DPP – 2 (PEE)

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Q 1. When photons of energy hν are incident on the surface of photosensitive material of work function $h\nu_0$, then-
(a) the kinetic energy of all emitted electrons is $h\nu_0$
(b) the kinetic energy of all emitted electrons is $h(\nu - \nu_0)$
(c) the kinetic energy of all fastest electrons is $h(\nu - \nu_0)$
(d) the kinetic energy of all emitted electrons is hν

Q 2. Photoelectric effect supports quantum nature of light because:
(a) there is a minimum frequency of light below which no photoelectrons are emitted
(b) the maximum kinetic energy of photoelectrons depends only on the frequency of light and not on its intensity
(c) even when the metal surface is faintly illuminated, the photoelectrons leave the surface immediately
(d) electric charge of the photoelectrons is quantized

Q 3. When a monochromatic point source of light is at a distance of 0.2 m from a photoelectric cell, the cut-off voltage and the saturation current are respectively 0.6 volt and 18.0 mA. If the same source is placed 0.6 m away from the photoelectric cell, then
(a) the stopping potential will be 0.2 volt
(b) the stopping potential will be 0.6 volt
(c) the saturation current will be 6.0 mA
(d) the saturation current will be 2.0 mA

Q 4. When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy, T_A expressed in eV and de-Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70 eV is $T_B = (T_A - 1.50 \text{ eV})$. If the de-Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$ then:
(a) the work function of A is 2.25 eV
(b) the work function of B is 4.20 eV
(c) $T_A = 2.00$ eV
(d) $T_B = 2.75$eV

Q 5. In photoelectric effect match the following table:

Table-1		Table-2	
(A)	If frequency of incident light is increased	(P)	Photoelectric current will decrease
(B)	If distance of light source from cathode is increased	(Q)	Stopping potential will increase
(C)	If work function of metal is increased	(R)	Photoelectric effect may stop
		(S)	None

Q 6. Mark the incorrect statements
(i) Bound electrons absorbs whole energy of incident photon
(ii)Isolated free electrons can't absorb whole energy of photon
(iii) Classical mechanics permits massless particles to carry energy and momentum
(iv) Energy and momentum of electrons are related as E = pc

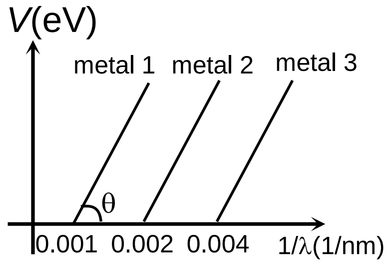
(a) (ii) and (iii) (b) (iii) and (iv)
(c) All of these (d) None of these

Q 7. The surface of metal with work function φ is illuminated by electromagnetic radiation whose electric field components are E = a(1 + cos ωt) cos ω_0t. Then maximum kinetic energy of photoelectron liberated from surface is
(a) $\frac{h\omega}{2\pi}$ - φ
(b) $\frac{h\omega_0}{2\pi}$ - φ
(c) $\frac{h(\omega+\omega_0)}{2\pi}$ - φ
(d) $\frac{h(\omega-\omega_0)}{2\pi}$ - φ

Q 8. Kinetic energy of photoelectron is E wavelength of incident light is $\frac{\lambda}{2}$.If energy of photoelectron becomes double when wavelength is reduced to $\frac{\lambda}{3}$, then work function of metal is
(a) $\frac{3hc}{\lambda}$
(b) $\frac{hc}{3\lambda}$
(c) $\frac{hc}{\lambda}$
(d) $\frac{hc}{2\lambda}$

Q 9. The threshold wavelength for photoelectric emission from material is 5200 A^o. Photo electrons will be emitted when this material is illuminated with monochromatic radiation from a
(a) 50 W infrared lamp (b) 20 W infrared lamp
(c) 50 W UV lamp (d) 20 UV lamp

Q 10. The graph between 1/λ, where λ is wavelength of incident light and stopping potential (*V*) of three metals having work functions ϕ_1, ϕ_2 and ϕ_3 in an experiment of photo-electric effect is plotted as shown in the figure. Which of the following statements is correct?



(a) Ratio of work functions $\varphi_1 : \varphi_2 : \varphi_3 = 1:2:4$
(b) Ratio of work functions $\varphi_1 : \varphi_2 : \varphi_3 = 4:2:1$
(c) tan θ is inversely proportional to $\frac{hc}{e}$, where *h* is Planck's constant and *c* is the speed of light
(d) The violet colour light can eject photoelectrons from metals 2 and 3

Q 11. Which of the following statement(s) is/are true?
(I) maximum velocity of photoelectrons depends on frequency and intensity of the incident light.
(II) maximum velocity of photoelectrons depends only on the frequency of the Incident light.
(III) photoelectric current increases with increase in intensity of incident light.
(IV) photoelectric current is independent of the intensity of the incident light.

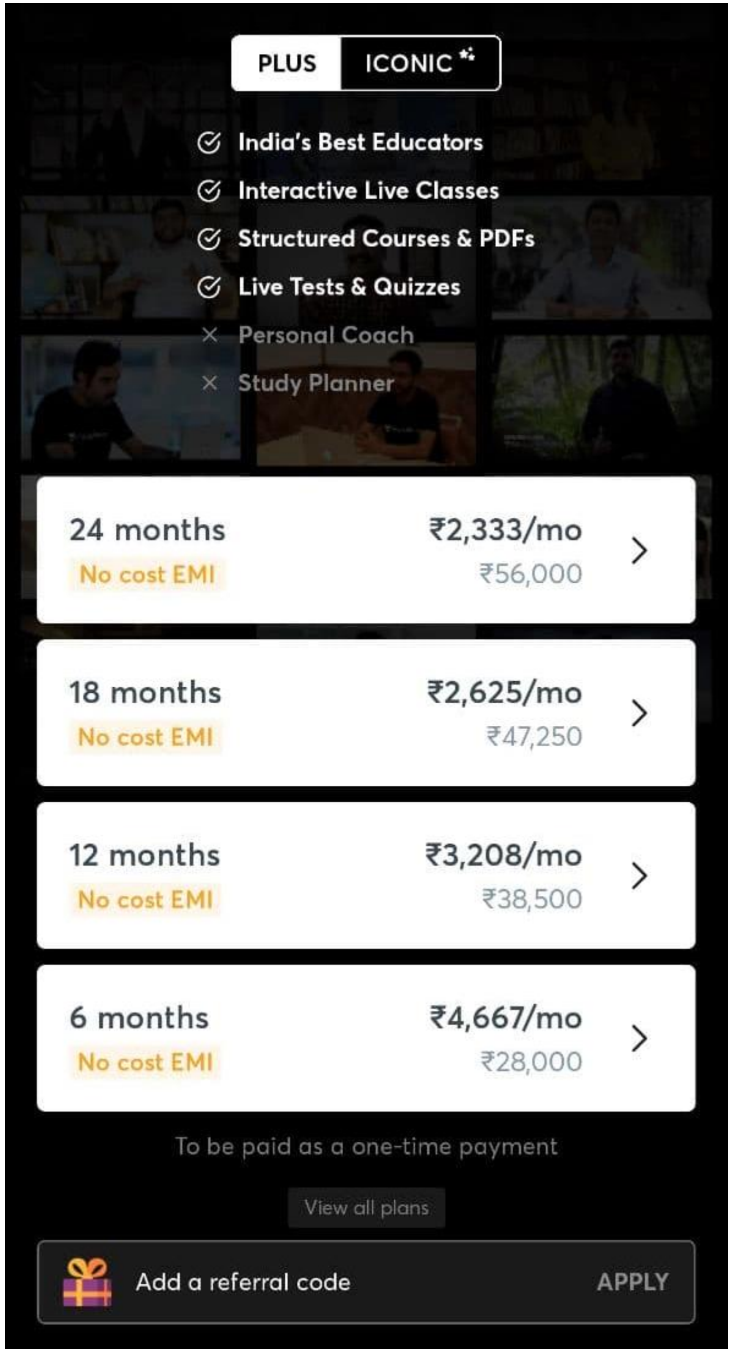
The correct option is
(a) I and IV (b) II and III
(c) III and I (d) none of these

Q 12. Electrons are emitted from a metal plate when yellow light is incident on its surface. Then
(I) electrons will be certainly emitted from it if red light is incident on its surface
(II) electrons will be certainly emitted from the plate when violet light is incident on its surface
(III) when blue light is incident, electrons will be emitted and maximum kinetic energy of emitted electrons will be greater
(IV) when blue light is incident, electrons will be emitted and maximum kinetic energy of emitted electrons will be smaller

The correct option is ,
(a) I and III (b) II and III
(c) I and IV (d) none of these

Answer Key

Q.1 c	Q.2 a,b, c	Q.3 b,d	Q.4 a,b,c	Q.5 (A) Q, (B) P, (C) R
Q.6 b	Q.7 c	Q.8 c	Q.9 c,d	Q.10 a
Q.11 b	Q.12 b			



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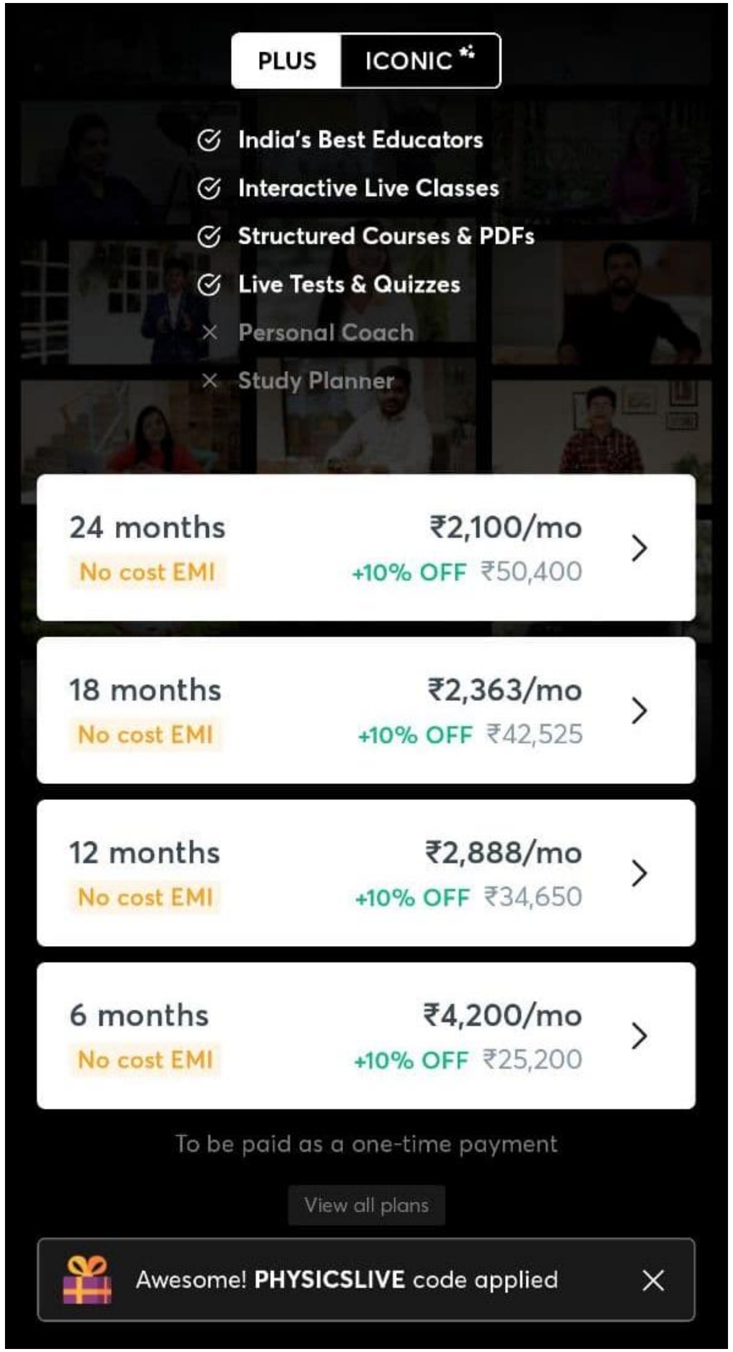

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Physics DPP - Solution

DPP- 2 Experimental Verification of Photoelectric Effect

By Physicsaholics Team

Q1) When photons of energy hν are incident on the surface of photosensitive material of work function $h\nu_0$, then → energy loss in collision with metal ions

$K = h\nu - \Delta H - \phi$

$K_{max} = h\nu - \phi = h(\nu - \nu_0)$

(a) the kinetic energy of all emitted electrons is $h\nu_0$

(b) the kinetic energy of all emitted electrons is $h(\nu - \nu_0)$

(c) the kinetic energy of all fastest electrons is $h(\nu - \nu_0)$ ✓

(d) the kinetic energy of all emitted electrons is $h\nu$

Q2) Photoelectric effect supports quantum nature of light because:

for a wave energy absorbed = $\int P\,dt$

(a) there is a minimum frequency of light below which no photoelectrons are emitted

(b) the maximum kinetic energy of photoelectrons depends only on the frequency of light and not on its intensity

(c) even when the metal surface is faintly illuminated, the photoelectrons leave the surface immediately

(d) electric charge of the photoelectrons is quantized

Q3) When a monochromatic point source of light is at a distance of 0.2 m from a photoelectric cell, the cut-off voltage and the saturation current are respectively 0.6 volt and 18.0 mA. If the same source is placed 0.6 m away from the photoelectric cell, then

(a) the stopping potential will be 0.2 volt

(b) the stopping potential will be 0.6 volt

(c) the saturation current will be 6.0 mA

(d) the saturation current will be 2.0 mA

3 times

$i \propto I \propto \frac{1}{r^2}$

$\frac{1}{9}$ times, $\frac{1}{9}$ times, 3 times

$\frac{18 mA}{9} = 2 mA$

V_{st} does not depend on I

Q4) When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy, T_A expressed in eV and de-Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70 eV is $T_B = (T_A - 1.50 \text{ eV})$. If the de-Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$ then:

$T_A = 4.25 \text{ eV} - \phi_A$

$T_B = 4.70 \text{ eV} - \phi_B \Rightarrow T_A - T_B = 1.5 \text{ eV}$

(a) the work function of A is 2.25 eV ✓

(b) the work function of B is 4.20 eV ✓

(c) T_A = 2.00 eV ✓

(d) T_B =2.75eV

$\lambda_B = 2\lambda_A \Rightarrow \frac{h}{\sqrt{2mT_B}} = \frac{2h}{\sqrt{2mT_A}}$

$T_A = 4T_B$

$T_A - T_B = 1.5 \text{ eV}$

$3T_B = 1.5 \text{ eV} \Rightarrow T_B = .5 \text{ eV}$

$T_A = 2 \text{ eV}$

$\phi_A = 4.25 - T_A = 2.25 \text{ eV}$

$\phi_B = 4.70 - .5 = 4.2 \text{ eV}$

Q5) In photoelectric effect match the following table:

$$eV_{st} = h(\nu - \nu_0)$$

Table-1		Table-2	
(A)	If frequency of incident light is increased	(P)	Photoelectric current will decrease
(B)	If distance of light source from cathode is increased	(Q)	Stopping potential will increase
(C)	If work function of metal is increased	(R)	Photoelectric effect may stop
		(S)	None

Q6) Mark the incorrect statements

(i) Bound electrons absorbs whole energy of incident photon

(ii)Isolated free electrons can't absorb whole energy of photon

(iii) Classical mechanics permits massless particles to carry energy and momentum

(iv) Energy and momentum of electrons are related as $E = pc$

(a) (ii) and (iii)

(b) (iii) and (iv)

(c) All of these

(d) None of these

Q7) The surface of metal with work function φ is illuminated by electromagnetic radiation whose electric field components are $E = a(1 + \cos \omega t)\cos \omega_0 t$. Then maximum kinetic energy of photoelectron liberated from surface is

(a) $\frac{h\omega}{2\pi} - \varphi$

(b) $\frac{h\omega_0}{2\pi} - \varphi$

(c) $\frac{h(\omega+\omega_0)}{2\pi} - \varphi$ ✓

(d) $\frac{h(\omega-\omega_0)}{2\pi} - \varphi$

$E = a(1+\cos\omega t)\cos\omega_0 t$

$= a\cos\omega_0 t + a\cos\omega t\cos\omega_0 t$

$= a\cos\omega_0 t + \frac{a}{2}\times 2\cos\omega t\cos\omega_0 t$

$= a\cos\omega_0 t + \frac{a}{2}\cos(\omega-\omega_0)t + \frac{a}{2}\cos(\omega+\omega_0)t$

$\frac{\omega_0}{2\pi}, \frac{\omega-\omega_0}{2\pi}, \frac{\omega+\omega_0}{2\pi}$ ✓ largest frequency.

Q8) Kinetic energy of photoelectron is E (maximum) wavelength of incident light is $\frac{\lambda}{2}$ .If energy of photoelectron becomes double when wavelength is reduced to $\frac{\lambda}{3}$, then work function of metal is

(a) $\frac{3hc}{\lambda}$

(b) $\frac{hc}{3\lambda}$

(c) $\frac{hc}{\lambda}$

(d) $\frac{hc}{2\lambda}$

$E = \frac{2hc}{\lambda} - \phi$

$2E = \frac{3hc}{\lambda} - \phi$

$\frac{4hc}{\lambda} - 2\phi = \frac{3hc}{\lambda} - \phi$

$\frac{hc}{\lambda} = \phi$

Q9) The threshold wavelength for photoelectric emission from material is 5200 A^o. Photo electrons will be emitted when this material is illuminated with monochromatic radiation from a

5200A = 520 nm → visible light

(a)50 W infrared lamp

(b)20 W infrared lamp

(c)50 W UV lamp

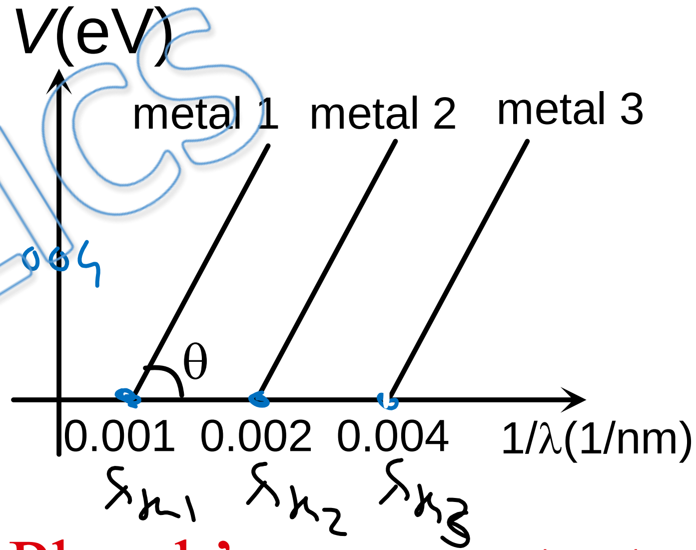
(d)20 UV lamp

Q10) The graph between $1/\lambda$, where λ is wavelength of incident light and stopping potential (V) of three metals having work functions ϕ_1, ϕ_2 and ϕ_3 in an experiment of photo-electric effect is plotted as shown in the figure. Which of the following statements is correct?

$$V_{st} = \frac{1}{e}\left(\frac{hc}{\lambda} - \phi\right)$$

$$V_{st} = 0 \Rightarrow \phi = \frac{hc}{\lambda}$$

$$\phi_1 : \phi_2 : \phi_3 = \frac{1}{\lambda_1} : \frac{1}{\lambda_2} : \frac{1}{\lambda_3} = .001 : .002 : .004 = 1 : 2 : 4$$



(a) Ratio of work functions $\varphi_1 : \varphi_2 : \varphi_3 = 1 : 2 : 4$

(b) Ratio of work functions $\varphi_1 : \varphi_2 : \varphi_3 = 4 : 2 : 1$

(c) $\tan\theta$ is inversely proportional to $\frac{hc}{e}$, where h is Planck's constant and c is the speed of light

(d) The violet colour light can eject photoelectrons from metals 2 and 3

$$V_{st} = \left(\frac{hc}{e}\right)\left(\frac{1}{\lambda}\right) - \phi$$

Ans. a

for Metal 3

$$\frac{1}{\lambda(nm)} = .004$$

$$\lambda = \frac{1}{.004} nm$$

$$= \frac{1000}{4} nm = 250 nm$$

Visible (300nm – 700nm)

no visible light can eject photoelectron from metal 3

Q11) Which of the following statement(s) is/are true?

(I) maximum velocity of photoelectrons depends on frequency and intensity of the incident light.

(II) maximum velocity of photoelectrons depends only on the frequency of the Incident light.

(III) photoelectric current increases with increase in intensity of incident light.

(IV) photoelectric current is independent of the intensity of the incident light.

The correct option is ,

$$\frac{1}{2} m V_{max}^2 = h\nu - \phi$$

(a) I and IV

(b) II and III

(c) III and I

(d) none of these

Q12) Electrons are emitted from a metal plate when yellow light is incident on its surface. Then

(I) electrons will be certainly emitted from it if red light is incident on its surface
(II) electrons will be certainly emitted from the plate when violet light is incident on its surface
(III) when blue light is incident, electrons will be emitted and maximum kinetic energy of emitted electrons will be greater
(IV) when blue light is incident, electrons will be emitted and maximum kinetic energy of emitted electrons will be smaller

The correct option is ,

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(b) II and III

(c) I and IV

(d) none of these

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