

Q3: 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

Photoelectrons are emitted at different kinetic energies because of different amount of loss of energy due to collision with metal kernels and other electrons not because of range of frequencies. Therefore,

Statement-2 is false.

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