광전효과와 태양전지

정애라

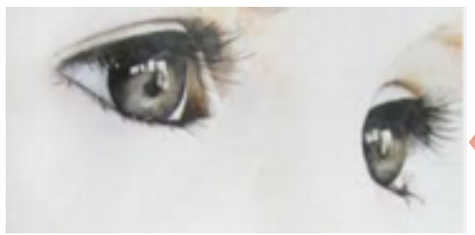
WHAT IS LIGHT?

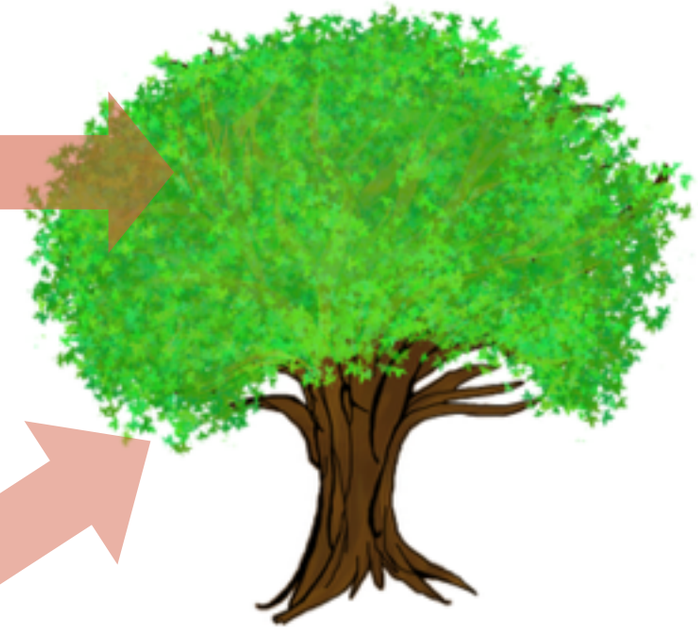
- Information transfer: sound and light





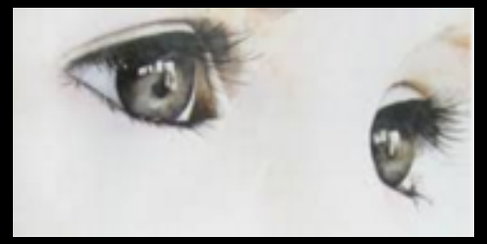
- with light: seeing the messengers







- w/o light



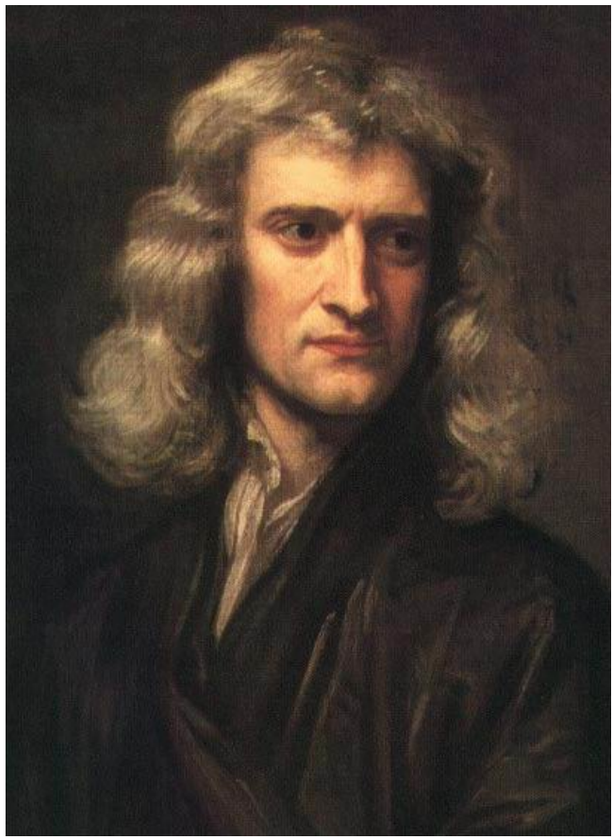
WHAT IS LIGHT?

- Wave theories of light



Christian Huygens (1629-1695)

- Particle theory of light



Sir Isaac Newton (1643-1727)

CORPUSCULAR THEORY OF LIGHT

CORPUSCULAR THEORY OF LIGHT

CORPUSCULAR THEORY OF LIGHT

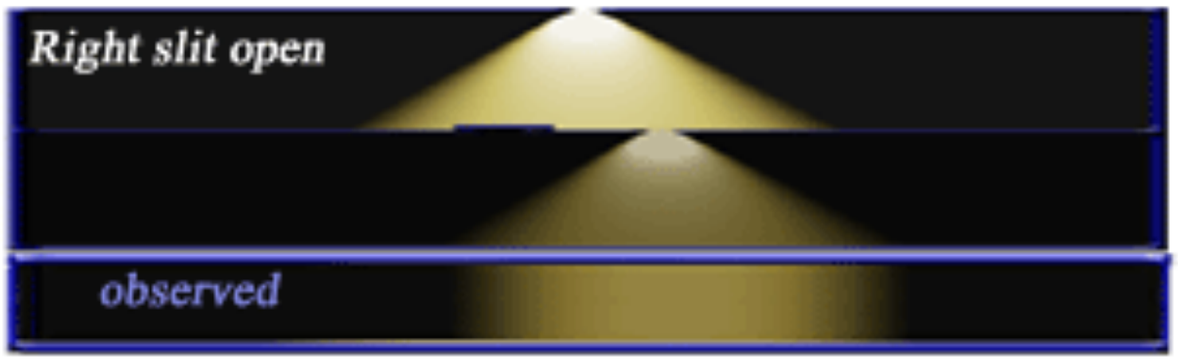
CORPUSCULAR THEORY OF LIGHT

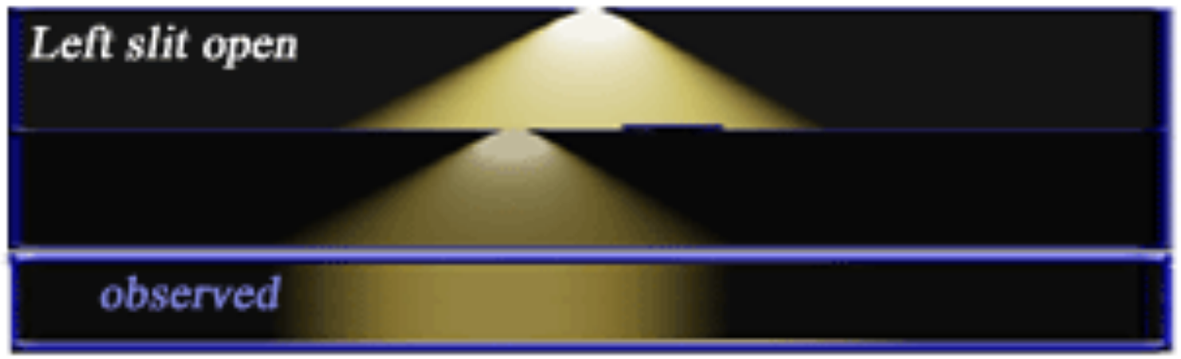
"Light does not bend into the shadow."

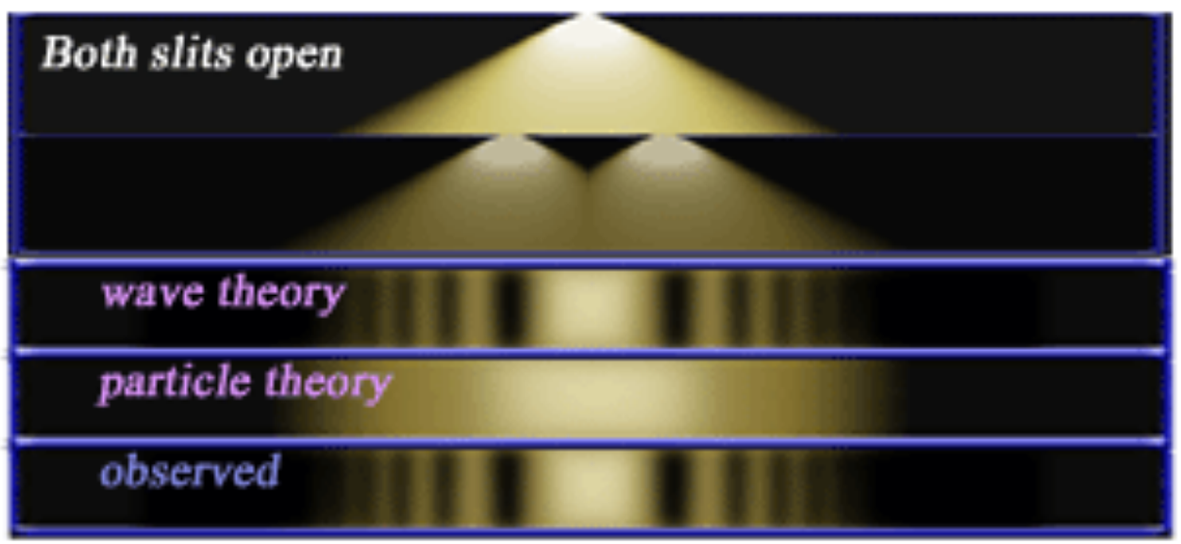
DIFFRACTION

https://www.youtube.com/watch?v=GgfKdVFfM28

DOUBLE SLIT EXPERIMENT OF YOUNG







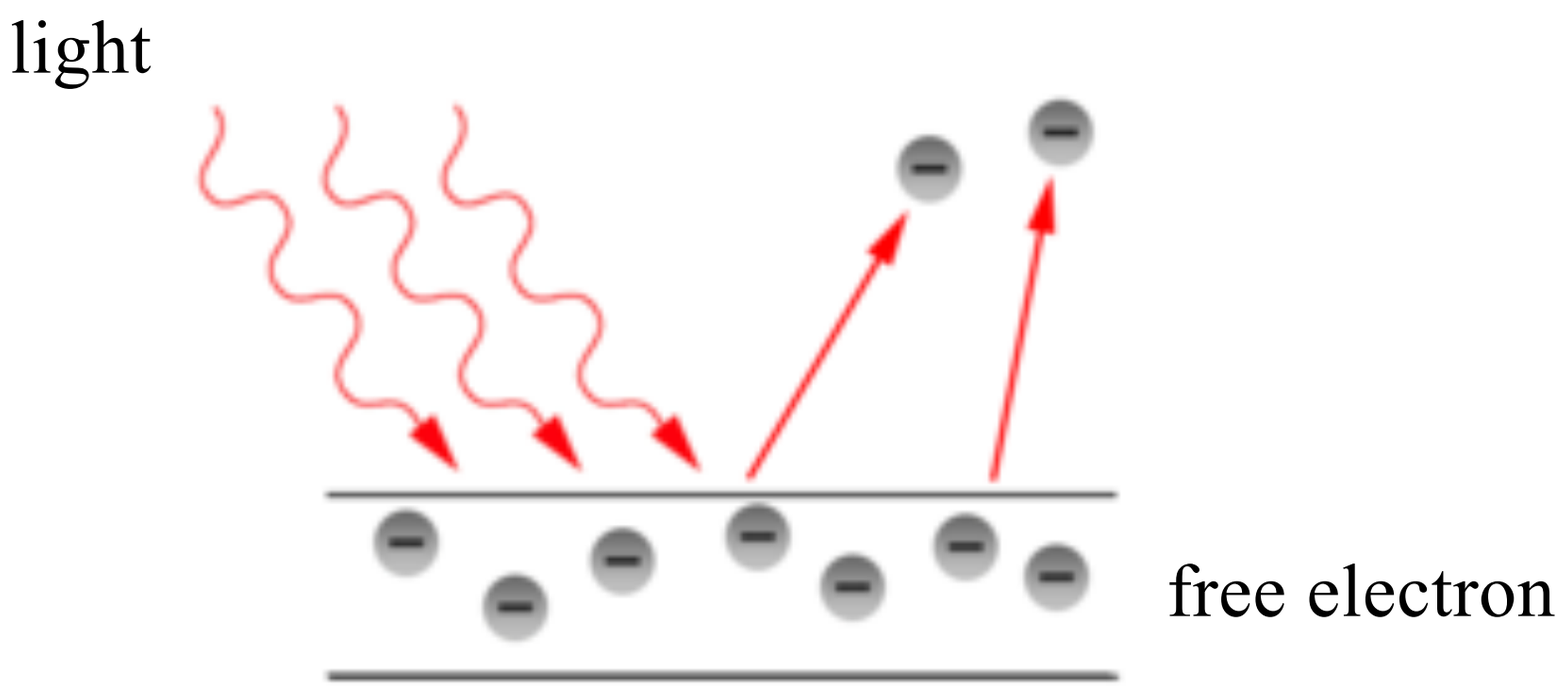


Thomas Young
(1773-1829)

Light is WAVE!

PARTICLE NATURE OF LIGHT

- Photoelectric effect (광전효과)



LIGHT IS WAVE

➤ 빛의 세기가 세다 = 진폭이 크다 = 에너지가 크다

$$E=kA^2f \qquad (k: \text{비례상수}, A: \text{진폭}, f: \text{진동수})$$

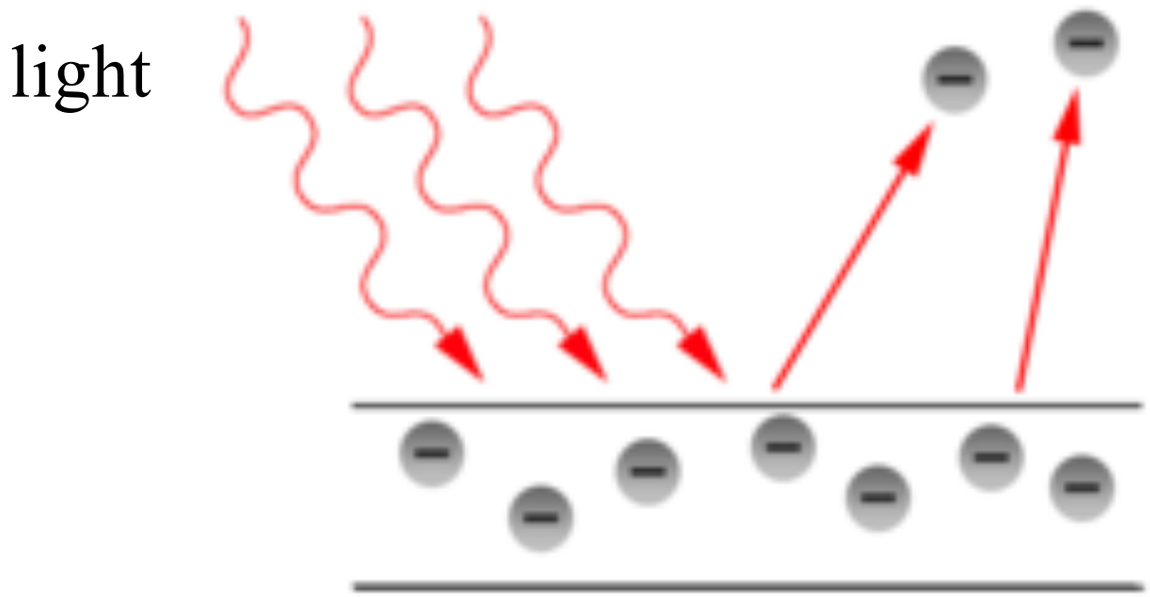
➤ 빛

- 강: 전자가 즉시 방출된다.
- 약: 에너지가 흡수되는데 시간이 필요해서 전자가 천천히 방출된다.

➤ 전자가 가지는 에너지는 빛의 세기와 관련이 없다.

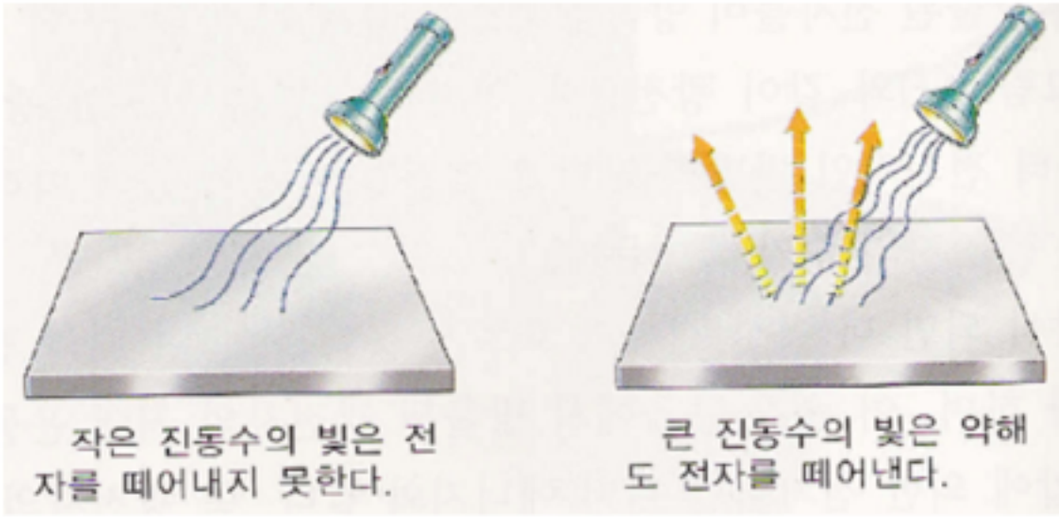
PARTICLE NATURE OF LIGHT

- Photoelectric effect (광전효과)



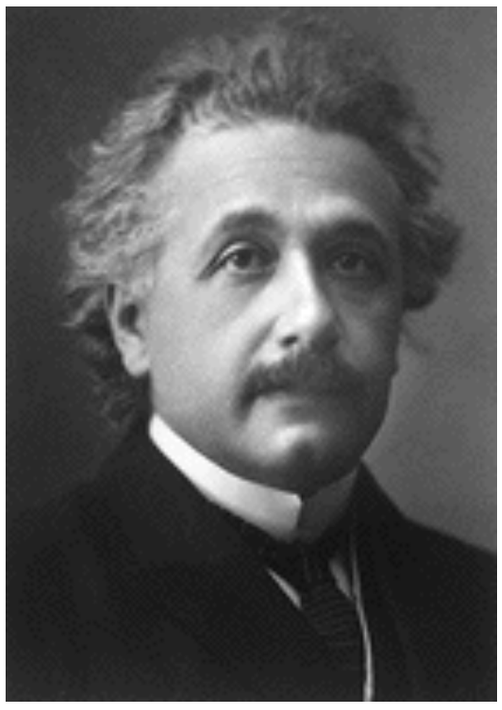
Electrons are emitted:

- Instantaneously when light is applied
- Only when f, is higher than certain value
- below that f, intensity doesn't matter



DUALITY OF LIGHT

- Atoms of light



Albert Einstein

(1879 ~ 1955)

"I therefore take the liberty of proposing for this hypothetical new atom, which is not light but plays an essential part in every process of radiation, the name photon", Gibert Newton, Lewis, 1926

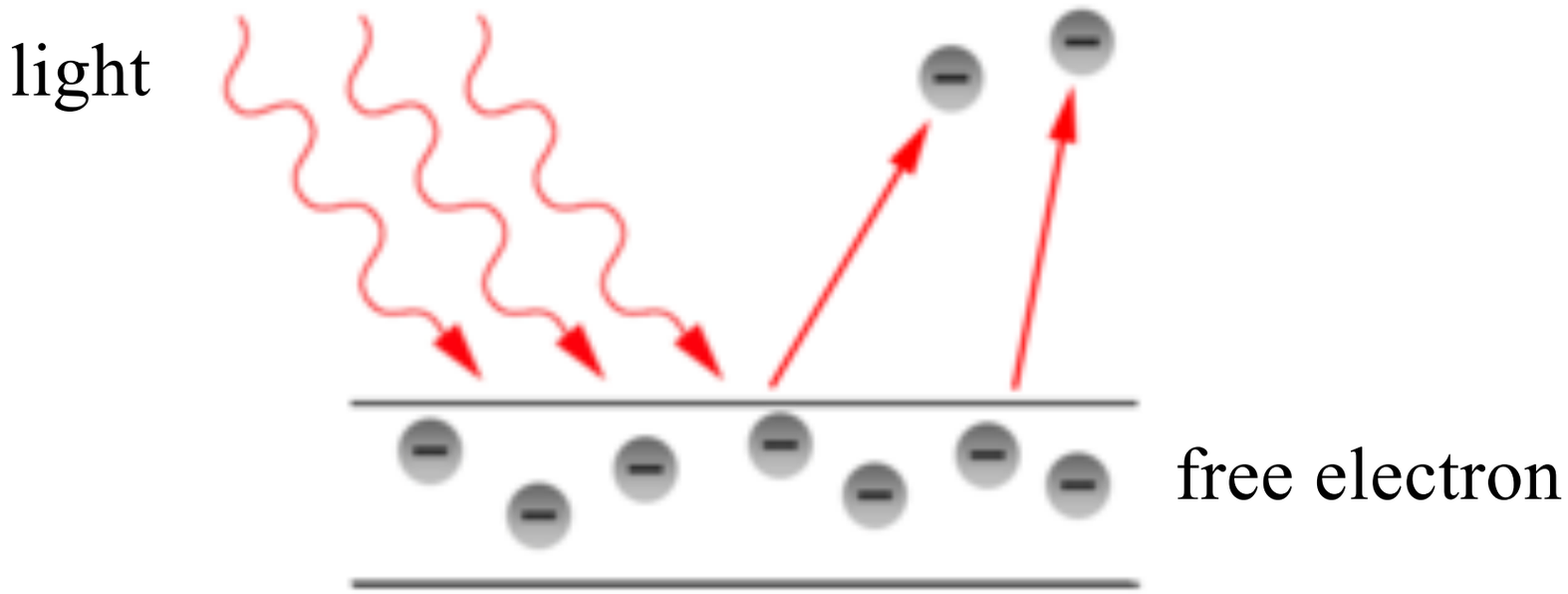
"On a Heuristic Viewpoint Concerning the Production and Transformation of Light", Einstein, 1905

Light is composed of light quanta E=hf

Light (wavicle) = wave + particle

PARTICLE NATURE OF LIGHT

➤ Photoelectric effect (광전효과)



1) One-to-one interaction of a light quantum *(hf)* and the electron.

PARTICLE NATURE OF LIGHT



총 2만원

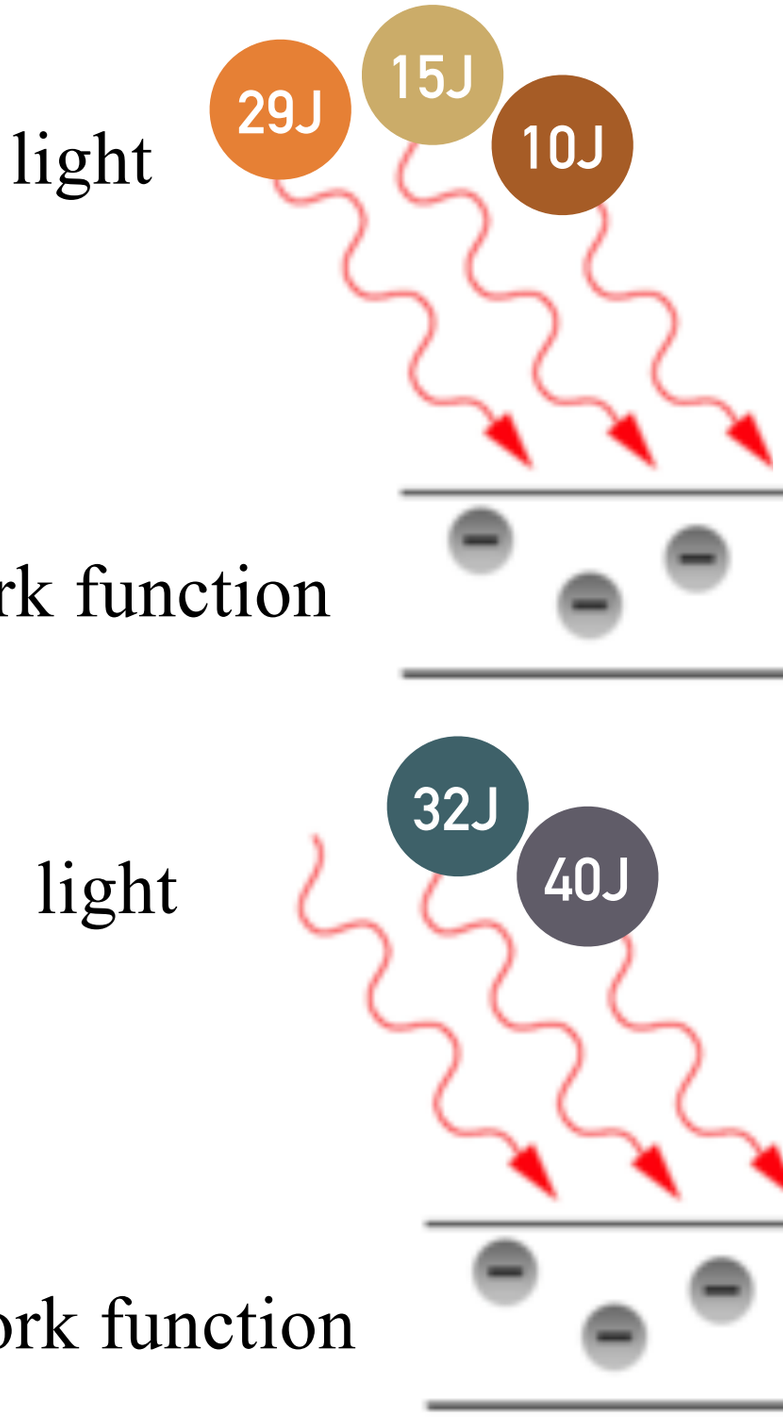


총 5만원

2) Each signal photon will have the same photon energy.

PARTICLE NATURE OF LIGHT

➤ Photoelectric effect (광전효과)



ENERGY OF PHOTONS

- Frequency

$E=hf$ $\quad$ *h: Planck's constant* $(6.626 \times 10^{-34} Js)$

$E>W$

$f_0>W/h$ $\quad$ f_0: *threshold frequency*

- Wavelength

$C= \lambda f$

$\lambda_0 < hc/W$ $\quad$ λ_0 : *threshold wavelength*

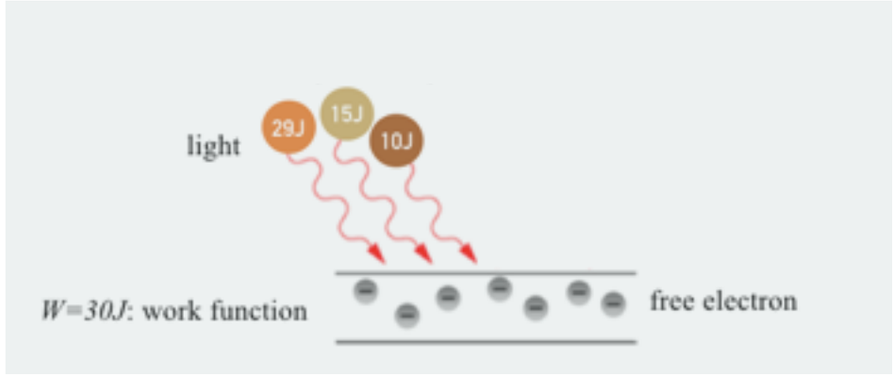
GRAPH OF FREQUENCY

$E-W=E_k$

↑

$E=hf$ h: Planck's constant ($6.626\times10^{-34}Js$)

$hf-W=E_k$ $ax-b=y$

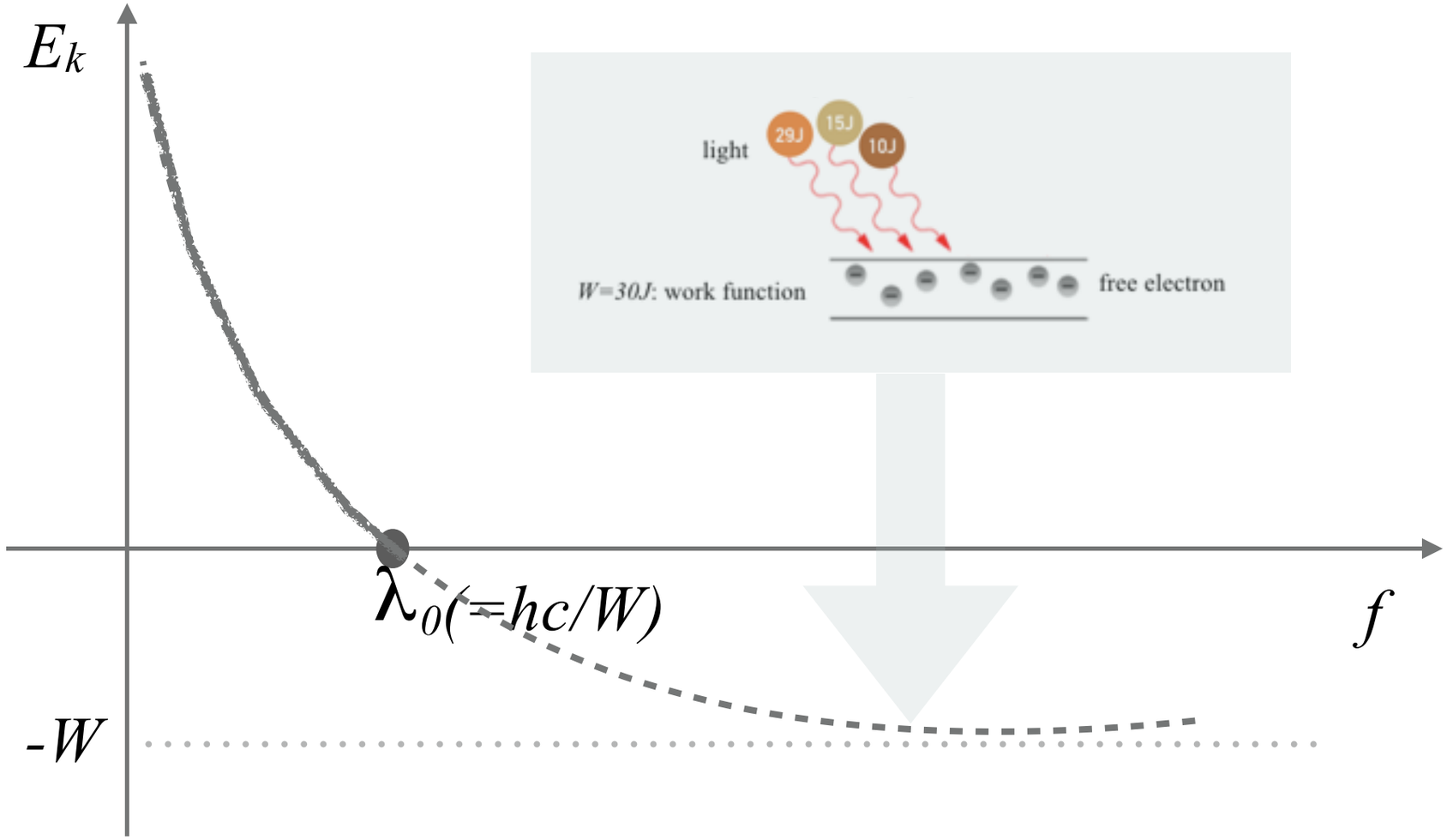


GRAPH OF WAVELENGTH

$E\text{-}W=E_k$ $\qquad$ $C=\lambda f$

$E=hf$

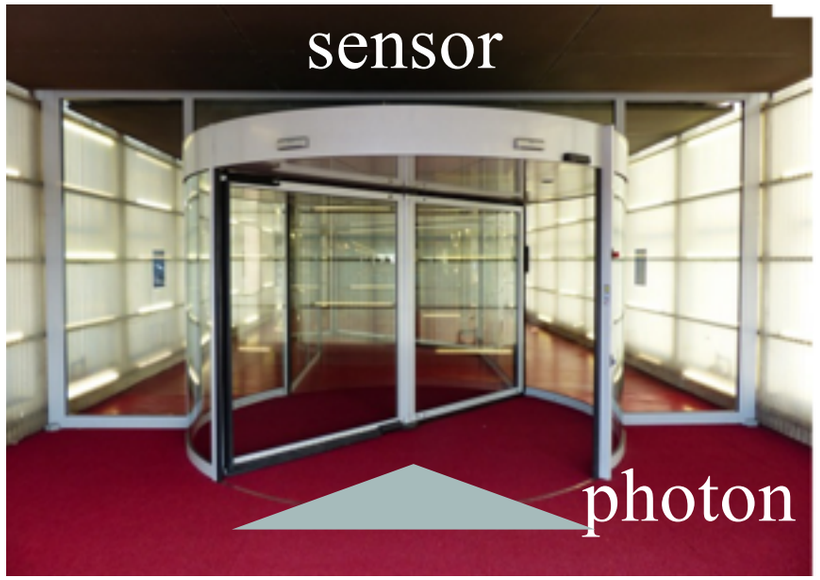
$hC/\lambda\text{-}W=E_k$ $\qquad$ $a/x\text{-}b=y$

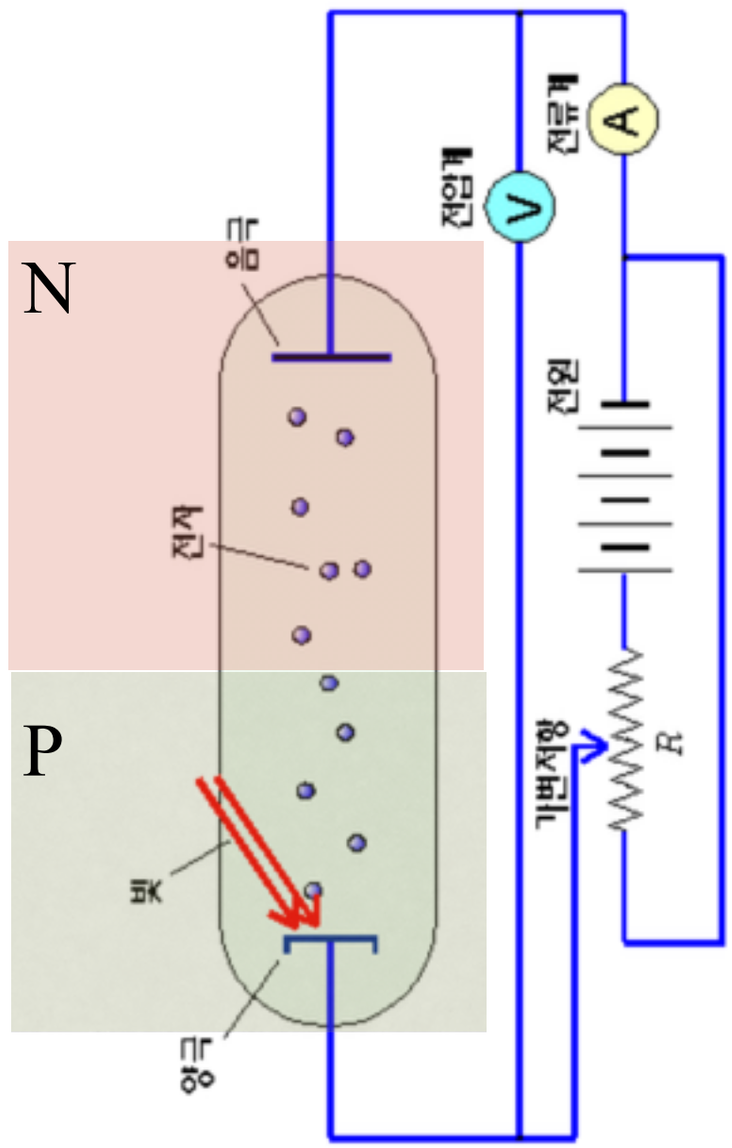


APPLICATION



ultraviolet







infrared

