Physicsaholics

DPP – 3

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Q 1. Light of frequency ν falls on material of threshold frequency ν_o. Maximum kinetic energy of emitted electron is proportional to:
(a) $\nu - \nu_o$ (b) ν
(c) $\sqrt{\nu - \nu_o}$ (d) ν_o

Q 2. When ultraviolet light of photon energy 6.2 eV incidents on a aluminium surface, it emits photo electrons. If work function for aluminium surface is 4.2 eV, then kinetic energy of emitted electrons is-
(a) 3.2×10^{-19} J (b) 3.2×10^{-17} J
(c) 3.2×10^{-16} J (d) 3.2×10^{-11} J

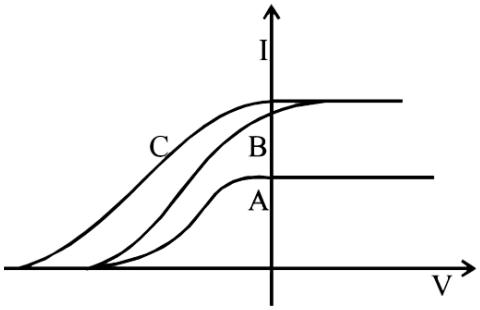
Q 3. The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately-
(a) 540 nm (b) 400 nm (c) 310 nm (d) 220 nm

Q 4. In photoelectric effect if the intensity of light is doubled then maximum kinetic energy of photoelectrons will become
(a) Double (b) Half
(c) Four time (d) No change

Q 5. When photons of energy $h\nu$ are incident on the surface of photosensitive material of work function $h\nu_o$, 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 $h\nu$

Q.6 When the electromagnetic radiations of frequencies 4×10^{15} Hz and 6×10^{15} Hz fall on the same metal, in different experiments, the ratio of maximum kinetic energy of electrons liberated is 1 : 3 . The threshold frequency for the metal is:
(a) 2×10^{15} Hz (b) 1×10^{15} Hz
(c) 3×10^{15} Hz (d) 1.67×10^{15} Hz

Q 7. In a photoelectric experiment anode potential is plotted against plate current. Then:



(a) A and B will have same intensity while B and C will have same frequencies
(b) B and C will have different intensities while A and C will have different frequencies
(c) A and B will have different intensities while A and C will have equal frequencies
(d) B and C will have equal intensities while A and B will have same frequencies

Q 8. A surface is irradiated with ultra violet radiation of wavelength 0.2 micrometer. If the maximum velocity of electron liberated from the surface is 8.8×10^5 m/s, then the work function of the surface is
(a) 3 eV (b) 4 eV (c) 5 eV (d) 6 eV

Q 9. A metal ball is illuminated by UV radiation of wavelength 200 nm. The work function of metal is 2 eV. The electric potential acquired as a result of photoelectric effect is
(a) 4.2 V (b) 3.2 V
(c) 1.2 V (d) Data insufficient

Q 10. Photoelectric effect is observed from a surface for frequency's 3×10^{14} Hz and 2×10^{14} Hz for incident radiation. If maximum kinetic energies are in ratio 2 : 1 then threshold frequency is
(a) 10^{14}Hz (b) 1.5×10^{14}Hz
(c) 1.33×10^{14}Hz (d) None of these

Q 11. Which of the following statements are incorrect about photoelectric effect?
(a) Photoelectric effect supports quantum nature of radiation
(b) Maximum kinetic energy of photoelectric effect is proportional to frequency of incident radiation
(c) The phenomena of photoelectric effect is almost instantaneous
(d) Saturation photocurrent is proportional to intensity of radiation

Q 12. Which metal will be suitable for a photo electric cell using light of wavelength 4000Å. The work functions of sodium and copper are respectively 2.0 eV and 4.0 eV.
(a) sodium (b) copper
(c) Both (d) None of both

Q 13. The work function for the surface of aluminum is 4.2 eV. What will be the wavelength of that incident light for which the stopping potential will be zero.
(a) 2496 Å (b) 2946×10^{-7} m
(c) 2649 Å (d) 2946 Å

Q 14. When light source is placed at 1 m distance from photo electric cell, then value of stopping potential is obtained 4 volt. If it is placed at 4 m distant, then value of stopping potential becomes –
(a) 2 volt (b) 1 volt
(c) 4 volt (d) 16 volt

Q 15. Which of the following statement is wrong ?
(a) photoelectric current depends on intensity
(b) the maximum kinetic energy of emitted electrons is equal to eV_s where V_s is stopping potential
(c) at stopping potential on increasing the intensity of light photoelectric current increases
(d) the maximum energy of photoelectron does not depend on the intensity of light

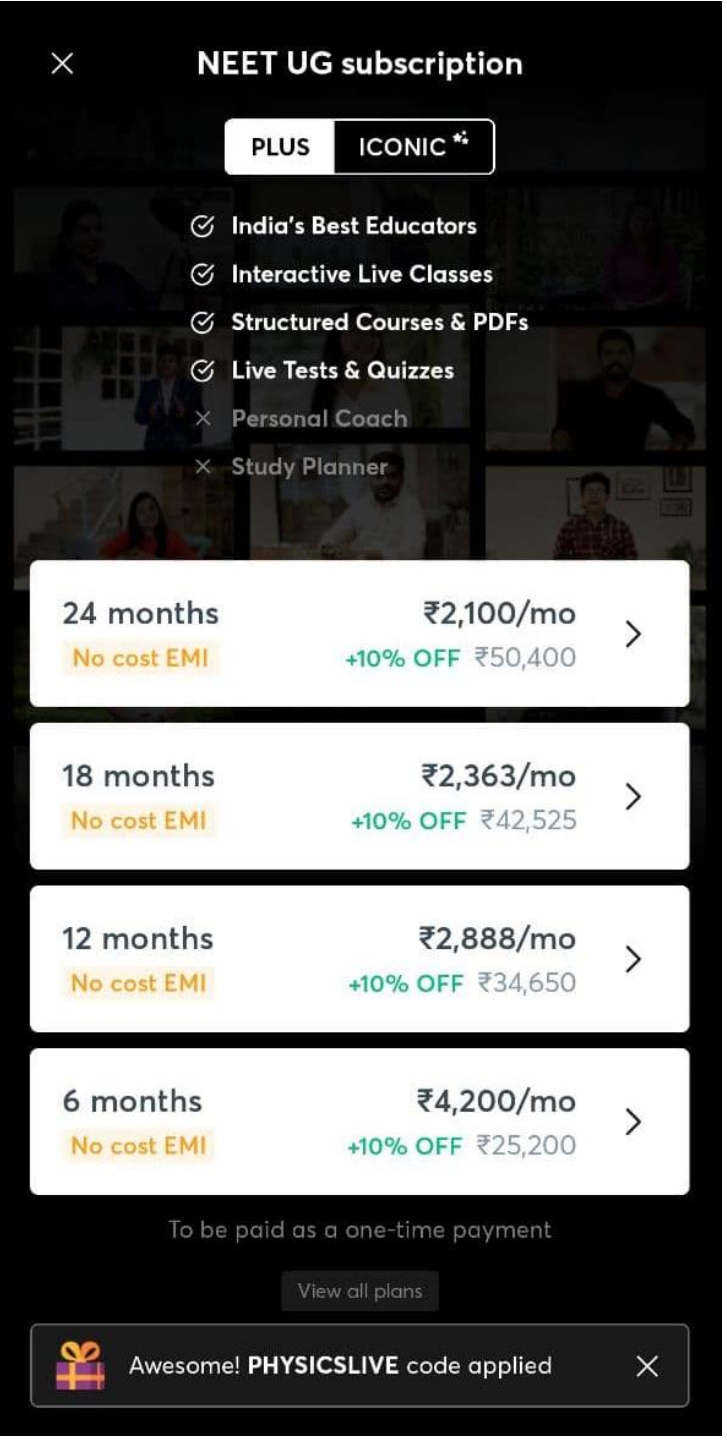
Q 16. In photoelectric effect work function of any metal is 2.5 eV. Emitted electrons are stopped by the potential of –1.5 volt then –
(a) energy of incident photons is 4 eV
(b) energy of incident photons is 1 eV
(c) photoelectric current increases when we use photons of high frequency
(d) none of the above

Q 17. If the frequency of light in a photoelectric experiment is doubled, the stopping potential will –
(a) be doubled
(b) be halved
(c) become more than double
(d) become less than double

Q 18. Slope of curve between stopping potential and frequency depends on –
(a) nature of material (b) intensity
(c) both (d) none of these

Answer Key

Q.1 a	**Q.2 a**	**Q.3 c**	**Q.4 d**	**Q.5 c**
Q.6 c	**Q.7 d**	**Q.8 b**	**Q.9 a**	**Q.10 a**
Q.11 b	**Q.12 a**	**Q.13 d**	**Q.14 c**	**Q.15 c**
Q.16 a	**Q.17 c**	**Q.18 d**		



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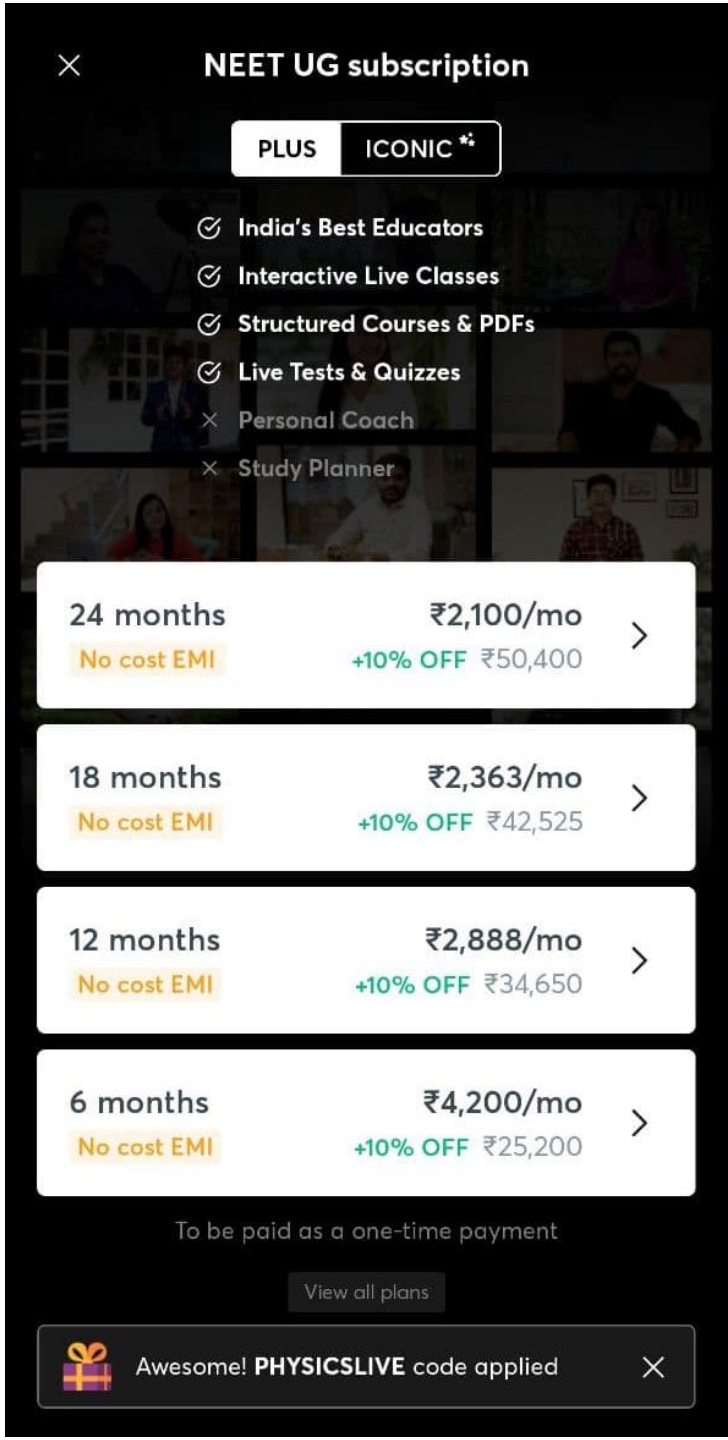


Physics DPP

DPP 3- Photoelectric Effect

By Physicsaholics Team

Solution: 1

$$K = E - \phi$$

$$K = h\nu - h\nu_0$$

$$K = h(\nu - \nu_0)$$

$$\boxed{K \propto (\nu - \nu_0)}$$ As

Ans. a

Solution: 2

$$K_{max} = \frac{hc}{\lambda} - \phi$$

$$= 6.2\,eV - 4.2\,eV$$

$$= 2\,eV$$

$$= 2 \times 1.6 \times 10^{-19}\ J$$

$$= 3.2 \times 10^{-19}\ J$$

Ans (a)

Solution: 3

Longest wavelength which can knockout an electron is called threshold wavelength.

$$\phi = \frac{hc}{\lambda_{th}} \Rightarrow \lambda_{th} = \frac{hc}{\phi} = \frac{1240 \text{ nm eV}}{4 \text{ eV}}$$

$$= 310 \text{ nm}$$

Ans (c)

Solution: 4

$K.E._{max}$ of photoelectrons are independent of the intensity of light. So there will be no change in the maximum kinetic energy even if the intensity of light is doubled.

Ans. d

Solution: 5

Energy absorbed by electron = $h\nu$

work function = $h\nu_0$

Energy loss in collisions = ΔH

Kinetic energy of photoelectron

$K = h\nu - h\nu_0 - \Delta H$

for maximum Kinetic energy, $\Delta H = 0$

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

photoelectron may have any energy between 0 to $h(\nu - \nu_0)$

Ans(c)

Solution: 6

$$K_{max_1} = h(4\times10^{15}) - h\nu_{th}$$

$$K_{max_2} = h(6\times10^{15}) - h\nu_{th}$$

$$\frac{K_{max_1}}{K_{max_2}} = \frac{1}{3} = \frac{4\times10^{15} - \nu_{th}}{6\times10^{15} - \nu_{th}} \Rightarrow 6\times10^{15} - \nu_{th} = 12\times10^{15} - 3\nu_{th}$$

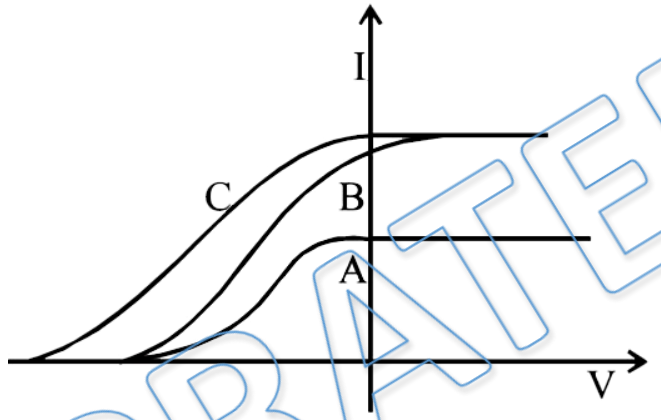
$$\Rightarrow 2\nu_{th} = 6\times10^{15}$$

$$\Rightarrow \nu_{th} = 3\times10^{15}\ Hz$$

Ans (c)

Solution: 7

From the graph, it is clear that A and B have the same stopping potential and therefore the same frequency. Also, B and C have same saturation current so they will have the same intensity.



Ans. d

Solution: 8

$$K_{max} = \frac{1}{2} m v_{max}^2 = \frac{9.1 \times 10^{-31}}{2} \times \left(8.8 \times 10^5\right)^2 \quad J$$

$$= \frac{9.1}{2} \times 10^{-31} \times \frac{2.2 \quad 11}{8.8 \times 8.8 \times 10^{10}} \quad eV$$
$$1.6 \times 10^{-19} \quad 2$$

$$= 2.2\,eV$$

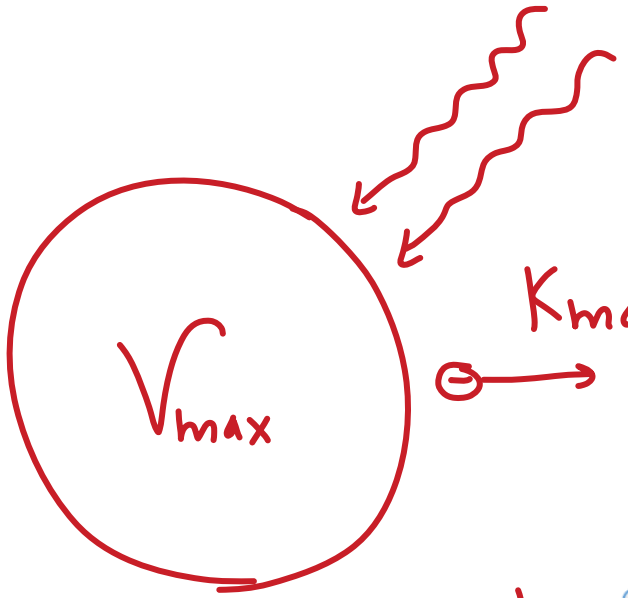
$$\text{Energy of one photon} = \frac{hc}{\lambda} = \frac{1240\,nm\,eV}{\cdot 2\,\mu} = 6.2\,eV$$

$$K_{max} = \frac{hc}{\lambda} - \phi$$

$$\Rightarrow \phi = \frac{hc}{\lambda} - K_{max} = 6.2\,eV - 2.2\,eV = 4\,eV$$

Ans. b

Solution: 9



V_{max} → maximum potential acquired by ball

by Conservation of mechanical energy →

$$K_{max} - eV_{max} = 0$$

$$\Rightarrow V_{max} = \frac{K_{max}}{e} = \frac{1}{e}\left[\frac{1240\,nmeV}{200\,nm} - 2eV\right]$$

$$= \frac{4.2eV}{e} = 4.2V$$

Ans (a)

Solution: 10

$$\frac{K_{max\,1}}{K_{max\,2}} = \frac{h\nu_1 - \phi}{h\nu_2 - \phi} = \frac{2}{1}$$

$$\Rightarrow \quad h\nu_1 - \phi = 2h\nu_2 - 2\phi$$

$$\Rightarrow \quad \phi = h(2\nu_2 - \nu_1)$$

$$h\nu_{th} = h[2 \times 2 \times 10^{14} - 3 \times 10^{14}]$$

$$\nu_{th} = 10^{14}\ Hz$$

Ans (a)

Solution: 11

$$K_{max} = h\nu - \phi$$

K_{max} increases on increasing ν but K_{max} is not proportional to ν.

Ans(b)

Solution: 12

$$\text{Energy of photon} = \frac{hc}{\lambda} = \frac{12400\ \text{Å eV}}{4000\ \text{Å}} = 3.1\ \text{eV}$$

$$\phi_{Cu} = 4\ \text{eV}$$

$\Rightarrow$ Cu will not show photoelectric effect with this wavelength of radiation.

Ans (a)

Solution: 13

$$V_{st} = \frac{K_{max}}{e} = 0 \Rightarrow K_{max} = 0$$

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

$$\Rightarrow \lambda = \frac{hc}{\phi} = \frac{12400\ \text{Å eV}}{4.2\ \text{eV}}$$

$$= 2946\ \text{Å}$$

Ans(d)

Solution: 14

stopping potential depends on energy of incident photon, which does not depend on distance from source.

Ans(c)

Solution: 15

At stopping potential electron having K_{max} just misses collector. Increasing intensity (i.e. no of photons) will not increase K_{max}, so photocurrent will remain zero.

Ans (c)

Solution: 16

$$eV_{st} = \frac{hc}{\lambda} - \phi$$

$$e \times 1.5\,V = \frac{hc}{\lambda} - 2.5\,eV$$

$$\Rightarrow \quad \frac{hc}{\lambda} = 4\,eV$$

energy of incident photon is 4eV.

Ans (a)

Solution: 17

$$eV_i = h\nu - \phi$$
$$eV_f = 2h\nu - \phi$$

] V_i & V_f are initial & final stopping potentials.

$$\Rightarrow \frac{V_f}{V_i} = \frac{2h\nu - \phi}{h\nu - \phi} = \frac{2h\nu - 2\phi}{h\nu - \phi} + \frac{\phi}{h\nu - \phi}$$

$$= 2 + \frac{\phi}{h\nu - \phi} > 2$$

$$\Rightarrow V_f > 2V_i$$

Ans (c)

Solution: 18

$$V_{st} = \frac{1}{e}(h\nu - \phi)$$

Slope of curve between V_{st} & ν

$= \frac{h}{e}$ = same for all materials & radiation.

Ans(d)

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