

Exercise walk-through

15.5

The Photoelectric Effect

AP Physics 2

The photoelectric effect

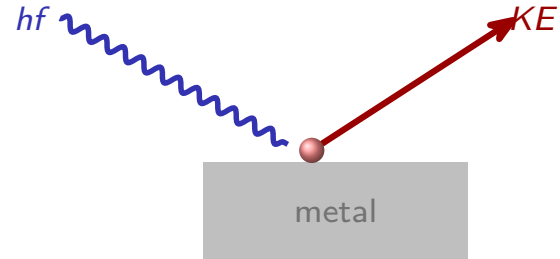
Light ejects electrons from a metal – only if each photon is energetic enough:

One photon, one electron

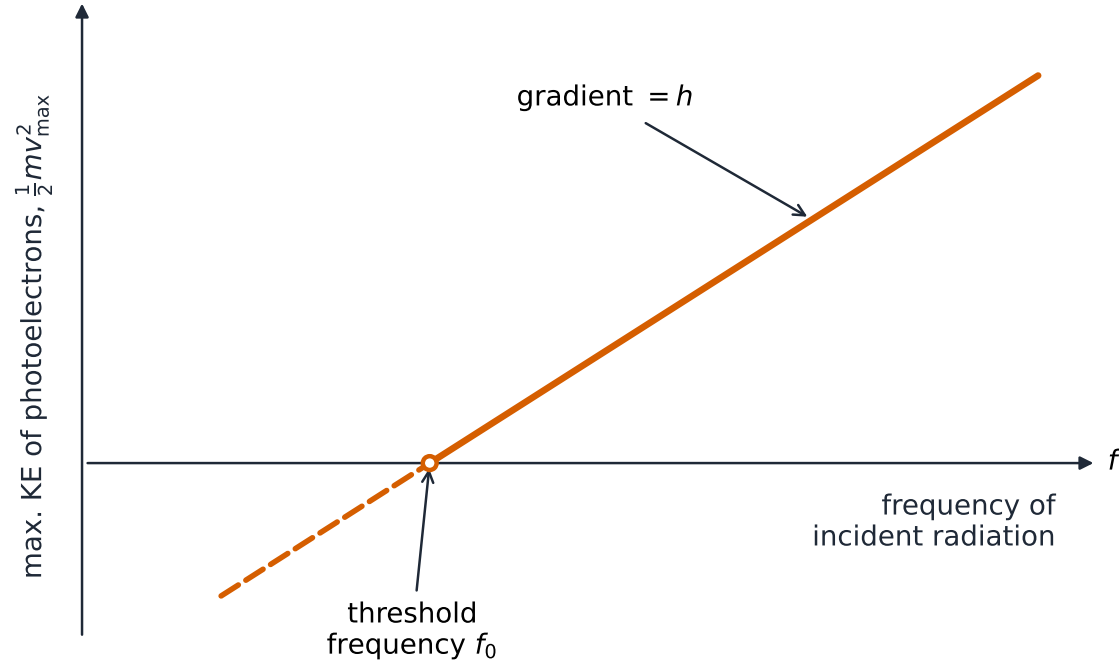
$$E = hf = \phi + KE_{max}$$

work function ϕ = energy to escape.

Below the **threshold frequency**, **no** electrons come out – however bright the light.



The maximum kinetic energy of photoelectrons rises



The maximum kinetic energy of photoelectrons rises linearly with frequency

Exercises 2.1-2.3

2.1 State what the photoelectric effect is.

[1]

2.2 Define the work function of a metal.

[1]

2.3 A metal has a work function of 2.0 eV. A photon of 5.0 eV strikes it. Find the maximum kinetic energy of the ejected electron.

[2]

Exercises 2.1-2.3

2.1 State what the photoelectric effect is.

[1]

2.1

- light ejecting electrons from the surface of a metal

2.2 Define the work function of a metal.

[1]

2.2

- the minimum energy needed to free an electron from the metal

2.3 A metal has a work function of 2.0 eV. A photon of 5.0 eV strikes it. Find the maximum kinetic energy of the ejected electron.

[2]

2.3

- $KE_{max} = hf - \phi = 5.0 - 2.0 = 3.0 \text{ eV}$

Exercises 3.1-3.2

3.1 The photoelectric equation is

[1]

☐

A $hf = \phi + KE_{max}$

B $E = mc^2$

C $E = \frac{1}{2}mv^2$

D $\lambda = h/p$

3.2 Below the threshold frequency, the number of electrons emitted is

[1]

☐

A at its maximum

B zero

C half the usual

D steadily increasing

Exercises 3.1-3.2

3.1 The photoelectric equation is

[1]

☐

A $hf = \phi + KE_{max}$

B $E = mc^2$

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D $\lambda = h/p$

3.1 A

- $hf = \phi + KE_{max}$.

3.2 Below the threshold frequency, the number of electrons emitted is

[1]

☐

A at its maximum

B zero

C half the usual

D steadily increasing

3.2 B

- zero.

Exercise 3.3 (a)

3.3 Light of photon energy 4.0 eV strikes a metal of work function 2.5 eV .

(a) Find the maximum kinetic energy of an ejected electron.

[2]

Exercise 3.3 (a)

3.3 Light of photon energy 4.0 eV strikes a metal of work function 2.5 eV.

(a) Find the maximum kinetic energy of an ejected electron.

[2]

(a)

- $KE_{max} = 4.0 - 2.5 = 1.5 \text{ eV}$

Exercise 3.3 (b)

3.3 Light of photon energy 4.0 eV strikes a metal of work function 2.5 eV .

(b) Explain why even very dim light of this frequency still ejects electrons. [2]

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3.3 Light of photon energy 4.0 eV strikes a metal of work function 2.5 eV .

(b) Explain why even very dim light of this frequency still ejects electrons. [2]

(b)

- each photon has enough energy on its own to free an electron, so even a few photons (dim light) eject some – brightness only changes how many