Higher Photoelectric Effect Answers

1. a) i) f_o – Threshold Frequency.

ii) If $f < f_o$ then no photoelectric emission takes place.

If $f > f_o$, Photoelectric emission takes place and as f increases then the current will increase.

b) i) $f > f_o$ as no photoelectric emission will take place below this frequency.

ii) With $f > f_o$ the irradiance of the photons is directly proportional to the photoelectric current produced.

2. a) Gold - 1.18×10^{15}Hz.
Zinc - 1.04×10^{15}Hz.
Calcium - 6.49×10^{14}Hz.
Potassium - 4.83×10^{14}Hz.

b) i) $E = 5.3 \times 10^{-19}$J.

ii) $E_K = 1 \times 10^{-19}$J.

iii) $v = 4.69 \times 10^5 ms^{-1}$.

3. a) $\lambda = 2.88 \times 10^{-7}$m.

b) As 4.0×10^{-7}m is greater than the maximum wavelength that will cause an electron to be emitted, no electrons will be emitted from the zinc surface.

4. a) Photoelectric emission is the term used to describe the process by which an electron bound in an atom can absorb enough energy from a single photon to escape, or be emitted, from the atom.

b) The threshold frequency describes the lowest frequency that the electromagnetic radiation can have to stimulate photoelectric emission.

5. a) Work Function is the minimum energy required to free an electron from an atom in a metal.

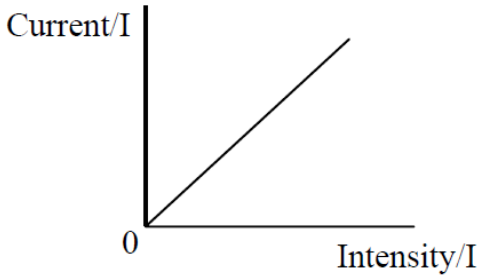
b) E > Eo, so photoelectric emission occurs.

c) i) Extra Energy = 3.55×10^{-19}J.

ii) This extra energy changes to Kinetic energy in the photoelectrons emitting from the metal.

iii) Blue light as this has the highest frequency of photons.

6. a) i)



ii) When the frequency of the photons < threshold frequency of the metal then no photoelectric emission will take place. No current will flow as no photoelectrons will be leaving the metal plate per second.

b) i) Threshold frequency for metal X = 6.5×10^{14}Hz.

ii) Work Function = $hf_o = 4.3 \times 10^{-19}$J. Thus metal X = Calcium.

7. a) i) Photoelectric emission is the term used to describe the process by which an electron bound in an atom can absorb enough energy from a single photon to escape, or be emitted, from the atom.

ii) Threshold frequency f_o.

iii) The greater the intensity of the light the greater the number of photons incident on the metal.

More electrons will be able to absorb these photons and so more photoelectrons will be able to leave the metal plate per second. This increases the photoelectric current.

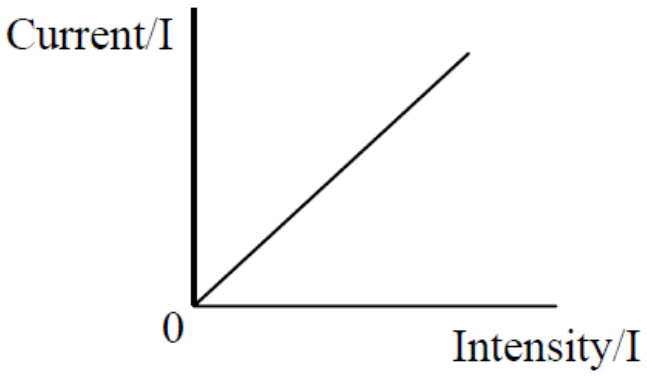
b) i) Energy of a photon = 5.967×10^{-19}J.

ii) Number of photons = 6.79×10^{13}.

iii) The time for sunlight to erase the chip will be greater.

Only a portion of the 25Wm^{-2} from sunlight is ultraviolet, and so it will take longer for the semiconductor material to absorb the required number of photons.

8. a)

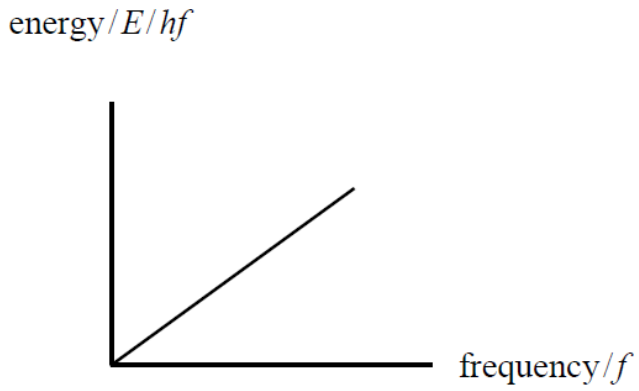


b) i) E = 4.97×10^{-19}J.

$E_K = 1.86 \times 10^{-19}$J.

ii) Some electrons may have enough energy to travel from the metal plate to the metal cylinder.

9. a)



b) E = 4.04 x 10^{-19}J.

E_o = 3.44 x 10^{-19}J.

c) Each photon will have the same amount of energy.

The increase in irradiance will increase the number of photoelectrons leaving the metal plate per second, but the photoelectrons leave the metal plate with the same kinetic energy.

10. a) Turn the wavelength into a frequency using **v = f λ**.

Then use E = hf = 3.29 x 10^{-19}J.

b) i) E_K =1.83 x 10^{-19}J.

ii) Irradiance decreases and so the current reading will decrease.

There will be fewer photons available for the electrons to absorb and so the number of photoelectrons leaving the metal plate per second will decrease.