PHYSICS

BOOKS - CENGAGE PHYSICS (HINGLISH)

ELECTRON,PHONTS,PHOTOELECTRIC EFFECT & X-RAYS

Subjective Type

1. An electron of mass m with an initial velocity $\vec{v} = v_0 \hat{}(\text{i})\ (v_0 > 0)$ enters an electric field $\vec{E} = -E_0 \hat{i}\ (E_0 = cons\tan t > 0)$ at $t = 0$. If

λ_0 is its de - Broglie wavelength initially, then its de - Broglie wavelength at time t is

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Single Correct Answer Type

1. A silver of radius $4.8cm$ is suspended by a thread in the vacuum chamber . UV light of wavelength $200nm$ is incident on the ball for some times during which a total energy of $1 \times 10^{-7} J$ falls on the surface . Assuming on an

average one out of 103 photons incident is able to eject electron. The potential on sphere will be

A. 1 V

B. 2V

C. 3V

D. zero

Answer: C

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2. The minimum intensity of light to be detected by human eye is $10^{-10}W/m^2$. The number of photons of wavelength $5.6 \times 10^{-7}m$ entering the eye , with pupil area $10^{-6}m^2$, per second for vision will be nearly

A. 100

B. 200

C. 300

D. 400

Answer: C

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3. The eye can detect 5×10^4 photons $\left(m^2 s\right)^{-1}$ of green light ($\lambda = 5000A$), whole ear can detect $10^{-13} W m^2$. As a power detector, which is more sensitive and by what factor?

A. 5

B. 10

C. 10^6

D. 15

Answer: A

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4. The radiation force experienced by body exposed to radiation of intensity I, assuming surface of body to be perfectly absorbing is:

A. $\frac{\pi R^2 I}{c}$

B. $\frac{\pi R^2 I}{2c}$

C. $\frac{IRH}{2c}$

D. $\frac{IRH}{c}$

Answer: D

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5. Radiation pressure on any surface is :

A. is dependent on wavelength of the light used

B. is dependent on nature of surface and intensity of light used

C. is dependent on frequency and nature of surface

D. depends on the nature of source from which light is coming

Answer: B

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6. Which of the following figure represents the variation of particle momentum and the associated de - Broglie wavelength ?

A. 

B. 

C. 

D. 

Answer: D

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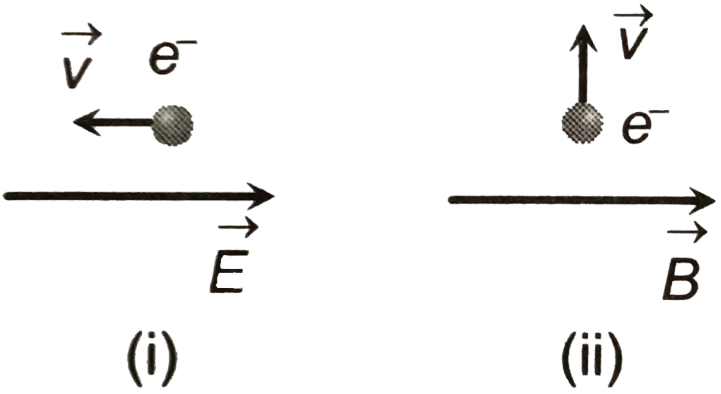
7. An electron is moving through a field. It is moving (i) opposite an electric field (ii) perpendicular to a magnetic field as shown. For each situation the de - Broglie wave length of electron



A. Increasing, increasing

B. increasing, decreasing

C. decreasing,same

D. same,same

Answer: C

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8. The energy that should be added to an electron to reduce its de - Broglie wavelength from one $nm \rightarrow 0.5nm$ is

A. four times the initial energy

B. equal to the initial energy

C. twice the initial energy

D. thrice the initial energy

Answer: D

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9. A particle of mass 3m at rest decays into two particles of masses m and 2m having non-zero

velocities. The ratio of the de Broglie wavelengths of the particles $\left(\frac{\lambda_1}{\lambda_2}\right)$ is

A. m_1 / m_2

B. m_2 / m_1

C. 1.0

D. $\sqrt{m_2} / \sqrt{m_1}$

Answer: C

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10. Find the ratio of de Broglie wavelength of molecules of hydrogen and helium which are at temperatures 27° and $127^\circ C$, respectively.

A. $\frac{1}{2}$

B. $\sqrt{\frac{3}{8}}$

C. $\sqrt{\frac{8}{3}}$

D. 1

Answer: C

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11. The potential energy of a partical varies as .

$U(x) = E_0$ for $0 \leq x \leq 1$

$= 0$ for $x > 1$

for $0 \leq x \leq 1$ de- Broglie wavelength is λ_1 and for $x > 1$ the de-Broglie wavelength is λ_2. Total energy of the partical is $2E_0$. find $\frac{\lambda_1}{\lambda_2}$.

A. 2

B. 1

C. $\sqrt{2}$

D. $\frac{1}{\sqrt{2}}$

Answer: C

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12. If the momentum of electron is changed by P_m then the de-Broglie wavelength associated with it changes by 0.50%. The initial momentum of electron will be:

A. $\frac{\Delta p}{200}$

B. $\frac{\Delta p}{199}$

C. $199\Delta p$

D. $400\Delta p$

Answer: C

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13. Two particles A_1 and A_2 of masses $m_1, m_2 (m_1 > m_2)$ have the same de-broglie wavelength. Then

A. their momenta ar the same

B. their energies are the same

C. energy of A_1 is less than the energy of A_2

D. energy of A_1 is more than the energy of A_2

Answer: A::C

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Multiple Correct

1. A particle moves in a closed orbit around the origin, due to a force which is directed towards the origin. The de-broglie wavelength of the particles varies cyclically between two values $\lambda_1, \lambda_2 with \lambda_1 > \lambda_2$. Which of the following statements are true?

A. the particle could be moving in a circular orbit with origin as centre

B. The particle could be moving in an elliptic orbit with origin as its focus

C. When the de-broglie wavelength is λ_1 the particle is nearer the origin than when its value is λ_2

D. When the de-broglie wavelength is λ_2, the particle is nearer the origini than when its value is λ_1.

Answer: B::D

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Dpp 3 2

1. Which one of the following is true in photoelectric emission

A. Photoelectric current is directly propotional to the amplitude of light of a given frequency

B. Photoelectric current is directly proportional to the intencsity of light of a given frequency at moderate intensities.

C. Above the threshold frequency, the maximum K.E. of photoelectrons is inversely proportional to the frequency of incident light

D. The threshold frequency depends upon wavelength of incident light.

Answer: A

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2. If intensity of incident light is increased in photo electric effect then which of the following is true ?

A. Maximum KE of ejected electron will increase

B. Work function will remain unchanged

C. Stopping potential will decrease

D. Maximum KE of ejected electron will decrease

Answer: B

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3. The cathode of a photoelectric cell is changed such that the work function changes from $(W_1 \to W_2(W_2 > W_1)$. If the current before and after change are I_1 and I_2, all other conditions remaining unchanged , then (assuming $hv > W_2$)

A. $I_1 = I_2$

B. $I_1 < I_2$

C. $I_1 > I_2$

D. $I_1 < I_2 < 2I_2$

Answer: A

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4. For a photoelectric cell the graph showing the variation of cut of voltage (V_0) with frequency (v) of incident light is best represented by

A. 

B. 

C. 

D. 

Answer: D

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5. The curves $(a), (b), (c)$ and (d) show the variation between the applied potential difference (V) and the photoelectric current (i), at two different intensities of light $(I_1 > I_2)$. In which figure is the correct variation shown ?

A. 

B. 

C. 

D. 

Answer: B

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6. A photo cell is receiving light from a source placed at a distance of $1m$. If the same source is

to be placed at a distance of $2m$, then the ejected electron

A. moves with one-fouth energy as that of the initial energy

B. moves with one-fourth of momemtum as that of the initial momentum

C. will be half in number

D. will be one-fourth in number

Answer: D

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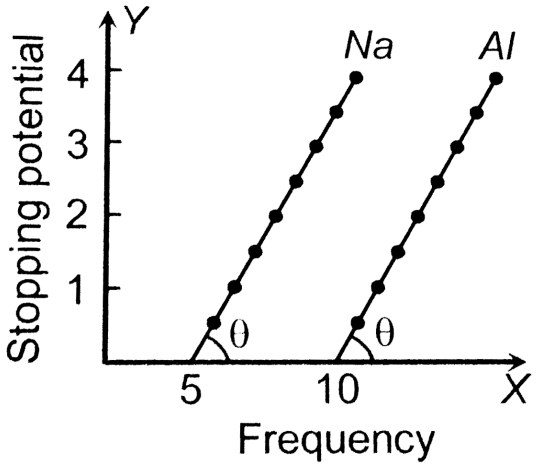
7. From the figure describing photoelectric effect we may infer correctly that



A. Na and Al both have the same threshold frequency

B. Maximum kinetic energy for both the metals depens lineraly o the frequency

C. The stopping potentials are different for Na and Al for the same change in frequency

D. Al is a better photosentive material than Na

Answer: B

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8. Five elements A, B, C, D and E have work functions $1.2eV, 2.4eV, 3.6eV, 4.8eV$ and $6eV$ respectively . If light of wavelength $4000Å$ is allowed to fall on these elements , then photoelectrons are emitted by

A. A,B and C

B. A,B,C,D and E

C. A and B

D. Only E

Answer: C

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9. Light of wavelength λ strikes a photo - sensitive surface and electrons are ejected with kinetic

energy E. Now if K.E is to be increased to $2E$, the wavelength must be changed to λ' where

A. $\lambda' = \frac{\lambda}{2}$

B. $\lambda' = 2\lambda$

C. $\frac{\lambda}{2} < \lambda' < lamba$

D. $\lambda' > \lambda$

Answer: C

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10. The work functions of metals A and B are in the ratio $1:2$. If light of frequencies f and $2f$ are incident on the surfaces of A and B respectively , the ratio of the maximum kinetic energy of photoelectrons emitted is (f is greater than threshold frequency of A, $2f$ is greater than threshold frequency of B)

A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: B

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11. When a metal surface is illuminated by light wavelengths $400nm$ and $250nm$, the maximum velocities of the photoelectrons ejected are v and $2v$ respectively . The work function of the metal is $(h = \text{Planck's constant}, c = \text{velocity of light in air})$

A. $2he \times 10^6$ J

B. $1.5hc \times 10^6 J$

C. $hc \times 10^6$ J

D. $0.5hc \times 10^6 \text{J}$

Answer: A

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12. A photosensitive metallic surface has work function hv_0. If photons of energy $2hv_0$ fall on this surface the electrons come out with a maximum velocity of $4 \times 10^6 m/s$. When the photon energy is increases to $5hv_0$ then maximum velocity of photo electron will be

A. 2×10^6 m/s

B. 2×10^7 m/s

C. 8×10^5 m/s

D. 8×10^6 m/s

Answer: D

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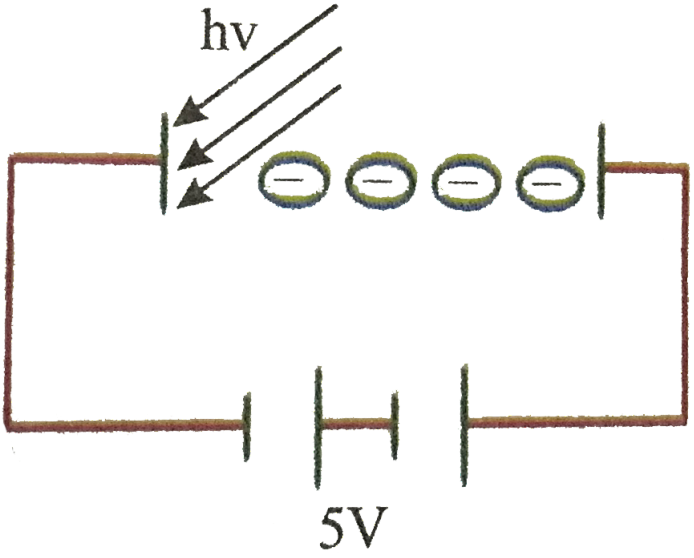
13. The collecter of the photocell (in photoelectric experiment) is made of tugsten while the emitter is Platinum having work function of $10eV$

.Monochromotic radiation of wavelength 124Å & power 100 watt is incident on emitter which emits photo electrons with a quantum efficiency of $1\ \%$ .The accelerating voltage acros the photocell is of $10,000$ volts (Use: $hc = 12400eV\text{Å}$)

What is the power supplied by the accelerating voltage source.



A. 100 watt

B. 10 watt

C. 0.1 watt

D. 1 watt

Answer: A

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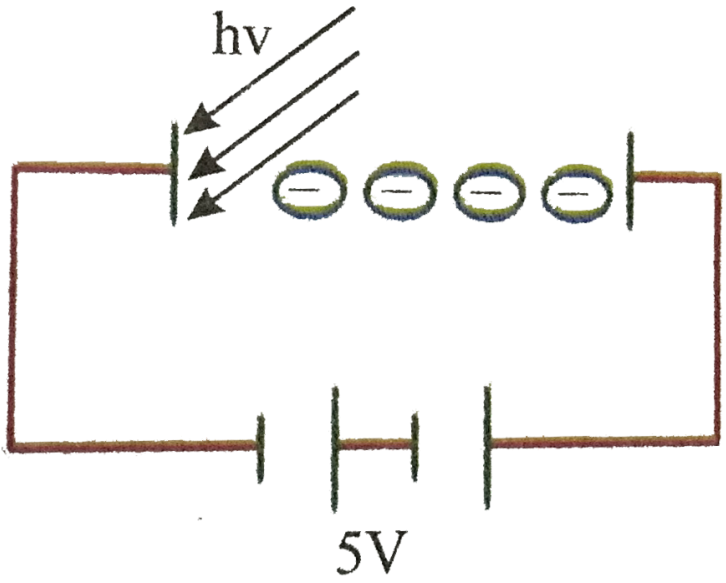
14. The collector of the photocell (in photoelectric experiment) is made of tungsten while the emitter is Platinum having work function of $10eV$

.Monochromatic radiation of wavelength 124Å & power 100 watt is incident on emitter which emits photo electrons with a quantum efficiency of $1\ \%$ .The accelerating voltage acros the photocell is of $10,\ 000$ volts (Use: $hc = 12400eV\text{Å}$)

The minimum wavelength of radiation coming from the tungsten target (collector) is



A. 124 Å

B. 1.24 Å

C. 1.23 Å

D. 12.3 Å

Answer: C

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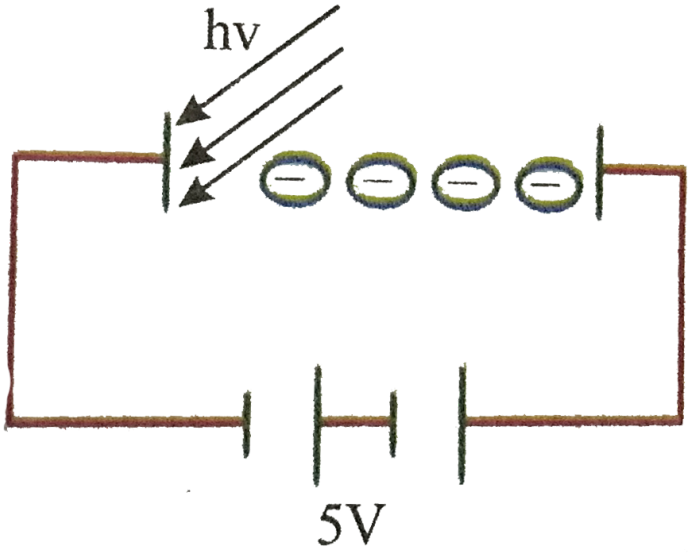
15. The collector of the photocell (in photoelectric experiment) is made of tungsten while the emitter is Platinum having work function of $10eV$

.Monochromatic radiation of wavelength 124Å & power 100 watt is incident on emitter which emits photo electrons with a quantum efficiency of $1\,\%$ .The accelerating voltage acros the photocell is of $10,000$ volts (Use: $hc = 12400eV\text{Å}$)

If the source of monochromatic radiation of wavelength 124Å has an efficiency of $50\,\%$, and the power of X ray emitted by the tungsten target is $3W$, the overall efficiency of the

apparatus for $X - ray$ production is



A. $1\ \%$

B. $0.1\ \%$

C. $1.5\ \%$

D. $0.67\ \%$

Answer: A

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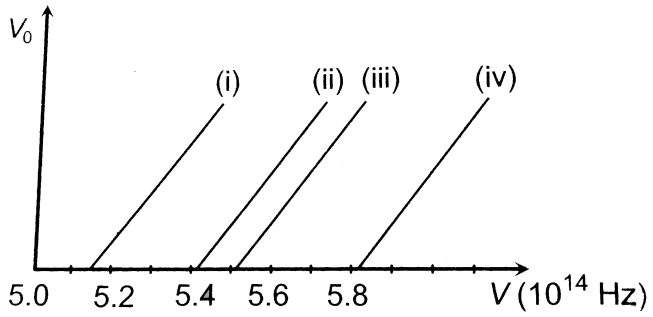
Dpp 3 3

1. The figure shows different graphs between stopping potential (V_0) and frequency (v) for photosensitive surface of cesium , potassium , sodium and lithium. The plots are parallel. Correct ranking of the targets according to their work

function greatest forst will be



A. $(i) > (ii) > (iii) > (iv)$

B. $(i) > (iii) > (ii) > (iv)$

C. $(iv) > (iii) > (ii) > (i)$

D. $(i) > (iii) > (ii) = (iv)$

Answer: C

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2. If maximum velocity with which an electron can be emitted is (mass of electron $= 9 \times 10^{-31}$ kg)

A. 30 volt

B. 45 volt

C. 59 volt

D. Information is insufficient

Answer: B

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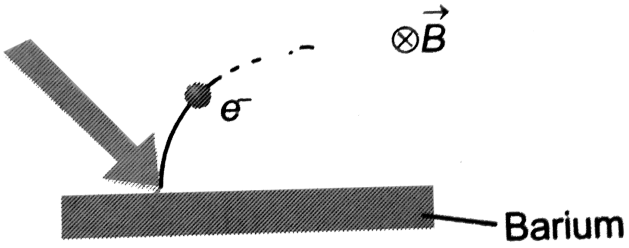
3. Light of wavelength 2475Å is incident on barium. Photoelectrons emitted describe a circle of radius $100cm$ by a magnetic field of flux density $\frac{1}{\sqrt{17}} \times 10^{-5} Tesla.$

Work function of the barium is (Given $\frac{e}{m} = 1.7 \times 10^{11}$)



A. 1.8eV

B. 2.1eV

C. 4.5eV

D. 3.3eV

Answer: C

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4. If light of wavelength λ_1 is allowed to fall on a metal , then kinetic energy of photoelectrons emitted is E_1. If wavelength of light changes to λ_2 then kinetic energy of electrons changes to E_2 . Then work function of the metal is

A. $\frac{E_1E_2(\lambda_1 - \lambda_2)}{\lambda_1\lambda_2}$

B. $\frac{E_1\lambda_1 - E_2\lambda_2}{\lambda_1 - \lambda_2}$

C. $\frac{E_1\lambda_1 - E_2\lambda_2}{\lambda_2 - \lambda_1}$

D. $\frac{\lambda_1\lambda_2E_1E_2}{\lambda_2 - \lambda_1}$

Answer: C

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5. In a photoemissive cell, with exciting wavelength λ, the faster electron has speed v. If

the exciting wavelength is changed to $3\lambda/4$, the speed of the fastest electron will be

A. $v(3/4)^{1/2}$

B. $v(4/3)^{1/2}$

C. Less than $v(4/3)6(1/2)$

D. Greater than $v(4/3)^{1/2}$

Answer: D

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6. In a photocell bichromatic light of wavelength 2475Å and 6000Å are incident on cathode whose work function is $4.8eV$. If a uniform magnetic field of $3 \times 10^{-5} Tesla$ exists parallel to the plate , the radius of the path describe by the photoelectron will be (mass of electron $= 9 \times 10^{-31} kg$)

A. 1 cm

B. 5 cm

C. 10 cm

D. 25 cm

Answer: B

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7. Two metallic plates A and B , each of area $5 \times 10m$ are placed parallel to each other at a separation of 1 cm . Plate B carries a positive charge of 33.7 pc . A monochromatic beam of light, with photons of energy 5 eV each, starts falling on plate A at t = 0, so that 10 photons fall on it per square meter per second. Assume that one photoelectron is emitted for every 10 incident photons. Also assume that all the

emitted photoelectrons are collected by plate B and the work function of plate A remains constant at the value 2 eV . Electric field between the plates at the end of 10 seconds is

A. 2×10^3 N/C

B. 10^3 N/C

C. 5×10^3 N/C

D. Zero

Answer: A

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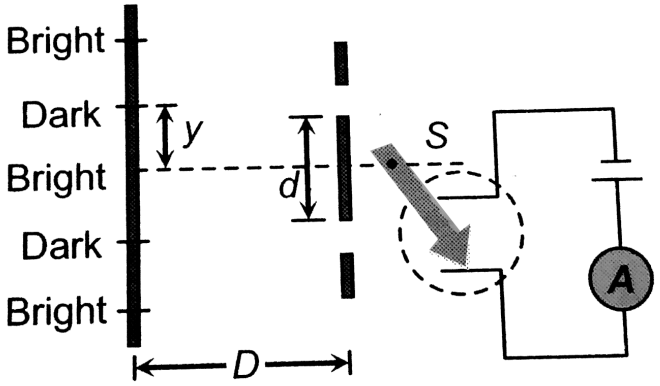
8. In the following arrangement $y = 1.0mm, d = 0.24mm$ and $D = 1.2m$. The work function of the material of the emitter is $2.2eV$. The stopping potential V needed to stop the photo current will be



A. 0.9V

B. 0.5V

C. 0.4V

D. 0.1V

Answer: A

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9. Photoelectric emission is observed from a metallic surface for frequencies v_1 and v_2 of the incident light rays $(v_1 > v_2)$. If the maximum values of kinetic energy of the photoelectrons emitted in the two cases are in the ratio of $1 : k$, then the threshold frequency of the metallic surface is

A. $\frac{v_1 - v_2}{k - 1}$

B. $\frac{kv_1 - v_2}{k - 1}$

C. $\frac{kv_2 - v_1}{k - 1}$

D. $\frac{v_2 - v_1}{k}$

Answer: B

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10. Light from a hydrogen tube is incident on the cathode of a photoelectric cell the work function of the cathode surface is $4.2eV$. In order to

reduce the photo - current to zero the voltage of the anode relative to the cathode must be made

A. $-4.2\,\mathrm{V}$

B. $-9.4\,\mathrm{V}$

C. $-17.8\,\mathrm{V}$

D. $+9.4\,\mathrm{V}$

Answer: B

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11. Work function of lithium and copper are respectively $2.3eV$ and $4.0eV$. Which one of the metal will be useful for the photoelectric cell working with visible light ?

$\left(h = 6.6 \times 10^{-34} J - s, c = 3 \times 10^{8} m/s\right)$

A. lithium

B. Copper

C. Both

D. None of these

Answer: A

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12. The work function of a certain metal is $\frac{hC}{\lambda_0}$. When a monochromatic light of wavelength $\lambda < \lambda_0$ is incident such that the plate gains a total power P. If the efficiency of photoelectric emission is $\eta\%$ and all the emitted photoelectrons are captured by a hollow conducting sphere of radius R already charged to potential V, then neglecting any interaction of potential of the sphere at time t is:

A. $V + \frac{100\eta\lambda Pet}{4\pi\varepsilon RhC}$

B. $V - \frac{\eta\lambda Pet}{400\pi\varepsilon RhC}$

C. V

D. $\frac{\lambda Pet}{4\pi\varepsilon RhC}$

Answer: B

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13. A physicist wishes to eject electrons by shining light on a metal surface. The light source emits light of wavelength of 450 nm. The table lists the only available metals and their work functions.

Metal	$W_0(eV)$
Barium	2.5
Lithium	2.3
tantalum	4.2
Tungsten	4.5

Which metal(s) can be used to produce electrons by the photoelectric effect from given source of light?

A. Barium only

B. Barium or lithium

C. Lithium, tantanlum ot tungsten

D. Tungsten or tantalum

Answer: B

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Metal	$W_0(eV)$
Barium	2.5
Lithium	2.3
tantalum	4.2
Tungsten	4.5

Which option correctly identifies the metal that will produce the most energetic electrons and their energies?

A. Lithium, 0.45 eV

B. Tungsten 1.75 eV

C. Lithium, 2.30eV

D. Tungsten, 2.75 eV

Answer: A

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Metal	$W_0(eV)$
Barium	2.5
Lithium	2.3
tantalum	4.2
Tungsten	4.5

Suppose photoelectric experiment is done separately with these metals with light of wavelenght 450 nm. The maximum magnitude of stopping potential amongst all the metals. is-

A. 2.75 volt

B. 4.5 volt

C. 0.45 volt

D. 0.25 volt

Answer: C

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