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PHYSICS · JEE MAIN

# Dual Nature of Matter & Radiation

## Previous Year Questions with answers

**208** questions · **181** papers · **2002–2026** · newest paper first

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**What is in this PDF:** every Dual Nature of Matter & Radiation question we hold from past JEE Main and AIEEE papers, with its options and answer. Where an answer comes from a source other than the official final key, it says so next to the answer.

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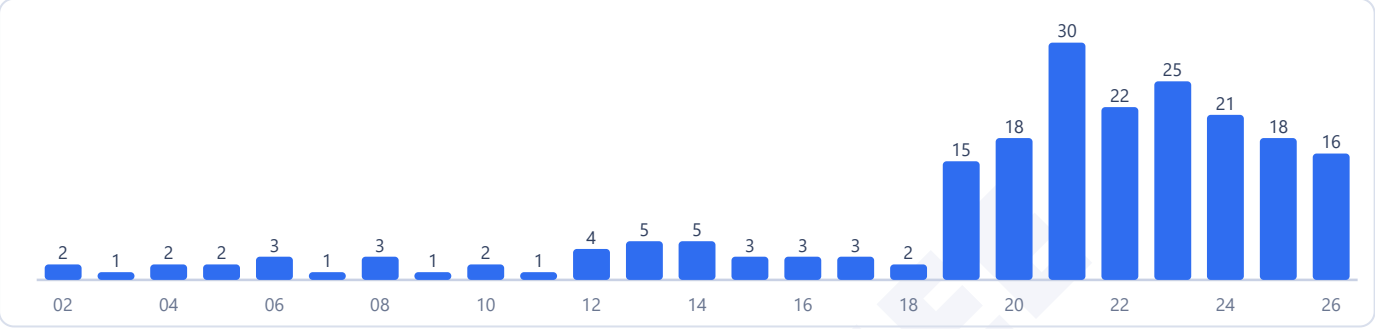
# Chapter at a glance

| 3.6% | 208 | 148 of 162 | 191 / 17 |
|---|---|---|---|
| of Physics questions, 2019–2026 | questions, 2002–2026 | papers asked it, 2019–2026 | MCQ / numerical, 2002–2026 |

**Trend.** Steady: 0.9 questions per paper in 2024–2026 against 1.1 in 2019–2023.

### Questions per year




Counts are the questions we hold: 208 in 181 papers. No question in this chapter was found repeated across papers.

### Most-asked topics in this chapter (2002–2026)

| | |
|---|---|
| Photoelectric Effect | 119 |
| Matter Waves | 89 |

## How often it comes up

Dual nature of matter and radiation analyzes quantum energy packets and particle waves under Unit 17: Dual Nature of Matter and Radiation in the Class 12 syllabus, holding rank 11 among the 29 physics chapters. In the computer-based testing era from 2019 to 2026, candidates faced 165 questions across 162 papers, representing an average rate of 1.0 question per shift. The chapter featured in 148 of those 162 papers, and questions have been set every single year throughout the cycle. During the recent 2024 to 2026 examination seasons, testing recorded 55 questions across 58 papers, maintaining an average of 0.9 questions per sitting and a 3.6 percent subject share. The chapter's share has stayed about the same when compared to the 2002 to 2018 testing interval, which recorded 43 questions across 38 papers for a 3.2 percent share. In 2026 specifically, 16 questions appeared across 19 papers, showing up in 14 individual shifts. Across 2019 to 2026, 17 questions appeared as numerical answer questions, while the vast majority were multiple choice questions testing graphical interpretations and straightforward wavelength ratios.

## Most-asked topics

The chapter divides into two tightly focused conceptual areas:

- **Photoelectric Effect**: 119 questions historically, with 92 asked between 2019 and 2026, tested up to 2026. This dominant area tests Einstein's photoelectric equation, work function, threshold frequency, threshold wavelength, stopping potential variations with frequency and intensity, photon emission rates from continuous lasers, and saturation currents.
- **Matter Waves**: 89 total questions, including 73 from 2019 to 2026, continuing in 2026. Concepts explore the de Broglie wavelength formula lambda equals h over p, wavelengths of charged particles accelerated through electric potentials, thermal neutrons and gas molecules at absolute temperature, and de Broglie wavelength comparisons between electrons, protons, deuterons, and alpha particles.

## What the questions look like

Exam questions in this chapter rely on concise algebraic equations and ratio comparisons:

- **Stopping potential ratios across varying wavelengths**: Illuminating a metallic emitter with light of wavelength lambda produces a stopping potential of several volts, which drops to a lower specified value when the wavelength doubles. Students formulate dual equations to find the threshold wavelength or work function.
- **Matter wave ratios for accelerated particles**: Comparing the de Broglie wavelengths of different particles like deuterons and alpha particles possessing identical kinetic energy or accelerated across identical potential differences.
- **Photon flux from optical sources**: Calculating the number of photons emitted per second by a laser given its operating power and emission wavelength.
- **Thermal de Broglie wavelength**: Evaluating the matter wavelength of an oxygen molecule or neutron in thermal equilibrium at a specified temperature in degrees Celsius.

## How to practise it

Master Einstein's photoelectric equation in both electron-volt and joule units. Remember that stopping potential multiplied by elementary charge e directly equals maximum kinetic energy in electron-volts. Be comfortable converting between photon energy in electron-volts and wavelength using standard physical constants.

Practice setting up simultaneous equations when stopping potentials are given at two different illumination frequencies or wavelengths. Subtracting the two equations eliminates the work function, giving a direct calculation of Planck's constant or the threshold wavelength.

For matter waves, express momentum in terms of kinetic energy, accelerating potential V, and thermal energy three-halves k T. Memorize the numerical shortcuts for electrons, protons, and alpha particles accelerated through potential V to solve ratio questions rapidly.

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**Q1** JEE Main 2026 · 8 Apr · Shift 2 MCQ

A monochromatic source of light operating at 15 kW emits $2.5 \times 10^{22}$ photons/s. The region of an electromagnetic spectrum to which the emitted electromagnetic radiation belongs to _____. (Take $h = 6.6 \times 10^{-34}$ J.s and $c = 3 \times 10^{8}$ m/s).

(A) Microwave
(B) Infrared
(C) Visible
(D) Ultraviolet

**Answer: (D) Ultraviolet** · Official NTA final key

**Q2** JEE Main 2026 · 8 Apr · Shift 2 MCQ

$K_1$ and $K_2$ be the maximum kinetic energies of photoelectrons emitted from a surface of a given material for the light of wavelength $\lambda_1$ and $\lambda_2$, respectively. If $\lambda_1 = 2\lambda_2$ then the work function of material is given by :

(A) $K_2 + 2K_1$
(B) $2K_2 - K_1$
(C) $K_1 - 2K_2$
(D) $K_2 - 2K_1$

**Answer: (D)** $K_2 - 2K_1$ · Official NTA final key

**Q3** JEE Main 2026 · 6 Apr · Shift 2 Numerical

The de Broglie wavelength for an electron accelerated through the potential difference of $V_1$ volt is $\lambda_1$ . When the potential difference is changed to $V_2$ volt, the associated de Broglie wavelength is increased by 50%. If $(V_1/V_2) = (9/\alpha)$, then the value of $\alpha$ is _____.

Numerical value type: the answer is a number.

**Answer: 4.** · Official NTA final key

**Q4** JEE Main 2026 · 5 Apr · Shift 1 MCQ

An electron of mass $m$ is moving in an electric field $\vec{E} = -2E_o\hat{i}$ ($E_o$ = constant > 0), with an initial velocity $\vec{V} = v_o\hat{i}$ ($v_o$ = constant > 0). If $\lambda_o = \dfrac{h}{4mv_o}$, its de Broglie wavelength at time $t$ is _____.

($e$ = charge of electron)

(A) $\dfrac{4\lambda_o}{\left[1-\dfrac{E_o e\,t}{2m\,v_o}\right]}$

(B) $\dfrac{4\lambda_o}{\left[1+\dfrac{E_o e\,t}{2m\,v_o}\right]}$

(C) $\dfrac{4\lambda_o}{\left[1+\dfrac{2E_o e\,t}{m\,v_o}\right]}$

(D) $\dfrac{4\lambda_o}{\left[1-\dfrac{2E_o e\,t}{m\,v_o}\right]}$

**Answer: (C)** $\dfrac{4\lambda_o}{\left[1+\dfrac{2E_o e\,t}{m\,v_o}\right]}$ · Official NTA final key

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**Q5** JEE Main 2026 · 5 Apr · Shift 1 MCQ

Light source having wavelength 331 nm is used to generate photo-electrons whose stopping potential is 0.2 V. The work function of the used metal in the experiment is $\alpha \times 10^{-19}$ J. The value of $\alpha$ is _____.
($h = 6.62 \times 10^{-34}$ J s, $e = 1.6 \times 10^{-19}$ C and $c = 3 \times 10^{8}$ m/s)

(A) 3.68

(B) 4.68

(C) 5.68

(D) 2.68

**Answer: (C)** 5.68 · Official NTA final key

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**Q6** JEE Main 2026 · 5 Apr · Shift 2 MCQ

An electron is travelling with a velocity $v$ in free space and when it enters a medium, its velocity is reduced by 20%. The de Broglie wavelength of electron in the medium is $\alpha\lambda_0$, where $\lambda_0$ is its de Broglie wavelength in free space. The value of $\alpha$ is _____.

(A) 1.20

(B) 1.0

(C) 1.25

(D) 0.75

**Answer: (C)** 1.25 · Official NTA final key

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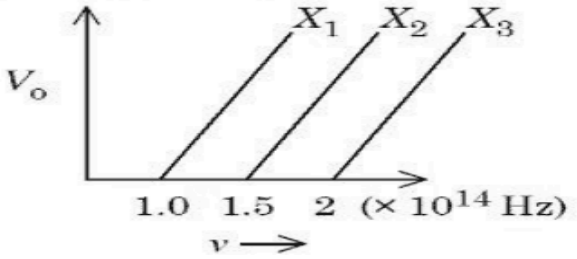
**Q7** JEE Main 2026 · 4 Apr · Shift 1 MCQ

The graph shows variation of stopping potential $V_o$ with the frequency $\nu$ of the incident radiation for three photosensitive metals $X_1$, $X_2$ and $X_3$. Which metal will give out electrons with greater kinetic energy, for the same wavelength of incident radiation?

*(see the figure above)*

The graph shows variation of stopping potential $V_o$ with the frequency $\nu$ of the incident radiation for three photosensitive metals $X_1$, $X_2$ and $X_3$. Which metal will give out electrons with greater kinetic energy, for the same wavelength of incident radiation?




**Options :**

695278875. $X_1$

695278876. $X_2$

695278877. $X_3$

695278878. All the metals will give out photo electrons with same kinetic energies.

(A) $X_1$

(B) $X_2$

(C) $X_3$

(D) All the metals will give out photo electrons with same kinetic energies.

**Answer: (A)** $X_1$ · Official NTA final key

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**Q8** JEE Main 2026 · 4 Apr · Shift 2 MCQ

The de Broglie wavelength associated with an electron accelerated through a potential difference V is $\lambda_e$ and the de Broglie wavelength associated with a proton accelerated through the same potential difference is $\lambda_p$. If their corresponding masses are $m_e$ and $m_p$, respectively, then the ratio of their de Broglie wavelengths $\left(\frac{\lambda_e}{\lambda_p}\right)$ is _____.

(A) $\sqrt{\frac{m_p}{m_e}}$

(B) $\sqrt{\frac{m_e}{m_p}}$

(C) $\frac{m_p}{m_e}$

(D) $\left(\frac{m_p}{m_e}\right)^2$

**Answer: (A)** $\sqrt{\frac{m_p}{m_e}}$ · Official NTA final key

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**Q9** JEE Main 2026 · 2 Apr · Shift 1 MCQ

For a certain metal, when monochromatic light of wavelength $\lambda$ is incident, the stopping potential for photoelectrons is $3V_o$. When the same metal is illuminated by light of wavelength $2\lambda$, then the

stopping potential becomes $V_o$. The threshold wavelength for photoelectric emission for the given metal is $\alpha\lambda$. The value of $\alpha$ is _____.

(A) 1
(B) 4
(C) 2
(D) 3

**Answer: (B) 4** · Official NTA final key

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**Q10** JEE Main 2026 · 28 Jan · Shift 1 Numerical

The ratio of de Broglie wavelength of a deutron with kinetic energy $E$ to that of an alpha particle with kinetic energy $2E$, is $n$ : 1. The value of $n$ is _____.

(Assume mass of proton = mass of neutron) :

Numerical value type: the answer is a number.

**Answer: 2.** · Official NTA final key

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**Q11** JEE Main 2026 · 28 Jan · Shift 2 MCQ

Number of photons of equal energy emitted per second by a 6 mW laser source operating at 663 nm is _____. (Given : h= $6.63 \times 10^{-34}$ J.s and c= $3 \times 10^8$ m/s)

(A) $10 \times 10^{15}$
(B) $5 \times 10^{16}$
(C) $5 \times 10^{15}$
(D) $2 \times 10^{16}$

**Answer: (D)** $2 \times 10^{16}$ · Official NTA final key

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**Q12** JEE Main 2026 · 24 Jan · Shift 2 MCQ

When a light of a given wavelength falls on a metallic surface the stopping potential for photoelectrons is 3.2 V. If a second light having wavelength twice of first light is used, the stopping potential drops to 0.7 V. The wavelength of first light is _____ m.

(h = $6.63 \times 10^{-34}$ J.s, e = $1.6 \times 10^{-19}$ C, c = $3 \times 10^8$ m/s)

(A) $2.2 \times 10^{-8}$
(B) $3.1 \times 10^{-7}$
(C) $2.5 \times 10^{-7}$
(D) $2.9 \times 10^{-8}$

**Answer: (C)** $2.5 \times 10^{-7}$ · Official NTA final key

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**Q13** JEE Main 2026 · 23 Jan · Shift 1 MCQ

The de Broglie wavelength of an oxygen molecule at 27°C is $x \times 10^{-12}$ m. The value of $x$ is

(take Planck's constant $= 6.63 \times 10^{-34}$ J.s, Boltzmann constant $= 1.38 \times 10^{-23}$ J/K, mass of oxygen molecule $= 5.31 \times 10^{-26}$ kg)

(A) 24
(B) 20
(C) 26
(D) 30

**Answer: (C) 26** · Official NTA final key

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**Q14** JEE Main 2026 · 22 Jan · Shift 2 MCQ

Light is incident on a metallic plate having work function $110 \times 10^{-20}$ J. If the produced photoelectrons have zero kinetic energy then the angular frequency of the incident light is _____ rad/s. (h $= 6.63 \times 10^{-34}$ J.s).

(A) $1.66 \times 10^{16}$
(B) $1.04 \times 10^{13}$
(C) $1.66 \times 10^{15}$
(D) $1.04 \times 10^{16}$

**Answer: (D)** $1.04 \times 10^{16}$ · Official NTA final key

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**Q15** JEE Main 2026 · 21 Jan · Shift 1 MCQ

A light wave described by $E = 60[\sin(3 \times 10^{15})t + \sin(12 \times 10^{15})t]$ (in SI units) falls on a metal surface of work function 2.8 eV. The maximum kinetic energy of ejected photoelectron is (approximately) _____ eV. ($h = 6.6 \times 10^{-34}$ J.s. and $e = 1.6 \times 10^{-19}$ C)

(A) 3.8
(B) 5.1
(C) 6.0
(D) 7.8

**Answer: (B) 5.1** · Official NTA final key

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**Q16** JEE Main 2026 · 21 Jan · Shift 2 Numerical

A particle having electric charge $3 \times 10^{-19}$ C and mass $6 \times 10^{-27}$ kg is accelerated by applying an electric potential of 1.21 V. Wavelength of the matter wave associated with the particle is $\alpha \times 10^{-12}$ m. The value of $\alpha$ is _____. (Take Planck's constant = $6.6 \times 10^{-34}$ J.s)

Numerical value type: the answer is a number.

**Answer: 10.** · Official NTA final key

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**Q17** JEE Main 2025 · 8 Apr · Shift 2 Numerical

An electron is released from rest near an infinite non-conducting sheet of uniform charge density '$-\sigma$'. The rate of change of de-Broglie wave length associated with the electron varies inversely as $n^{th}$ power of time. The numerical value of n is _____.

Numerical value type: the answer is a number.

**Answer: 2.** · Key from source paper

**Q18** JEE Main 2025 · 7 Apr · Shift 2 MCQ

A photo-emissive substance is illuminated with a radiation of wavelength $\lambda_i$ so that it releases electrons with de-Broglie wavelength $\lambda_e$. The longest wavelength of radiation that can emit photoelectron is $\lambda_o$. Expression for de-Broglie wavelength is given by : (m : mass of the electron, h : Planck's constant and c : speed of light)

(A) $\lambda_e = \frac{h}{\sqrt{2mc\left(\frac{1}{\lambda_i}-\frac{1}{\lambda_o}\right)}}$

(B) $\lambda_e = \sqrt{\frac{h\lambda_i}{2mc}}$

(C) $\lambda_e = \sqrt{\frac{h}{2mc\left(\frac{1}{\lambda_i}-\frac{1}{\lambda_o}\right)}}$

(D) $\lambda_e = \sqrt{\frac{h\lambda_o}{2mc}}$

**Answer: (C)** $\lambda_e = \sqrt{\frac{h}{2mc\left(\frac{1}{\lambda_i}-\frac{1}{\lambda_o}\right)}}$ · Key from source paper

**Q19** JEE Main 2025 · 4 Apr · Shift 1 MCQ

Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**

**Assertion A:** In photoelectric effect, on increasing the intensity of incident light the stopping potential increases.

**Reason R:** Increase in intensity of light increases the rate of photoelectrons emitted, provided the frequency of incident light is greater than threshold frequency.

In the light of the above statements, choose the correct answer from the options given below

(A) Both **A** and **R** are true and **R** is the correct explanation of **A**

(B) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**

(C) **A** is false but **R** is true

(D) **A** is true but **R** is false

**Answer: (C) A is false but R is true** · Key from source paper

**Q20** JEE Main 2025 · 3 Apr · Shift 1 MCQ

The work function of a metal is 3 eV. The color of the visible light that is required to cause emission of photoelectrons is

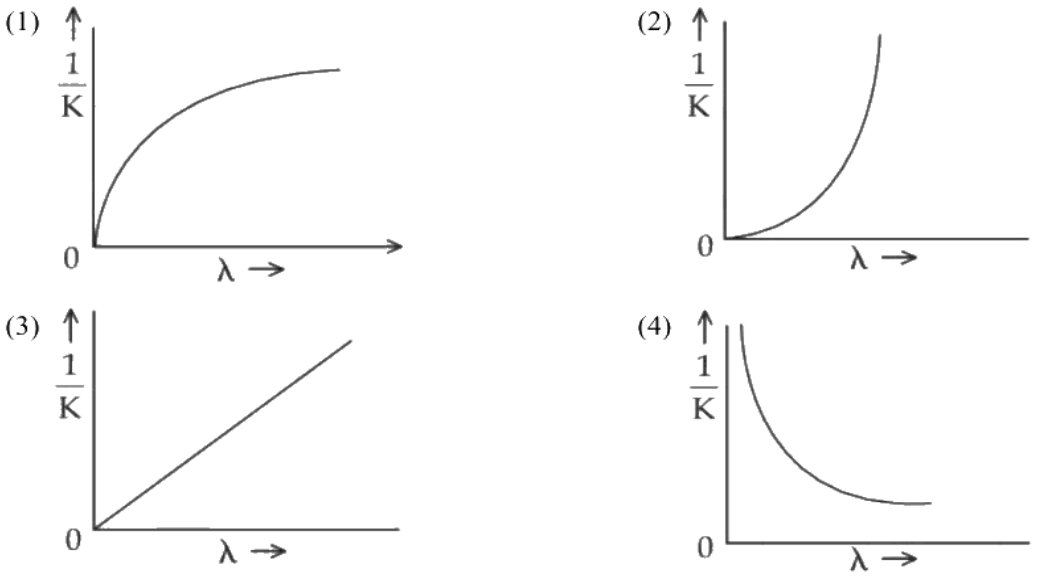
(A) Red
(B) Yellow
(C) Green
(D) Blue

**Answer: (D) Blue** · Key from source paper

## Q21 JEE Main 2025 · 29 Jan · Shift 1 MCQ

If $\lambda$ and $K$ are de Broglie wavelength and kinetic energy, respectively, of a particle with constant mass. The correct graphical representation for the particle will be

**Q32.** If $\lambda$ and $K$ are de Broglie wavelength and kinetic energy, respectively, of a particle with constant mass. The correct graphical representation for the particle will be




(A) *see figure*
(B) *see figure*
(C) *see figure*
(D) *see figure*

**Answer: (B)** · Key from source paper

## Q22 JEE Main 2025 · 29 Jan · Shift 1 MCQ

Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : Emission of electrons in photoelectric effect can be suppressed by applying a sufficiently negative electron potential to the photoemissive substance. Reason (R) : A negative electric potential, which stops the emission of electrons from the surface of a photoemissive substance, varies linearly with frequency of incident radiation. In the light of the above statements, choose the most appropriate answer from the options given below :

(A) (A) is false but (R) is true
(B) (A) is true but (R) is false
(C) Both (**A**) and (**R**) are true and (**R**) is the correct explanation of (**A**)
(D) Both (**A**) and (**R**) are true but (**R**) is not the correct explanation of (**A**)

**Answer: (D) Both (A) and (R) are true but (R) is not the correct explanation of (A)** · Key from source paper

## Q23 JEE Main 2025 · 29 Jan · Shift 2 MCQ

In an experiment with photoelectric effect, the stopping potential,

(A) increases with increase in the intensity of the incident light
(B) decreases with increase in the intensity of the incident light
(C) increases with increase in the wavelength of the incident light
(D) is $\left(\frac{1}{e}\right)$ times the maximum kinetic energy of the emitted photoelectrons

**Answer: (D) is $\left(\frac{1}{e}\right)$ times the maximum kinetic energy of the emitted photoelectrons** · Key from source paper

## Q24 JEE Main 2025 · 28 Jan · Shift 1 MCQ

A proton of mass ' $m_p$ ' has same energy as that of a photon of wavelength ' $\lambda$ '. If the proton is moving at non-relativistic speed, then ratio of its de Broglie wavelength to the wavelength of photon is.

(A) $\frac{1}{c}\sqrt{\frac{\mathrm{E}}{\mathrm{m_p}}}$
(B) $\frac{1}{c}\sqrt{\frac{2\mathrm{E}}{\mathrm{m_p}}}$
(C) $\frac{1}{2c}\sqrt{\frac{\mathrm{E}}{\mathrm{m_p}}}$
(D) $\frac{1}{\mathrm{c}}\sqrt{\frac{\mathrm{E}}{2\,\mathrm{m_p}}}$

**Answer: (D)** $\frac{1}{\mathrm{c}}\sqrt{\frac{\mathrm{E}}{2\,\mathrm{m_p}}}$ · Key from source paper

## Q25 JEE Main 2025 · 28 Jan · Shift 2 MCQ

Which of the following phenomena can not be explained by wave theory of light?

(A) Compton effect
(B) Refraction of light
(C) Reflection of light
(D) Diffraction of light

**Answer: (A) Compton effect** · Key from source paper

## Q26 JEE Main 2025 · 24 Jan · Shift 1 MCQ

An electron of mass ' m ' with an initial velocity $\vec{\mathrm{v}} = \mathrm{v}_0\hat{i}$ $(\mathrm{v}_0 > 0)$ enters an electric field $\vec{\mathrm{E}} = -\mathrm{E}_\mathrm{o}\hat{\mathrm{k}}$. If the initial de Broglie wavelength is $\lambda_0$, the value after time t would be

(A) $\frac{\lambda_0}{\sqrt{1+\frac{e^2E_0^2t^2}{m^2v_0^2}}}$

(B) $\lambda_0\sqrt{1+\frac{e^2E_0^2t^2}{m^2v_0^2}}$

(C) $\frac{\lambda_0}{\sqrt{1-\frac{e^2E_0^2t^2}{m^2v_0^2}}}$

(D) $\lambda_0$

**Answer: (A)** $\frac{\lambda_0}{\sqrt{1+\frac{e^2E_0^2t^2}{m^2v_0^2}}}$ · Key from source paper

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## Q27 JEE Main 2025 · 24 Jan · Shift 2 MCQ

In photoelectric effect, the stopping potential $(V_0)$v/s frequency $(\nu)$ curve is plotted. ( h is the Planck's constant and $\phi_0$ is work function of metal ) (A) $V_0$v/s$\nu$ is linear. (B) The slope of $V_0$v/s$\nu$ curve $= \frac{\phi_0}{h}$ (C) h constant is related to the slope of $V_0$v/s$\nu$ line. (D) The value of electric charge of electron is not required to determine $h$ using the $V_0$v/s$\nu$ curve. (E) The work function can be estimated without knowing the value of $h$. Choose the correct answer from the options given below :

(A) (C) and (D) only

(B) (A), (C) and (E) only

(C) (A), (B) and (C) only

(D) (D) and (E) only

**Answer: (B)** (A), (C) and (E) only · Key from source paper

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## Q28 JEE Main 2025 · 24 Jan · Shift 2 MCQ

The energy $E$ and momentum $p$ of a moving body of mass $m$ are related by some equation. Given that c represents the speed of light, identify the correct equation

(A) $E^2 = pc^2 + m^2c^2$

(B) $E^2 = p^2c^2 + m^2c^2$

(C) $E^2 = pc^2 + m^2c^4$

(D) $E^2 = p^2c^2 + m^2c^4$

**Answer: (D)** $E^2 = p^2c^2 + m^2c^4$ · Key from source paper

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## Q29 JEE Main 2025 · 24 Jan · Shift 2 Numerical

The ratio of the power of a light source $S_1$ to that the light source $S_2$ is 2. $S_1$ is emitting $2 \times 10^{15}$ photons per second at 600 nm . If the wavelength of the source $S_2$ is 300 nm , then the number of photons per second emitted by $S_2$ is _____ $\times 10^{14}$.

Numerical value type: the answer is a number.

**Answer: 5.** · Key from source paper

**Q30** JEE Main 2025 · 23 Jan · Shift 1 MCQ

A sub-atomic particle of mass $10^{-30}$ kg is moving with a velocity $2.21 \times 10^{6}$ m/s. Under the matter wave consideration, the particle will behave closely like $\left(\mathrm{h} = 6.63 \times 10^{-34}\ \mathrm{J.s}\right)$

(A) Visible radiation
(B) Gamma rays
(C) Infra-red radiation
(D) X-rays

**Answer: (D)** X-rays · Key from source paper

**Q31** JEE Main 2025 · 23 Jan · Shift 2 MCQ

In photoelectric effect an em-wave is incident on a metal surface and electrons are ejected from the surface. If the work function of the metal is 2.14 eV and stopping potential is 2 V , what is the wavelength of the em-wave ? (Given hc = 1242eVnm where h is the Planck's constant and c is the speed of light in vaccum.)

(A) 300 nm
(B) 400 nm
(C) 600 nm
(D) 200 nm

**Answer: (A)** 300 nm · Key from source paper

**Q32** JEE Main 2025 · 22 Jan · Shift 1 MCQ

An electron in the ground state of the hydrogen atom has the orbital radius of $5.3 \times 10^{-11}$ m while that for the electron in third excited state is $8.48 \times 10^{-10}$ m. The ratio of the de Broglie wavelengths of electron in the excited state to that in the ground state is

(A) 3
(B) 16
(C) 9
(D) 4

**Answer: (D)** 4 · Key from source paper

**Q33** JEE Main 2025 · 22 Jan · Shift 1 MCQ

The work functions of cesium (Cs) and lithium (Li) metals are 1.9 eV and 2.5 eV , respectively. If we incident a light of wavelength 550 nm on these two metal surfaces, then photo-electric effect is possible for the case of

(A) Both Cs and Li
(B) Neither Cs nor Li
(C) Cs only
(D) Li only

**Answer: (C)** Cs only · Key from source paper

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**Q34** JEE Main 2025 · 22 Jan · Shift 2 MCQ

A light source of wavelength $\lambda$ illuminates a metal surface and electrons are ejected with maximum kinetic energy of 2 eV . If the same surface is illuminated by a light source of wavelength $\frac{\lambda}{2}$, then the maximum kinetic energy of ejected electrons will be (The work function of metal is 1 eV )

(A) 3 eV
(B) 2 eV
(C) 6 eV
(D) 5 eV

**Answer: (D)** 5 eV · Key from source paper

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**Q35** JEE Main 2024 · 9 Apr · Shift 1 MCQ

A proton, an electron and an alpha particle have the same energies. Their de-Broglie wavelengths will be compared as :

(A) $\lambda_\alpha < \lambda_p < \lambda_e$
(B) $\lambda_e > \lambda_\alpha > \lambda_p$
(C) $\lambda_p > \lambda_e > \lambda_\alpha$
(D) $\lambda_p < \lambda_e < \lambda_\alpha$

**Answer: (A)** $\lambda_\alpha < \lambda_p < \lambda_e$ · Key from source paper

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**Q36** JEE Main 2024 · 9 Apr · Shift 2 MCQ

UV light of 4.13eV is incident on a photosensitive metal surface having work function 3.13eV. The maximum kinetic energy of ejected photoelectrons will be:

(A) 4.13eV
(B) 3.13eV
(C) 1eV
(D) 7.26eV

**Answer: (C)** 1eV · Key from source paper

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**Q37** JEE Main 2024 · 8 Apr · Shift 1 MCQ

A proton and an electron are associated with same de-Broglie wavelength. The ratio of their kinetic energies is: (Assume h=6.63 $\times 10^{-34}$ J s, $\mathrm{m_e}$ = 9.0 $\times 10^{-31}$ kg and $\mathrm{m_p}$ = 1836 times $\mathrm{m_e}$ )

(A) $1 : \sqrt{1836}$
(B) $1 : \frac{1}{1836}$
(C) $1 : \frac{1}{\sqrt{1836}}$
(D) 1: 1836

**Answer: (D)** 1: 1836 · Key from source paper

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**Q38** JEE Main 2024 · 8 Apr · Shift 2 MCQ

A proton and an electron have the same de Broglie wavelength. If $K_p$ and $K_e$ be the kinetic energies of proton and electron respectively, then choose the correct relation :

(A) $K_p > K_e$
(B) $K_p < K_e$
(C) $K_p = K_e$
(D) $K_p = K_e^2$

**Answer: (B)** $K_p < K_e$ · Key from source paper

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**Q39** JEE Main 2024 · 6 Apr · Shift 1 MCQ

In photoelectric experiment energy of 2.48eV irradiates a photo sensitive material. The stopping potential was measured to be 0.5 V. Work function of the photo sensitive material is :

(A) 1.68eV
(B) 2.48eV
(C) 1.98eV
(D) 0.5eV

**Answer: (C)** 1.98eV · Key from source paper

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**Q40** JEE Main 2024 · 6 Apr · Shift 1 MCQ

Which of the following phenomena does not explain by wave nature of light. A. reflection B. diffraction C. photoelectric effect D. interference E. polarization Choose the most appropriate answer from the options given below:

(A) E only
(B) B, D only
(C) C only
(D) A, C only

**Answer: (C)** C only · Key from source paper

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**Q41** JEE Main 2024 · 6 Apr · Shift 2 MCQ

When UV light of wavelength 300 nm is incident on the metal surface having work function 2.13eV, electron emission takes place. The stopping potential is: (Given hc = 1240eVnm )

(A) 1.5 V
(B) 4.1 V
(C) 2 V
(D) 4 V

**Answer: (C) 2 V** · Key from source paper

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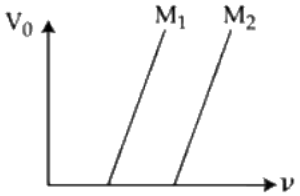
**Q42** JEE Main 2024 · 5 Apr · Shift 1 MCQ

*see figure*

**Q18.**




Given below are two statements : Statement I : Figure shows the variation of stopping potential with frequency $(v)$ for the two photosensitive materials $M_1$ and $M_2$. The slope gives value of $\frac{h}{e}$, where h is Planck's constant, e is the charge of electron. Statement II : $M_2$ will emit photoelectrons of greater kinetic energy for the incident radiation having same frequency. In the light of the above statements, choose the most appropriate answer from the options given below.

(1) Both Statement I and Statement II are correct
(2) Statement I is incorrect but Statement II is correct
(3) Both Statement I and Statement II are incorrect
(4) Statement I is correct and Statement II is incorrect

(A) Both Statement I and Statement II are correct
(B) Statement I is incorrect but Statement II is correct
(C) Both Statement I and Statement II are incorrect
(D) Statement I is correct and Statement II is incorrect

**Answer: (D) Statement I is correct and Statement II is incorrect** · Key from source paper

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**Q43** JEE Main 2024 · 5 Apr · Shift 2 MCQ

Which of the following statement is not true about stopping potential $(V_0)$ ?

(A) It is 1/ e times the maximum kinetic energy of electrons emitted.
(B) It increases with increase in intensity of the incident light.
(C) It depends on the nature of emitter material.
(D) It depends upon frequency of the incident light.

**Answer: (B) It increases with increase in intensity of the incident light.** · Key from source paper

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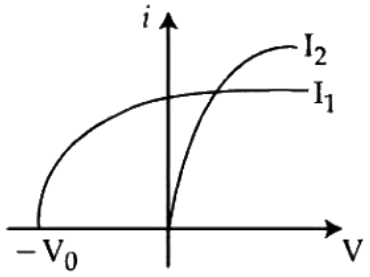
**Q44** JEE Main 2024 · 4 Apr · Shift 1 MCQ

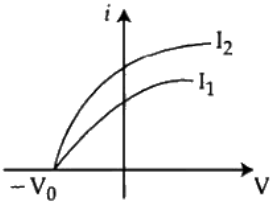
Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light $(I_1 < I_2)$ of same wavelengths :

**Q18.** Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light ($I_1 < I_2$) of same wavelengths :

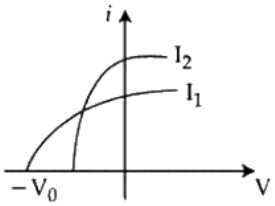
(1)



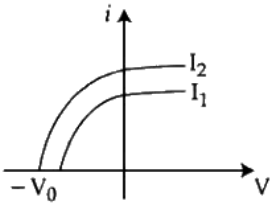

(2)




(3)




(4)




(A) *see figure*
(B) *see figure*
(C) *see figure*
(D) *see figure*

**Answer: (B)** · Key from source paper

## Q45 JEE Main 2024 · 4 Apr · Shift 2 MCQ

Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason R. Assertion A: Number of photons increases with increase in frequency of light. Reason R: Maximum kinetic energy of emitted electrons increases with the frequency of incident radiation. In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A**.
(B) Both **A** and **R** are correct and **R** is NOT the correct explanation of **A**.
(C) **A** is not correct but **R** is correct.
(D) **A** is correct but **R** is not correct.

**Answer: (C) A is not correct but R is correct.** · Key from source paper

## Q46 JEE Main 2024 · 1 Feb · Shift 1 MCQ

The de Broglie wavelengths of a proton and an $\alpha$ particle are $\lambda$ and $2\lambda$ respectively. The ratio of the velocities of proton and $\alpha$ particle will be :

(A) 1 : 8
(B) 1 : 2
(C) 4 : 1
(D) 8 : 1

**Answer: (D) 8 : 1** · Key from source paper

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**Q47** JEE Main 2024 · 1 Feb · Shift 2 MCQ

Monochromatic light of frequency $6 \times 10^{14}$ Hz is produced by a laser. The power emitted is $2 \times 10^{-3}$ W. How many photons per second on an average, are emitted by the source?

(Given h = $6.63 \times 10^{-34}$ J s)

(A) $9 \times 10^{18}$
(B) $6 \times 10^{15}$
(C) $5 \times 10^{15}$
(D) $7 \times 10^{16}$

**Answer: (C) $5 \times 10^{15}$** · Key from source paper

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**Q48** JEE Main 2024 · 31 Jan · Shift 1 MCQ

When a metal surface is illuminated by light of wavelength $\lambda$, the stopping potential is 8 V. When the same surface is illuminated by light of wavelength $3\lambda$, stopping potential is 2 V. The threshold wavelength for this surface is :

(A) $5\lambda$
(B) $3\lambda$
(C) $9\lambda$
(D) $4.5\lambda$

**Answer: (C) $9\lambda$** · Key from source paper

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**Q49** JEE Main 2024 · 31 Jan · Shift 2 MCQ

In a photoelectric effect experiment a light of frequency $1.5$ times the threshold frequency is made to fall on the surface of photosensitive material. Now if the frequency is halved and intensity is doubled, the number of photo electrons emitted will be:

(A) Doubled
(B) Quadrupled
(C) Zero
(D) Halved

**Answer: (C) Zero** · Key from source paper

**Q50** JEE Main 2024 · 30 Jan · Shift 1 MCQ

The work function of a substance is 3. 0 eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately:

(A) 215 nm
(B) 414 nm
(C) 400 nm
(D) 200 nm

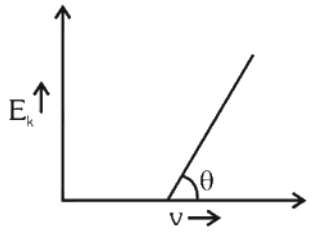
**Answer: (B) 414 nm** · Key from source paper

**Q51** JEE Main 2024 · 30 Jan · Shift 2 MCQ

For the photoelectric effect, the maximum kinetic energy $E_k$ of the photoelectrons is plotted against the frequency ($\nu$) of the incident photons as shown in figure. The slope of the graph gives

*(see the figure above)*

**Q16.** For the photoelectric effect, the maximum kinetic energy $E_k$ of the photoelectrons is plotted against the frequency $(\nu)$ of the incident photons as shown in figure. The slope of the graph gives




(1) Ratio of Planck's constant to electric charge
(2) Work function of the metal
(3) Charge of electron
(4) Planck's constant

(A) Ratio of Planck's constant to electric charge
(B) Work function of the metal
(C) Charge of electron
(D) Planck's constant

**Answer: (D) Planck's constant** · Key from source paper

**Q52** JEE Main 2024 · 29 Jan · Shift 1 MCQ

The de-Broglie wavelength of an electron is the same as that of a photon. If velocity of electron is 25% of the velocity of light, then the ratio of K.E. of electron and K.E. of photon will be:

(A) $\frac{1}{1}$
(B) $\frac{1}{8}$
(C) $\frac{8}{1}$
(D) $\frac{1}{4}$

**Answer: (B)** $\frac{1}{8}$ · Key from source paper

**Q53** JEE Main 2024 · 29 Jan · Shift 2 MCQ

Two sources of light emit with a power of 200 W. The ratio of number of photons of visible light emitted by each source having wavelengths 300 nm and 500 nm respectively, will be :

(A) 1 : 5
(B) 1 : 3
(C) 5 : 3
(D) 3 : 5

**Answer: (D)** 3 : 5 · Key from source paper

**Q54** JEE Main 2024 · 27 Jan · Shift 1 MCQ

A convex lens of focal length 40 cm forms an image of an extended source of light on a photoelectric cell. A current $I$ is produced. The lens is replaced by another convex lens having the same diameter but focal length 20 cm. The photoelectric current now is

(A) $\frac{I}{2}$
(B) $4I$
(C) $2I$
(D) $I$

**Answer: (D)** $I$ · Key from source paper

**Q55** JEE Main 2024 · 27 Jan · Shift 2 MCQ

The threshold frequency of a metal with work function 6.63 eV is :

(A) $16 \times 10^{15}$ Hz
(B) $16 \times 10^{12}$ Hz
(C) $1.6 \times 10^{12}$ Hz
(D) $1.6 \times 10^{15}$ Hz

**Answer: (D)** $1.6 \times 10^{15}$ Hz · Key from source paper

**Q56** JEE Main 2023 · 15 Apr · Shift 1 MCQ

The de Broglie wavelength of an electron having kinetic energy $E$ is $\lambda$. If the kinetic energy of electron becomes $\frac{E}{4}$, then its de-Broglie wavelength will be:

(A) $\sqrt{2}\lambda$
(B) $\frac{\lambda}{\sqrt{2}}$
(C) $\frac{\lambda}{2}$
(D) $2\lambda$

**Answer: (D)** $2\lambda$ · Key from source paper

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**Q57** JEE Main 2023 · 13 Apr · Shift 1 MCQ

The difference between threshold wavelengths for two metal surfaces $A$ and $B$ having work function $\phi_A = 9$ eV and $\phi_B = 4.5$ eV in nm is:
{Given, $hc$ = 1242 eV nm}

(A) 540
(B) 276
(C) 264
(D) 138

**Answer: (D)** 138 · Key from source paper

**Q58** JEE Main 2023 · 13 Apr · Shift 2 MCQ

Given below are two statements:
Statement I : Out of microwaves, infrared rays and ultraviolet rays, ultraviolet rays are the most effective for the emission of electrons from a metallic surface
Statement II : Above the threshold frequency, the maximum kinetic energy of photoelectrons is inversely proportional to the frequency of the incident light
In the light of above statements, choose the correct answer from the options given below

(A) Statement I is false but Statement II is true
(B) Statement I is true but Statement II is false
(C) Both Statement I and Statement II are true
(D) Both Statement I and Statement II are false

**Answer: (B) Statement I is true but Statement II is false** · Key from source paper

**Q59** JEE Main 2023 · 13 Apr · Shift 2 Numerical

An atom absorbs a photon of wavelength 500 nm and emits another photon of wavelength 600 nm. The net energy absorbed by the atom in this process is $n \times 10^{-4}$ eV. The value of $n$ is [Assume the atom to be stationary during the absorption and emission process] (Take $h = 6.6 \times 10^{-34}$ J s and $c = 3 \times 10^8$ m s$^{-1}$).

Numerical value type: the answer is a number.

**Answer: 4125.** · Key from source paper

**Q60** JEE Main 2023 · 12 Apr · Shift 1 MCQ

A proton and an $\alpha$-particle are accelerated from rest by 2 V and 4 V potentials, respectively. The ratio of their de-Broglie wavelength is :

(A) $8:1$
(B) $2:1$
(C) $4:1$
(D) $16:1$

**Answer: (C)** $4:1$ · Key from source paper

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**Q61** JEE Main 2023 · 11 Apr · Shift 1 MCQ

A metallic surface is illuminated with radiation of wavelength $\lambda$, the stopping potential is $V_0$. If the same surface is illuminated with radiation of wavelength $2\lambda$, the stopping potential becomes $\frac{V_0}{4}$. The threshold wavelength for this metallic surface will be

(A) $3\lambda$
(B) $4\lambda$
(C) $\frac{3}{2}\lambda$
(D) $\frac{\lambda}{4}$

**Answer: (A)** $3\lambda$ · Key from source paper

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**Q62** JEE Main 2023 · 11 Apr · Shift 2 MCQ

The ratio of the de-Broglie wavelengths of proton and electron having same kinetic energy: (Assume $m_p = m_e \times 1849$)

(A) $1:43$
(B) $1:30$
(C) $1:62$
(D) $2:43$

**Answer: (A)** $1:43$ · Key from source paper

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**Q63** JEE Main 2023 · 10 Apr · Shift 1 MCQ

The de Broglie wavelength of a molecule in a gas at room temperature 300 K is $\lambda_1$. If the temperature of the gas is increased to 600 K, then the de Broglie wavelength of the same gas molecule becomes

(A) $\frac{1}{2}\lambda_1$
(B) $\sqrt{2}\lambda_1$
(C) $\frac{1}{\sqrt{2}}\lambda_1$
(D) $2\lambda_1$

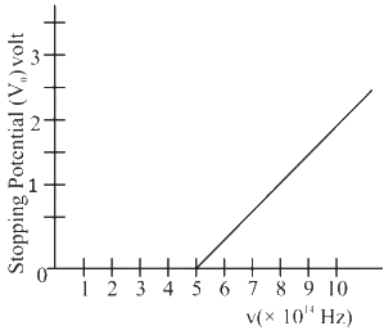
**Answer: (C)** $\frac{1}{\sqrt{2}}\lambda_1$ · Key from source paper

## Q64 JEE Main 2023 · 10 Apr · Shift 2 MCQ

The variation of stopping potential $V_0$ as a function of the frequency $(\nu)$ of the incident light for a metal is shown in figure. The work function of the surface is

*(see the figure above)*

**Q16.** The variation of stopping potential $V_0$ as a function of the frequency $(\nu)$ of the incident light for a metal is shown in figure. The work function of the surface is




(1) 2.98 eV
(2) 2.07 eV
(3) 1.36 eV
(4) 18.6 eV

(A) 2.98 eV
(B) 2.07 eV
(C) 1.36 eV
(D) 18.6 eV

**Answer: (B)** 2.07 eV · Key from source paper

## Q65 JEE Main 2023 · 8 Apr · Shift 1 MCQ

Proton (P) and electron (e) will have same de-Broglie wavelength when the ratio of their momentum is (assume, $m_p = 1849\ m_e$)

(A) 1 : 1
(B) 1 : 1849
(C) 1 : 43
(D) 43 : 1

**Answer: (A)** 1 : 1 · Key from source paper

## Q66 JEE Main 2023 · 8 Apr · Shift 2 MCQ

In photoelectric effect

A. The photocurrent is proportional to the intensity of the incident radiation.

B. Maximum kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.

C. Max K.E. with which photoelectrons are emitted depends on the frequency of incident light.

D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.

E. Max K.E. of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below:

(A) A and B only
(B) A and E only
(C) A and C only
(D) B and C only

**Answer: (C) A and C only** · Key from source paper

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## Q67 JEE Main 2023 · 6 Apr · Shift 1 MCQ

The kinetic energy of an electron, $\alpha$ - particle and a proton are given as $4K$, $2K$ and $K$ respectively. The de-Broglie wavelength associated with electron $(\lambda_e)$, $\alpha$ - particle $(\lambda_\alpha)$ and the proton $(\lambda_p)$ are as follows:

(A) $\lambda_\alpha = \lambda_p > \lambda_e$
(B) $\lambda_\alpha < \lambda_p < \lambda_e$
(C) $\lambda_\alpha = \lambda_p < \lambda_e$
(D) $\lambda_\alpha > \lambda_p > \lambda_e$

**Answer: (B)** $\lambda_\alpha < \lambda_p < \lambda_e$ · Key from source paper

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## Q68 JEE Main 2023 · 6 Apr · Shift 2 MCQ

The work functions of Aluminium and Gold are $4.1\ \text{eV}$ and $5.1\ \text{eV}$ respectively. The ratio of the slope of the stopping potential versus frequency plot for Gold to that of Aluminium is

(A) $1.24$
(B) $2$
(C) $1$
(D) $1.5$

**Answer: (C)** $1$ · Key from source paper

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## Q69 JEE Main 2023 · 1 Feb · Shift 1 MCQ

A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of $\lambda$. An alpha particle having certain kinetic energy has the same de-Brogle wavelength $\lambda$. The ratio of kinetic energy of proton and that of alpha particle is :

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(A) 2 : 1
(B) 4 : 1
(C) 1 : 2
(D) 1 : 4

**Answer: (B) 4 : 1** · Key from source paper

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**Q70** JEE Main 2023 · 1 Feb · Shift 2 MCQ

The threshold frequency of metal is $f_0$. When the light of frequency $2f_0$ is incident on the metal plate, the maximum velocity of photoelectron is $v_1$. When the frequency of incident radiation is increased to $5f_0$, the maximum velocity of photoelectrons emitted is $v_2$. The ratio of $v_1$ to $v_2$ is:

(A) $\frac{v_1}{v_2} = \frac{1}{2}$
(B) $\frac{v_1}{v_2} = \frac{1}{8}$
(C) $\frac{v_1}{v_2} = \frac{1}{16}$
(D) $\frac{v_1}{v_2} = \frac{1}{4}$

**Answer: (A)** $\frac{v_1}{v_2} = \frac{1}{2}$ · Key from source paper

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**Q71** JEE Main 2023 · 31 Jan · Shift 1 MCQ

Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A : The beam of electrons shows wave nature and exhibit interference and diffraction.
Reason R : Davisson Germer Experimentally verified the wave nature of electrons.
In the light of the above statements. Choose the most appropriate answer from the options given below :

(A) A is correct but R is not correct
(B) A is not correct but R is correct
(C) Both A and R are correct but R is Not the correct explanation of A
(D) Both A and R are correct and R is the correct explanation of A

**Answer: (D) Both A and R are correct and R is the correct explanation of A** · Key from source paper

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**Q72** JEE Main 2023 · 31 Jan · Shift 1 MCQ

If a source of electromagnetic radiation having power 15 $\mathrm{kW}$ produces $10^{16}$ photons per second, the radiation belongs to a part of spectrum is :
(Take Planck constant $h$ = $6 \times 10^{-34}$ $\mathrm{J\ s}$)

(A) Micro waves
(B) Ultraviolet rays
(C) Gamma rays
(D) Radio waves

**Answer: (C) Gamma rays** · Key from source paper

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**Q73** JEE Main 2023 · 31 Jan · Shift 2 MCQ

If the two metals $A$ and $B$ are exposed to radiation of wavelength 350 nm. The work functions of metals $A$ and $B$ are 4.8 eV and 2.2 eV. Then choose the correct option

(A) Metal $B$ will not emit photo-electrons
(B) Both metals $A$ and $B$ will emit photo-electrons
(C) Both metals $A$ and $B$ will not emit photoelectrons
(D) Metal $A$ will not emit photo-electrons

**Answer: (D) Metal $A$ will not emit photo-electrons** · Key from source paper

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**Q74** JEE Main 2023 · 30 Jan · Shift 2 MCQ

An electron accelerated through a potential difference $V_1$ has a de-Broglie wavelength of $\lambda$. When the potential is changed to $V_2$, its de-Broglie wavelength increases by 50%. The value of $\left(\frac{V_1}{V_2}\right)$ is equal to :

(A) 3
(B) $\frac{9}{4}$
(C) $\frac{3}{2}$
(D) 4

**Answer: (B) $\frac{9}{4}$** · Key from source paper

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**Q75** JEE Main 2023 · 29 Jan · Shift 1 MCQ

The threshold wavelength for photoelectric emission from a material is $5500\ \text{Å}$. Photoelectrons will be emitted, when this material is illuminated with monochromatic radiation from a

A. $75\ \text{W}$ infra-red lamp
B. $10\ \text{W}$ infra-red lamp
C. $75\ \text{W}$ ultra-violet lamp
D. $10\ \text{W}$ ultra-violet lamp

Choose the correct answer from the options given below :

(A) B and C only
(B) A and D only
(C) C only
(D) C and D only

**Answer: (D) C and D only** · Key from source paper

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**Q76** JEE Main 2023 · 29 Jan · Shift 2 MCQ

The ratio of de-Broglie wavelength of an $\alpha$-particle and a proton accelerated from rest by the same potential is $\frac{1}{\sqrt{m}}$ , the value of $m$ is:

(A) 4
(B) 16
(C) 8
(D) 2

**Answer: (C) 8** · Key from source paper

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**Q77** JEE Main 2023 · 25 Jan · Shift 1 MCQ

Electron beam used in an electron microscope, when accelerated by a voltage of $20\ \mathrm{kV}$ has a de-Broglie wavelength of $\lambda_0$. If the voltage is increased to $40\ \mathrm{kV}$ then the de-Broglie wavelength associated with the electron beam would be:

(A) $3\lambda_0$
(B) $9\lambda_0$
(C) $\frac{\lambda_0}{2}$
(D) $\frac{\lambda_0}{\sqrt{2}}$

**Answer: (D)** $\frac{\lambda_0}{\sqrt{2}}$ · Key from source paper

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**Q78** JEE Main 2023 · 25 Jan · Shift 2 MCQ

Given below are two statements :

**Statement I :** Stopping potential in photoelectric effect does not depend on the power of the light source.

**Statement II :** For a given metal, the maximum kinetic energy of the photoelectron depends on the wavelength of the incident light.

In the light of above statements, choose the most appropriate answer from the options given below.

(A) Statement I is incorrect but statement II is correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but statement II is incorrect
(D) Both Statement I and statement II are correct

**Answer: (D) Both Statement I and statement II are correct** · Key from source paper

## Q79 JEE Main 2023 · 24 Jan · Shift 1 MCQ

From the photoelectric effect experiment, following observations are made. Identify which of these are correct

A. The stopping potential depends only on the work function of the metal.

B. The saturation current increases as the intensity of incident light increases.

C. The maximum kinetic energy of a photo electron depends on the intensity of the incident light.

D. Photoelectric effect can be explained using wave theory of light.

Choose the correct answer from the options given below:

(A) B, C only
(B) A, C, D only
(C) B only
(D) A, B, D only

**Answer: (C) B only** · Key from source paper

## Q80 JEE Main 2023 · 24 Jan · Shift 2 MCQ

An $\alpha$ particle, a proton and an electron have the same kinetic energy. Which one of the following is correct in case of their de-Broglie wavelength:

(A) $\lambda_\alpha > \lambda_p > \lambda_e$
(B) $\lambda_\alpha < \lambda_p < \lambda_e$
(C) $\lambda_\alpha = \lambda_p = \lambda_e$
(D) $\lambda_\alpha > \lambda_p < \lambda_e$

**Answer: (B)** $\lambda_\alpha < \lambda_p < \lambda_e$ · Key from source paper

## Q81 JEE Main 2022 · 29 Jul · Shift 1 MCQ

The kinetic energy of emitted electron is $E$ when the light incident on the metal has wavelength $\lambda$. To double the kinetic energy, the incident light must have wavelength:

(A) $\frac{hc}{E\lambda - hc}$
(B) $\frac{hc\lambda}{E\lambda + hc}$
(C) $\frac{h\lambda}{E\lambda + hc}$
(D) $\frac{hc\lambda}{E\lambda - hc}$

**Answer: (B)** $\frac{hc\lambda}{E\lambda + hc}$ · Key from source paper

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## Q82 JEE Main 2022 · 29 Jul · Shift 2 MCQ

An $\alpha$ particle and a proton are accelerated from rest through the same potential difference. The ratio of linear momenta acquired by above two particals will be :

(A) $\sqrt{2} : 1$
(B) $2\sqrt{2} : 1$
(C) $4\sqrt{2} : 1$
(D) $8 : 1$

**Answer: (B)** $2\sqrt{2} : 1$ · Key from source paper

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## Q83 JEE Main 2022 · 28 Jul · Shift 1 MCQ

The equation $\lambda = \frac{1.227}{x}$ nm can be used to find the de-Broglie wavelength of an electron. In this equation $x$ stands for :
Where,
$m =$ mass of electron
$P =$ momentum of electron
$K =$ Kinetic energy of electron
$V =$ Accelerating potential in volts for electron

(A) $\sqrt{mK}$
(B) $\sqrt{P}$
(C) $\sqrt{K}$
(D) $\sqrt{V}$

**Answer: (D)** $\sqrt{V}$ · Key from source paper

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## Q84 JEE Main 2022 · 28 Jul · Shift 2 MCQ

Two streams of photons, possessing energies to five and ten times the work function of metal are incident on the metal surface successively. The ratio of the maximum velocities of the photoelectron emitted, in the two cases respectively, will be

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(A) $1:2$
(B) $1:3$
(C) $2:3$
(D) $3:2$

**Answer: (C)** $2:3$ · Key from source paper

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**Q85** JEE Main 2022 · 27 Jul · Shift 1 MCQ

An electron (mass $m$) with an initial velocity $\overrightarrow{v} = v_0\hat{i}(v_0 > 0)$ is moving in an electric field $\overrightarrow{E} = -E_0\hat{i}(E_0 > 0)$ where $E_0$ is constant. If at $t = 0$, de-Broglie wavelength is $\lambda_0 = \frac{h}{mv_0}$, then its de-Broglie wavelength after time $t$ is given by

(A) $\lambda_0$
(B) $\lambda_0\left(1 + \frac{eE_0t}{mv_0}\right)$
(C) $\lambda_0 t$
(D) $\frac{\lambda_0}{\left(1+\frac{eE_0t}{mv_0}\right)}$

**Answer: (D)** $\frac{\lambda_0}{\left(1+\frac{eE_0t}{mv_0}\right)}$ · Key from source paper

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**Q86** JEE Main 2022 · 27 Jul · Shift 2 MCQ

With reference to the observations in photo-electric effect, identify the correct statements from below:
A. The square of maximum velocity of photoelectrons varies linearly with frequency of incident light.
B. The value of saturation current increases on moving the source of light away from the metal surface.
C. The maximum kinetic energy of photo-electrons decreases on decreasing the power of LED (light emitting diode) source of light.
D. The immediate emission of photo-electrons out of metal surface can not be explained by particle nature of light/electromagnetic waves.
E. Existence of threshold wavelength can not be explained by wave nature of light/electromagnetic waves.
Choose the correct answer from the options given below:

(A) A and B only
(B) A and E only
(C) C and E only
(D) D and E only

**Answer: (B)** A and E only · Key from source paper

**Q87** JEE Main 2022 · 26 Jul · Shift 1 MCQ

A parallel beam of light of wavelength 900 nm and intensity $100\ \mathrm{Wm}^{-2}$ is incident on a surface perpendicular to the beam. The number of photons crossing 1 $\mathrm{cm}^2$ area perpendicular to the beam in one second is

(A) $3 \times 10^{16}$
(B) $4.5 \times 10^{16}$
(C) $4.5 \times 10^{17}$
(D) $4.5 \times 10^{20}$

**Answer: (B)** $4.5 \times 10^{16}$ · Key from source paper

**Q88** JEE Main 2022 · 26 Jul · Shift 2 MCQ

A nucleus of mass $M$ at rest splits into two parts having masses $\frac{M}{3}$ and $\frac{2M}{3}$ $M' < M$. The ratio of de Broglie wavelength of two parts will be

(A) $1:2$
(B) $2:1$
(C) $1:1$
(D) $2:3$

**Answer: (C)** $1:1$ · Key from source paper

**Q89** JEE Main 2022 · 25 Jul · Shift 1 MCQ

A metal exposed to light of wavelength 800 nm and emits photoelectrons with a certain kinetic energy. The maximum kinetic energy of photo-electron doubles when light of wavelength 500 nm is used. The work function of the metal is
(Take $hc = 1230$ eV - nm).

(A) 1.537eV
(B) 2.46eV
(C) 0.615eV
(D) 1.23eV

**Answer: (C)** 0.615eV · Key from source paper

**Q90** JEE Main 2022 · 25 Jul · Shift 2 MCQ

The ratio of wavelengths of proton and deuteron accelerated by potential $V_p$ and $V_d$ is $1:\sqrt{2}$. Then, the ratio of $V_p$ to $V_d$ will be

(A) $1:1$
(B) $\sqrt{2}:1$
(C) $2:1$
(D) $4:1$

**Answer: (D)** $4:1$ · Key from source paper

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**Q91** JEE Main 2022 · 29 Jun · Shift 1 MCQ

Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
**Assertion A :** The photoelectric effect does not take place, if the energy of the incident radiation is less than the work function of a metal.
**Reason R :** Kinetic energy of the photoelectrons is zero, if the energy of the incident radiation is equal to the work function of a metal.

(A) Both A and R are correct and R is the correct explanation of A
(B) Both A and R are correct but R is not the correct explanation of A
(C) A is correct but R is not correct
(D) A is not correct but R is correct

**Answer: (B) Both A and R are correct but R is not the correct explanation of A** · Key from source paper

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**Q92** JEE Main 2022 · 29 Jun · Shift 2 MCQ

The electric field at a point associated with a light wave is given by
$E = 200\left[\sin\left(6\times10^{15}\right)t + \sin\left(9\times10^{15}\right)t\right]\ \mathrm{Vm}^{-1}$
Given: $h = 4.14\times10^{-15}\ \mathrm{eVs}$
If this light falls on a metal surface having a work function of $2.50\ \mathrm{eV}$, the maximum kinetic energy of the photoelectrons will be

(A) $1.90\ \mathrm{eV}$
(B) $3.27\ \mathrm{eV}$
(C) $3.60\ \mathrm{eV}$
(D) $3.42\ \mathrm{eV}$

**Answer: (D)** $3.42\ \mathrm{eV}$ · Key from source paper

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**Q93** JEE Main 2022 · 28 Jun · Shift 1 MCQ

The de Broglie wavelengths for an electron and a photon are $\lambda_e$ and $\lambda_p$ respectively. For the same kinetic energy of electron and photon, which of the following presents the correct relation between the de Broglie wavelengths of two?

(A) $\lambda_p \propto \lambda_e^2$
(B) $\lambda_p \propto \lambda_e$
(C) $\lambda_p \propto \sqrt{\lambda_e}$
(D) $\lambda_p \propto \sqrt{\frac{1}{\lambda_e}}$

**Answer: (A)** $\lambda_p \propto \lambda_e^2$ · Key from source paper

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**Q94** JEE Main 2022 · 28 Jun · Shift 2 MCQ

Let $K_1$ and $K_2$ be the maximum kinetic energies of photo-electrons emitted when two monochromatic beams of wavelength $\lambda_1$ and $\lambda_2$, respectively are incident on a metallic surface. If $\lambda_1 = 3\lambda_2$ then :

(A) $K_1 > \frac{K_2}{3}$
(B) $K_1 < \frac{K_2}{3}$
(C) $K_1 = \frac{K_2}{3}$
(D) $K_2 = \frac{K_1}{3}$

**Answer: (B)** $K_1 < \frac{K_2}{3}$ · Key from source paper

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**Q95** JEE Main 2022 · 27 Jun · Shift 1 MCQ

An $\alpha$ particle and a carbon 12 atom has same kinetic energy $K$. The ratio of their de-Broglie wavelengths $(\lambda_\alpha : \lambda_{C12})$ is

(A) $\sqrt{3} : 1$
(B) $1 : \sqrt{3}$
(C) $2 : \sqrt{3}$
(D) $3 : 1$

**Answer: (A)** $\sqrt{3} : 1$ · Key from source paper

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**Q96** JEE Main 2022 · 26 Jun · Shift 1 MCQ

An electron with speed $v$ and a photon with speed $c$ have the same de-Broglie wavelength. If the kinetic energy and momentum of electron are $E_e$ and $P_e$ and that of photon are $E_{ph}$ and $P_{ph}$ respectively. Which of the following is correct?

(A) $\frac{E_e}{E_{ph}} = \frac{2c}{v}$
(B) $\frac{E_e}{E_{ph}} = \frac{v}{2c}$
(C) $\frac{P_e}{P_{ph}} = \frac{2c}{v}$
(D) $\frac{P_e}{P_{ph}} = \frac{v}{2c}$

**Answer: (B)** $\frac{E_e}{E_{ph}} = \frac{v}{2c}$ · Key from source paper

**Q97** JEE Main 2022 · 26 Jun · Shift 2 MCQ

A metal surface is illuminated by a radiation of wavelength $4500\ \text{Å}$. The ejected photo-electron enters a constant magnetic field of $2\ \text{mT}$ making an angle of $90^\circ$ with the magnetic field. If it starts revolving in a circular path of radius $2\ \text{mm}$, the work function of the metal is approximately

(A) $1.36\ \text{eV}$
(B) $1.69\ \text{eV}$
(C) $2.78\ \text{eV}$
(D) $2.23\ \text{eV}$

**Answer: (A)** $1.36\ \text{eV}$ · Key from source paper

**Q98** JEE Main 2022 · 26 Jun · Shift 2 Numerical

The stopping potential for photoelectrons emitted from a surface illuminated by light of wavelength $6630\ \text{Å}$ is $0.42\ \text{V}$. If the threshold frequency is $x \times 10^{13}\ \text{s}$, where $x$ is (nearest integer): (Given: speed light $= 3 \times 10^8\ \text{m s}^{-1}$. Planck's constant $= 6.63 \times 10^{-34}\ \text{J s}$)

Numerical value type: the answer is a number.

**Answer: 35.** · Key from source paper

**Q99** JEE Main 2022 · 25 Jun · Shift 1 MCQ

Given below are two statements :
Statement I : Davisson-Germer experiment establishes the wave nature of electrons.
Statement II : If electrons have wave nature, they can interfere and show diffraction.
In the light of the above statements choose the correct answer from the option given below :

(A) Both Statement I and Statement II are true.
(B) Both Statement I and Statement II are false.
(C) Statement I is true but Statement II is false.
(D) Statement I is false but Statement II is true.

**Answer: (A) Both Statement I and Statement II are true.** · Key from source paper

**Q100** JEE Main 2022 · 25 Jun · Shift 2 MCQ

A proton, a neutron, an electron and an $\alpha$-particle have same energy. If $\lambda_p, \lambda_n, \lambda_e$ and $\lambda_\alpha$ are the de Broglie's wavelengths of proton, neutron, electron and $\alpha$ particle respectively, then choose the correct relation from the following

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(A) $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$
(B) $\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$
(C) $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$
(D) $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$.

**Answer: (B)** $\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$ · Key from source paper

## Q101 JEE Main 2022 · 24 Jun · Shift 1 Numerical

When light of frequency twice the threshold frequency is incident on the metal plate, the maximum velocity of emitted electron is $v_1$. When the frequency of incident radiation is increased to five times the threshold value, the maximum velocity of emitted electron becomes $v_2$. If $v_2 = xv_1$, the value of $x$ will be _____ .

Numerical value type: the answer is a number.

**Answer: 2.** · Key from source paper

## Q102 JEE Main 2022 · 24 Jun · Shift 2 MCQ

The light of two different frequencies whose photons have energies $3.8\ \text{eV}$ and $1.4\ \text{eV}$ respectively, illuminate a metallic surface whose work function is $0.6\ \text{eV}$ successively. The ratio of maximum speeds of emitted electrons for the two frequencies respectively will be :

(A) $2 : 1$
(B) $4 : 1$
(C) $1 : 2$
(D) $1 : 4$

**Answer: (A)** $2 : 1$ · Key from source paper

## Q103 JEE Main 2021 · 1 Sep · Shift 2 MCQ

The temperature of an ideal gas in three dimensions is $300$ K. The corresponding de-Broglie wavelength of the electron approximately at $300$ K is:
$m_e$ = mass of electron $= 9 \times 10^{-31}$ kg, $h$ = Planck constant $= 6.6 \times 10^{-34}$ J s, $k_B$ = Boltzmann constant $= 1.38 \times 10^{-23}$ J K$^{-1}$

(A) $2.26$ nm
(B) $3.25$ nm
(C) $8.46$ nm
(D) $6.26$ nm

**Answer: (D)** $6.26$ nm · Key from source paper

**Q104** JEE Main 2021 · 31 Aug · Shift 1 MCQ

A moving proton and electron have the same de-Broglie wavelength. If $K$ and $P$ denote the $K.E.$ and momentum respectively. Then choose the correct option :

(A) $K_p > K_e$ and $P_p = P_e$
(B) $K_p < K_e$ and $P_p = P_e$
(C) $K_p < K_e$ and $P_p < P_e$
(D) $K_p = K_e$ and $P_p = P_e$

**Answer: (B)** $K_p < K_e$ and $P_p = P_e$ · Key from source paper

**Q105** JEE Main 2021 · 31 Aug · Shift 2 MCQ

Consider two separate ideal gases of electrons and protons having same number of particles. The temperature of both the gases are same. The ratio of the uncertainty in determining the position of an electron to that of a proton is proportional to:

(A) $\sqrt{\frac{m_p}{m_e}}$
(B) $\frac{m_p}{m_e}$
(C) $\frac{m_p^{3/2}}{m_e}$
(D) $\sqrt{\frac{m_e}{m_p}}$

**Answer: (A)** $\sqrt{\frac{m_p}{m_e}}$ · Key from source paper

**Q106** JEE Main 2021 · 27 Aug · Shift 1 MCQ

In a photoelectric experiment, increasing the intensity of incident light:

(A) increases the number of photons incident and also increases the K.E. of the ejected electrons.
(B) increases the frequency of photons incident and increases the K.E. of the ejected electrons.
(C) increases the number of photons incident and the K.E. of the ejected electrons remains unchanged.
(D) increases the frequency of photons incident and the K.E. of the ejected electrons remains unchanged.

**Answer: (C) increases the number of photons incident and the K.E. of the ejected electrons remains unchanged.** · Key from source paper

**Q107** JEE Main 2021 · 27 Aug · Shift 2 MCQ

A monochromatic neon lamp with wavelength of $670.5\ \text{nm}$ illuminates a photo-sensitive material which has a stopping voltage of $0.48\ \text{V}$. What will be the stopping voltage if the source light is changed with another source of wavelength of $474.6\ \text{nm}$ ?

(A) $0.24\ \text{V}$
(B) $1.5\ \text{V}$
(C) $1.25\ \text{V}$
(D) $0.96\ \text{V}$

**Answer: (C)** $1.25\ \text{V}$ · Key from source paper

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**Q108** JEE Main 2021 · 26 Aug · Shift 1 MCQ

In a photoelectric experiment, ultraviolet light of wavelength $280\ \text{nm}$ is used with lithium cathode having work function $\phi = 2.5\ \text{eV}$. If the wavelength of incident light is switched to $400\ \text{nm}$, find out the change in the stopping potential.
$(\text{h} = 6.63 \times 10^{-34}\ \text{J s}, \text{c} = 3 \times 10^{8}\ \text{m s}^{-1})$

(A) $1.1\ \text{V}$
(B) $0.6\ \text{V}$
(C) $1.3\ \text{V}$
(D) $1.9\ \text{V}$

**Answer: (C)** $1.3\ \text{V}$ · Key from source paper

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**Q109** JEE Main 2021 · 26 Aug · Shift 2 MCQ

The de-Broglie wavelength of a particle having kinetic energy $E$ is $\lambda$. How much extra energy must be given to this particle so that the de-Broglie wavelength reduces to $75\%$ of the initial value?

(A) $E$
(B) $\frac{7E}{9}$
(C) $\frac{16E}{9}$
(D) $\frac{E}{9}$

**Answer: (B)** $\frac{7E}{9}$ · Key from source paper

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**Q110** JEE Main 2021 · 27 Jul · Shift 1 Numerical

A particle of mass $9.1 \times 10^{-31}\ \text{kg}$ travels in a medium with a speed of $10^{6}\ \text{m s}^{-1}$ and a photon of radiation of linear momentum $10^{-27}\ \text{kg m s}^{-1}$ travels in a vacuum. The wavelength of the photon is _____ times the wavelength of the particle.

Numerical value type: the answer is a number.

**Answer: 910.** · Key from source paper

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**Q111** JEE Main 2021 · 25 Jul · Shift 1 MCQ

What should be the order of arrangement of de-Broglie wavelength of electron $\lambda_e$, an $\alpha$-particle $\lambda_\alpha$ and proton $\lambda_p$ given that all have the same kinetic energy ?

(A) $\lambda_e = \lambda_p = \lambda_\alpha$
(B) $\lambda_e < \lambda_p < \lambda_\alpha$
(C) $\lambda_e > \lambda_p > \lambda_\alpha$
(D) $\lambda_e = \lambda_p > \lambda_\alpha$

**Answer: (C)** $\lambda_e > \lambda_p > \lambda_\alpha$ · Key from source paper

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**Q112** JEE Main 2021 · 25 Jul · Shift 1 MCQ

A particle of mass $4M$ at rest disintegrates into two particles of mass $M$ and $3M$, respectively, having non zero velocities. The ratio of de-Broglie wavelength of particle of mass $M$ to that of mass $3M$ will be:

(A) $1:3$
(B) $3:1$
(C) $1:\sqrt{3}$
(D) $1:1$

**Answer: (D)** $1:1$ · Key from source paper

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**Q113** JEE Main 2021 · 25 Jul · Shift 2 MCQ

An electron moving with speed $v$ and a photon moving with speed $c$, have the same D-Broglie wavelength. The ratio of the kinetic energy of the electron to that of a photon is:

(A) $\frac{3c}{v}$
(B) $\frac{v}{3c}$
(C) $\frac{v}{2c}$
(D) $\frac{2c}{v}$

**Answer: (C)** $\frac{v}{2c}$ · Key from source paper

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**Q114** JEE Main 2021 · 25 Jul · Shift 2 MCQ

When radiation of wavelength $\lambda$ is incident on a metallic surface, the stopping potential of ejected photoelectrons is $4.8\ \text{V}$. If the same surface is illuminated by radiation of double the previous wavelength, then the stopping potential becomes $1.6\ \text{V}$. The threshold wavelength of the metal is:

(A) $2\lambda$
(B) $4\lambda$
(C) $8\lambda$
(D) $6\lambda$

**Answer: (B)** $4\lambda$ · Key from source paper

**Q115** JEE Main 2021 · 25 Jul · Shift 2 Numerical

A light beam of wavelength $500\ \text{nm}$ is incident on a metal having work function of $1.25\ \text{eV}$, placed in a magnetic field of intensity $B$. The electrons emitted perpendicular to the magnetic field $B$, with maximum kinetic energy are bent into a circular arc of radius $30\ \text{cm}$. The value of $B$ is _____ $\times 10^{-7}\ \text{T}$. Given $hc = 20 \times 10^{-26}\ \text{J m}$, the mass of the electron$= 9 \times 10^{-31}\ \text{kg}$.

Numerical value type: the answer is a number.

**Answer: 125.** · Key from source paper

**Q116** JEE Main 2021 · 22 Jul · Shift 1 MCQ

An electron of mass $m_e$ and a proton of mass $m_p$ are accelerated through the same potential difference. The ratio of the de-Broglie wavelength associated with the electron to that with the proton is

(A) $\frac{m_p}{m_e}$
(B) $1$
(C) $\sqrt{\frac{m_p}{m_e}}$
(D) $\frac{m_e}{m_p}$

**Answer: (C)** $\sqrt{\frac{m_p}{m_e}}$ · Key from source paper

**Q117** JEE Main 2021 · 20 Jul · Shift 1 MCQ

The radiation corresponding to $3 \rightarrow 2$ transition of a hydrogen atom falls on a gold surface to generate photoelectrons. These electrons are passed through a magnetic field of $5 \times 10^{-4}\ \text{T}$. Assume that the radius of the largest circular path followed by these electrons is $7\ \text{mm}$, the work function of the metal is:
(Mass of electron $= 9.1 \times 10^{-31}\ \text{kg}$)

(A) $1.36\ \text{eV}$
(B) $1.88\ \text{eV}$
(C) $0.16\ \text{eV}$
(D) $0.82\ \text{eV}$

**Answer: (D)** $0.82\ \text{eV}$ · Key from source paper

**Q118** JEE Main 2021 · 20 Jul · Shift 2 Numerical

A certain metallic surface is illuminated by monochromatic radiation of wavelength $\lambda$. The stopping potential for photoelectric current for this radiation is $3\ V_0$. If the same surface is illuminated with a radiation of wavelength $2\lambda$, the stopping potential is $V_0$. The threshold wavelength of this surface for photoelectric effect is _____ $\lambda$.

Numerical value type: the answer is a number.

**Answer: 4.** · Key from source paper

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**Q119** JEE Main 2021 · 18 Mar · Shift 1 MCQ

A particle is travelling 4 times as fast as an electron. Assuming the ratio of de-Broglie wavelength of a particle to that of electron is $2:1$, the mass of the particle is :-

(A) $\frac{1}{16}$ times the mass of $e^-$

(B) 8 times the mass of $e-$

(C) 16 times the mass of $e^-$

(D) $\frac{1}{8}$ times the mass of $e^-$

**Answer: (D) $\frac{1}{8}$ times the mass of $e^-$** · Key from source paper

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**Q120** JEE Main 2021 · 18 Mar · Shift 2 MCQ

The speed of electrons in a scanning electron microscope is $1 \times 10^7\ ms^{-1}$. If the protons having the same speed are used instead of electrons, then the resolving power of scanning proton microscope will be changed by a factor of:

(A) $1837$

(B) $\frac{1}{1837}$

(C) $\sqrt{1837}$

(D) $\frac{1}{\sqrt{1837}}$

**Answer: (A) $1837$** · Key from source paper

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**Q121** JEE Main 2021 · 17 Mar · Shift 1 MCQ

An electron of mass $m$ and a photon have same energy $E$. The ratio of wavelength of electron to that of photon is : ($c$ being the velocity of light)

(A) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

(B) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(C) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(D) $c(2mE)^{\frac{1}{2}}$

**Answer: (B) $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$** · Key from source paper

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**Q122** JEE Main 2021 · 17 Mar · Shift 2 MCQ

Two identical photocathodes receive the light of frequencies $f_1$ and $f_2$ respectively. If the velocities of the photo-electrons coming out are $v_1$ and $v_2$ respectively, then

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(A) $v_1^2 - v_2^2 = \frac{2h}{m}[f_1 - f_2]$
(B) $v_1^2 + v_2^2 = \frac{2h}{m}[f_1 + f_2]$
(C) $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{\frac{1}{2}}$
(D) $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{\frac{1}{2}}$

**Answer: (A)** $v_1^2 - v_2^2 = \frac{2h}{m}[f_1 - f_2]$ · Key from source paper

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**Q123** JEE Main 2021 · 16 Mar · Shift 1 MCQ

The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation:

(A) Phase
(B) Intensity
(C) Amplitude
(D) Frequency

**Answer: (D) Frequency** · Key from source paper

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**Q124** JEE Main 2021 · 16 Mar · Shift 2 MCQ

The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of $100\ \mathrm{V}$. What should nearly be the ratio of their wavelengths ? ($m_p = 1.00727\ \mathrm{u}, m_e = 0.00055\ \mathrm{u}$)

(A) $1860 : 1$
(B) $(1860)^2 : 1$
(C) $41.4 : 1$
(D) $43 : 1$

**Answer: (D)** $43 : 1$ · Key from source paper

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**Q125** JEE Main 2021 · 26 Feb · Shift 1 MCQ

Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : An electron microscope can achieve better resolving power than an optical microscope.
Reason R : The de Broglie's wavelength of the electrons emitted from an electron gun is much less than wavelength of visible light.
In the light of the above statements, choose the correct answer from the options given below:

(A) A is false but R is true.
(B) Both A and R are true and R is the correct explanation of A
(C) Both A and R are true but R is NOT the correct explanation of A
(D) A is true but R is false.

**Answer: (B) Both A and R are true and R is the correct explanation of A** · Key from source paper

**Q126** JEE Main 2021 · 26 Feb · Shift 2 Numerical

Two stream of photons, possessing energies equal to twice and ten times the work function of metal are incident on the metal surface successively. The value of ratio of maximum velocities of the photoelectrons emitted in the two respective cases is $x : 3$ The value of $x$ is

Numerical value type: the answer is a number.

**Answer: 1.** · Key from source paper

**Q127** JEE Main 2021 · 25 Feb · Shift 1 MCQ

An $\alpha$ particle and a proton are accelerated from rest by a potential difference of $200\ \mathrm{V}$. After this, their de Broglie wavelengths are $\lambda_\alpha$ and $\lambda_p$ respectively. The ratio $\frac{\lambda_p}{\lambda_\alpha}$ is :

(A) $8$
(B) $3.8$
(C) $2.8$
(D) $7.8$

**Answer: (C)** $2.8$ · Key from source paper

**Q128** JEE Main 2021 · 25 Feb · Shift 2 MCQ

An electron of mass $m_e$ and a proton of mass $m_p = 1836\ m_e$ are moving with the same speed. The ratio of their de Broglie wavelength $\frac{\lambda_{electron}}{\lambda_{proton}}$ will be :

(A) $1836$
(B) $\frac{1}{1836}$
(C) $918$
(D) $1$

**Answer: (A)** $1836$ · Key from source paper

**Q129** JEE Main 2021 · 25 Feb · Shift 2 MCQ

The stopping potential for electrons emitted from a photosensitive surface illuminated by light of wavelength $491\ \mathrm{nm}$ is $0.710\ \mathrm{V}$. When the incident wavelength is changed to a new value, the stopping potential is $1.43\ \mathrm{V}$. The new wavelength is :

(A) $382\ \mathrm{nm}$
(B) $309\ \mathrm{nm}$
(C) $329\ \mathrm{nm}$
(D) $400\ \mathrm{nm}$

**Answer: (A)** $382\ \mathrm{nm}$ · Key from source paper

**Q130** JEE Main 2021 · 25 Feb · Shift 2 Numerical

The wavelength of an X-ray beam is $10\ \text{Å}$. The mass of a fictitious particle having the same energy as that of the X-ray photons is $\frac{x}{3}h\ \text{kg}$. The value of $x$ is _____. ($h$ =Planck's constant)

Numerical value type: the answer is a number.

**Answer: 10.** · Key from source paper

**Q131** JEE Main 2021 · 24 Feb · Shift 1 MCQ

Given below are two statements:
Statement I: Two photons having equal linear momenta have equal wavelengths.
Statement II: If the wavelength of the photon is decreased, then the momentum and energy of a photon will also decrease.
In the light of the above statements, choose the correct answer from the options given below.

(A) Both Statement I and Statement II are false
(B) Both Statement I and Statement II are true
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true

**Answer: (C) Statement I is true but Statement II is false** · Key from source paper

**Q132** JEE Main 2021 · 24 Feb · Shift 2 MCQ

The de Broglie wavelength of a proton and $\alpha$-particle are equal. The ratio of their velocities is

(A) $4:1$
(B) $4:3$
(C) $1:4$
(D) $4:2$

**Answer: (A)** $4:1$ · Key from source paper

**Q133** JEE Main 2020 · 6 Sep · Shift 1 MCQ

An electron, a doubly ionized helium ion ($He^{++}$) and proton are having the same kinetic energy. The relation between their respective de-Broglie wavelength $\lambda_e, \lambda_{He^{++}}$ and $\lambda_p$ is :

(A) $\lambda_e > \lambda_{He^{++}} > \lambda_p$
(B) $\lambda_e < \lambda_{He^{++}} == \lambda_p$
(C) $\lambda_e > \lambda_p > \lambda_{He^{++}}$
(D) $\lambda_e < \lambda_p < \lambda_{He^{++}}$

**Answer: (C)** $\lambda_e > \lambda_p > \lambda_{He^{++}}$ · Key from source paper

**Q134** JEE Main 2020 · 6 Sep · Shift 2 MCQ

Assuming the nitrogen molecule is moving with r. m. s. velocity at 400 K, the de-Broglie wave length of nitrogen molecule is close to : (Given : nitrogen molecule weight : $4.64 \times 10^{-26}$ kg, Boltzman constant : $1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$, Planck constant : $6.63 \times 10^{-34}\ \mathrm{J\,s}$)

(A) $0.24\ \mathring{\mathrm{A}}$
(B) $0.20\ \mathring{\mathrm{A}}$
(C) $0.34\ \mathring{\mathrm{A}}$
(D) $0.44\ \mathring{\mathrm{A}}$

**Answer: (A)** $0.24\ \mathring{\mathrm{A}}$ · Key from source paper

**Q135** JEE Main 2020 · 5 Sep · Shift 1 Numerical

A beam of electrons of energy E scatters from a target having atomic spacing of 1 Å. The first maximum intensity occurs at $\theta = 60^{\circ}$. Then E(in eV) is.....
(Planck's constant $h = 6.64 \times 10^{-34}$ Js, 1 eV = 1.6 $\times 10^{-19}$J, electron mass m = 9.1 $\times 10^{-31}$ kg)

Numerical value type: the answer is a number.

**Answer: 50.** · Key from source paper

**Q136** JEE Main 2020 · 5 Sep · Shift 2 Numerical

The surface of a metal is illuminated alternately with photons of energies $E_1 = 4$ eV and $E_2 = 2.5$ eV respectively. The ratio of maximum speeds of the photoelectrons emitted in the two cases is 2. The work function of the metal (in eV) is _____

Numerical value type: the answer is a number.

**Answer: 2.** · Key from source paper

**Q137** JEE Main 2020 · 4 Sep · Shift 1 MCQ

Particle A of mass $\mathrm{m_A} = \frac{\mathrm{m}}{2}$ moving along the x -axis with velocity $\mathrm{v_0}$ collides elastically with another particle B at rest having mass $\mathrm{m_B} = \frac{\mathrm{m}}{3}$. If both the particles move along the x -axis after the collision, the change $\Delta\lambda$ in the wavelength of the particle A, in terms of its de-Broglie wavelength $(\lambda_0)$ before the collision is:

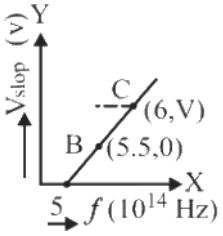
(A) $\Delta\lambda = \frac{3}{2}\lambda_0$
(B) $\Delta\lambda = \frac{5}{2}\lambda_0$
(C) $\Delta\lambda = 2\lambda_0$
(D) $\Delta\lambda = 4\lambda_0$

**Answer: (D)** $\Delta\lambda = 4\lambda_0$ · Key from source paper

## Q138 JEE Main 2020 · 4 Sep · Shift 1 MCQ

Given figure shows few data points in a photo-electric effect experiment for a certain metal. The minimum energy for ejection of electrons from its surface is: (Planck's constant h = $6.62 \times 10^{-34}$ J.s) *(see the figure above)*

**Q19.** Given figure shows few data points in a photo-electric effect experiment for a certain metal. The minimum energy for ejection of electrons from its surface is: (Planck's constant h = $6.62 \times 10^{-34}$ J.s)




(1) 2.27 eV
(2) 2.59 eV
(3) 1.93 eV
(4) 2.10 eV

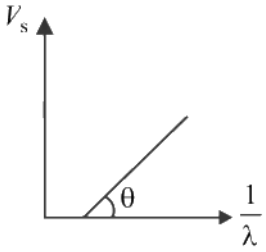
(A) 2.27 eV
(B) 2.59 eV
(C) 1.93 eV
(D) 2.10 eV

**Answer: (A) 2.27 eV** · Key from source paper

## Q139 JEE Main 2020 · 4 Sep · Shift 2 MCQ

In a photoelectric effect experiment, the graph of stopping potential $V$ versus reciprocal of wavelength obtained is shown in the figure. As the intensity of incident radiation is increased : *(see the figure above)*

**Q18.** In a photoelectric effect experiment, the graph of stopping potential $V$ versus reciprocal of wavelength obtained is shown in the figure. As the intensity of incident radiation is increased :




(1) Straight line shifts to right
(2) Slope of the straight line get more steep
(3) Straight line shifts to left
(4) Graph does not change

(A) Straight line shifts to right
(B) Slope of the straight line get more steep
(C) Straight line shifts to left
(D) Graph does not change

**Answer: (D) Graph does not change** · Key from source paper

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**Q140** JEE Main 2020 · 3 Sep · Shift 1 MCQ

When the wavelength of radiation falling on a metal is changed from $500\ \text{nm}$ to $200\ \text{nm}$, the maximum kinetic energy of the photoelectrons becomes three times larger. The work function of the metal is close to:

(A) $0.81\ \text{eV}$
(B) $1.02\ \text{eV}$
(C) $0.52\ \text{eV}$
(D) $0.61\ \text{eV}$

**Answer: (D)** $0.61\ \text{eV}$ · Key from source paper

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**Q141** JEE Main 2020 · 3 Sep · Shift 2 MCQ

Two sources of light emit X-rays of wavelength $1\ \text{nm}$ and visible light of wavelength $500\ \text{nm}$, respectively. Both the sources emit light of the same power $200\ \text{W}$. The ratio of the number density of photons of X-rays to the number density of photons of the visible light of the given wavelengths is:

(A) $\frac{1}{500}$
(B) $250$
(C) $\frac{1}{250}$
(D) $500$

**Answer: (A)** $\frac{1}{500}$ · Key from source paper

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**Q142** JEE Main 2020 · 2 Sep · Shift 1 Numerical

When radiation of wavelength $\lambda$ is used to illuminate a metallic surface, the stopping potential is V. When the same surface is illuminated with radiation of wavelength $3\lambda$, the stopping potential is $\frac{\text{V}}{4}$. If the threshold wavelength for the metallic surface is n$\lambda$ then value of n will be :

Numerical value type: the answer is a number.

**Answer: 9.** · Key from source paper

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**Q143** JEE Main 2020 · 2 Sep · Shift 2 MCQ

A particle is moving 5 times as fast as an electron. The ratio of the de-Broglie wavelength of the particle to that of the electron is $1.878 \times 10^{-4}$. The mass of the particle is close to :

(A) $4.8 \times 10^{-27}\ \text{kg}$
(B) $9.1 \times 10^{-31}\ \text{kg}$
(C) $1.2 \times 10^{-28}\ \text{kg}$
(D) $9.7 \times 10^{-28}\ \text{kg}$

**Answer: (D)** $9.7 \times 10^{-28}\ \text{kg}$ · Key from source paper

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**Q144** JEE Main 2020 · 9 Jan · Shift 1 MCQ

Radiation, with wavelength $6561\ \text{Å}$ falls on a metal surface to produce photoelectrons. The electrons are made to enter a uniform magnetic field of $3 \times 10^{-4}\ \text{T}$ . If the radius of the largest circular path followed by the electrons is $10\ \text{mm}$ , the work function of the metal is close to:

(A) 1.6 eV
(B) 0.8eV
(C) 1.1 eV
(D) 1.8eV

**Answer: (C)** 1.1 eV · Key from source paper

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**Q145** JEE Main 2020 · 9 Jan · Shift 1 MCQ

A particle moving with kinetic energy $E$ has de Broglie wavelength $\lambda$ . If energy $\Delta E$ is added to its energy, the wavelength become $\frac{\lambda}{2}$ . Value of $\Delta E$, is:

(A) $E$
(B) $4E$
(C) $3E$
(D) $2E$

**Answer: (C)** $3E$ · Key from source paper

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**Q146** JEE Main 2020 · 9 Jan · Shift 2 MCQ

An electron of mass $m$ and magnitude of charge $e$ at rest, gets accelerated by a constant electric field $E$. The rate of change of de-Broglie wavelength of this electron at a time $t$ is (ignore relativistic effects)

(A) $\frac{d\lambda}{dt} = -\frac{h}{eEt}$
(B) $\frac{d\lambda}{dt} = -\frac{2h}{eEt}$
(C) $\frac{d\lambda}{dt} = -\frac{2h}{eEt^2}$
(D) $\frac{d\lambda}{dt} = -\frac{h}{eEt^2}$

**Answer: (D)** $\frac{d\lambda}{dt} = -\frac{h}{eEt^2}$ · Key from source paper

**Q147** JEE Main 2020 · 8 Jan · Shift 1 MCQ

When photon of energy $4.0\text{eV}$ strikes the surface of a metal $A$, the ejected photoelectrons have maximum kinetic energy $T_A\text{eV}$ and de-Broglie wavelength $\lambda_A$. The maximum kinetic energy of photoelectrons liberated from another metal $B$ by photon of energy $4.50\text{eV}$ is $T_B = (T_A - 1.5)\text{eV}$. If the de-Broglie wavelength of these photoelectrons $\lambda_B = 2\lambda_A$, then the work function of metal $B$ is:

(A) $4\text{eV}$
(B) $2\text{eV}$
(C) $1.5\text{eV}$
(D) $3\text{eV}$

**Answer: (A)** $4\text{eV}$ · Key from source paper

**Q148** JEE Main 2020 · 8 Jan · Shift 2 MCQ

An electron (mass $\text{m}$ ) with initial velocity $\vec{v} = v_0\hat{i} + v_0\hat{j}$ is in an electric filed $\vec{E} = -E_0\hat{k}$. If $\lambda_0$ is initial de-Broglie wavelength of electron, its de-Broglie wave length at time $t$ is given by:

(A) $\frac{\lambda_0\sqrt{2}}{\sqrt{1+\frac{e^2E^2t^2}{m^2v_0^2}}}$
(B) $\frac{\lambda_0}{\sqrt{1+\frac{e^2E^2t^2}{m^2v_0^2}}}$
(C) $\frac{\lambda_0}{\sqrt{1+\frac{e^2E^2t^2}{2m^2v_0^2}}}$
(D) $\frac{\lambda_0}{\sqrt{2+\frac{e^2E^2t^2}{m^2v_0^2}}}$

**Answer: (C)** $\frac{\lambda_0}{\sqrt{1+\frac{e^2E^2t^2}{2m^2v_0^2}}}$ · Key from source paper

**Q149** JEE Main 2020 · 7 Jan · Shift 1 Numerical

A beam of electromagnetic radiation of intensity $6.4 \times 10^{-5}\text{W/cm}^2$ is comprised of wavelength, $\lambda = 310\text{nm}$ . It falls normally on a metal (work function $\varphi = 2\text{eV}$ ) of surface area of $1\text{cm}^2$ . If one in $10^3$ photons ejects an election, total number of electrons ejected in 1s is $10^x$ . ($hc = 1240\text{eVnm}$, $1\text{eV} = 1.6 \times 10^{-19}J$), then $x$ is

_____

Numerical value type: the answer is a number.

**Answer: 11.** · Key from source paper

**Q150** JEE Main 2020 · 7 Jan · Shift 2 MCQ

An electron (of mass $m$ ) and a photon have the same energy $E$ in the range of a few eV. The ratio of the de-Broglie wavelength associated with the electron and the wavelength of the photon is ( $\text{c} =$ speed of light in vacuum)

(A) $\frac{1}{c}\left(\frac{2E}{m}\right)^{1/2}$
(B) $c(2mE)^{1/2}$
(C) $\frac{1}{c}\left(\frac{E}{2m}\right)^{1/2}$
(D) $\left(\frac{E}{2m}\right)^{1/2}$

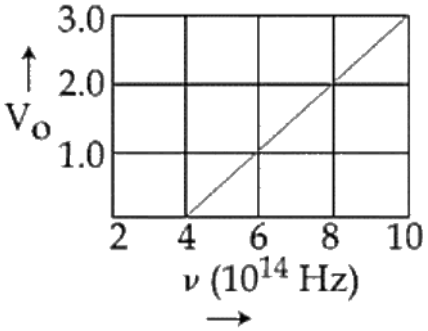
**Answer: (C)** $\frac{1}{c}\left(\frac{E}{2m}\right)^{1/2}$ · Key from source paper

## Q151 JEE Main 2019 · 12 Apr · Shift 1 MCQ

The stopping potential $V_o$ (in volt) as a function of frequency ($\nu$) for a sodium emitter, is shown in the figure. The work function of sodium, form the data plotted in the figure, will be:
(Given: Planck's constant $h = 6.63 \times 10^{-34}$ J s , electron charge $(e) = 1.6 \times 10^{-19}$ C)
*(see the figure above)*

**Q27.** The stopping potential $V_o$ (in volt) as a function of frequency ($\nu$) for a sodium emitter, is shown in the figure. The work function of sodium, form the data plotted in the figure, will be:

(Given: Planck's constant $h = 6.63 \times 10^{-34}$ J s , electron charge $(e) = 1.6 \times 10^{-19}$ C)




(1) 2.12 eV
(2) 1.82 eV
(3) 1.95 eV
(4) 1.66 eV

(A) 2.12 eV
(B) 1.82 eV
(C) 1.95 eV
(D) 1.66 eV

**Answer: (D)** 1.66 eV · Key from source paper

## Q152 JEE Main 2019 · 10 Apr · Shift 1 MCQ

In a photoelectric effect experiment, the threshold wavelength of light is 380 nm . If the wavelength of incident light is 260 nm , the maximum kinetic energy of emitted electrons will be
Given E (in eV) $= \frac{1237}{\lambda(\text{in nm})}$

(A) $4.5\ \text{eV}$
(B) $3.0\ \text{eV}$
(C) $1.5\ \text{eV}$
(D) $15.1\ \text{eV}$

**Answer: (C)** $1.5\ \text{eV}$ · Key from source paper

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**Q153** JEE Main 2019 · 10 Apr · Shift 2 MCQ

A 2 mW laser operates at a wavelength of $500\ \text{nm}$. The number of photons that will be emitted per second is:
[Given Planck's constant $h = 6.6 \times 10^{-34}\ \text{J s}$, speed of light $c = 3.0 \times 10^{8}\ \text{m/s}$ ]

(A) $1.5 \times 10^{16}$
(B) $5 \times 10^{15}$
(C) $2 \times 10^{16}$
(D) $1 \times 10^{16}$

**Answer: (B)** $5 \times 10^{15}$ · Key from source paper

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**Q154** JEE Main 2019 · 9 Apr · Shift 1 MCQ

The electric field of light wave is given as $\vec{E} = 10^{-3} \cos\left(\frac{2\pi x}{5 \times 10^{-7}} - 2\pi \times 6 \times 10^{14} t\right) \hat{x}\ \frac{\text{N}}{\text{C}}$. This light falls on a metal plate of work function 2 eV . The stopping potential of the photo-electrons is: Given, E (in eV ) = $\frac{12375}{\lambda(\text{in } \mathring{\text{A}})}$

(A) 0.72 V
(B) 2.0 V
(C) 2.48 V
(D) 0.48 V

**Answer: (D)** 0.48 V · Key from source paper

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**Q155** JEE Main 2019 · 9 Apr · Shift 2 MCQ

A particle 'P' is formed due to a completely inelastic collision of particles 'x' and 'y' having de-Broglie wavelengths '$\lambda_x$' and '$\lambda_y$' respectively. If x and y were moving in opposite directions, then the de-Broglie wavelength of 'P' is:

(A) $\lambda_x - \lambda_y$

(B) $\dfrac{\lambda_x \lambda_y}{\lambda_x + \lambda_y}$

(C) $\dfrac{\lambda_x \lambda_y}{|\lambda_x - \lambda_y|}$

(D) $\lambda_x + \lambda_y$

**Answer: (C)** $\dfrac{\lambda_x \lambda_y}{|\lambda_x - \lambda_y|}$ · Key from source paper

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## Q156 JEE Main 2019 · 8 Apr · Shift 1 MCQ

Two particles move at right angle to each other. Their de Broglie wavelengths are $\lambda_1$ and $\lambda_2$ respectively. The particles suffer perfectly inelastic collision. The de Broglie wavelength $\lambda$ of the final particle, is given by:

(A) $\dfrac{2}{\lambda} = \dfrac{1}{\lambda_1} + \dfrac{1}{\lambda_2}$

(B) $\lambda = \dfrac{\lambda_1 + \lambda_2}{2}$

(C) $\lambda = \sqrt{\lambda_1 \lambda_2}$

(D) $\dfrac{1}{\lambda^2} = \dfrac{1}{\lambda_1^2} + \dfrac{1}{\lambda_2^2}$

**Answer: (D)** $\dfrac{1}{\lambda^2} = \dfrac{1}{\lambda_1^2} + \dfrac{1}{\lambda_2^2}$ · Key from source paper

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## Q157 JEE Main 2019 · 8 Apr · Shift 2 MCQ

A nucleus A, with a finite de-broglie wavelength $\lambda_{\mathrm{A}}$, undergoes spontaneous fission into two nuclei B and C of equal mass. B flies in the same direction as that of A, while C flies in the opposite direction with a velocity equal to half of that of B . The de-Broglie wavelengths $\lambda_{\mathrm{B}}$ and $\lambda_{\mathrm{C}}$ of B and C are respectively:

(A) $\lambda_{\mathrm{A}}, \frac{\lambda_{\mathrm{A}}}{2}$

(B) $\frac{\lambda_{\mathrm{A}}}{2}, \lambda_{\mathrm{A}}$

(C) $\lambda_{\mathrm{A}}, 2\lambda_{\mathrm{A}}$

(D) $2\lambda_{\mathrm{A}}, \lambda_{\mathrm{A}}$

**Answer: (B)** $\frac{\lambda_{\mathrm{A}}}{2}, \lambda_{\mathrm{A}}$ · Key from source paper

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## Q158 JEE Main 2019 · 12 Jan · Shift 1 MCQ

A particle A of mass $m$ and charge $q$ is accelerated by a potential difference of 50 V. Another particle B of mass $4m$ and charge $q$ is accelerated by a potential difference of 2500 V. The ratio of de-Broglie wavelengths $\frac{\lambda_A}{\lambda_B}$ is close to:

(A) 0.07
(B) 10.00
(C) 4.47
(D) 14.14

**Answer: (D) 14.14** · Key from source paper

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**Q159** JEE Main 2019 · 12 Jan · Shift 2 MCQ

When a certain photosensitive surface is illuminated with a monochromatic light of frequency $\nu$, the stopping potential of the photo current is $-\frac{V_0}{2}$. When the surface is illuminated by monochromatic light of frequency $\frac{\nu}{2}$, the stopping potential is $-V_0$. The threshold frequency for photoelectric emission is

(A) $\frac{5\nu}{3}$
(B) $\frac{3\nu}{2}$
(C) $\frac{4}{3}\nu$
(D) $2\nu$

**Answer: (B)** $\frac{3\nu}{2}$ · Key from source paper

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**Q160** JEE Main 2019 · 11 Jan · Shift 1 MCQ

If the deBroglie wavelength of an electron is equal to $10^{-3}$ times the wavelength of a photon of frequency $6 \times 10^{14}$ Hz, then the speed of electron is equal to : (Speed of light = $3 \times 10^8$ m/s) Planck's constant = $6.63 \times 10^{-34}$ J. s Mass of electron = $9.1 \times 10^{-31}$ kg)

(A) $1.1 \times 10^6$ m/s
(B) $1.7 \times 10^6$ m/s
(C) $1.8 \times 10^6$ m/s
(D) $1.45 \times 10^6$ m/s

**Answer: (D)** $1.45 \times 10^6$ **m/s** · Key from source paper

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**Q161** JEE Main 2019 · 11 Jan · Shift 2 MCQ

In a photoelectric experiment, the wavelength of the light incident on a metal is changed from 300nm to 400nm. The decrease in the stopping potential is close to : $\left(\frac{hc}{e} = 1240\text{nm} - \text{V}\right)$

(A) 0.5 V
(B) 1.5 V
(C) 1.0 V
(D) 2.0 V

**Answer: (C) 1.0 V** · Key from source paper

**Q162** JEE Main 2019 · 10 Jan · Shift 1 MCQ

In an electron microscope, the resolution that can be achieved is of the order of the wavelength of electrons used. To resolve a width of $7.5 \times 10^{-12}\ m$, the minimum electron energy required is close to:

(A) $100\ keV$
(B) $25\ keV$
(C) $1\ keV$
(D) $500\ keV$

**Answer: (B)** $25\ keV$ · Key from source paper

**Q163** JEE Main 2019 · 10 Jan · Shift 2 MCQ

A metal plate of area $1 \times 10^{-4}\ m^2$ is illuminated by a radiation of intensity $16\ \frac{milli\ W}{m^2}$. The work function of the metal is $5\ eV$. The energy of the incident photons is $10\ eV$ and only $10\%$ of it produces photo electrons. The number of emitted photo electron per second and their maximum energy, respectively, will be: $\left[1eV = 1.6 \times 10^{-19} J\right]$

(A) $10^{14}$ and $10\ eV$
(B) $10^{12}$ and $5\ eV$
(C) $10^{11}$ and $5\ eV$
(D) $10^{10}$ and $5\ eV$

**Answer: (C)** $10^{11}$ and $5\ eV$ · Key from source paper

**Q164** JEE Main 2019 · 9 Jan · Shift 1 MCQ

The surface of certain metal is first illuminated with light of wavelength $\lambda_1 = 350\ \text{nm}$ and then, by a light of wavelength $\lambda_2 = 540\ \text{nm}$. It is found that the maximum speed of the photoelectrons in the two cases differ by a factor of 2. The work function of the metal (in eV) is close to
(Energy of photon $= \frac{1240}{\lambda\ \text{in nm}}\ \text{eV}$ )

(A) $2.5$
(B) $1.8$
(C) $5.6$
(D) $1.4$

**Answer: (B)** $1.8$ · Key from source paper

**Q165** JEE Main 2019 · 9 Jan · Shift 2 MCQ

The magnetic field associated with a light wave is given, at the origin, by $B = B_0\left[\sin\left(3.14 \times 10^7\right) ct + \sin\left(6.28 \times 10^7\right) ct\right]$. If this light falls on a silver plate having a work function of $4.7\ \text{eV}$, what will be the maximum kinetic energy of the photoelectrons?
$\left(c = 3 \times 10^8\ \text{m s}^{-1}, h = 6.6 \times 10^{-34}\ \text{J s}\right)$

(A) $6.82\ \text{eV}$
(B) $7.72\ \text{eV}$
(C) $12.5\ \text{eV}$
(D) $8.52\ \text{eV}$

**Answer: (B)** $7.72\ \text{eV}$ · Key from source paper

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## Q166 JEE Main 2018 · 15 Apr · Shift 1 MCQ

Two electrons are moving with non-relativistic speeds perpendicular to each other. If corresponding de Broglie wavelengths are $\lambda_1$ and $\lambda_2$, their de Broglie wavelength in the frame of reference attached to their centre of mass is:

(A) $\lambda_{CM} = \lambda_1 = \lambda_2$
(B) $\frac{1}{\lambda_1} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$
(C) $\lambda_{CM} = \frac{2\lambda_1\lambda_2}{\sqrt{\lambda_1^2+\lambda_2^2}}$
(D) $\lambda_{CM} = \left(\frac{\lambda_1+\lambda_2}{2}\right)$

**Answer: (C)** $\lambda_{CM} = \frac{2\lambda_1\lambda_2}{\sqrt{\lambda_1^2+\lambda_2^2}}$ · Key from source paper

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## Q167 JEE Main 2018 · 15 Apr · Shift 2 MCQ

If the de Broglie wavelengths associated with a proton and an $\alpha$-particle are equal, then the ratio of velocities of the proton and the $\alpha$-particle will be:

(A) $1:4$
(B) $1:2$
(C) $4:1$
(D) $2:1$

**Answer: (C)** $4:1$ · Key from source paper

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## Q168 JEE Main 2017 · 9 Apr · Online MCQ

A laser light of wavelength 660 nm is used to weld Retina detachment. If a laser pulse of width 60 ms and power 0.5 kW is used, the approximate number of photons in the pulse are (Take Planck's Constant, $h = 6.62 \times 10^{-34}$ J s)

(A) $10^{22}$
(B) $10^{19}$
(C) $10^{20}$
(D) $10^{18}$

**Answer: (C)** $10^{20}$ · Key from source paper

**Q169** JEE Main 2017 · 8 Apr · Online MCQ

The maximum velocity of the photoelectrons emitted from the surface is $v$ when light of frequency $n$ falls on a metal surface. If the incident frequency is increased to $3n$, the maximum velocity of the ejected photoelectrons will be:

(A) more than $\sqrt{3}v$
(B) equal to $\sqrt{3}v$
(C) $v$
(D) less than $\sqrt{3}v$

**Answer: (A) more than $\sqrt{3}v$** · Key from source paper

**Q170** JEE Main 2017 · 2 Apr · Offline MCQ

A particle $A$ of mass $m$ and initial velocity $v$ collides with a particle $B$ of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de-Broglie wavelengths $\lambda_A$ to $\lambda_B$ after the collision is:

(A) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$
(B) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$
(C) $\frac{\lambda_A}{\lambda_B} = 2$
(D) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$

**Answer: (C) $\frac{\lambda_A}{\lambda_B} = 2$** · Key from source paper

**Q171** JEE Main 2016 · 10 Apr · Online MCQ

A photoelectric surface is illuminated successively by monochromatic light of wavelengths $\lambda$ and $\frac{\lambda}{2}$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface is :

(A) $\frac{hc}{2\lambda}$
(B) $\frac{hc}{\lambda}$
(C) $\frac{hc}{3\lambda}$
(D) $\frac{3hc}{\lambda}$

**Answer: (A) $\frac{hc}{2\lambda}$** · Key from source paper

**Q172** JEE Main 2016 · 9 Apr · Online MCQ

When photons of wavelength $\lambda_1$ are incident on an isolated sphere, the corresponding stopping potential is found to be $V$. When photons of wavelength $\lambda_2$ are used, the corresponding stopping potential was thrice that of the above value. If light of wavelength $\lambda_3$ is used then find the stopping potential for this case:

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(A) $\frac{hc}{e}\left[\frac{1}{\lambda_3}+\frac{1}{\lambda_2}-\frac{1}{\lambda_1}\right]$

(B) $\frac{hc}{e}\left[\frac{1}{\lambda_3}+\frac{1}{2\lambda_2}-\frac{1}{\lambda_1}\right]$

(C) $\frac{hc}{e}\left[\frac{1}{\lambda_3}-\frac{1}{\lambda_2}-\frac{1}{\lambda_1}\right]$

(D) $\frac{hc}{e}\left[\frac{1}{\lambda_3}+\frac{1}{2\lambda_2}-\frac{3}{2\lambda_1}\right]$

**Answer: (D)** $\frac{hc}{e}\left[\frac{1}{\lambda_3}+\frac{1}{2\lambda_2}-\frac{3}{2\lambda_1}\right]$ · Key from source paper

## Q173 JEE Main 2016 · 3 Apr · Offline MCQ

Radiation of wavelength $\lambda$ is incident on a photocell. The fastest emitted photoelectron has a speed v. If the wavelength is changed to $\frac{3\lambda}{4}$, the speed of the fastest emitted photoelectron will be

(A) $= v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

(B) $= v\left(\frac{3}{4}\right)^{\frac{1}{2}}$

(C) $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

(D) $< v\left(\frac{4}{3}\right)^{\frac{1}{2}}$

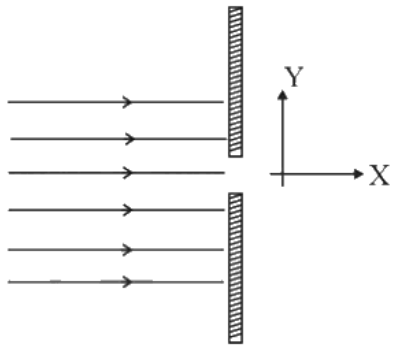
**Answer: (C)** $> v\left(\frac{4}{3}\right)^{\frac{1}{2}}$ · Key from source paper

## Q174 JEE Main 2015 · 10 Apr · Online MCQ

A parallel beam of electrons travelling in x - direction falls on a slit of width d (see figure). If after passing the slit, an electron acquires momentum $p_y$ in the y - direction then for a majority of electrons passing through the slit (h is Planck's constant):

*(see the figure above)*

**Q26.** A parallel beam of electrons travelling in x - direction falls on a slit of width d (see figure). If after passing the slit, an electron acquires momentum $p_y$ in the y - direction then for a majority of electrons passing through the slit (h is Planck's constant):




(1) $|p_y|d < h$

(2) $|p_y|d > h$

(3) $|p_y|d \simeq h$

(4) $|p_y|d >> h$

(A) $|p_y|d < h$
(B) $|p_y|d > h$
(C) $|p_y|d \simeq h$
(D) $|p_y|d >> h$

**Answer: (A)** $|p_y|d < h$ · Key from source paper

**Q175** JEE Main 2015 · 10 Apr · Online MCQ

De-Broglie wavelength of an electron accelerated by a voltage of 50 V is close to ($|e| = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.6 \times 10^{-34}$ J s)

(A) 0.5 Å
(B) 1.2 Å
(C) 1.7 Å
(D) 2.4 Å

**Answer: (C)** 1.7 Å · Key from source paper

**Q176** JEE Main 2015 · 4 Apr · Offline MCQ

Match list-I (Fundamental Experiment) with List-II (its conclusion) and select the correct option from the choices given below the list:
List-I
A Franck-Hertz Experiment
B Photo-electric experiment
C Davison-Germer Experiment
List-II
(i) Particle nature of light
(ii) Discrete energy levels of the atom
(iii) Wave nature of electron
(iv) Structure of atom

(A) A – (iv) ; B – (iii); C – (ii)
(B) A – (i) ; B – (iv); C – (iii)
(C) A – (ii) ; B – (iv); C – (iii)
(D) A – (ii) ; B – (i); C – (iii)

**Answer: (D)** A – (ii) ; B – (i); C – (iii) · Key from source paper

**Q177** JEE Main 2014 · 19 Apr · Online MCQ

Match List-I (Experiment performed) with List-II (Phenomena discovered/associated)and select the correct option from the options given below the lists
List-I
(a) Davisson and Germer experiment

(b) Millikan's oil drop experiment
(c) Rutherford experiment
(d) Franck-Hertz experiment
List-II
(i) Wave nature of electrons
(ii) Charge of an electron
(iii) Quantisation of energy levels
(iv) Existence of the nucleus

(A) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
(B) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)
(C) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
(D) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

**Answer: (B)** (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii) · Key from source paper

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## Q178 JEE Main 2014 · 12 Apr · Online MCQ

A beam of light has two wavelengths of $4972\mathring{A}$ and $6216\mathring{A}$ with a total intensity of $3.6 \times 10^{-3}\ \mathrm{Wm}^{-2}$ equally distributed among the two wavelengths. The beam falls normally on an area of $1\ \mathrm{cm}^2$ of a clean metallic surface of work function $2.3\mathrm{eV}$. Assume that there is no loss of light by reflection and that each capable photon ejects one electron. The number of photoelectrons liberated in $2\ \mathrm{s}$ is approximately:

(A) $6 \times 10^{11}$
(B) $9 \times 10^{11}$
(C) $11 \times 10^{11}$
(D) $15 \times 10^{11}$

**Answer: (B)** $9 \times 10^{11}$ · Key from source paper

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## Q179 JEE Main 2014 · 11 Apr · Online MCQ

A photon of wavelength $\lambda$ is scattered from an electron, which was at rest. The wavelength shift $\Delta\lambda$ is three times of $\lambda$ and the angle of scattering $\theta$ is $60^\circ$. The angle at which the electron recoiled is $\phi$. The value of $\tan\phi$ is : (electron speed is much smaller than the speed of light)

(A) 0.16
(B) 0.22
(C) 0.25
(D) 0.28

**Answer: (C)** 0.25 · Checked by our team

**Q180** JEE Main 2014 · 9 Apr · Online MCQ

For which of the following particles will it be most difficult to experimentally verify the de-Broglie relationship?

(A) An electron
(B) An $\alpha$-particle
(C) A dust particle
(D) A proton

**Answer: (C)** A dust particle · Key from source paper

**Q181** JEE Main 2014 · 6 Apr · Offline MCQ

The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of $3 \times 10^{-4}$ T. If the radius of the largest circular path followed by these electrons is 10.0 mm, the work function of the metal is close to :

(A) 1.8 eV
(B) 1.1 eV
(C) 0.8 eV
(D) 1.6 eV

**Answer: (B)** 1.1 eV · Key from source paper

**Q182** JEE Main 2013 · 25 Apr · Online MCQ

In an experiment on photoelectric effect, a student plots stopping potential $V_0$ against reciprocal of the wavelength $\lambda$ of the incident light for two different metals A and B. These are shown in the figure. *(see the figure above)*
Looking at the graphs, you can most appropriately say that:

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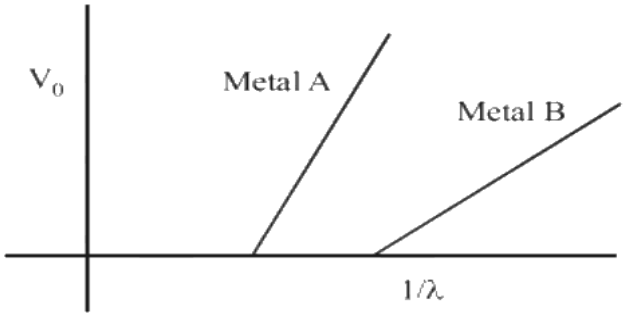
**Q26.** In an experiment on photoelectric effect, a student plots stopping potential $V_0$ against reciprocal of the wavelength $\lambda$ of the incident light for two different metals A and B. These are shown in the figure.




Looking at the graphs, you can most appropriately say that:

(1) Work function of metal B is greater than that of metal A

(2) For light of certain wavelength falling on both metal, maximum kinetic energy of electrons emitted from A will be greater than those emitted from B.

(3) Work function of metal A is greater than that of metal B

(4) Students data is not correct

(A) Work function of metal B is greater than that of metal A

(B) For light of certain wavelength falling on both metal, maximum kinetic energy of electrons emitted from A will be greater than those emitted from B.

(C) Work function of metal A is greater than that of metal B

(D) Students data is not correct

**Answer: (D) Students data is not correct** · Key from source paper

## Q183 JEE Main 2013 · 25 Apr · Online MCQ

A copper ball of radius 1 cm and work function 4.47 eV is irradiated with ultraviolet radiation of wavelength 2500 Å. The effect of irradiation results in the emission of electrons from the ball. Further the ball will acquire charge and due to this there will be a finite value of the potential on the ball. The charge acquired by the ball is :

(A) $5.5 \times 10^{-13}$ C

(B) $7.5 \times 10^{-13}$ C

(C) $4.5 \times 10^{-12}$ C

(D) $2.5 \times 10^{-11}$ C

**Answer: (A)** $5.5 \times 10^{-13}$ C · Key from source paper

## Q184 JEE Main 2013 · 23 Apr · Online MCQ

Electrons are accelerated through a potential difference V and protons are accelerated through a potential difference 4 V. The de-Broglie wavelengths are $\lambda_e$ and $\lambda_p$ for electrons and protons respectively. The ratio of $\frac{\lambda_e}{\lambda_p}$ is given by: (given $m_e$ is mass of electron and $m_p$ is mass of proton).

(A) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$

(B) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_e}{m_p}}$

(C) $\frac{\lambda_e}{\lambda_p} = \frac{1}{2}\sqrt{\frac{m_e}{m_p}}$

(D) $\frac{\lambda_e}{\lambda_p} = 2\sqrt{\frac{m_p}{m_e}}$

**Answer: (D)** $\frac{\lambda_e}{\lambda_p} = 2\sqrt{\frac{m_p}{m_e}}$ · Key from source paper

## Q185 JEE Main 2013 · 22 Apr · Online MCQ

Orbits of a particle moving in a circle are such that the perimeter of the orbit equals an integer number of de-Broglie wavelengths of the particle. For a charged particle moving in a plane perpendicular to a magnetic field, the radius of the $n^{\text{th}}$ orbital will therefore be proportional to :

(A) $n^2$

(B) $n$

(C) $n^{1/2}$

(D) $n^{1/4}$

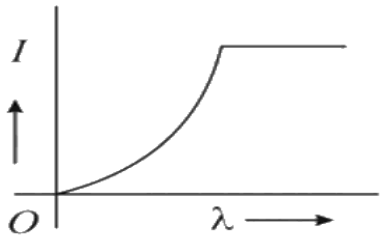
**Answer: (C)** $n^{1/2}$ · Key from source paper

## Q186 JEE Main 2013 · 7 Apr · Offline MCQ

The anode voltage of a photocell is kept fixed. The wavelength $\lambda$ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows :

**Q27.** The anode voltage of a photocell is kept fixed. The wavelength $\lambda$ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows :

(1)

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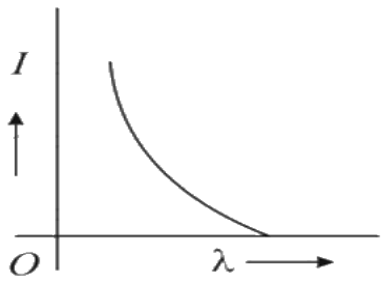


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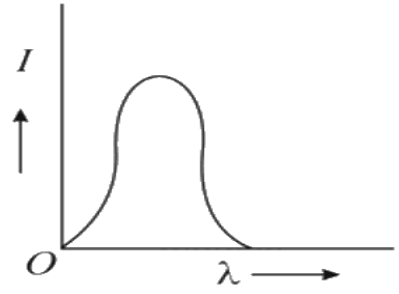
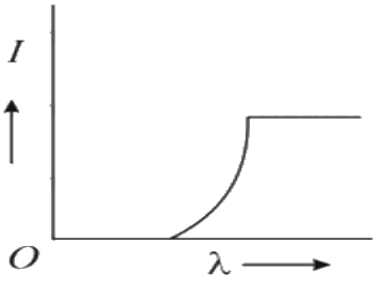



(4)



(A) *see figure*
(B) *see figure*
(C) *see figure*
(D) *see figure*

**Answer: (B)** · Key from source paper

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## Q187 AIEEE 2012 · 26 May · Online MCQ

Photoelectrons are ejected from a metal when light of frequency $v$ falls on it. Pick out the wrong statement from the following.

(A) No electrons are emitted if $v$ is less than $W/h$, where $W$ is the work function of the metal
(B) The ejection of the photoelectrons is instantaneous.
(C) The maximum energy of the photoelectrons is $hv$.
(D) The maximum energy of the photoelectrons is independent of the intensity of the light.

**Answer: (C) The maximum energy of the photoelectrons is $hv$.** · Key from source paper

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## Q188 AIEEE 2012 · 19 May · Online MCQ

This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). If the incident frequency is now doubled, the photocurrent and the maximum kinetic energy are also doubled. Statement 2: The maximum kinetic energy of photoelectrons emitted from a surface is linearly dependent on the frequency of the incident light. The photocurrent depends only on the intensity of the incident light.

(A) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.
(B) Statement 1 is false, Statement 2 is true.
(C) Statement 1 is true, Statement 2 is false.
(D) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

**Answer: (B) Statement 1 is false, Statement 2 is true.** · Key from source paper

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## Q189 AIEEE 2012 · 12 May · Online MCQ

A $10$ kW transmitter emits radio waves of wavelength $500$ m. The number of photons emitted per second by the transmitter is of the order of

(A) $10^{37}$
(B) $10^{31}$
(C) $10^{25}$
(D) $10^{43}$

**Answer: (B)** $10^{31}$ · Key from source paper

**Q190** AIEEE 2012 · Offline MCQ

This question has statement 1 and statement 2. Of the four choices given after the statements, choose the one that best describes the two statements Statement 1 : Davisson - germer experiment established the wave nature of electrons. Statement 2 : If electrons have wave nature, they can interfere and show diffraction.

(A) Statement 1 is false, Statement 2 is true
(B) Statement 1 is true, Statement 2 is false
(C) Statement 1 is true, Statement 2 is the correct explanation for statement 1
(D) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation for statement 1.

**Answer: (C) Statement 1 is true, Statement 2 is the correct explanation for statement 1** · Key from source paper

**Q191** AIEEE 2011 MCQ

This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement-1 : A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $K_{\max}$ and $V_0$ respectively. If the frequency incident on the surface doubled, both the $K_{\max}$ and $V_0$ are also doubled. Statement-2 : The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.

(A) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(B) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(C) Statement-1 is false, Statement-2 is true.
(D) Statement-1 is true, Statement-2 is false.

**Answer: (C) Statement-1 is false, Statement-2 is true.** · Key from source paper

**Q192** AIEEE 2010 MCQ

If a source of power 4 kW produces $10^{20}$ photons/second, the radiation belong to a part of the spectrum called

(A) X-rays
(B) ultraviolet rays
(C) microwaves
(D) $\gamma$-rays

**Answer: (A) X-rays** · Key from source paper

**Q193** AIEEE 2010 MCQ

Statement-1 : When ultraviolet light is incident on a photocell, its stopping potential is $V_0$ and the maximum kinetic energy of the photoelectrons is $K_{\max}$. When the ultraviolet light is replaced by X−rays, both $V_0$ and $K_{\max}$ increase. Statement-2 : Photoelectrons are emitted with speeds ranging from zero to a maximum value because of the range of frequencies present in the incident light. Of the four choices given after the statements, choose the one that best describes the two statements.

(A) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(B) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(C) Statement-1 is false, Statement-2 is true.
(D) Statement-1 is true, Statement- 2 is false.

**Answer: (D) Statement-1 is true, Statement- 2 is false.** · Key from source paper

**Q194** AIEEE 2009 MCQ

The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons was found to be 1.68eV. The work function of the metal is (hc = 1240eVnm)

(A) 3.09eV
(B) 1.41eV
(C) 151eV
(D) 1.68eV

**Answer: (B)** 1.41eV · Key from source paper

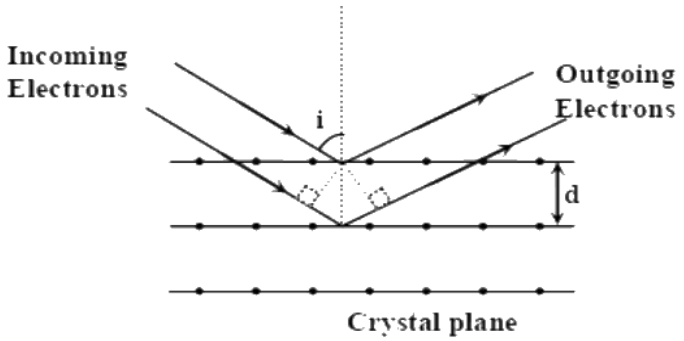
**Q195** AIEEE 2008 MCQ

Paragraph: Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see in figure).

*(see the figure above)*

Question: Electrons accelerated by potential $V$ are diffracted from a crystal. If $d = 1\mathring{A}$ and $i = 30^{\circ}$, $V$ should be about ($\mathrm{h} = 6.6 \times 10^{-34}$ Js, $\mathrm{m_e} = 9.1 \times 10^{-31}$ kg, $\mathrm{e} = 1.6 \times 10^{-19}\mathrm{C}$)

**Q27. Paragraph:** Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere




constructively (see in figure).

**Question:** Electrons accelerated by potential $V$ are diffracted from a crystal. If $d = 1\mathring{A}$ and $i = 30^{\circ}$, $V$ should be about $\left(\mathrm{h} = 6.6 \times 10^{-34}\mathrm{Js}, \mathrm{m_e} = 9.1 \times 10^{-31}\ \mathrm{kg}, \mathrm{e} = 1.6 \times 10^{-19}\mathrm{C}\right)$

(1) 2000 V
(2) 50 V
(3) 500 V
(4) 1000 V

(A) 2000 V
(B) 50 V
(C) 500 V
(D) 1000 V

**Answer: (B)** 50 V · Key from source paper

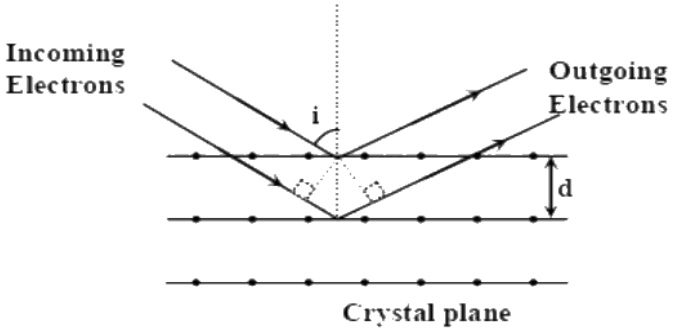
## Q196 AIEEE 2008 MCQ

Paragraph: Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see in figure).

*(see the figure above)*

Question: If a strong diffraction peak is observed when electrons are incident at an angle 'i' from the normal to the crystal planes with distance ' $d$ ' between them (see figure), de Broglie wavelength $\lambda_{\mathrm{dB}}$ of electrons can be calculated by the relationship ( $n$ is an integer)

**Q28. Paragraph:** Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere




constructively (see in figure).

**Question:** If a strong diffraction peak is observed when electrons are incident at an angle 'i' from the normal to the crystal planes with distance ' $d$ ' between them (see figure), de Broglie wavelength $\lambda_{\mathrm{dB}}$ of electrons can be calculated by the relationship ( $n$ is an integer)

(1) $d\sin i = n\lambda_{dB}$ (2) $2d\cos i = n\lambda_{dB}$

(3) $2d\sin i = n\lambda_{dB}$ (4) $d\cos i = n\lambda_{dB}$

(A) $d\sin i = n\lambda_{dB}$

(B) $2d\cos i = n\lambda_{dB}$

(C) $2d\sin i = n\lambda_{dB}$

(D) $d\cos i = n\lambda_{dB}$

**Answer: (B)** $2d\cos i = n\lambda_{dB}$ · Checked by our team

## Q197 AIEEE 2008 MCQ

Paragraph: Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere constructively (see in figure).

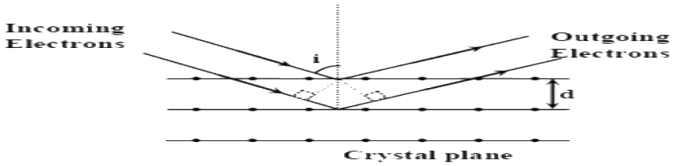
*(see the figure above)*

Question: In an experiment, electrons are made to pass through a narrow slit of width 'd' comparable to their de Broglie wavelength. They are detected on a screen at a distance ' $D$ ' from the slit (see figure).

*(see the figure above)*

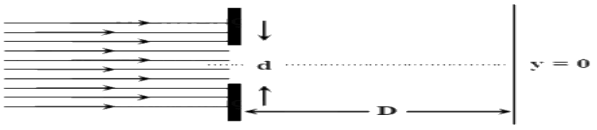
Which of the following graph can be expected to represent the number of electrons ' $N$ ' detected as a function of the detector position ' $y$ ' ($y = 0$ corresponds to the middle of the slit)?

**Q29. Paragraph:** Wave property of electrons implies that they will show diffraction effects. Davisson and Germer demonstrated this by diffracting electrons from crystals. The law governing the diffraction from a crystal is obtained by requiring that electron waves reflected from the planes of atoms in a crystal interfere



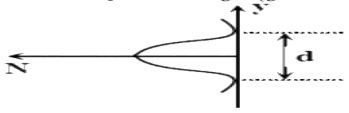

constructively (see in figure).

**Question:** In an experiment, electrons are made to pass through a narrow slit of width 'd' comparable to their de Broglie wavelength. They are detected on a screen at a distance ' $D$ ' from the slit (see figure).

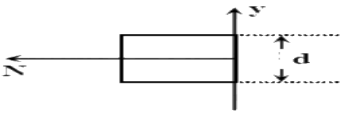



Which of the following graph can be expected to represent the number of electrons ' $N$ ' detected as a function of the detector position ' $y$ ' ($y = 0$ corresponds to the middle of the slit)?

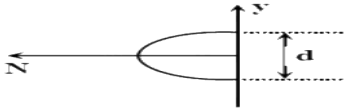
(1)




(2)




(3)

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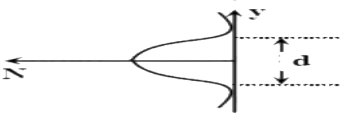



(A) *see figure*
(B) *see figure*
(C) *see figure*
(D) *see figure*

**Answer: (D)** · Key from source paper

## Q198 AIEEE 2007 MCQ

Photon of frequency v has a momentum associated with it. If c is the velocity of light, the momentum is

(A) v/c
(B) hvc
(C) $\mathrm{hv/c^2}$
(D) hv/c

**Answer: (D) hv/c** · Key from source paper

## Q199 AIEEE 2006 MCQ

The time by a photoelectron to come out after the photon strikes is approximately

(A) $10^{-1}$ s
(B) $10^{-4}$ s
(C) $10^{-10}$ s
(D) $10^{-16}$ s

**Answer: (C)** $10^{-10}$ s · Key from source paper

## Q200 AIEEE 2006 MCQ

The threshold frequency for a metallic surface corresponds to an energy of 6.2eV, and the stopping potential for a radiation incident on this surface 5 V. The incident radiation lies in

(A) X-ray region
(B) ultra-violet region
(C) infra-red region
(D) visible region

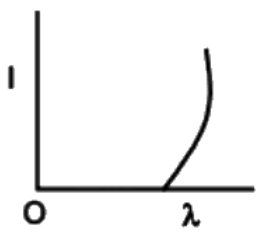
**Answer: (B) ultra-violet region** · Key from source paper

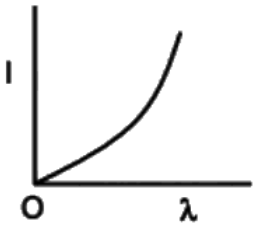
## Q201 AIEEE 2006 MCQ

The anode voltage of a photocell is kept fixed. The wavelength $\lambda$ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows :

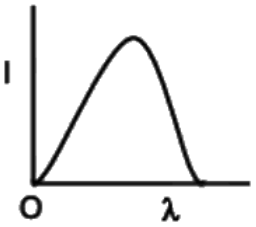
*(see the figure above)*

**Q45.** The anode voltage of a photocell is kept fixed. The wavelength $\lambda$ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows :

(1) 


(2) 


(3) 


(4) 


(A) *see figure*
(B) *see figure*
(C) *see figure*
(D) *see figure*

**Answer: (C)** · Key from source paper

## Q202 AIEEE 2005 MCQ

A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photo cathode would

(A) decrease by a factor of 4
(B) increase by a factor of 4
(C) decrease by a factor of 2
(D) increase by a factor of 2

**Answer: (B) increase by a factor of 4** · Key from source paper

## Q203 AIEEE 2005 MCQ

If the kinetic energy of a free electron doubles. Its deBroglie wavelength changes by the factor

(A) $\frac{1}{2}$
(B) 2
(C) $\frac{1}{\sqrt{2}}$
(D) $\sqrt{2}$

**Answer: (C)** $\frac{1}{\sqrt{2}}$ · Key from source paper

## Q204 AIEEE 2004 MCQ

According to EInstein's photoelectric equation, the plot of the kinetic energy of the emitted photo electrons from a metal $\mathrm{V_s}$ the frequency, of the incident radiation gives straight line whose slope

(A) depends on the nature of the metal used
(B) depends on the intensity of the radiation
(C) depends both on the intensity of the radiation and the metal used
(D) is the same for all metals and independent of the intensity of the radiation.

**Answer: (D) is the same for all metals and independent of the intensity of the radiation.** · Key from source paper

## Q205 AIEEE 2004 MCQ

The work function of a substance is 4.0eV. Then longest wavelength of light that can cause photoelectron emission from this substance approximately

(A) 540 nm
(B) 400 nm
(C) 310 nm
(D) 220 nm

**Answer: (C) 310 nm** · Key from source paper

## Q206 AIEEE 2003 MCQ

Two identical photocathodes receive light of frequencies $\mathrm{f_1}$ and $\mathrm{f_2}$. If the velocities of the photo electrons (of mass m ) coming out are respectively $\mathrm{v_1}$ and $\mathrm{v_2}$, then

(A) $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$
(B) $v_1 + v_2 = \left[\frac{2h}{m}(f_1 + f_2)\right]^{1/2}$
(C) $v_1^2 + v_2^2 = \frac{2h}{m}(f_1 + f_2)$
(D) $\mathrm{v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{1/2}}$

**Answer: (A)** $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$ · Key from source paper

## Q207 AIEEE 2002 MCQ

Sodium and copper have work functions 2.3eV and 4.5eV respectively. Then the ratio of the wave lengths is nearest to

(A) 1 : 2
(B) 4 : 1
(C) 2 : 1
(D) 1 : 4

**Answer: (C)** 2 : 1 · Key from source paper

## Q208 AIEEE 2002 MCQ

Formation of covalent bonds in compounds exhibits

(A) wave nature of electron
(B) particle nature of electron
(C) both wave and particle nature of electron
(D) none of these

**Answer: (A)** wave nature of electron · Key from source paper

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