6

(a)

Two observations about the photoelectric effect are:

Observation 1: For light below the threshold frequency, no electrons are emitted from the metal surface.

Observation 2: For light above the threshold frequency, the emission of electrons is almost instantaneous.

For each of the observation, explain how it provides support for the particle theory of light, but not the wave theory of light.

(i)

Observation 1 : ……..

……

……

……

……..... [2]

(ii)

Observation 2 : ……..

_____

_____

…….

_____

_____

…….

_____

……..... [2]

(b)

A narrow parallel beam of laser light is incident on a barium surface at an angle of incidence of 30°, as shown in Fig. 6.1.

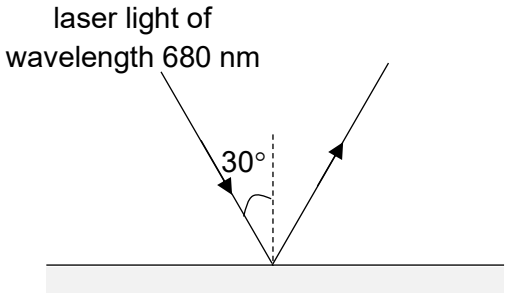

Fig. 6.1

The beam has a circular cross-section of diameter 1.5 mm.

The laser light has wavelength of 680 nm and intensity 3.2×10^3 W m^{-2}.

(i)

Determine

1.

the energy of a photon of the laser light; and

energy = …… J [2]

2.

the number of photons incident per unit time on the surface.

number of photons per unit time = …… s^{-1} [2]

(ii)

Assuming that all the photons are reflected, calculate the force *F* normal to the surface that is exerted by the laser light on the surface.

force = …… N [3]

(iii)

Due to the property of metal, a percentage of the photons incident on the surface is absorbed. Explain how this would affect your answer in **(b)(ii)**.

……

……

……

……... [1]