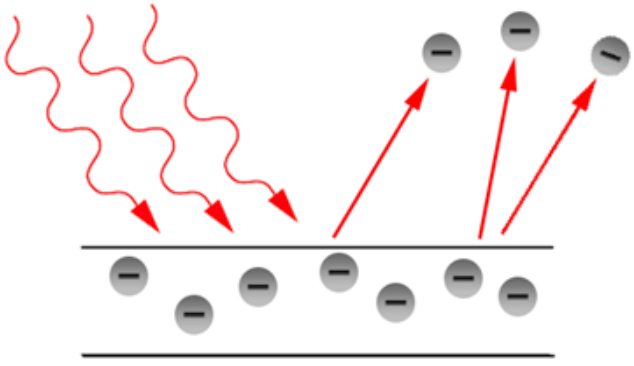
The above two observation can only be explained if the electromagnetic waves are emitted in packets of energy (quanta) called photons, the photoelectric effect can only be explained by the particle behaviour of light.

The diagram shows photons hitting the surface of a metal and photoelectrons being ejected.



Photons with their Photon Energy and at least the threshold frequency hit a metal. If the plate is Zinc, UV will nudge the photoelectrons off, if gamma rays hit the metal they will be whipped off with more force.

The surface photoelectrons absorb the energy and are emitted out of the metal with the excess energy in the form of Kinetic energy.



If the intensity increases so that there are now more photons, more photoelectrons are emitted. But each photon arriving at the surface has the same photon energy therefore each photoelectron emitted has the same kinetic energy.

Photon Energy (The Einstein relation)
Einstein assumed that each packet of light had a certain amount of energy. This energy must be proportional to its frequency.

Energy of a photon, $E = hf$

Using c = f λ we get

E = hc / λ

The Photon Energy	=	The Work Function Energy	+	The Photoelectron's Kinetic Energy.
The Photoelectron's Kinetic Energy.	=	The Photon Energy	−	The Work Function Energy
E_K	=	hf	−	ϕ

Exercise

When red light of frequency 7.5×10^{14} Hz is incident on a metal surface, the maximum kinetic energy of the emitted electrons is 9.44×10^{-20} J.

Calculate the

(i) energy of the photons. **(1 mark)**

(ii) work function of the metal. **(1 mark)**

(iii) threshold frequency of the metal. **(1 mark)**