Photoelectric-001-worked

10 March 2020 10:03

lit 18

SECTION C

Answer **all** the questions.

This section is based on the Advance Notice article, which is an insert.

7 In 1905, Einstein explained the photoelectric effect using the equation

maximum kinetic energy of photoelectrons emitted from a surface = $hf - \phi$

where h is the Planck constant, f is the frequency of light incident on the surface and ϕ is the work function of the surface. Fig. 7.1 shows this relationship for the metal rubidium.

$E_k = hf - \phi$

$y = mx + c$

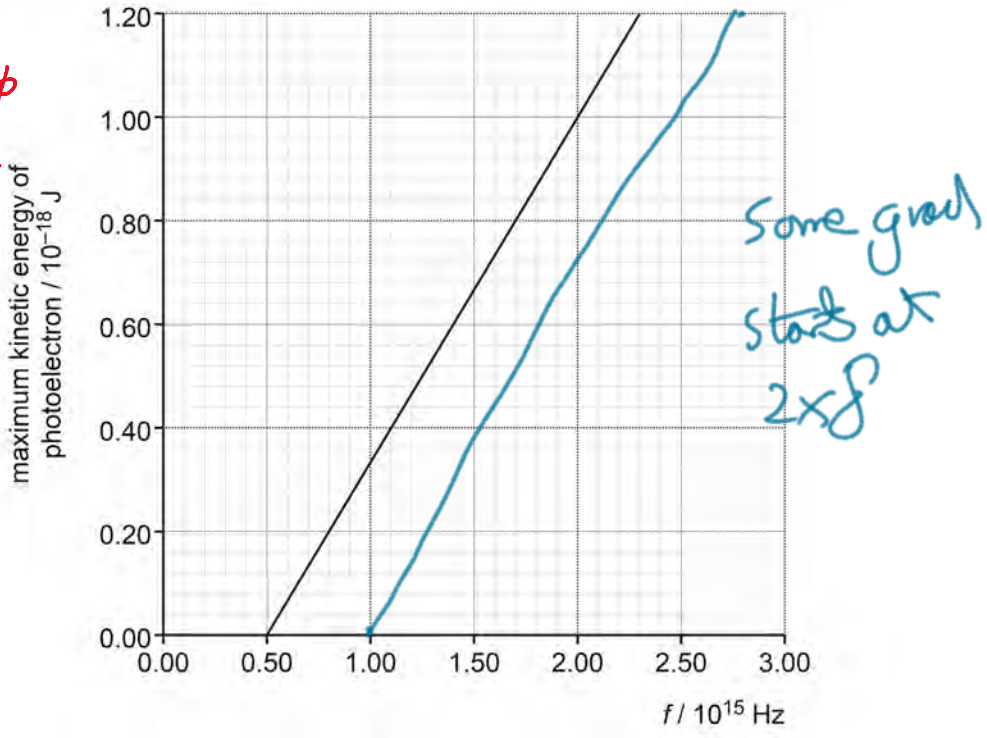

Fig. 7.1

(a) (i) Use the graph in Fig. 7.1 to find the work function of the metal.

where $E_k = 0$ $\quad 0 = hf_0 - \phi \Rightarrow \phi = hf_0$ $\quad f_0 = 0.5 \times 10^{15}$

(6.6×10^{-34})

where $KE = 0$ $\quad 0 = hf_0 - \phi \Rightarrow \phi = hf_0$

6.63×10^{-34}

3.3×10^{-19}

work function = ... J **[2]**

(ii) Explain the meaning of the term *work function* and explain why Einstein's equation gives the **maximum** kinetic energy of the electrons emitted for a particular frequency of incident light (lines 14 – 17 in the Article).

ϕ is min energy to release e^- from surface of metal.

Some photons will be absorbed by photons deeper than surface (require more energy) **[2]**

(b) Add a second line to the graph of Fig. 7.1 for a metal surface with a work function which is double that of the work function for rubidium. **[2]**

Turn over

fund 2018

$1eV = 1.6 \times 10^{-19}\ J$

11 An electron is travelling at a speed of $3.1 \times 10^5\,m\,s^{-1}$.

What is its kinetic energy in electronvolts?

$E = \frac{1}{2} m v^2$

$= \frac{1}{2} \times 9.11 \times 10^{-31} \times (3.1 \times 10^5)^2$

$= 4.38 \times 10^{-20}\ J$

$\therefore eV: \quad \frac{4.38 \times 10^{-20}}{1.6 \times 10^{-19}}$

A $4.4 \times 10^{-20}\,eV$

B $8.8 \times 10^{-7}\,eV$

C 0.27 eV

D 500 eV

Your answer [ ] **[1]**

fund 2017

9 Electrons accelerated through a potential difference V pass through a thin layer of graphite. The beam forms a diffraction pattern of rings on a fluorescent screen.
When V is made larger the diameter of the rings get smaller and they also become brighter.

Which **one** of the following statements about this experiment is correct?

A The power delivered to the fluorescent screen decreases as V increases.

B The diameter of the diffraction rings is independent of the interatomic spacings in graphite.

C The wavelength of the electrons decreases as their kinetic energy increases.

D The momentum of the electrons decreases as V increases.

Your answer [ ] **[1]**

10 Which **one** of the following statements about photons is correct?

10 Which **one** of the following statements about photons is correct?

The probability of arrival of a photon at a position

A is proportional to the amplitude of the waves arriving at that position.

B is greater if the phasor amplitudes for paths from the source to that position "curl up" when they are added.

C is proportional to the (resultant phasor amplitude)^2 for all photon paths from the source to that position.

D is proportional to the phasor amplitude for the photon path straight from the source to that position.

Your answer [ ] **[1]**