

Q8: This question has Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement-1: When ultraviolet light is incident on a photocell, its stopping potential is V_0 and the maximum kinetic energy of the photoelectrons is K_{\max} . When the ultraviolet light is replaced by X-rays, both V_0 and K_{\max} increase.

Statement-2: Photoelectrons are emitted with speeds ranging from zero to a maximum value because of the range of frequencies present in the incident light.

- (a) Statement-1 is true, Statement-2 is false
- (b) Statement-1 is true, Statement-2 is True; Statement-2 is the correct explanation of Statement-1
- (c) Statement-1 is true, Statement-2 is True; Statement-2 is not the correct explanation of Statement-1
- (d) Statement-1 is False, Statement-2 is true

Solution

According to Einstein's photoelectric equation

$$K_{\max} = hf - \Phi_0$$

where, f = frequency of incident light

Φ_0 = work function of the metal

Since the frequency of ultraviolet light is less than the frequency of x-rays, the energy of the photon will be more than x-rays

$$\text{Since } K_{\max} = eV_0$$

$$V_0 = (hf/e) - (\Phi_0/e)$$

$$\text{AS } f_{\text{X-rays}} > f_{\text{Ultraviolet}}$$

Therefore, both K_{\max} and V_0 increase when ultraviolet light is replaced by X-rays.

Statement-2 is false.

Answer: (a) Statement-1 is true, Statement-2 is false