

15.5 The Photoelectric Effect

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS work function 功函数 • photoelectric effect 光电效应
• threshold frequency 截止频率 • photons 光子

Objective

Build the skills to answer exam questions on **the photoelectric effect**.

You must be able to:

- describe the **photoelectric effect** 光电效应: light ejecting electrons from a metal
- apply the photoelectric equation $E = hf = \phi + KE_{max}$ with the **work function** 功函数 ϕ
- explain why a **threshold frequency** 截止频率 exists

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ The photoelectric effect

Light shining on a metal can eject electrons, but only if each **photon** carries enough energy.

■ The photoelectric equation

$hf = \phi + KE_{max}$, where ϕ (the work function) is the minimum energy to free an electron, and KE_{max} is the most kinetic energy an ejected electron can have.

■ Threshold frequency

Below a threshold frequency f_0 (where $hf_0 = \phi$), **no** electrons are emitted, however bright the light — direct evidence that light is quantized.

2 Practice

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]

3 Exam-style questions

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 |

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]

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