Ultimate KCET Crash Course 2026

PHYSICS

Dual Nature of Radiation and Matter

DPP :- 01

Q1 Energy from the sun is received on earth at the rate of 2 cal per cm^2 per min. If average wavelength of solar light be taken at 5500 Å then how many photons are received on the earth per cm^2 per min (h=6.6×10^{-34} J-s,1cal = 4.2 J).

(A) 1.5×10^{13}

(B) 2.9×10^{13}

(C) 2.3×10^{19}

(D) 1.75×10^{19}

Q2 What is the momentum of a photon having frequency 1.5×10^{13} Hz?

(A) 3.3×10^{-29} kg m/s

(B) 6.6×10^{-30} kg m/s

(C) 3.3×10^{-34} kg m/s

(D) 6.6×10^{-34} kg m/s

Q3 Threshold wavelength of a photoelectric emission from a material is 600 Which of the following illuminating source will emit photoelectrons?

(A) 100 W, ultraviolet lamp

(B) Both 10 W, ultraviolet lamp and 100 W, ultraviolet lamp

(C) 400 W, infrared lamp

(D) 10 W, ultraviolet lamp

Q4 **The de-Brogle wavelength of an electron and the wavelength of a photon are the same. The ratio between the energy of the photon and the momentum of the electron is (c= velocity of light. h= Planck's constant)**

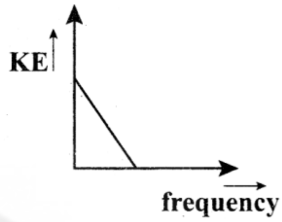
(A) h

(B) c

(C) $\frac{1}{h}$

(D) $\frac{1}{c}$

Q5 According to Einstein's photoelectric equation the graph between kinetic energy of photoelectrons ejected and the frequency of incident radiation is

(A)


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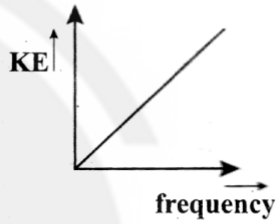

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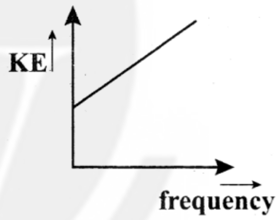

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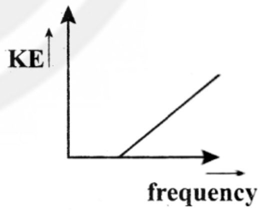


Q6 A particle A of mass m and initial velocity v collides with a particle B of mass $\frac{m}{2}$ which is at rest. The collision is head on, and elastic. The ratio of the de-Broglie wavelengths λ_A to λ_B after the collision is

(A) $\frac{\lambda_A}{\lambda_B} = \frac{1}{3}$

(B) $\frac{\lambda_A}{\lambda_B} = 2$

(C) $\frac{\lambda_A}{\lambda_B} = \frac{2}{3}$

(D) $\frac{\lambda_A}{\lambda_B} = \frac{1}{2}$

Q7 What is the de Broglie wavelength of the electron accelerated through a potential difference of 100 volt ?

(A) 0.1227 Å

(B) 12.27 Å

(C) 0.001227 Å

(D) 1.227 Å

Q8 The de Broglie wavelength of an electron moing with a velocity c/2(c= velocity of light in vacum) is equal to the wavelength of a photon. The ratio of the kinetic energies of electron and photon is

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

(C) 1 : 1 (D) 2 : 1

Q9 Light of frequency 10^{15} Hz falls on a metal surface of work function 2.5 eV. The stopping potential of potential electrons (in V) is

(A) 1.6 (B) 2.5

(C) 4.1 (D) 6.6

Q10 The ratio of the de-Broglie wavelengths of proton and -particle which haαve been accelerated through same potential difference is

(A) $2\sqrt{3}$ (B) $3\sqrt{2}$

(C) $2\sqrt{2}$ (D) $3\sqrt{3}$

Q11 Light of certain frequency and intensity incident on a photosensitive material causes photoelectric effect. If both the frequency and intensity are doubled, then photoelectric saturation current becomes

(A) doubled

(B) unchanged

(C) quadrupled

(D) halved

Q12 About 6% of the power of a 100 W light bulb is converted to visible radiation. The average intensity of visible radiation at a distance of 8 m is (Assume that the radiation is emitted isotopically and neglect reflection.)

(A) 3.5×10^{-3} W m^{-2}

(B) 2.3×10^{-3} W m^{-2}

(C) 7.2×10^{-3} W m^{-2}

(D) 5.1×10^{-3} W m^{-2}

Q13 The wavelength of a 1 keV photon is 1.24×10^{-9}m. What is the frequency of 1 MeV photon?

(A) 1.24×10^{18}

(B) 1.24×10^{15}

(C) 2.4×10^{20}

(D) 2.4×10^{23}

Q14 If K_1 and K_2 are maximum kinetic energies of photoelectrons emitted when lights of wavelength λ_1 and λ_2 respectively incident on a metallic surface. If $\lambda_1 = 3\lambda_2$, then

(A) $K_1 > \left(\frac{K_2}{3}\right)$

(B) $K_1 < \left(\frac{K_2}{3}\right)$

(C) $K_1 = 3K_2$

(D) $K_2 = 3K_1$

Q15 **Light of two different frequencies whose photons have energies 2.5eV and 8.5eV respectively, illuminate a metallic surface whose work function is 0.5eV successively. Ratio of maximum speeds of emitted electrons will be:**

(A) 1:2 (B) 1:1

(C) 1:5 (D) 1:4

Q16 Calculate the velocity of the electron ejected from platinum surface when radiation of 200 nm incident on it. The work function of the metal is 5eV.

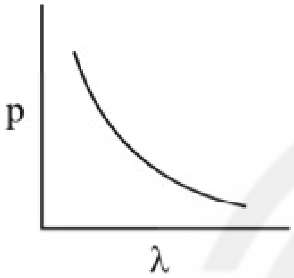
(A) 6.54×10^5 m/s

(B) 0.54×10^2 m/s

(C) 6.5×10^2 m/s

(D) 6.4×10^2 m/s

Q17 Variation of momentum of particle (p) with associated de-Broglie wavelength (λ) is shown correctly by

(A)


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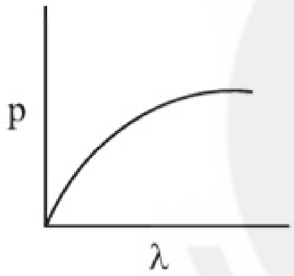

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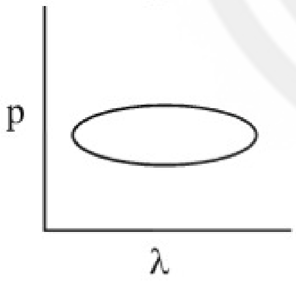

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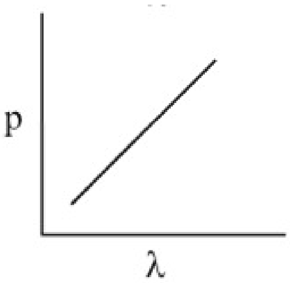


Q18 The minimum energy required to eject an electron from the metal surface is called

(A) atomic energy

(B) mechanical energy

(C) work function

(D) electrical energy

Q19 Light of frequency v falls on material of threshold frequency v_0. Maximum kinetic energy of emitted electron is proportional to

(A) $\upsilon - \upsilon_0$ (B) v

(C) $\sqrt{\upsilon - \upsilon_0}$ (D) υ_0

Q20 Light of wavelength 0.6μm from a sodium lamp falls on a photocell and causes the emission of photoelectrons for which the stopping potential is 0.5 V. With light of wavelength 0.4μm from a mercury vapor lamp, the stopping potential is 1.5 V. Then, the work function [in electron volts] of the photocell surface is

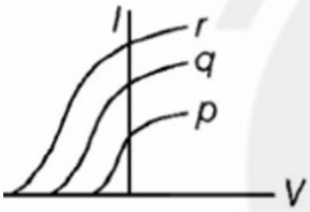
(A) 0.75eV (B) 1.5eV

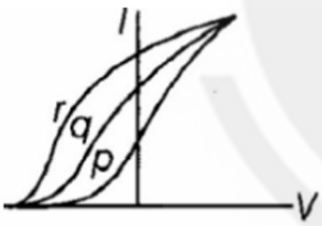
(C) 3eV (D) 2.5eV

Q21 Photoelectric effect experiments are performed using three different metal plates p, q and r having work functions $Q_s = 20eV, Q_q = 2.5eV$ and $Q_r = 3.0eV$ are respectively. A light beam containing wavelength of $550\ nm, 450\ nm$ and 350 nm with equal intensities illuminates each of the plates. The correct $I - V$ graph of the experiment is (take $h_c = 1240eV\,nm$)

(A) 

(B) 

(C) 

(D) 

Q22 What is the momentum of a photon in space having frequency 3×10^{15} Hz? ($h = 6.6 \times 10^{-34}$ J.s)

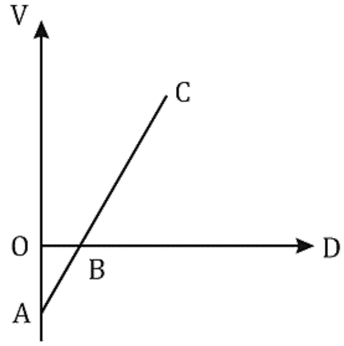
(A) 2.2×10^{-29} kg m/s

(B) 2.2×10^{-34} mg m/s

(C) 6.6×10^{-34} kg m/s

(D) 6.6×10^{-27} kg m/s

Q23 The stopping potential V for photoelectric emission from a metal surface is plotted along Y-axis and frequency U of incident light along X-axis. A straight line is obtained as shown in the figure. Planck's constant is given by



(A) slope of the line.

(B) product of slope of the line and charge on the electron.

(C) intercept along Y-axis divided by charge on the electron.

(D) product of intercept along X-axis and mass of the electron.

Q24 Two separate monochromatic light beams A and B of the same intensity (energy per unit time) are falling normally on a unit area of a metallic surface. Their wavelength are λ_A and λ_B respectively. Assuming that all the incident light is used in ejecting the photoelectrons, the ratio of the number of photoelectrons from beam A to that form B

(A) $\left(\frac{\lambda_A}{\lambda_B}\right)$

(B) $\left(\frac{\lambda_B}{\lambda_A}\right)$

(C) $\left(\frac{\lambda_A}{\lambda_B}\right)^2$

(D) $\left(\frac{\lambda_B}{\lambda_A}\right)^2$

Q25 The maximum kinetic energy of the photoelectrons varies:

1. inversely with the intensity and is independent of the frequency of the incident radiation
2. inversely with the frequency and is independent of the intensity of the incident radiation
3. linearly with the frequency and the intensity of the incident radiation
4. linearly with the frequency and is independent of the intensity of the incident radiation

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

Q26 If K_1 and K_2 are maximum kinetic energies of photoelectrons emitted when lights of wavelength λ_1 and λ_2 respectively incident on a metallic surface. If $\lambda_1 = 3\lambda_2$, then

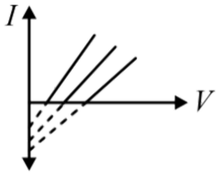
(A) $K_1 > (K_2 / 3)$

(B) $K_1 < (K_2 / 3)$

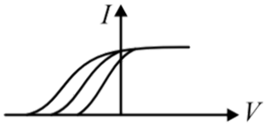
(C) $K_1 = 3K_2$

(D) $K_2 = 3K_1$

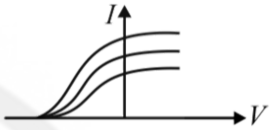
Q27 Variation of photoelectric current (I) with applied potential difference (V) for three different frequencies of incident radiation but a fixed incident intensity is described by which of the following graph?



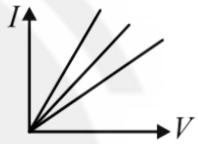
(A)



(B)



(C)



(D)

Q28 Plancks constant :
(A) depends upon medium
(B) depends upon wavelength of light
(C) depends upon frequency of light
(D) is universal constant

Q29 A beam of light has a wavelength of 650 nm in What is the speed of this light in a liquid whose index of refraction at this wavelength is 1.47?

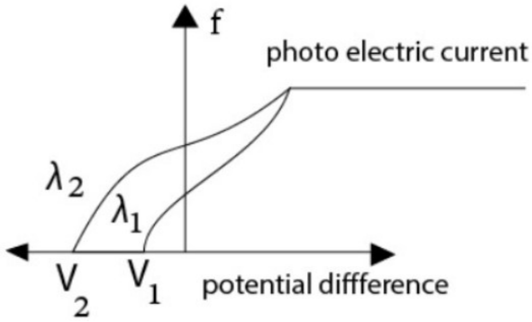
(A) $3.3 \times 10^8 ms^{-1}$

(B) $3.1 \times 10^8 ms^{-1}$

(C) $2.04 \times 10^8 ms^{-1}$

(D) $2.9 \times 10^8 ms^{-1}$

Q30 In the follwoing daigram if $V_2 > V_1$



(A) $\lambda_1 = \sqrt{\lambda_2}$
(B) $\lambda_1 < \lambda_2$
(C) $\lambda_1 = \lambda_2$
(D) $\lambda_1 > \lambda_2$

Answer Key

Q1	C
Q2	A
Q3	B
Q4	B
Q5	D
Q6	B
Q7	D
Q8	A
Q9	A
Q10	C
Q11	A
Q12	C
Q13	C
Q14	B
Q15	A
Q16	A
Q17	A
Q18	C
Q19	A
Q20	B
Q21	A
Q22	D
Q23	B
Q24	A
Q25	A
Q26	B
Q27	B
Q28	D
Q29	C
Q30	D

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Video Solution:

Q2 Text Solution:

$P = \frac{hf}{C} = \frac{6.6\times10^{-34}\times1.5\times10^{13}}{3\times10^{8}} = 3.3 \times 10^{-29}\, kgm/s$

Video Solution:

Q3 Text Solution:

Both 10 W, ultraviolet lamp and 100 W, ultraviolet lamp

Explanation:

The incident wavelength should be less than threshold wavelength for photoelectric emission. IR has a wavelength of more than 600 nm. UV has a wavelength of less than 600 nm. So, photoelectrons emitted when illuminated by UV lamp either 100 W or 10 W.

Video Solution:

Q4 Text Solution:

$\lambda_r = \frac{h}{mv} and \lambda_p = \frac{hc}{E_p}\left(E_p = energy\ of\ photon\right)$

$Given, \lambda_f = \lambda_p \Rightarrow \frac{h}{mv} = \frac{hc}{E_p} \Rightarrow \frac{h}{P_e} = \frac{hc}{E_p}$

$\left(P_e = mv = momentum\ of\ electron\right) or \frac{E_p}{P_e} = c$

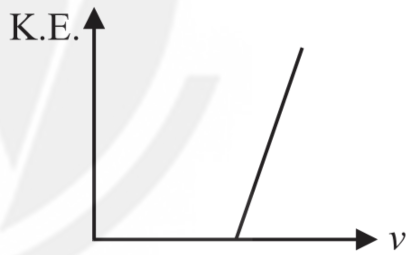
Video Solution:

Q5 Text Solution:

According to Einstein photoelectric equation

$E = W_0$ + K.E. $\Rightarrow hv = hv_0$ + K.E.

K.E. $= hv - hv_0$



This is comparable to

$y = mx + c$

The graph is represented as shown.

Video Solution:

Q6 Text Solution:

$\frac{\lambda_A}{\lambda_B} = 2$

$v_1 = \left(\frac{m_1 - m_1}{m_1 + m_2}\right) u_1 + \left(\frac{2m_2 u_2}{m_1 + m_2}\right)$

$v_1 = \left(\frac{m - \frac{m}{2}}{m + \frac{m}{2}}\right) v \Rightarrow v_1 = \frac{m/2(v)}{3m/2} = \frac{v}{3}$

$v_2 = \frac{2m_1 u_1}{m_1 + m_2} + 0$

$\Rightarrow v_2 = \frac{2m}{\frac{3}{2}m} v$

$v_2 = \frac{4}{3} v$

$\therefore \frac{h_1}{h_2} = \frac{m_2 v_2}{m_1 v_1} = \frac{\frac{m}{2} \times \frac{4}{3} v}{\frac{v}{3}} = \frac{4}{2}$

$\frac{h_1}{h_2} = 2$

Video Solution:

Q7 Text Solution:

As we know the equation;

$$\lambda = \frac{12.27}{\sqrt{V}} \mathring{A}$$

$$\lambda = \frac{12.27}{\sqrt{100}} \mathring{A}$$

$$\lambda = \frac{12.27}{10} \mathring{A}$$

$$\lambda = 1.227 \mathring{A}$$

Video Solution:

Q8 Text Solution:

The de Broglie wavelength is given by,

$\lambda_e = \frac{h}{m_e v} = \frac{h}{m_e\left(\frac{c}{2}\right)} = \frac{2h}{m_e c}$

As the wavelength of photon and electron are same;

$$\lambda_p = \frac{2h}{m_e c};$$

the kinetic energy of photon;

$K.E_p = \frac{hc}{\lambda_p} = \frac{hc(m_e c)}{2h} = \frac{1}{2} m_e c^2 \ldots\ldots\ldots\ldots \ldots (1)$

The kinetic energy of electron ,

$K.E_e = \frac{1}{2} mv^2 = \frac{1}{2} m\left(\frac{c}{2}\right)^2 = \frac{1}{8} mc^2 \ldots\ldots \ldots\ldots (2)$

Take ratio of Eq. (2) to (1).

$$\frac{K.E_e}{K.E_p} = \frac{\frac{1}{8} mc^2}{\frac{1}{2} mc^2} = \frac{1}{4}$$

Video Solution:

Q9 Text Solution:

Frequency of incident of incident light,

$\nu = 10^{15}$ Hz

Work function, ϕ_0 = 25. eV

Energy of incident photon,

$E=h\nu$

$= 6.62 \times 10^{-34} \times 10^{15}$

$= 6.62 \times 10^{-19}$ J

$\frac{6.62\times10^{-19}}{1.6\times10^{-19}} eV$

= 4.1 eV

According to Einstein's photoelectric equation,

$K_{max} = h\nu - \phi_0$

$eV_0 = h\nu - \phi_0$

$eV_0 = 4.1 eV - 25\ eV$

$eV_0 = 1.6\ eV$

$V_0 = 1\ 6.\ V$

Video Solution:

Q10 Text Solution:

K. E. gained by a charge q after being accelerated through a potential difference V volt is given by $qV = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2qV}{m}}$ and $mv = \sqrt{2mqV}$

de Broglie wavelength, $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mqV}}$

Now, $\lambda_p = \frac{h}{\sqrt{2m_p q_p V_p}}$ For α-particle

$\lambda_\alpha = \frac{h}{\sqrt{2m_\alpha q_\alpha V_\alpha}} \therefore \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{m_\alpha q_\alpha V_\alpha}{m_p q_p V_p}}$

Putting $V_a = V_p$ we get

$\frac{\lambda_p}{\lambda_a} = \sqrt{\frac{m_0 q_\alpha}{m_p q_p}} = \sqrt{\frac{4\times2}{1\times1}} = \sqrt{8} = 2\sqrt{2}$

Video Solution:

Q11 Text Solution:

We know that photo electric current is directly proportional to the intensity of light.

Given that incident frequency is greater than threshold frequency.

When intensity is doubled,

Photo electric saturation current doubles.

Video Solution:

Q12 Text Solution:

Here, power of bulb = 100 W

As intensity, $I = \frac{\text{Power of visible light}}{\text{area}}$

$= \frac{100\times6/100}{4\pi(8)^2} = 7.2 \times 10^{-3} W\ m^{-2}$

Video Solution:

Q13 Text Solution:

4×10^{20}

Explanation:

$E_1 = hc/\lambda_1$ and $E_2 = h\nu_2$

$h\upsilon_2 \times \frac{\lambda_1}{hc} = \frac{E_2}{E_1} or\ \upsilon_2 = \frac{hc}{\lambda_1} . \frac{E_2}{E_1}$

$= \frac{3\times10^8}{1.24\times10^{-9}} . \frac{10^6 eV}{10^3 eV}$

1.24×10^{-9} 10^3eV

$= 2.4 \times 10^{20}$ Hz

Video Solution:

Q14 Text Solution:

Given,

$\lambda_1 = 3\lambda_2$

According

$\frac{hc}{\lambda} = \phi_0 + KE_{\max}$

$\therefore K_1 = \frac{hc}{\lambda_1} - \phi_0$ and $K_2 = \frac{hc}{\lambda_2} - \phi_0$

$or,$

$K_1 - K_2 = hc\left[\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right]$

$= hc\left[\frac{1}{3\lambda_2} - \frac{1}{\lambda_2}\right] = -\frac{2hc}{3\lambda_2}$

$\Rightarrow K_1 - K_2 = -\frac{2}{3}(K_2 + \phi_0)$

$or,$

$K_1 = K_2 - \frac{2}{3}\left(K_2 + \phi_0\right) = \frac{K_2}{3} - \frac{2}{3}\phi_0$

$Or,$

$K_1 < \frac{K_2}{3}$

Video Solution:

Q15 Text Solution:

Kinetic energy

$K = \phi - \phi_0$

$Here\ K_1 = 2.5 - 0.5 = 2eV$

$K_2 = 8.5 - 0.5 = 8eV$

$\therefore \frac{K_1}{K_2} = \frac{2}{8} = \frac{1}{4} = \frac{1}{4}$

$or\ \frac{\upsilon_1}{\upsilon_2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

Video Solution:

Q16 Text Solution:

Given:

$W = 5eV = 5 \times (1.6 \times 10^{-19})J = 8.0 \times 10^{-19}$ J

Using Einstein's photoelectric equation,

$E_1 = KE + W$

$E_1 = \frac{hc}{\lambda} ......(i)$

$h = 6.63 \times 10^{-34}$, $c = 3 \times 10^8$ m/s

$\lambda = 200 \times 10^{-9}$ m

Put the given values in (i).

$= 9.945 \times 10^{-19}$

$KE = E_1 - W.....(ii)$

Put the given values in (ii).

$= 9.945 \times 10^{-19} - 8.0 \times 10^{-19}$

$= 1.945 \times 10^{-19}$ J

Kinetic energy of the electron

$(KE) = \frac{1}{2}mv^2$

$v = \left[\frac{2(1.945 \times 10^{-19})}{9.1 \times 10^{-31}}\right]^{\frac{1}{2}} = 6.54 \times 10^5$ m/s

Video Solution:

Q17 Text Solution:

As $\lambda \propto 1/p$ we will have a rectangular hyperbola.

Video Solution:

Q18 Video Solution:

Q19 Text Solution:

According to Einstein's Photoelectric equation

$h\upsilon = (KE)_{\max} + \phi_o$

But $\phi_0 = h\nu_0$,

ν_0 being threshold frequency.

$\therefore$ $(\mathrm{KE})_{\max} = h0 - h\nu_0$ or $(\mathrm{KE})_{\max} \approx \upsilon - \omega_0$

Video Solution:

Q20 Text Solution:

$E - W_0 = \frac{1}{2}mv^2 = eV_s$

or $\frac{hc}{\lambda} - W_0 = eV_s$

Hence, $\frac{hc}{0.4 \times 10^{-6}} - W_0 = e(1.5)$

Solving, we get $W_0 = 1.5$eV

Video Solution:

Q21 Text Solution:

Consider the expression,

$V_B = \left(\frac{1}{e}\right)\left(\frac{hc}{l} - f\right)$

For P,

$V_P \ = \left(\frac{1}{e}\right)\left(\frac{1240}{550} - 2\right) \quad = 0.2545\ V$

For q,

$V_q \ = \left(\frac{1}{e}\right)\left(\frac{1240}{450} - 2.5\right) \backslash\backslash\backslash$

$= 0.255\ V$

For r,

$V_r \ = \left(\frac{1}{e}\right)\left(\frac{1240}{350} - 3\right) \backslash\backslash\backslash$

$= 0.5428\ V$

P has the smallest work function and can emit photoelectron at all three wavelengths. As a result, the stopping potential and saturation current will be maximum for this magnitude of stopping potential.

Video Solution:

Q22 Text Solution:

$P = \frac{hv}{c} = \frac{6.6\times10^{-34}\times3\times10^{15}}{3\times10^{8}}$

$= 6.6 \times 10^{-27}$ kg m/s

Video Solution:

Q23 Text Solution:

According to Einstein's Photoelectric equation

$K = eV = h\upsilon - W_o$

$or\ V = \frac{h}{e}\upsilon - \frac{W_o}{e}$

Slope of striaght line between V and ν is $\frac{h}{e}$

h = e slope of stright line.

Video Solution:

Q24 Text Solution:

The number of photoelectrons depends on the number of photons.

Number of photons $= \frac{I}{hc/\lambda} = \frac{\lambda I}{hc} \propto \lambda.$

Ratio of number of photoelectrons $= \frac{\lambda_A}{\lambda_B}$

Video Solution:

Q25 Text Solution:

(a) Option 4

Explanation:

The maximum kinetic energy of the photoelectrons is directly proportional to the frequency and it is independent of the intensity of the incident radiation.

Video Solution:

Q26 Text Solution:

$K_1 < (K_2 / 3)$

Video Solution:

Q27 Text Solution:

For different frequencies, we have difference stopping potentials and as intensity is fixed, they will have same saturation current.

Video Solution:

Q28 Video Solution:

Q29 Text Solution:

$2.04 \times 10^8 ms^{-1}$

Explanation:

We know that, $\mu = c/v$

$1.47 = 3\times10^8/v$

$v = 2.04 \times 10^8$ m/s

Video Solution:

Q30 Video Solution: