S.6 PHYSICS REVISION EXERCISE ON PHOTO ELELECTRIC EFFECT (19th JUNE 2020)

The following constants may be useful;
Planck constant h = 6.6×10^{-34}Js
1eV = 1.6×10^{-19}J
Speed of light c = 3.0×10^{8}ms^{-1}

1. (a) What is meant by photo-electric emission?
   (a) State the laws of photoelectric emission.
   (b) Describe a laboratory experiment to determine Planck's constant.
   (c) Violet light of wavelength 0.4 μm is incident on a metal surface of threshold wavelength 0.65 μm. Find the maximum speed of the emitted electrons.
2. (a) Define the following terms as used in photo electricity.
   (i) work function.
   (ii) Threshold frequency
   (b) Electromagnetic radiation of frequency 8.8×10^{14} Hz falls onto a surface whose work function is 2.5eV. Calculate the velocity with which photoelectrons are released from the surface.

3. (a) Define stopping potential in relation to photo electric emission.
   (b) When monochromatic light of frequency 6.0×10^{14} Hz falls on a metal surface the stopping potential is 0.6 V while when the same surface is struck by light of frequency 1.0×10^{15} Hz the stopping potential becomes 2.2 V.
   Determine the work function of the metal.

4. (a) What is meant by Photo electrons?
   (b) Explain the failures of the classical wave theory in explaining photoelectric effect .
   (c) (i) Write an expression for the kinetic energy of the electrons liberated from a metal surface when light of frequency f falls on the surface.
   (ii) What condition must the incident light fulfill for photoelectrons to be produced?
   (iii) When light of frequency 10.8×10^{14} Hz shines on the metal surface the maximum energy of the emitted electrons is $2.4 \times 10^{=19}$ J. If the same metal is illuminated with light of frequency $13.2 \times `0^{14}$ Hz the maximum energy of the electrons is 4.0×10^{-19} J.Find the value of Planck's constant.
5. The work function for caesium is 1.35eV.
   (a) What is the longest wavelength that can cause photoelectric emission from a caesium surface?
   (b) What is the maximum velocity with which electrons will be emitted from a caesium surface if light of wavelength 400nm falls on it?
   (c) What potential difference will just prevent current from passing through a caesium photocell illuminated with light of wavelength400nm?
6. Radiation of wavelength 180nm ejects electrons from a potassium plate whose work function is 2.0eV.
   (a) What is the maximum energy of the emitted electrons?
   (b) What is the maximum wavelength that will cause electron emission?

7. A calcium surface is illuminated with radiation of different wavelength and the kinetic energies of the photoelectrons emitted at the wavelengths recorded in the following table.

Wavelength(nm)	415	387	368	345	325	315
Energy(J) $x10^{-19}$	0.5	0.8	1.1	1.5	1.75	2.00

Use these results to plot a graph of frequency against electron energy and use it to determine

(a) the work function of calcium

(b) the value of planck constant

8. If a sodium surface in vacuum is illuminated with a beam of monochromatic ultra violet light with a wavelength of 200nm, what is the maximum velocity with which electrons can be emitted ? (Assume work function of sodium = 2.4 eV)

END