B. Photoelectric Effect

11. Calculate the following :
    1. Frequency of a photon of energy 1.0×10^{-18} J
    2. Wavelength of a photon of energy 300 eV
    3. Energy in eV of a photon of wavelength 10 m
    4. Energy in joule of a photon of frequency 5.0×10^{14} Hz.

    (1.5×10^{15} Hz; 4.14 nm; 1.243×10^{-7} eV; 3.315×10^{-19} J)

12. The photoelectric work function of silver is 3.315 eV. Calculate the threshold frequency of silver. **(8×10^{14} Hz.)**

13. Light of wavelength 4800 A° can just cause photoemission from a metal. What is the work function for the metal in electron volt? **(2.59 eV)**

14. The photoelectric work function for a metal is 2 eV. What is the lowest frequency radiation that will cause photoemission from the surface ? **(4.83×10^{14} Hz)**

15. Work function of platinum is 6.3 eV and the longest wavelength that can eject photoelectrons from platinum is 1972 A° Calculate Planck's constant.

    (6.3×10^{-34} Js)

16. The work function of a metal surface is 1.32 eV. What is the longest wavelength that can cause photoelectric emission from the metal surface? $e = 1.6 \times 10^{-19}$ C; $h = 6.63 \times 10^{-34}$ Js. **(9418 A°)**

17. If the photoelectric work function for a metal is 5 eV, calculate the threshold frequency for the metal. If light of wavelength 4000 A° is incident on this metal surface, will photoelectrons be ejected ? **(1.2×10^{15} Hz; No)**

18. The photoelectric work function for a surface is 2.4 eV. Light of wavelength 6800 A° shines on the given surface. Find the incident and threshold frequencies. Will there be a photoemission or not ? **(4.4×10^{14} Hz; 5.8×10^{14} Hz; No)**

19. If the threshold frequency of a photo-cathode is 4.6×10^{14} Hz, calculate the maximum wavelength that will give rise to emission of electrons. If the work function of the photo-cathode material is 1.9 eV, find h/e. **(6521 A° ; 4.13×10^{-15})**

20. The P. E. work function of the emitter of a photoelectric cell is 3.63 eV. Determine the frequency of radiation incident on it if the stopping potential for emitted electrons is 3 volt. **(1.6×10^{15} Hz)**

21. Photoelectrons emitted by a surface have a maximum KE of 4×10^{-9} J. What is the stopping potential for photoemission from the surface for the incident radiation?

    (2.5 V)

22. Light of wavelength 2×10^{-7} m is incident on the cathode of a photocell. The current in a photocell is reduced to zero by a stopping potential of 2V. Find the threshold wavelength of the cathode. **(2949 A°)**

23. Photoelectrons are ejected from a metal surface when radiation of wavelength 160 nm is incident on its surface. Find the stopping potential of emitted electrons if the limiting wavelength is 240 nm for p.e. emission from the surface. ($h = 6.63 \times 10^{-34}$ Js). **(2.59 eV)**

24. Threshold frequency for Potassium is 4.22×10^{14} Hz. If yellow light of wavelength 5890 A° falls on a Potassium surface in vacuum, find the maximum K. E. of emitted electrons. **(0.36 eV)**

25. The threshold wavelength for certain metal is 3800 A°. Calculate the maximum kinetic energy and velocity of photo-electrons emitted when an ultraviolet light of wavelength 2500 A° falls on the metal surface. $m = 9.1 \times 10^{-31}$ kg; $c = 3 \times 10^8$ m/s ; $h = 6.63 \times 10^{-34}$ Js **(2.72×10^{-19} J; 7.73×10^5 m/s)**

26. What should be the wavelength of radiation which will emit photoelectrons of maximum energy 4 eV when the radiation is incident on the surface of the metal for which the work function is 2.4 eV ? **(1942 A°)**

27. When light of wavelength 1500 A° is incident on Platinum, the maximum K.E. of the emitted photoelectrons is found to be 2.04 eV. Find the work function for Platinum. **(6.25 eV)**

28. The maximum velocities of electrons emitted by a metal surface are $2v$ and v when light of wavelengths 350 nm and 540 nm respectively shine on the surface. Calculate the work function of the metal. **(3.01 eV)**

29. Radiation of wavelength 3800 A° can just liberate photoelectrons from silver. Determine the maximum energy of emitted electrons when radiation of wavelength 2600 A. U. falls on the silver surface. **(1.51 eV)**

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30. The photoelectric threshold wavelength for copper is 2750 A°. If ultraviolet light of wavelength 1500 A° is incident on copper surface, what would be the maximum energy in eV and velocity of the ejected photoelectrons ? $m = 9.1 \times 10^{-31}$ kg. **(3.77 eV; 1.15×10^6 m/s)**

31. Light of wavelength 6000 A° is incident on a metal surface. If 1.77 eV of energy is required to remove an electron from the metal surface, calculate the KE of the fastest electron. What will be the threshold frequency? **(0.2 eV; 4.83×10^{12} Hz)**

32. The work function of a metal surface is 2.2 eV. Find the maximum velocity of emitted electrons when light of wavelength 3×10^{-7} metre falls on the surface. $m = 9.1 \times 10^{-31}$ kg. **(8.26×10^5 m/s)**

33. Light of wavelength 2000 A° falls on a metal surface. The work function for the metal is 4.2 eV. What is the KE of (1) the fastest and (2) slowest photoelectrons emitted? What is the stopping potential? What is the threshold wavelength of the metal? **(2 eV; zero; 2 V; 2960 A°)**

34. Calculate the change in stopping potential when the wavelength of light incident on a p.e. surface is reduced from 4000 A° to 3600 A° . $h = 6.63 \times 10^{-34}$ Js , $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m/s. **(0.345 V)**

(Hint : Simplify calculations by calculating ν**)**

35. When light of frequency 2.2×10^{15} Hz is incident on a metal surface, photoelectrons emitted can be stopped by a retarding potential of 6.6 V. For light of frequency 4.6×10^{15} Hz, the reverse potential is 16.5 V. Find h. (6.67×10^{-34} Js)

36. In a P. E. experiment, when the incident frequency is 2×10^{15} Hz, a potential of 6 volt is necessary to reduce the photoelectric current to zero. When the frequency is reduced to 10^{15} Hz, the above potential is 2 volt. Find h, ϕ and ν_0.

(6.4×10^{-34} Js; 2 eV; 5×10^{14} Hz)

37. When the frequency of radiation incident on a metallic surface is doubled, the velocity of the most energetic photoelectrons emitted is also doubled. What is the work function of this metal? ($2h\nu/3$)

38. What is the retarding potential needed to stop the photoelectrons emitted by a surface of work function 1.2 eV when light of frequency 5.5×10^{14} Hz shines on the surface? $h = 6.63 \times 10^{-34}$ Js. (1.08 eV)

39. The photoelectric threshold wavelength for a certain metal is 2640 A°. What is the maximum KE of the photoelectrons emitted from the metal if u.v. light of wavelength 1810 A° is incident upon it? $c = 3 \times 10^8$ m/s; $h = 6.63 \times 10^{-34}$ Js.

(2.05 eV)

40. When radiation of frequency 7.5×10^{14} Hz is incident on a metal surface, electrons of maximum KE 1.6×10^{-19} J are emitted. What is the lowest frequency of radiation for emission from the surface? (5.09×10^{14} Hz)