Explain why electrons are emitted from the surface of a zinc plate when it is illuminated by UV radiation but not when it is illuminated by visible light. [3]

Explain why it is possible to convert a UV photon into visible light photons, say in phosphor, but it would not be possible to convert a visible light photon into a UV photon. [3]

. A particular filament lamp of rating 60 W emits 5.0 % of this power as light. The average wavelength of visible light is 550 nm.
(a) Calculate the average energy of a single photon of light. [1]
(b) Calculate the number of photons of light emitted per second from the lamp. [2]

The graph shows the variation of the maximum kinetic energy of the photoelectrons with the frequency of the photons incident on a caesium metal surface.

(a) Use the graph to determine:

(i) Planck's constant; [3]

(ii) the work function for caesium; [2]

(iii) the maximum velocity of the photoelectrons when the frequency of the incoming radiation is 1.0×10^{15} Hz. [3]

(b) Manganese has a work function of 4.08 eV. Draw a second line to show the variation with frequency of the maximum kinetic energy of photoelectrons emitted from a manganese surface. [2]
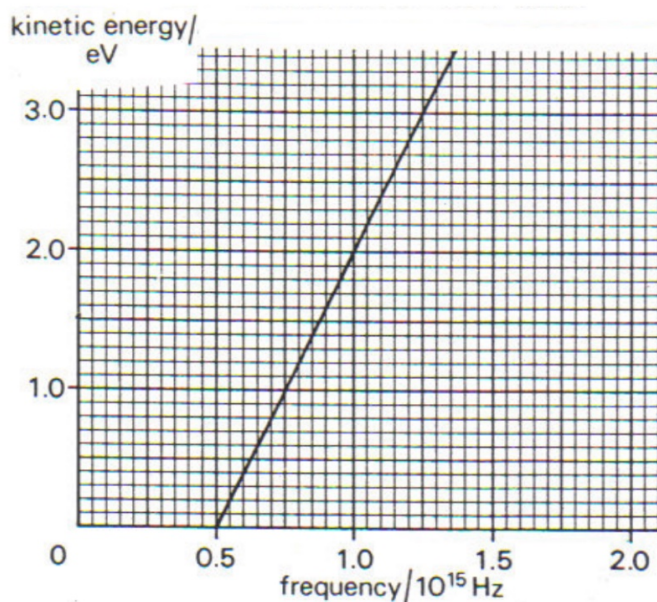
The Voyager 2 satellite has an 11 W transmitter and beams back a signal to Earth via a parabolic dish that focuses the radio waves in a diverging beam that is about 2° wide. This angular width of beam, when reaching the surface area of a sphere centred upon the receiving dish, corresponds to covering one ten thousandth of the surface area of the sphere. The satellite is at a distance of 10^{10} km from Earth. If it transmits at a frequency of 30 GHz, then determine the maximum number of photons per second that arrive at an 80 m diameter radio telescope dish on Earth. [5]