To study photoelectric effect

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Aim, Objectives

understand the phenomenon Photoelectric effect as a whole.

draw a graph between photocurrent and applied potential for various intensities at ant frequency.

draw a graph between photocurrent and applied potential for various frequencies at ant intensity.

Apparatus used, virtual experiment link

Physical experiment:

tal plate, Ammeter, Voltmeter, variable power supply, light source s of different powers
tts) and frequency (Colour and UV light) ,

Virtual experiment:

tp://vlab.amrita.edu/index.php?sub=1&brch=195&sim=840&cnt=

ds free sign up and flash player to access the simulation on photoelectric effect virtual experim

Theory: Photoelectric effect

velopment

- Newton corpuscular theory

- Huygens's wave theory

  -supported by Interference, Diffraction, Polarization etc phenomena.

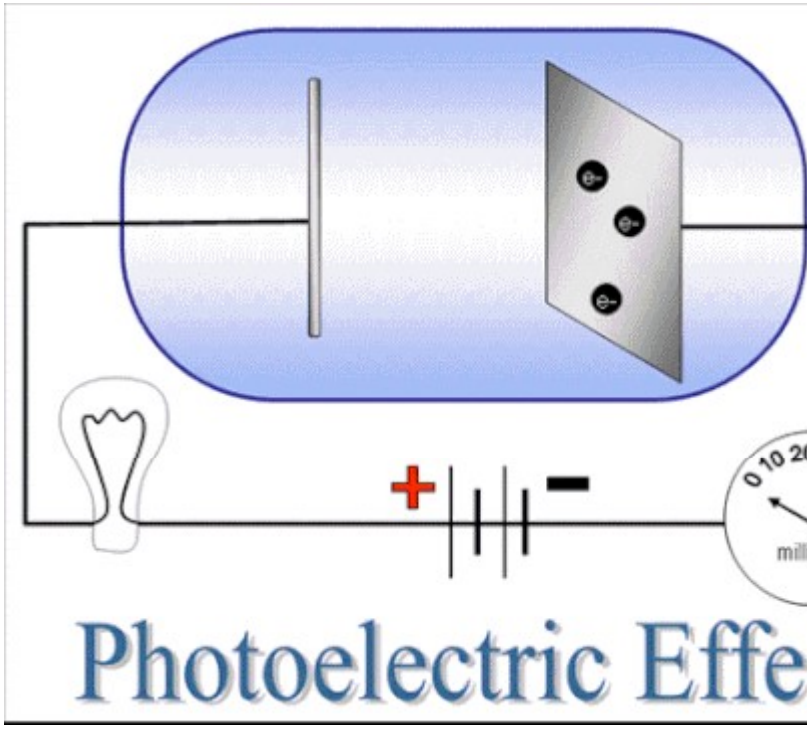
- Maxwell's electromagnetic theory

- H. Hertz experiment (1886)- photoelectric effect

Theory: Photoelectric effect

velopment

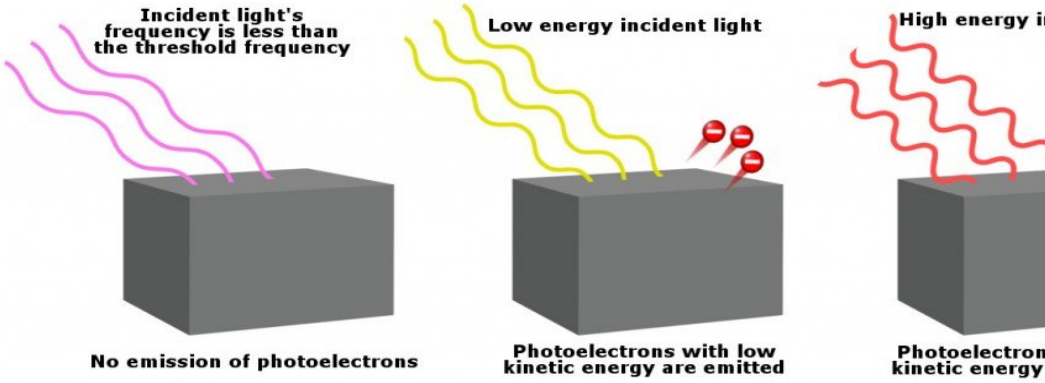
- When ultraviolet light is allowed to fall on metal plate, electrons are ejected.
- These electrons are known as photoelectrons and current is known as photocurrent.
- This phenomenon is known as photoelectric effect

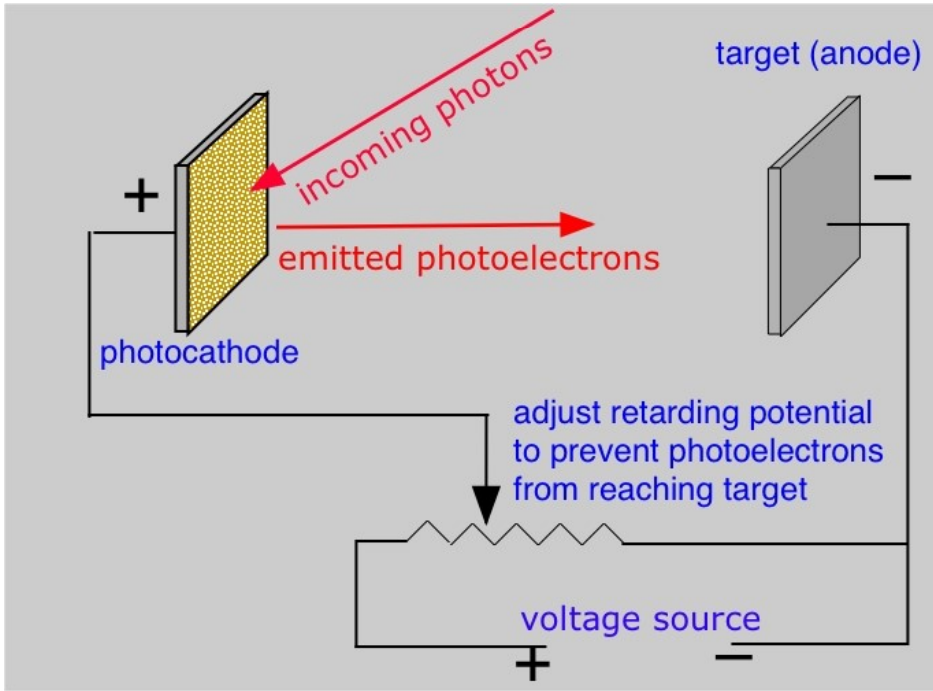


nce:https://gifer.com/en/gifs/effect; https://en.wikipedia.org/wiki/Heinrich_Hertz

Theory: Photoelectric effect- experimental observations

- No time lag.
- On increasing intensity at constant frequency, photocurrent increases.
- On frequency variation at constant intensity, stopping potential increases (more negative potential requires to stop photocurrent)





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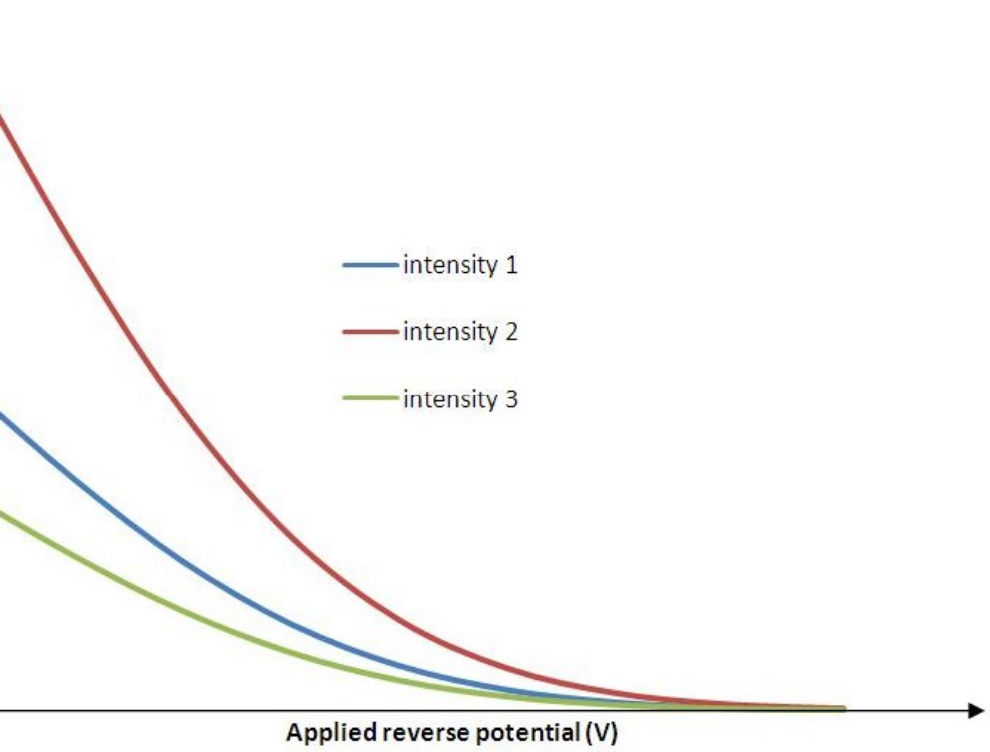
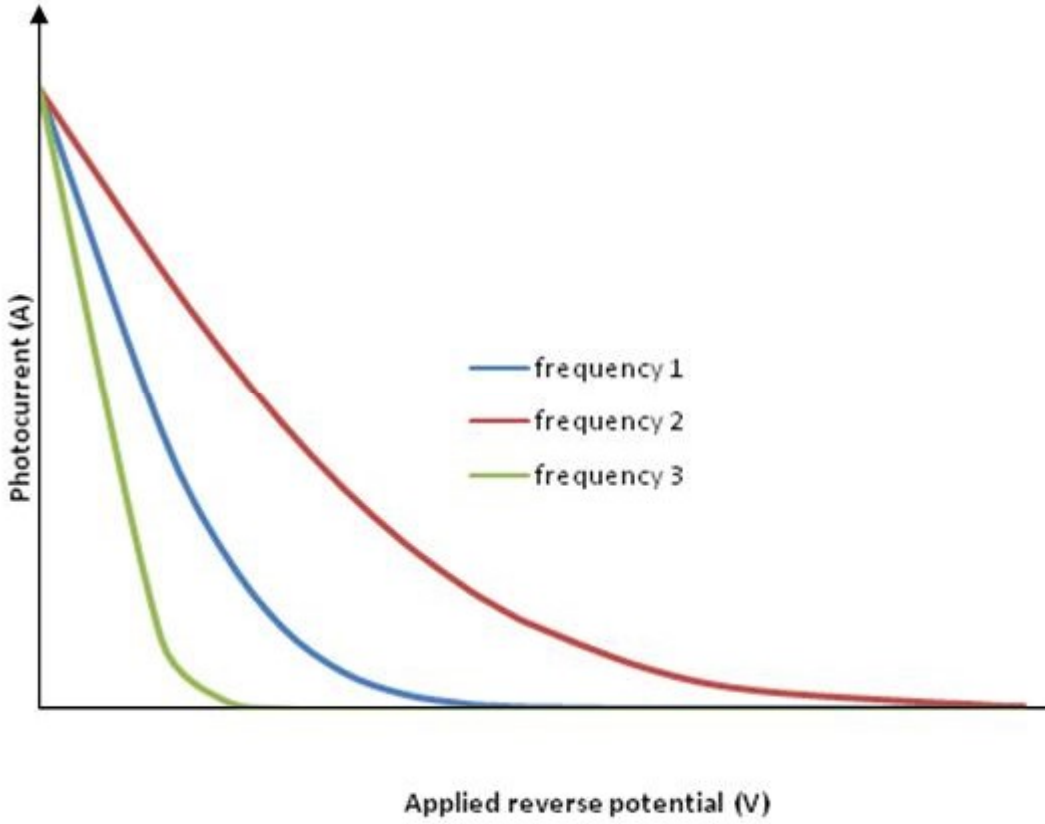
Theory: Photoelectric effect- experimental observations



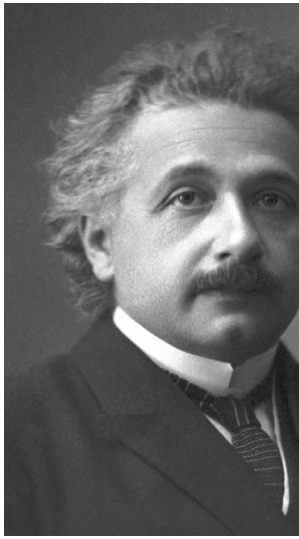


Theory: Photoelectric effect- wave theory fails to explain

- No time lag. –Not explained
- On increasing intensity at constant frequency, photocurrent increases. –Not explained as for wave intensity is related to energy= ½ eE^2 ; $E= E_0 \sin wt$
- On frequency variation at constant intensity, stopping potential increases (more negative potential requires to stop photocurrent) Not explained as for wave frequency is related to no of photoelectrons

/byjus.com/jee/photoelectric-effect/

Theory: Photoelectric effect- Einstein particle approach (1905)



- Light consist of bundle of energy known as photon or quanta ($E=h\,f$) .
- The energy required to emit electron from metal surface- Work function ($\varphi = h\,f_o$).
- Remaining part will be the KE of the emitted electron.

$$KE = h\,f - \varphi$$

$$KE = h\,f - h\,f_o$$

- When the negative potential on photoelectron receiving plate equal to the KE of emitted electron. No photocurrent will flow in the circuit.

$$KE = eV_o$$

- **Nobel prize (1921)**

www.nobelpriz

Theory: Photoelectric effect- photon theory explains

- No time lag. – explained (particle-particle interaction)
- On increasing intensity at constant frequency, photocurrent increases. –explained as intensity is related to number of photons per unit area.
- On frequency variation at constant intensity, stopping potential increases (more negative potential requires to stop photocurrent) explained as frequency is related to KE of emitted electrons.

Procedure: virtual lab

o to the given link and login-
http://vlab.amrita.edu/index.php?sub=1&brch=195&sim=840&cnt=1

. Select the material for studying photoelectric effect.

. Select area of the material,wave-length,intensity of incident light.

. Switch on the light source.

Procedure: virtual lab

. Measure the reverse current for various reverse voltages.

. Plot the current-voltage graph and determine the threshold voltage.

. Repeat the experiment by varying the intensity for a particular wavelength of
ncident light.

. Repeat the experiment by varying the wavelength for a particular intensity of the
ncident light

Observations

Table for intensity variation at constant frequency

Material- Plate area-

Wavelength=

S.No.	Voltage (V)	Current (μA)		
		I=5 w/m2	I=10w/m2	I=15 w/m2
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Observations

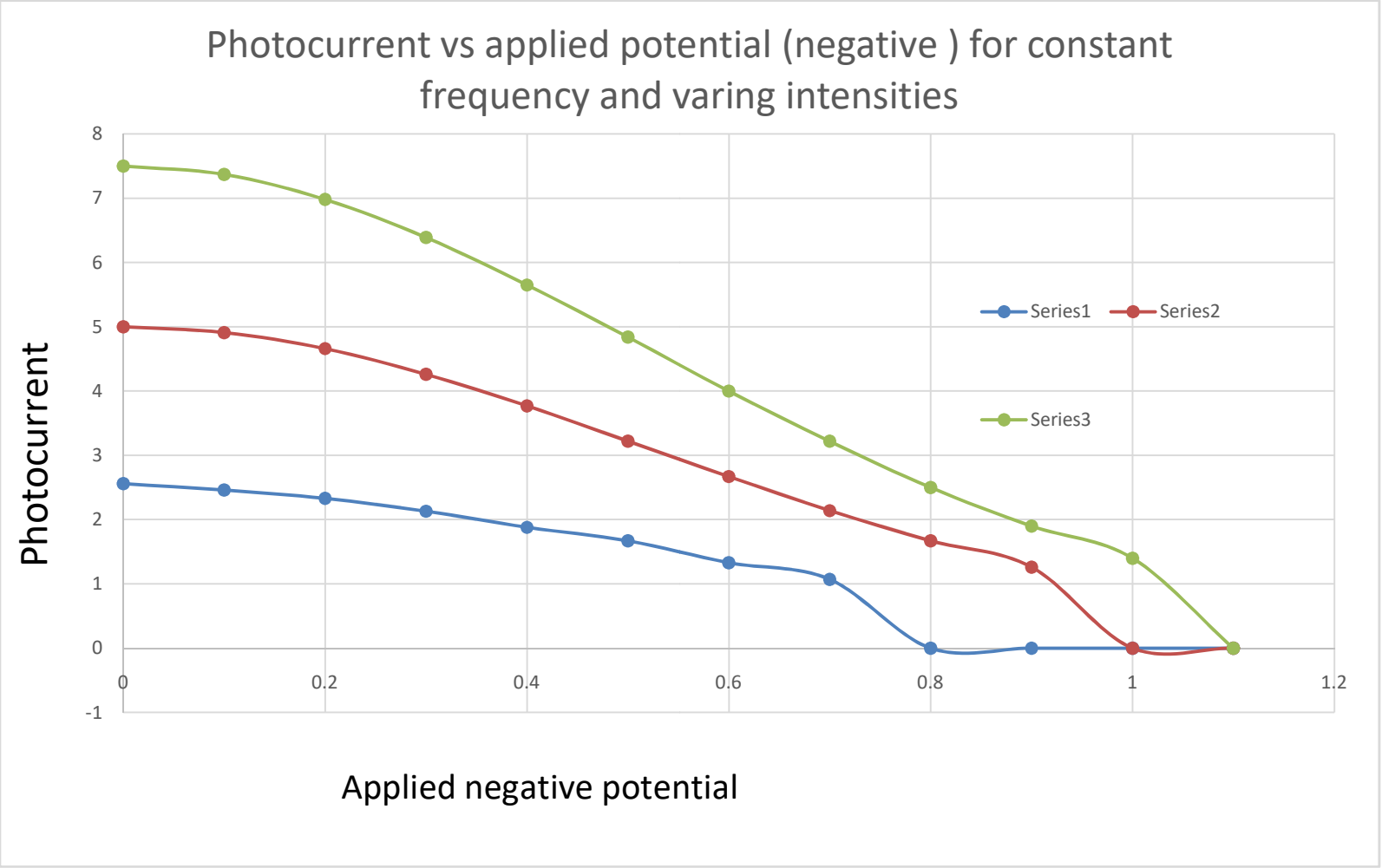
Table for intensity variation at constant frequency

Material- Sodium Plate area-0.1 cm2

Wavelength= 350 nm

S.No.	Voltage (V)	Current (μA)		
		I=5 w/m2	I=10w/m2	I=15 w/m2
1	0	2.56	5	7.5
2	0.1	2.46	4.91	7.37
3	0.2	2.33	4.66	6.98
4	0.3	2.13	4.26	6.39
5	0.4	1.88	3.77	5.65
6	0.5	1.67	3.22	4.84
7	0.6	1.33	2.67	4
8	0.7	1.07	2.14	3.22
9	0.8	0	1.67	2.5
10	0.9	0	1.26	1.9
11	1	0	0	1.4
12	1.1	0	0	0

Observations- Graph



Observations

Table for frequency variation at constant intensity

Material- Plate area-

Intensity=

S.No.	Voltage (V)	Current (μA)		
		f=6.64 x 10^14 Hz	f=7.5 x 10^14 Hz	f=8.57 x 10^14 Hz
1	0	5	5	5
2	0.1	4.38	4.79	4.91
3	0.2	2.98	4.23	4.66
4	0.3	1.6	3.44	4.26
5	0.4	0	2.59	3.77
6	0.5	0	1.81	3.22
7	0.6	0	1.18	2.67
8	0.7	0	0	2.14
9	0.8	0	0	1.67
10	0.9	0	0	1.26
11	1	0	0	0
12	1.1	0	0	0
13	1.2	0	0	0

Observations

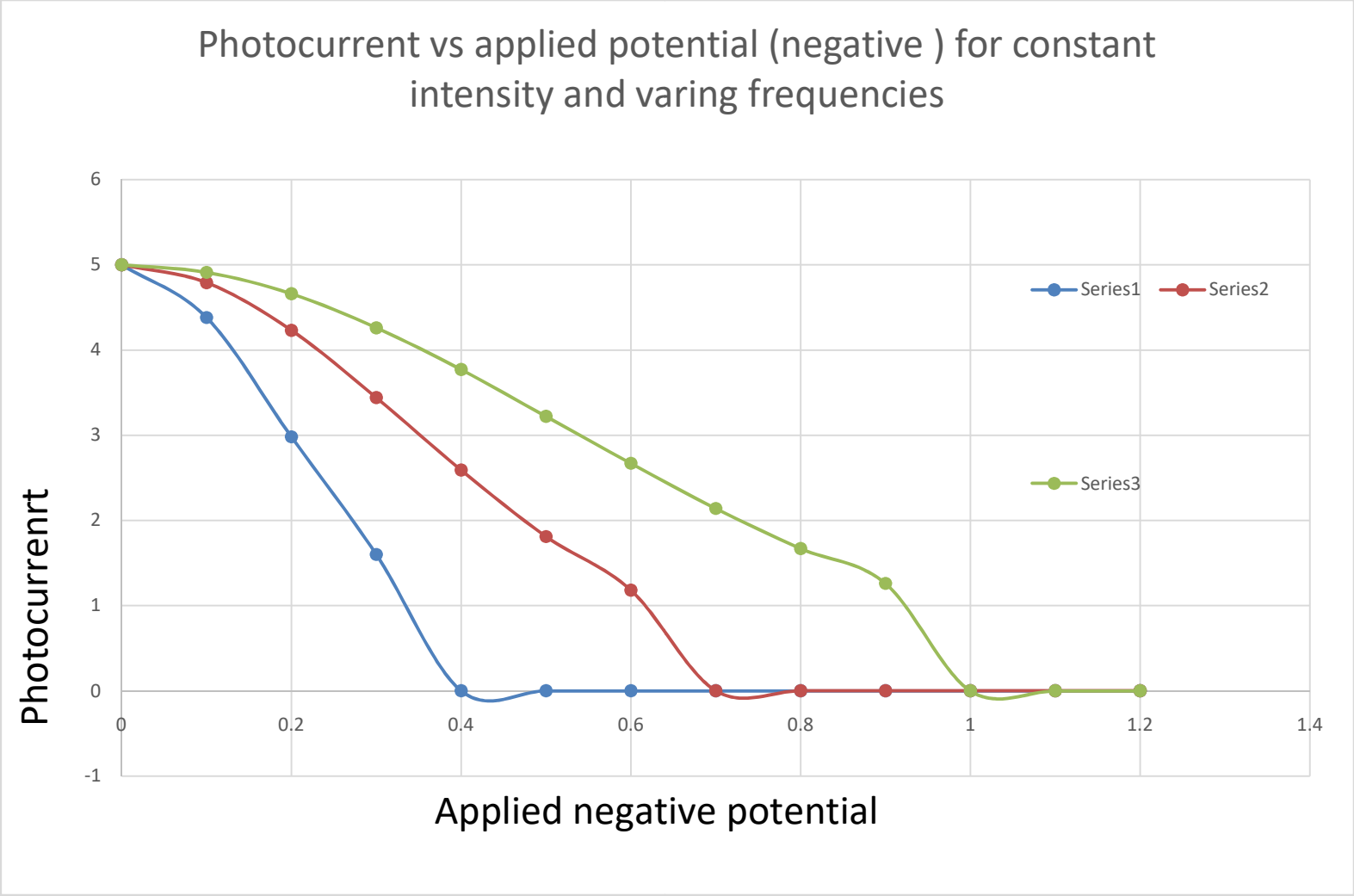
Table for frequency variation at constant intensity

Material- Sodium Plate area-0.1 cm2

Intensity= 10 w/m2

S.No.	Voltage (V)	Current (μA)		
		f=6.64 x 10^14 Hz	f=7.5 x 10^14 Hz	f=8.57 x 10^14 Hz
1	0	5	5	5
2	0.1	4.38	4.79	4.91
3	0.2	2.98	4.23	4.66
4	0.3	1.6	3.44	4.26
5	0.4	0	2.59	3.77
6	0.5	0	1.81	3.22
7	0.6	0	1.18	2.67
8	0.7	0	0	2.14
9	0.8	0	0	1.67
10	0.9	0	0	1.26
11	1	0	0	0
12	1.1	0	0	0
13	1.2	0	0	0

Observations- Graph



Observations

- Go to the given link and login- http://vlab.amrita.edu/index.php?sub=1&brch=195&sim=840&cnt=1
- The kinetic energy on decreasing the negative potential at at electron capturing plate– explained
- On increasing intensity at constant frequency, photocurrent increases. –explained as intensity is related to number of photons per unit area.
- On frequency variation at constant intensity, stopping potential increases (more negative potential requires to stop photocurrent) explained as frequency is related to KE of emitted electrons.

Results

(1) The phenomenon of Photoelectric effect is studied as a whole.

(2) A graph is plotted between photocurrent and applied potential for varic intensities at constant frequency.

(3) A graph is plotted between photocurrent and applied potential for varic frequencies at constant intensity.

Precautions

Precautions (for physical experiment)-

1. The wires should be connected tightly.

2. Switch off the various appliances when not in use.

Precautions (for virtual experiment)-

1. Sign up in the given link

1. Cite the reference of virtual link in the project/record of lab work.

THANK YOU