PHYSICS

BOOKS - OSWAAL PUBLICATION PHYSICS (KANNADA ENGLISH)

DUAL NATURE OF RADIATION AND MATTER

Topic 1 Photoelectric Effect Very Short Answer Type Questions

1. What is the outcome of Davission Germer Experiment?

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2. The mass of photon at rest is

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3. Who proposed quantum theory of light?

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4. Define intensity of radiation on the basis of photon picture of light. Write its S.I. unit.

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5. In photoelectric effect, the current

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6. Define the terms :

Stopping potential.

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7. A graph of stopping potential of a photo sensitive metal with the frequency of incident radiation is plotted. What does the slope of this curve represent?

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Topic 1 Photoelectric Effect Short Answer Type Questions I

1. What is a photo diode? In which mode of biasing does it work?

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2. Mention any two importance of speed of light.

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3. Write Einstein's photoelectric equation.

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4. A graph of stopping potential of a photo sensitive metal with the frequency of incident radiation is plotted. What does the slope of this curve represent?

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5. A monochromatic source emitting light of wavelength 600 nm has a power output of 66 W. Calculate the number of photons emitted by this source in 2 minutes.

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6. Two monochromatic radiations of frequencies v_1 and v_2 $(v_1 > v_2)$ and having the same intensity are, in turn,

incident on a photosensitive surface to cause photoelectric emission. Explain, giving reason, in which case (i) more number of electrons will be emitted and (ii) the maximum kinetic energy of the emitted photoelectrons will be more.

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Topic 1 Photoelectric Effect Short Answer Type Questions Ii

1. Mention any three properties of a photon.

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2. Write any three experimental observations of photoelectric effect

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3. (a) Why photoelectric effect can not be explained on the basis of wave nature of light ? Give reasons.

(b) Write the basic features of photon picture of electromagnetic radiation on which Einstein's photoelectric equation is based.

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4. Write Einstein's photoelectric equation. State clearly how this equation is obtained using the photon picture of electromagnetic radiation.

Write the three salient features observed in photoelectric effect which can be explained using this equation.

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5. Define the terms (i) 'cut-off voltage' and (ii) threshold frequency' in relation to the phenomenon of photoelectric effect.

Using Einstein's photoelectric equation show how the cut-off voltage and threshold frequency for a given

photosensitive material can be determined with the help of a suitable $\mathrm{plot/graph}$.

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6. Draw a plot showing the variation of potoelectric current with collector plate potential for two different frequencies, $v_1 > v_2$, of incident radiation having the same intensity. In which case will the stopping potential be hgiher ? Justify your answer.

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Topic 1 Photoelectric Effect Long Answer Type Questions

1. Write any three experimental observations of photoelectric effect

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2. With a neat diagram explain the working of G.P. Thomson's experiment.

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3. Write any three experimental observations of photoelectric effect

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4. Write any three experimental observations of photoelectric effect

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Topic 1 Photoelectric Effect Numerical Problems

1. The threshold wavelength of a photosensitive metal is 662.5 nm. If this metal is irradiated with a radiation of wavelength 331.3 nm, find the maximum kinetic energy of the photoelectrons. If the wavelength of radiation is increased to 496.5 nm, calculate the change in maximum kinetic energy of the photoelectrons. (Planck's constant

$h = 6.625 \times 10^{-34}$ Js and speed of light in vacuum $= 3 \times 10^{8} ms^{-1}$)

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2. For a metal the maximum wavelength required for photoelectron emission is 340 nm, find the work function. If the radiation of wavelength 250 nm falls on the surface of the given metal. Find the maximum kinetic energy of emitted photo electrons in eV. Given Planck's constant $= 6.625 \times 10^{-34} Js$, velocity of light in vacuum is $3 \times 10^{8} ms^{-1}$.

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3. When light of frequency 6×10^{14} Hz is incident on a photosensitive metal, the kinetic energy of the photoelectron ejected is 2e V. Calculate the kinetic energy of the photoelectron in eV when light to frequency 5×10^{14} Hz is incident on the same metal.

Given Planck's constant, $h = 6.625 \times 10^{-34} Js$, $1eV = 1.6 \times 10^{-19}$.

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4. When the frequency of the incident light on a photo sensitive metal is changed from 7.6×10^{14} Hz to 6×10^{14} Hz the value of stopping potential changes by 0.66 V. Calculate Planck's constant. [Note : Any form of Einstein's P.E. Equation can be considered]

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5. The work function of zinc is 6.8×10^{-19} J. What is the threshold frequency for emission of photoelectrons for zinc ?

Data: $W = 6.8 \times 10^{-19}$J, v_0 = ?

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6. A metallic surface when illuminated with light of wavelength 3333 Å emits electrons with energies upto 0.6 eV. Calculate the work function of the metal.

Data : $\lambda = 3333\text{Å}$, K.E=0.6eV, W=?

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7. Lithium has a work function of 2.3 eV. It is exposed to light of wavelength 4.8×10^{-7} m. Find the maximum kinetic energy with which the electron leaves the surface. What is the longest wave length which can produce the photo electrons ?

Data : W = 2.3 eV, $h = 6.626 \times 10^{-34} Js$, $e = 1.6 \times 10^{-19}$C. Longest wavelength = ? , Kinetic energy = ?

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8. At what speed is a particle moving if the mass is equal to three times its rest mass.

Data $m = 3m_0$, v = ?

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9. How fast would a rocket have to go relative to an observer for its length to be corrected to 99% of its length at rest.

Data: $\frac{l}{l_0} = 99\,\% = \frac{99}{100}$, v = ?

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10. Monochromatic light of frequency $6.0 \times 10^{14} Hz$ is produced by a laser. The power emitted is $2.0 \times 10^{-3} W$. (a) What is the energy of a photon in the

light beam? (b) How many photons per second, on an average, are emitted by the source?

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11. Monochromatic light of frequency $6.0 \times 10^{14} Hz$ is produced by a laser. The power emitted is $2.0 \times 10^{-3} W$. (a) What is the energy of a photon in the light beam? (b) How many photons per second, on an average, are emitted by the source?

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12. The work function of caesium is 2.14 ev. Find (a) the threshold frequency for caesium, and (b) the wavelength of the incident light if the photocurrent is brought to zero by a stopping potential of 0.60 V.

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13. The work function of caesium is 2.14 ev. Find (a) the threshold frequency for caesium, and (b) the wavelength of the incident light if the photocurrent is brought to zero by a stopping potential of 0.60 V.

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14. The wavelength of light in the visible region is about 390 nm for violet colour, about 550 nm (average wavelength) for yellowgreen colour and about 760 nm for red colour. What are the energies of photons in (eV) at the (i) violet end, (ii) average wavelength, yellow-green colour, and (iii) red end of the visible spectrum? $\left(\text{Take h} \quad = 6.63 \times 10^{-34} \text{ J s and } 1 \text{ eV} = 1.6 \times 10^{-19} J. \right)$

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15. The wavelength of light in the visible region is about 390 nm for violet colour, about 550 nm (average wavelength) for yellow-green colour and about 760 nm for red colour.

From which of the photosensitive materials with work functions listed given below and using the results of (i), (ii) and (iü) of (a), can you build a photoelectric device that operates with visible light ?

Work Functions of Some Metals			
Metal	Work function ϕ_0 (eV)	Metal	Work function ϕ_0 (eV)
Cs	2.14	Al	4.28
K	2.30	Hg	4.49
Na	2.75	Cu	4.65
Ca	3.20	Ag	4.70
Mo	4.17	Ni	5.15
Pb	4.25	Pt	5.65

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Topic 2 De Broglie Relation Very Short Answer Type Questions

1. A proton and an electron have same kinetic energy. Which one has smaller de-Broglie wavelength ?

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2. How does the de-Broglie wavelength of a charged particle changes when accelerating potential increases ?

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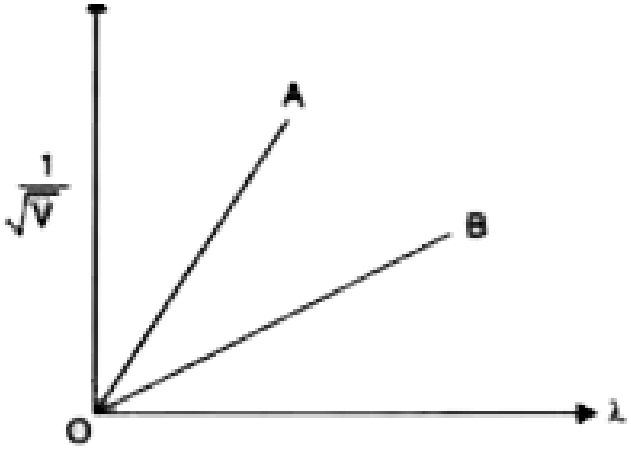
3. Figure shows a plot of where V is the accelerating potential. The de-Broglie wavelength 'λ' in the case of two particles having same charge 'q' but different masses m, and mz. Which line (A or B) represents a

particle of larger mass ?



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4. Find the ratio of de-Broglie wavelengths associated with two electrons accelerated through 25 and 36 V.

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5. State de-Broglie hypothesis.

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6. A proton and an electron have same kinetic energy. Which one has smaller de-Broglie wavelength ?

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7. Show graphically, the variation of the de-Broglie wavelength (λ) with the potential (V) through which an electron is accelerated from rest.

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8. De Broglie wavelength of a body of mass m and kinetic energy E is given by

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Topic 2 De Broglie Relation Short Answer Type Questions I

1. What are matter waves? Derive an expression for the de Broglie wave length.

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2. The equivalent wavelength of a moving electron has the same value as that of a photon having an energy of $6 \times 10^{-17} J$. Calculate the momentum of the electron.

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3. X-rays fall on a photosensitive surface to cause photoelectric emission. Assuming that the work function of the surface can be neglected, find the relation between the de-Broglie wavelength (λ) of the electrons emitted to the energy (E_v) of the incident photons. Draw the nature of the graph for λ as a function of E_v.

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4. An electron is revolving around the nucleus with a constant speed of $2.2 \times 10^8 m/s$. Find the de-Broglie wavelength associated with it.

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5. A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has :

(a) Greater value of de-Broglie wavelength associated with it, and

(b) Less momentum ?

Give reasons to justify your answer.

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6. An electron microscope uses electrons accelerated by a voltage of 50 kV. Determine the de-Broglie wavelength associated with the electrons. Taking other factors, such as numerical aperture etc. to be same, how does the resolving power of an electron microscope compare with that of an optical microscope which uses yellow light?

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7. Find the ratio of de-Broglie wavelengths, associated with

(i) Protons, accelerated through a potential of 128 V, and

(ii) α-particles, accelerated through a potential of 64 V.

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8. An electron is accelerated through a potential difference of 100 volts. What is the de-Broglie wavelength associated with it? To which part of the electromagnetic spectrum does this value of wavelength correspond ?

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9. A proton and an α particle are accelerated through the same potential difference V. The ratio of their de Broglie wavelengths is

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Topic 2 De Broglie Relation Short Answer Type Questions Ii

1. An electron and a photon each have a wavelength of 1.00 nm. Find (i) their momentum (ii) the energy of the photon and (iii) K.E of electron

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2. (a) The mass of a particle moving with velocity $5 \times 10^6 ms^{-1}$ has de-Broglie wave length associated with it to be 0.135 nm. Calculate its mass.

(b) In which region of the electromagnetic spectrum does this wave length lie?

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Topic 2 De Broglie Relation Long Answer Type Questions

1. What are matter waves? Derive an expression for the de Broglie wave length.

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Topic 2 De Broglie Relation Numerical Problems

1. Calculate de-Broglie wavelength associated with a rifle bullet of mass 2 gram moving with a speed of $400ms^{-1}$.

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2. Find the de-Broglie wavelength of an electron with kinetic energy of 120 eV.

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3. Find the accelerating potential of the electron, when its de-Broglie wave length is 1Å.

Data: $\lambda = \text{Å}$, V = ?

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4. In the Bohr model of hydrogen atom. What is the de-Broglie wavelength λ for the electron when it is in the (i) n = 1 level (ll) n = 4 level. In each case, compare the de-

Broglie wave length to the circumference of the orbit.

Data: n=1, n=4,λ=?

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5. What is the de Broglie wavelength associated with (a) an electron moving with a speed of $5.4 \times 10^6 m/s$, and (b) a ball of mass 150 g travelling at $30.0 m/s$?

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6. What is the de Broglie wavelength associated with (a) an electron moving with a speed of $5.4 \times 10^6 m/s$, and (b) a ball of mass 150 g travelling at $30.0 m/s$?

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7. An electron, an $\alpha -$ particle, and a proton have the same kinetic energy. Which of these particles has the shortest de Broglie wavelength?

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