Unit 2

Modern physics

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Revision

Chapter 5

Wave Particle Duality

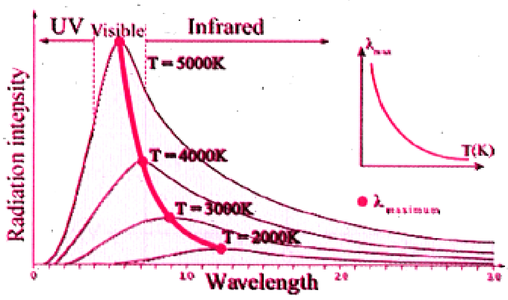
Chapter 6

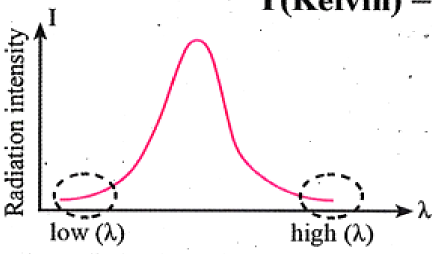
Atomic Spectra

100 Questions

Class sheet

Planck's Distribution & Wien's Law





Radiation intensity tends to zero

T(Kelvin) = t (Celisus) + 273

$\lambda_{max} \propto \frac{1}{T}$

$\frac{\lambda_{max\,(1)}}{\lambda_{max\,(2)}} = \frac{T_2}{T_1}$

Electromagnetic Waves

$c = \lambda\upsilon \quad E = h\upsilon$

Kinetic energy of electron

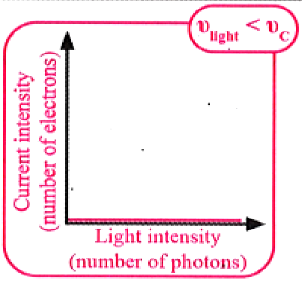
$K.E._{electron} = \frac{1}{2} m_e v^2 = eV$

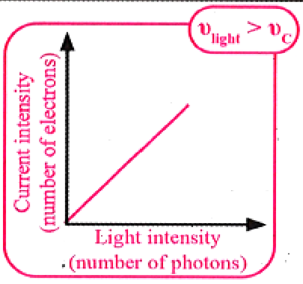
K.E. (eV) $\xrightarrow{\times (1.6 \times 10^{-19})}$ K.E. (J)

K.E. (J) $\xrightarrow{\div (1.6 \times 10^{-19})}$ K.E. (eV)

$v = \sqrt{\frac{2\,eV}{m_e}} \qquad v = \sqrt{\frac{2\,K.E.}{m_e}}$

Photoelectric Effect



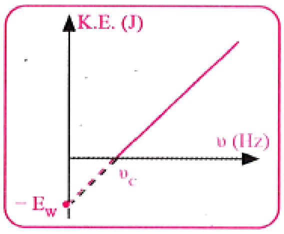


Effect of energy (frequency) and intensity of incident light on photoelectrons:

In case of $E_{photon} > E_W$ ($\upsilon_{light} > \upsilon_C$):

- Increasing (**frequency** of incident light / **energy** of photons) ⟶ Increase (**velocity** of photoelectrons / **K.E.** of photoelectrons)
- Increasing (**intensity** of incident light / **OR** Number of photons / **OR** Rate of photons) ⟶ Increase (**intensity** of photoelectrons / **OR** Number of electrons / **OR** Rate of electrons)

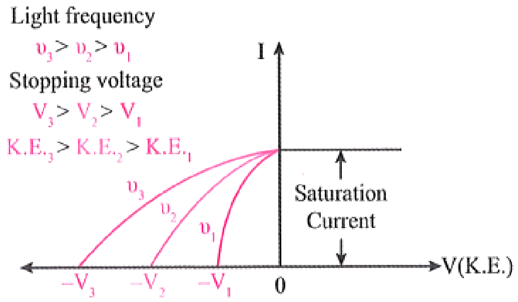
Relation between kinetic energy of emitted electrons from a metal surface and frequency of the incident light.

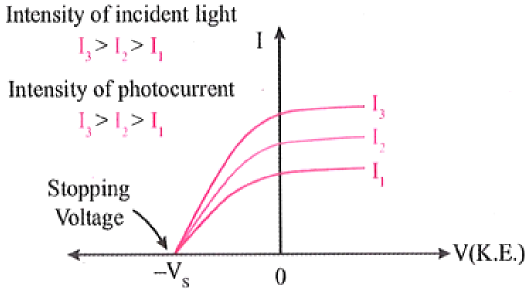


$K.E. = E_{ph} - E_W \qquad K.E. = h\upsilon - h\upsilon_c = h(\upsilon - \upsilon_c)$

$Slope = \frac{\Delta Y}{\Delta X} = \frac{K.E.}{\Delta\upsilon} = \frac{K.E.}{(\upsilon - \upsilon_c)} = h$ (h) Planck's constant

Relation between photocurrent (I) and potential difference (V)





Intensity of light (I:constant) → Intensity of current (I:constant)

Light frequency (υ:variable) → Stopping voltage (v(K.E.):variable)

Intensity of light (I:variable) → Intensity of current (I:variable)

Light frequency (υ:constant) → Stopping voltage (v(K.E.):constant)

Photoelectric Effect

Kinetic energy of electron = Energy of photon − Work function of metal

$K.E._e = \frac{1}{2} m_e v^2 = eV$ $\quad$ $E_{photon} = h\upsilon_{light} = h\frac{c}{\lambda_{light}}$ $\quad$ $E_W = h\upsilon_C = h\frac{c}{\lambda_C}$

Photon and Electron Properties

	Photon	Electron
Energy	$E = h\upsilon = \frac{hc}{\lambda} = mc^2$	$K.E._{electron} = \frac{1}{2} m_e v^2 = eV$
Momentum	$P_L = mc = \frac{E}{c} = \frac{h\upsilon}{c} = \frac{h}{\lambda}$	$P_L = m_e v = \frac{h}{\lambda}$
Wavelength	$\lambda = \frac{h}{P_L} = \frac{h}{mc}$	$\lambda = \frac{h}{P_L} = \frac{h}{m_e v}$
Mass	$m = \frac{E}{c^2} = \frac{h\upsilon}{c^2} = \frac{h}{c\lambda}$	Constant $m_e = 9.1 \times 10^{-31}$ Kg
Force, Power	$F = \frac{2P_W}{c}$ $\quad \phi_L = \frac{N}{\Delta t}$ $\quad P_W = \phi_L E$	———

Compton Effect

$$(P_{L\,electron} + P_{L\,photon})_{before} = (P_{L\,electron} + P_{L\,photon})_{after}$$

$$(K.E._{electron} + E_{photon})_{before} = (K.E._{electron} + E_{photon})_{after}$$

Compton Effect on Photon and Electron

After collision	Photon	Electron
Energy	Decrease	Increase
Frequency	Decrease ($E = h\upsilon$)	———
Mass	Decrease ($E = mc^2$)	Constant (m_e)
Velocity	Constant (c)	Increase ($K.E. = \frac{1}{2}m_e v^2$)
Momentum	Decrease ($P_L = mc$)	Increase ($P_L = m_e v$)

De-Broglie equation

$$\lambda = \frac{h}{P_L} \quad \lambda = \frac{h}{mv} \quad \lambda = \frac{h}{\sqrt{2meV}} \quad \lambda = \frac{h}{\sqrt{2m\,K.E.}}$$

Optical and Electron Microscope

Optical Microscope	Electron Microscope
Wavelength of light wave is less than object dimensions to be magnified. (λ_{light} < dimensions of object)	Wavelength of electron is less than object dimensions to be magnified(virus). ($\lambda_{electron}$ < dimensions of object)
Object is lighted by normal light.	Object is lighted by electron beam.
Final image seen by eye.	Final image formed on fluorescent screen.
The light beam is deviated by glass lenses.	Electron beam is deviated by electronic lenses. (prefered magnetic)

Electron and Photon

Points of comparison	Electron	Photon
Nature	Charged particle which has a wave nature	Electromagnetic wave which has a particle nature
Charge	Negative charge	No charge
Mass	Has mass during motion and rest ($m_e = 9.1\times10^{-31}$Kg) (constant)	Has mass just during motion at rest (mass = zero). ($m = E/c^2$)
Effect of Electric OR Magnetic field	Affected	Not affected
Acceleration	Can be accelerated	Can not be accelerated

Microscopic Model and Macroscopic Model

Particle model of light (Microscopic) Modern physics (Quantum theory)	Wave model of light (Macroscopic) Classical physics (Wave theory)
Theory applied on small objects. (like atom or electron or photon)	Theory applied on large object. (larger than the wavelenght of light)

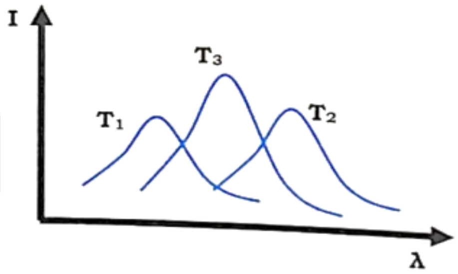
1) The graph relation between intensity of radiation (I) and wave length (λ) of three hot bodies at temperature T_1, T_2 and T_3 are shown. Then

(A) $T_3>T_2>T_1$

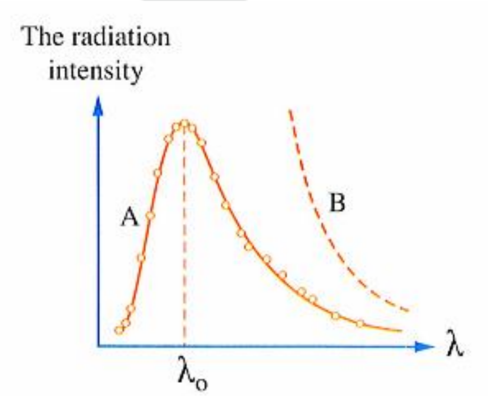
(B) $T_2>T_3>T_1$

(C) $T_1>T_3>T_2$

(D) $T_3>T_1>T_2$



2) In the opposite figure, the two curves A and B represent how the scientists visualized the change in the intensity of the radiation emitted from a hot body (sun) with the wavelengths constituting this radiation, which of the following statements agrees with what the curves represent?



	The curve (A)	The curve (B)	Both curves indicate
A	The energy emitted by the body is continuous	The energy emitted by the body is quantized	Solar radiation consist of range (spectrum) of wave length of different intensities
B	The energy emitted by the body is quantized	The energy emitted by the body is continuous	Solar radiation consist of range (spectrum) of wave length of different intensities
C	The intensity of the radiation increases by increasing the wavelength more than λo	The intensity of radiation decreases by increasing the wavelength	Solar radiation consist of range (spectrum) of wave length of same frequencies
D	The radiation intensity decreases by increasing the wavelength more than λo	The radiation intensity increases by increasing the wavelength	Solar radiation consist of range (spectrum) of wave length of same wavelength

3) An electron moves with velocity (v) under effect of p.d (V). if the P.D applied increase to 2V the electron velocity (v) increase to

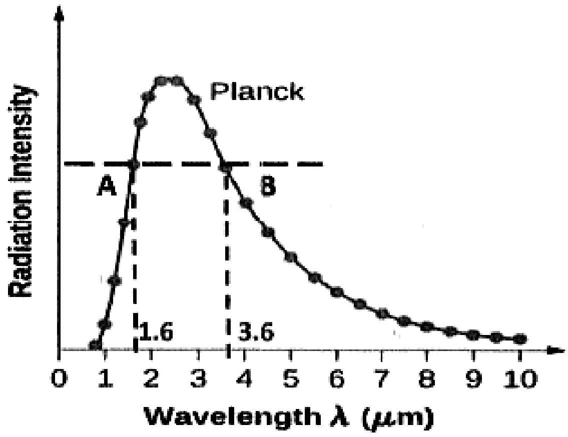
(A)2 v

(B) 4 v

(C) $\sqrt{2}v$

(D) $\frac{1}{2}$ v

4) In the opposite Plank's distribution; the points A & B are nearly equals in radiation intensities so……….



	The ratio between the number of their photons per sec ϕ_L	
A	4/9	Less than one
B	4/9	Greeter than one
C	4/9	Equal to
D	9/4	Less than one

5) To increase the light intensity of the final image on the fluorescent screen in the cathode ray tube:

(A) Increase the positivity of the anode

(B) Increase the negativity of the grid

(C) Decrease the positivity of the anode

(D) Decrease the negativity of the grid.

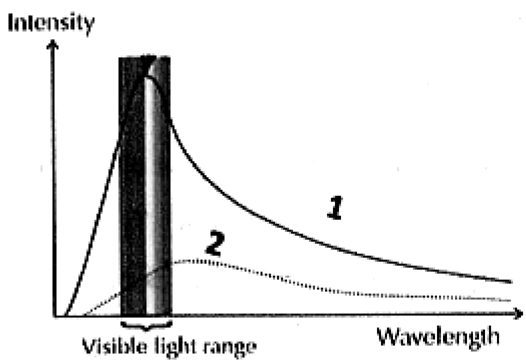
6) In the opposite Plank's curve, Body 1 is……..than body 2.

(A) Little hotter

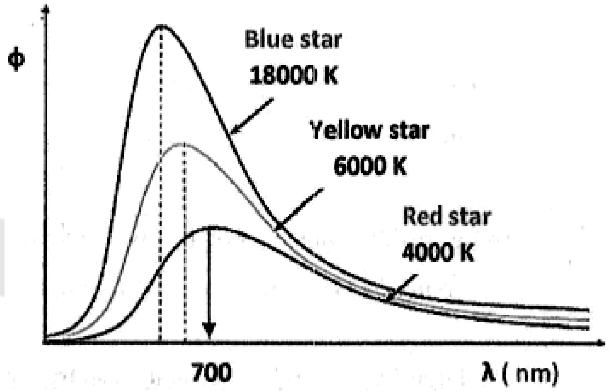
(B) Little Cooler

(C) Largely hotter

(D) Largely cooler



7) The diagram shows the distribution of the radiation intensities with wavelengths of different stars; wavelength λ_m of the blue star is……….



(A) 155.5nm

(B) 450.8nm

(C) 600nm

(D) 850nm

8) If the λ_m of the sun is 0.5μm and its surface temperature is 5727C°, so the wavelength emitted by a black metal container of boiling water is…………

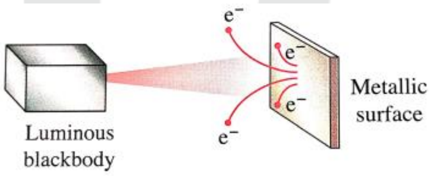
(A) 8 μm

(B) 4 μm

(C) 0.8 μm

(D) 80 μm

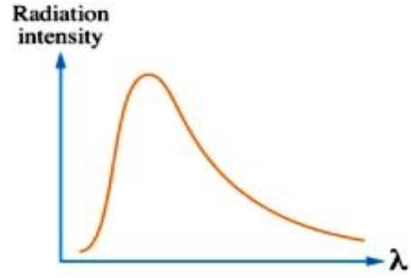
9) In the opposite figure, a luminous blackbody was placed in front of a metal surface, the radiation resulted from the blackbody caused electrons to be emitted from the surface of the metal, if the temperature of the blackbody was raised, the rate at which electrons were emitted from the surface.



	The rate at which electrons	The maximum K.E of electrons
A	Increases	Decreases
B	Increases	Increases
C	Decreases	Decreases
D	Doesn't change	Doesn't change

10) The opposite graph represents Planck's distribution curve for the blackbody radiation, so if the temperature of the body increases, the peak of the curve displaces to

and the area under the curve …………..



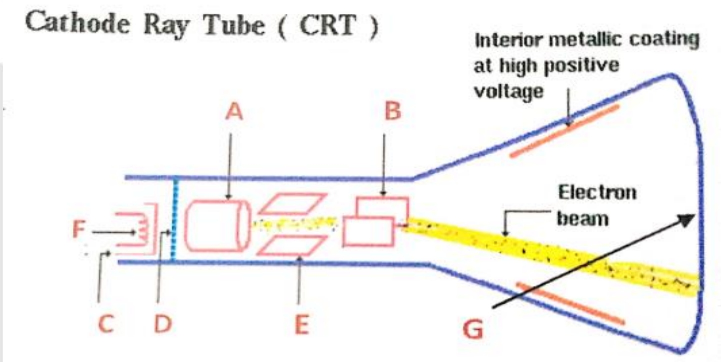
(A) the lower frequencies region, increases.

(B) the higher frequencies region, decreases.

(C) the lower frequencies region, decreases.

(D) the higher frequencies region, increases.

11) i) The pair of plates, B is used to deflect accelerated electrons on -----



(A) Horizontal directions

(B) Vertical direction

(C) Diagonal direction

(D) All

ii) The pair of plates, E is used to deflect accelerated electrons on -----

(A) Horizontal directions (B) Vertical direction

(C) Diagonal direction (D) All

iii)The plates, B and , E may use …………… field

(A)Electric (B)Magnetic (C)Both (D)Not both

iv) The anode A is used to ……. The electron beam

(A) Accelerate (B)Slow down (C)Both (D)Not both

vi)Emission of electrons in cathode ray tube depends on……..

A) Photo electric effect B) Thermionic effect C) Both together D) Not both

vii) What is meant by; "raster"

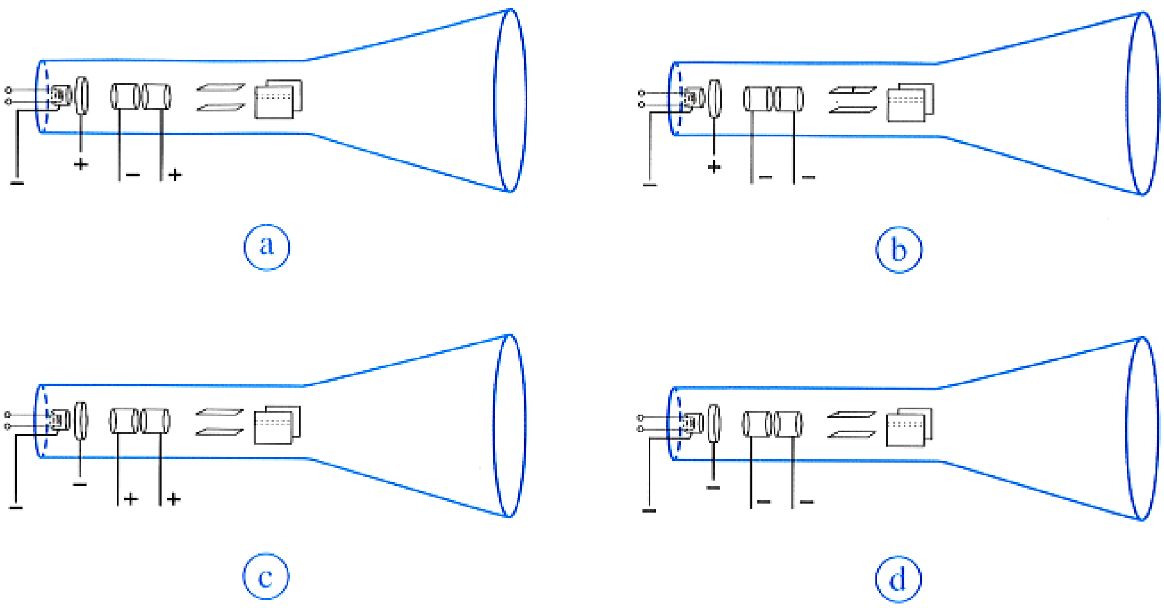
A. Forming the picture frame point by point

B. Forming the picture frame line by line

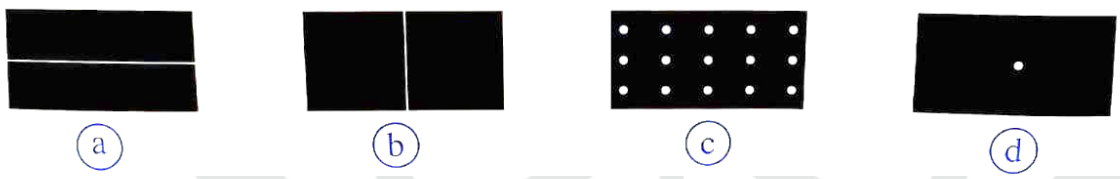
C. Forming the whole picture once a time

D. darken the whole picture frame

12) Which of the following choices represents correct electric potential set forming as image on the fluorescent screen of CRT



13) Which of the following choices represents what appears on the screen of the cathode ray tube when the two perpendicular electric fields do not exist in the electron beam guidance system?



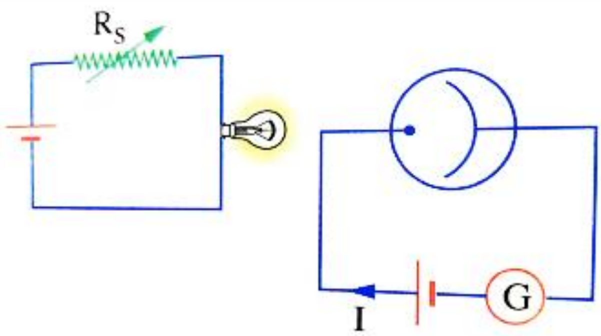
14) In the opposite figure, a light is emitted from an electric bulb and falls on a photoelectric cell causing the flow of a photocurrent, if the brightness of the bulb increases, the photocurrent intensity

(A) Increases

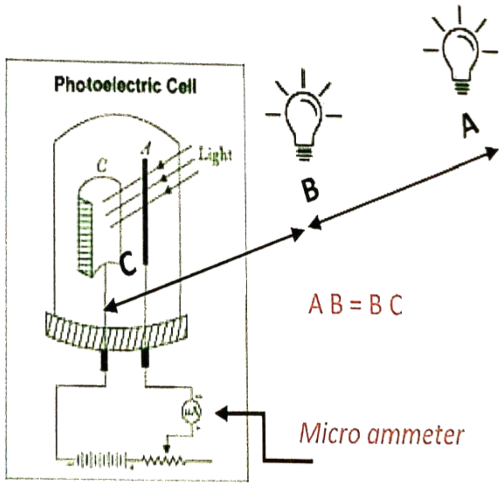
(B) Decreases

(C) Vanishes

(D) Doesn't change



15) A photo electric cell is facing to a light bulb at two positions A&B such that AB=BC, as shown, in the fig, So the ratio between reading of microammeter at bulb of position B to bulb of position A will be



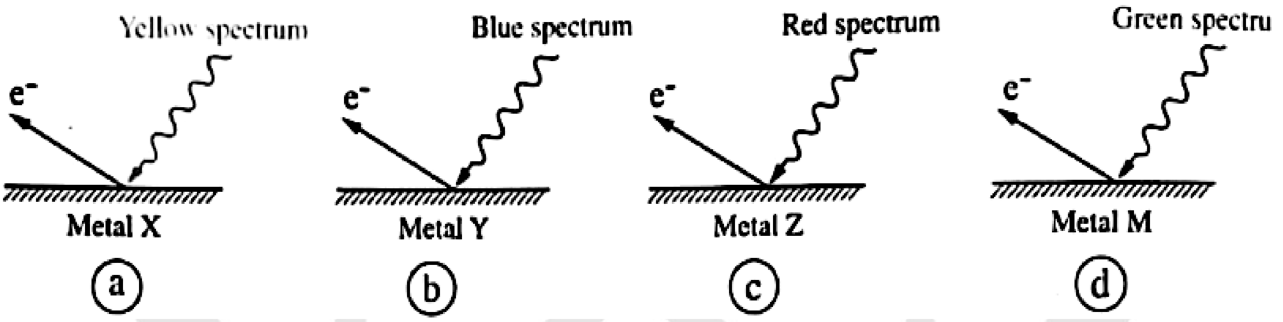
(A) 2

(B) 4

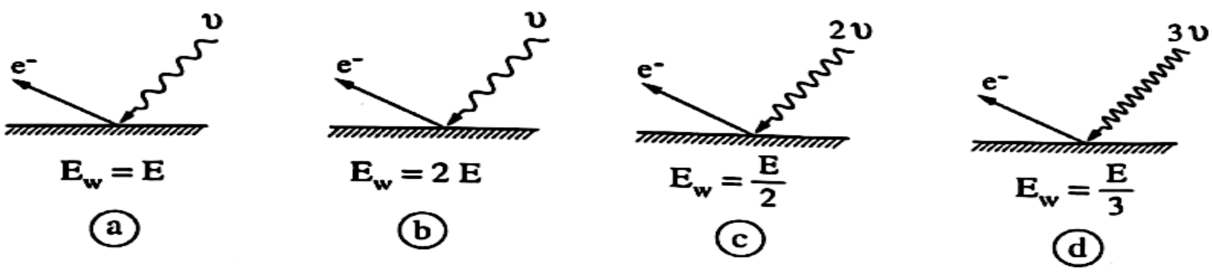
(C) $\frac{1}{4}$

(D) $\frac{1}{2}$

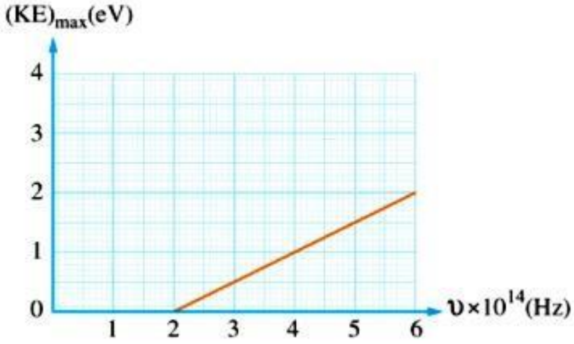
16) In the following figures, electrons are emitted from the surface of each metal with the same maximum kinetic energy, which of these metal surfaces has the greatest work function?



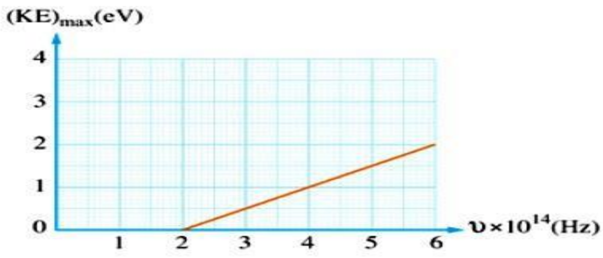
17) The following diagrams represent four cases of photoelectric emission, so in which of these cases the maximum speed of the emitted electrons



18) The opposite graph represents the relation between the maximum kinetic energy (KE)max for the emitted electrons from a metallic surface and the frequency of the incident light (υ) on that surface, so the graph which represents the same relation when the incident light intensity gets

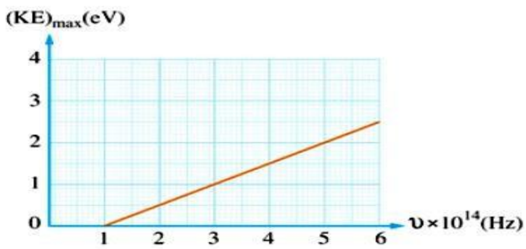


doubled is ……………….

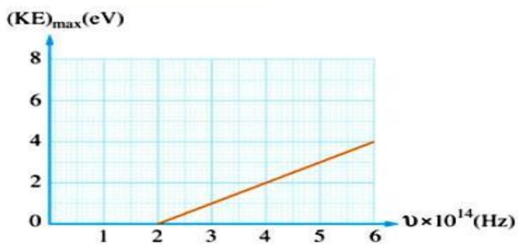


A

B

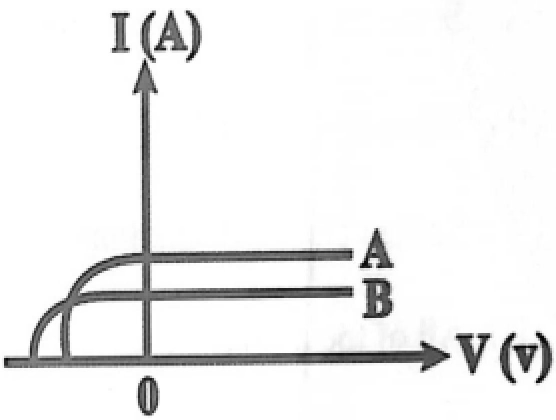


C



19) In the Following graph represent the relation between the electric current intensity and the potential difference between the cathode and anode of the photoelectric cell . When two radiation (A) and (B) is fall on the cell , which is the correct from the following?

	Intensity	Frequency
A	A> B	υA< υB
B	A< B	υA> υB
C	A< B	υA< υB
D	A> B	υA> υB



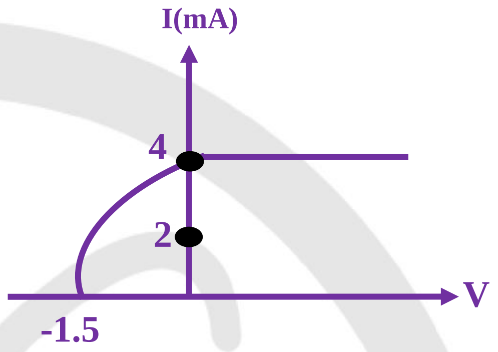
20) In the Following graph represent the relation between the electric current intensity and the potential difference between the cathode and anode of the photoelectric cell When light of wavelength 460nm is fall on the cell , So the work function of the metal surface equals ..

(A) 2.4×10^{-19}J

(B) 4.32×10^{-19}J

(C) 1.92×10^{-19}J

(D) 19.2×10^{-19}J



21) A monochromatic light beam of frequency υ and intensity I has fallen on the cathode of a photoelectric cell, if the electrons are emitted with a rate and a maximum kinetic energy that equals half the work function of the surface of the metal of the cathode, so to increase the emission rate of the electrons, we use a monochromatic light of

	Frequency	Intensity
A	υ	$\frac{I}{2}$
B	υ	2I
C	$\frac{\upsilon}{2}$	2I
D	$\frac{\upsilon}{2}$	$\frac{I}{2}$

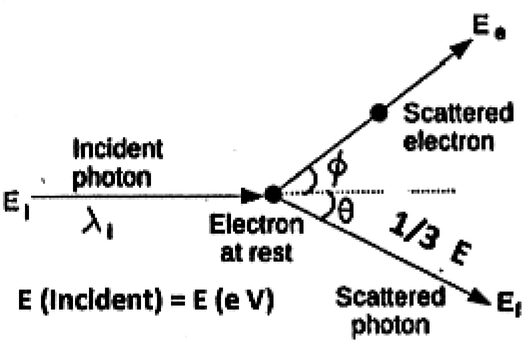
22) X-ray photon collides a graphite plate with incident energy of E(eV). As a result, a scattered photon of an energy E/3 so the scattered electron has a momentum P_L =…….

(A) 0.5 E.m

(B) 2/3 E.m

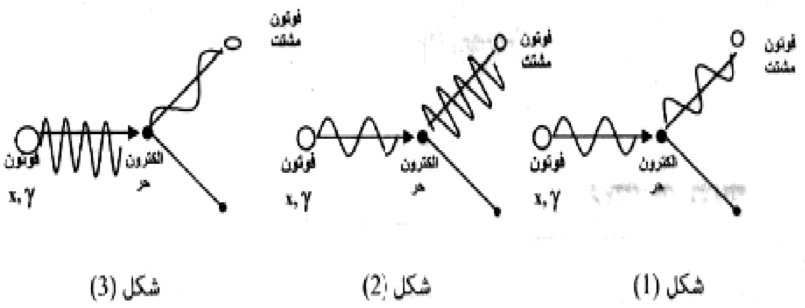
(C) $0.5\sqrt{E.m}$

(D) $2\sqrt{\frac{E.m}{3}}$



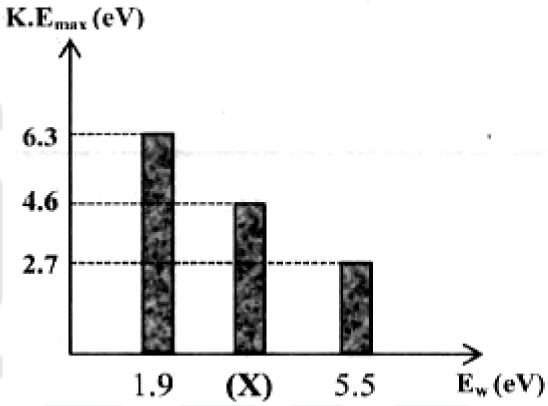
23) Which figure represents of falling photon on free electron……….

(A) Figure 1
(B) Figure 2
(C) Figure 3
(D) All is correct



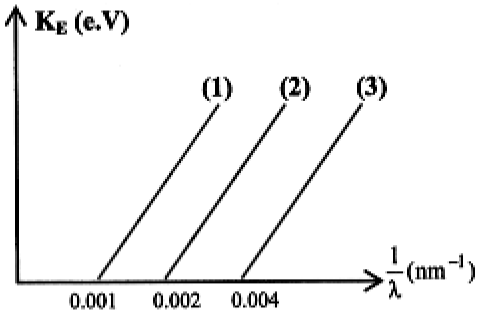
24) A beam of unknown frequency was directed at several metal surfaces, and the relationship between the work function of these surfaces and the maximum kinetic energy of the emitted electrons was recorded, as in the corresponding diagram. The magnitude of the work function of element (X) in units of eV is…….

(A) 3.3
(B) **3.6**
(C) 4
(D) 4.7



25) From the corresponding figure, the relation between the work function of each matel E_{W1} : E_{W2} : E_{W3} is…….

(A) 1 : 2 : 4
(B) 4 : 2 : 1
(C) 1 : 1 : 1
(D) No correct answer



26) When a light of frequency 6×10^{14}Hz has fallen on a metal surface, electrons are emitted from the surface by a maximum kinetic energy of 2eV. So the work function of the metal surface equals ..

(A) 9.12×10^{-20}J
(C) 2.15×10^{-19}J
(B) $6.34\times10_{-19}$J
(D) 7.75×10^{-20}J

27) If we want to see a clear image of the details of a virus that attacks the human body on the screen of the electron microscope, we should …………………

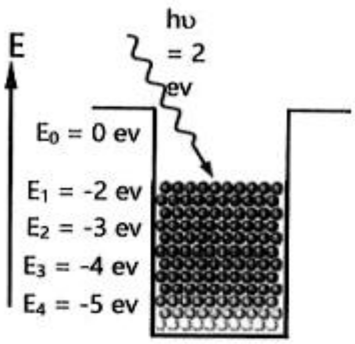
(A) increase the wavelength of the wave accompanied the moving electron.

(B) decrease the potential difference between the anode and cathode.

(C) decrease the kinetic energy of the electron.

(D) none of the above.

28) If the binding energy of electrons in a metal surface is represented by the energy diagram shown in figure so, the work function for this metal is equal to………eV



	work function for this metal is equal to………eV	**If a photon of energy 2 eV falls, an electron is released from the plane**	**An electron in E_2 energy level neads more photon energy than an electron in energy …level**
A	2eV	E_1 with kinetic energy 0	E_1 ,, E_3, E_4
B	3eV	E_1 with kinetic energy 2eV	E_1
C	2eV	E_3 with kinetic energy 2eV	E_3, E_4
D	2eV	E_2 with kinetic energy 0	E_1 , E_4

29) In Compton's phenomenon complete the table

P.O.C	Photon	Eletron
Energy	……….	…………
Frequency	………….	-
Velocity	………….	…………..
Mass	………….	…………..
Momentum	………….	…………..
Wavelength		Wavelength associating motion decrease

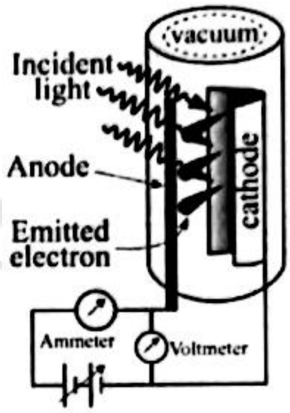
30) In Compton's phenomenon, the ratio between the kinetic energy of the electron before collision and it's kinetic energy after collision is ……

(A) greater than one (B) equal to one

(C) less than one (D) we cannot determine the answer

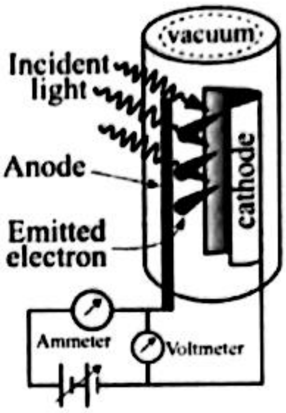
31) A certain light falling on the photoelectric cell as shown, knowing that (υ) is the frequency of the incident light and (υ_c) is the critical frequency. What will happen to the reading of ammeter when:

	Decreasing the brightness of the light while $\upsilon > \upsilon c$	Increasing the brightness of the light while $\upsilon > \upsilon c$
A	Decreases	Increases
B	Decreases	Zero
C	Remains the same	Increases
D	Remains the same	Zero



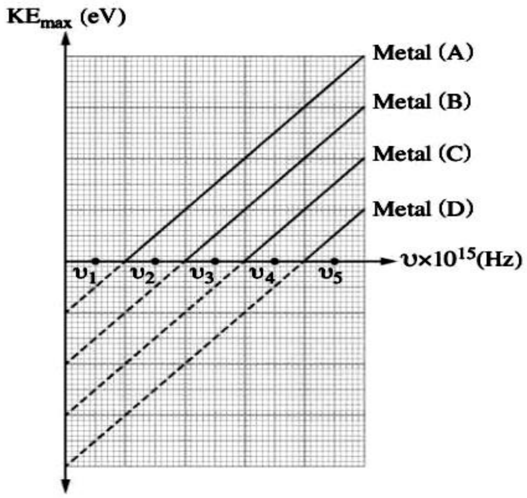
32) A certain light falling on the photoelectric cell as shown, knowing that (v) is the frequency of the incident light and (ve) is the critical frequency. What will happen to the reading of ammeter when:

	Replacing the light by another has the same intensity while $\upsilon = \upsilon c$	**Replacing the thin anode with a wide plate anode while $\upsilon > \upsilon c$**
A	Increases	Increases
B	Zero	Increases
C	Increases	Decreases
D	Zero	Decreases



33) The graph represents the relation between maximum kinetic energy for the emitted electrons from the surfaces of 4 different metals {A, B, C and D} and the frequency of the light falling on them. Which frequency causes electrons to get emitted from metals (A and B) but does not cause electrons emission from metals (C, D)?

(A) υ_3
(B) υ_5
(C) υ_2
(D) υ_4



34) The wavelength of an electron that has been accelerated through a potential difference of 100V is ………

(A) 3A°

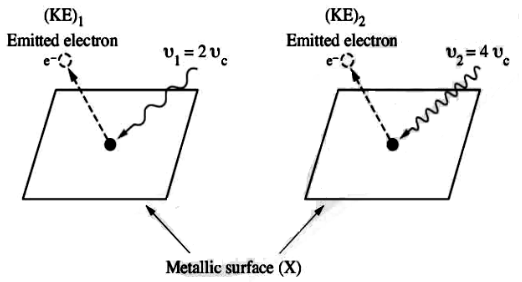
(B) 2.1A°

(C) 1.2A°

(D) 12.4 A°

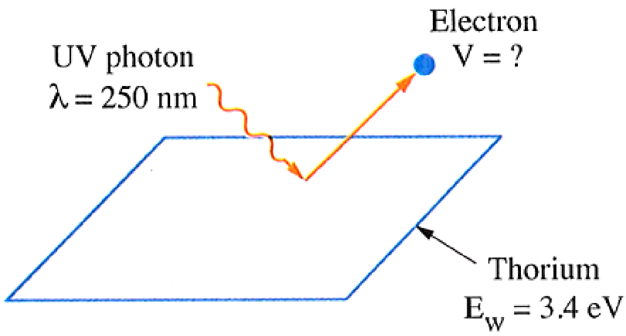
35) The figure shows a metallic surface (X), the critical frequency of its metal is (υ_c). Once a photon of frequency ($\upsilon_1 = 2\upsilon_c$) falls on the surface, a photoelectron is emitted with maximum kinetic energy (KE_1). When the previous photon is replaced by another one of frequency ($\upsilon_2 = 4\upsilon_c$). A photoelectron is emitted with maximum kinetic energy (KE_2). Then, the ratio of KE_1/KE_2 equals…….

(A) 1/2
(B) 1/3
(C) 1/4
(D) 1/8



36) If you know that mass of electron is 9.1×10^{-31} kg, electron charge 1.6×10^{-19}C, Planck's constant 6.625×10^{-34} j.s and the speed of light 3×10^{8} m/s. using the data on the diagram, the maximum velocity of the emitted electron is as a result of the fall of the UV photon on the surface of the metal thorium is………..

(A) 7.43×10^{4} m/s
(B) 7.43×10^{6} m/s
(C) 7.43×10^{5} m/s
(D) 7.43×10^{3} m/s



37) The power of a laser source is 300mW at a wavelength 6630Å, so the number of photons emitted from this source is each minute is.........photon.

(A) 6×10^{16}
(B) 6×10^{17}
(C) 6×10^{18}
(D) 6×10^{19}

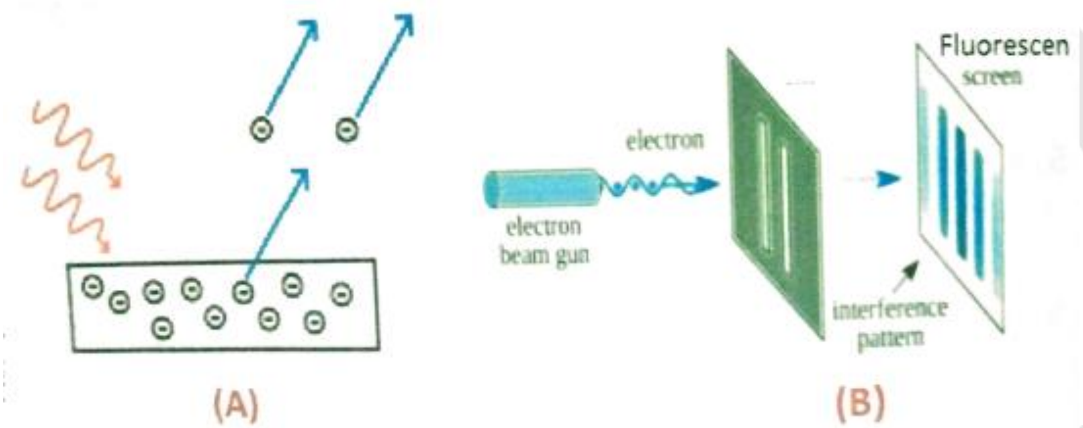
38) An electron microscope is used to observe a particle twice, in the first time a potential difference of 16kV is used and in the second time a potential difference of 25kV is used, so the ratio of the wavelengths associated with the motion of the electrons in the first time to that in the second time (λ_1/λ_2) equals ……………….

(A) 49/25 (B) 9/4 (C) 16/9 (D) 5/4

39) An electron of mass (me) moves with a speed (v) where the wavelength of the wave associated with its motion is (λ). If the electron speed is increased to three times as its initial value, then the wavelength of the wave associated with its motion becomes ……

(A) λ/9 (B) 3λ (C) λ/3 (D) 9λ

40) Figures (A) and (B) show two physical phenomena;



i) Name each of the opposite phenomena.

(A) Fig(A)photoelectric effect ⟶ & Particle nature of the wave &Fig(B) wave nature of the partial Thomas Yong ⟶ double slit experiment.

ii)Fig. (A) supports;

(A) Wave nature of the particle

B. Particle nature of the wave

C. Not both

iii) Fig. (B) Supports the hypothesis of;

A. Wave nature of the particle

B. Particle nature of the wave

C. Not both

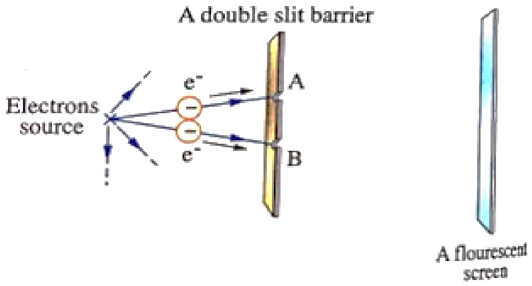
iv) Both figures (A) and, (B) prove;

A. Wave Particle duality

B. Surface potential barrier

C. Not both

41) When an electron beam is directed towards a double slit as in the figure, ...Will double slit appear on the fluorescent screen.



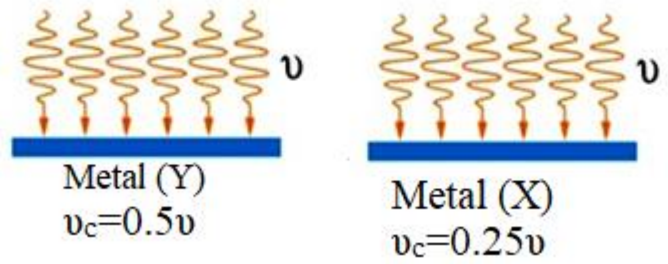
(A) One bright spot at the middle

(B) Two bright spots separated by a dark distance

(C) multiple bright and dark spots

(D) central dark spot surrounded with a bright circle

42) In the opposite figure light beam of frequency υ that have fallen on if two reflecting surfaces (X) and (Y) with the same intensity so the ratio between number of electrons are emitted from metal X to number of electrons are emitted from metal Y is....



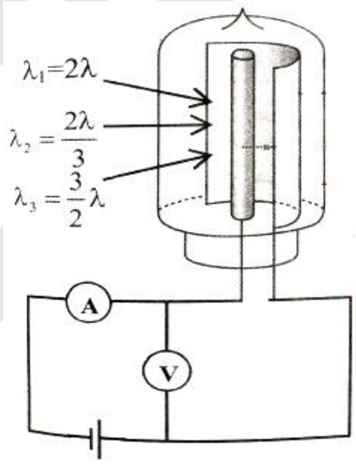
(A) 1/2

(B) 2/1

(C) 1/4

(D)1/1

43) In the opposite figure, a photovoltaic cell, if the critical wavelength of the cell cathode is $\lambda_c=\lambda$ which of the three rays when falling causes the pointer of ammeter deflect



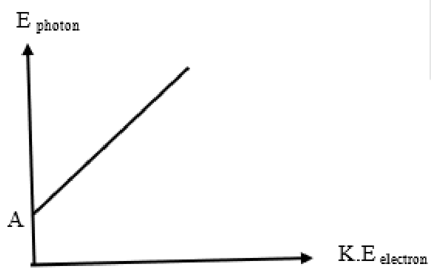
(A) λ_1

(B) λ_2

(C) λ_3

(D) All

44) In the opposite figure point A is.....



(A) Electric current intensity of (I)

(B) Critical frequency υ_c

(C) critical wavelength λ_c

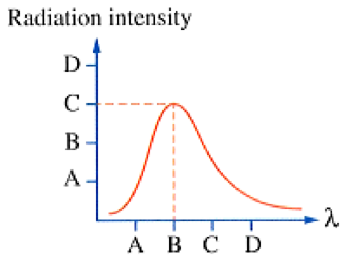
(D) Work function E_w

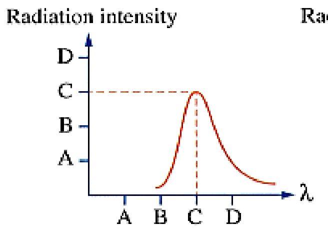
45) A photon in a Compton collision deals with all of the following except

(A) Microscopic model
(B) Macroscopic model
(C) Modern physics perceptions of light
(D) Einstein's interpretations on the properties of the photon

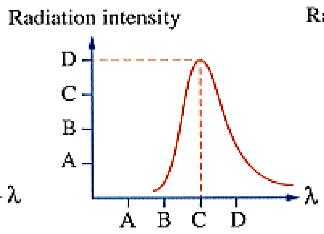
46) **Final Exams (2nd Session-23)**

The figure illustrates Planck's distribution curve for a hot body. If the body is left cool down, the curve changes to figure …..

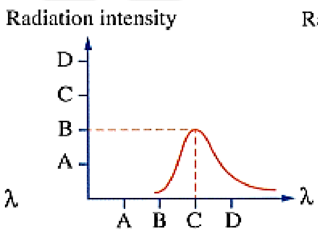




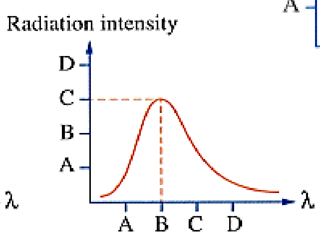
(a)



(b)



(c)



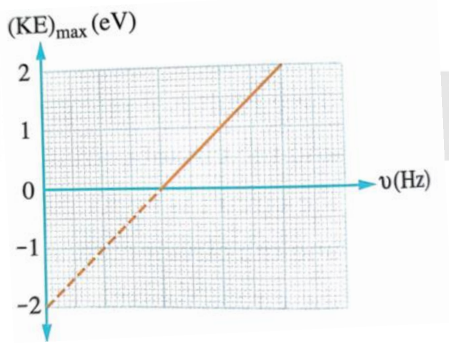
(d)

47) The number of the emitted photons per unit time (Φ_L) from a source of power P_w and frequency υ is calculated from the relation……..

a) $\Phi_L = p_w h\upsilon$
b) $\Phi_L = p_w\upsilon / h$
c) $\Phi_L = p_w / h\upsilon$
d) $\Phi_L = p_w / \upsilon$

48) The opposite graph represents the relation between the maximum kinetic energy $(KE)_{max}$ of the emitted electrons from the cathode of a photoelectric cell and the frequency of the incident light on the cathode , so the critical wavelength of the cathod's material is approximately equal to……………

a) 3421 A
b) 4111 A
c) 5104 A
d) 6211 A

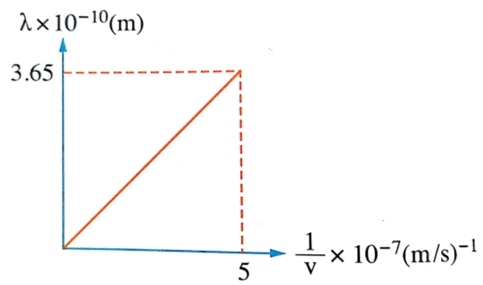


49) A monochromatic light ray has fallen on the surface of a metal, so electrons are barely emitted from the surface . if the frequency of the incident light has decreased to quarter its initial value , then….

(A) The speed of the emitted electrons decreases to quarter its initial value
(B) The work function decreases to quarter its initial value
(C) The number of emitted electrons decreases to quarter its initial value
(D) No electrons are emitted

50) The opposite graph represents the relation between the wavelength of the wave that is associated with the motion of a particle (λ) and the reciprocal of the speed of that particle (1/v) then the mass of that opject equals…..

(A) 9.1×10^{-31} kg
(B) 7.8×10^{-25} kg
(C) 2.4×10^{-24} kg
(D) 1.6×10^{-22} kg



51) An electromagnetic radiation of frequency υ has fallen on the surface of a metal of work function 3 eV so that electrons of maximum kinetic energy 2eV are emitted from the surface of the metal . If the incident radiation is replaced by another of frequency 2 υ , the maximum kinetic energy of the emitted electrons will be …..

(A) 7 eV
(B) 6 eV
(C) 5 eV
(D) 4 Ev

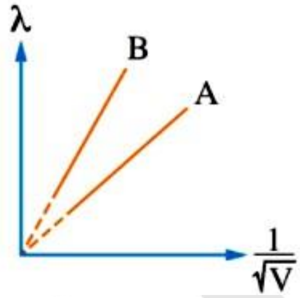
52) Two particles (A) and (B) of the same charge are accelerated under different potential (V) for several times while recording the associating wavelength in each time, thus the opposite graph represents the relation between the wavelength (λ) associated with the motion of each particle and the reciprocal of the square root of the accelerating voltage so the relation between the masses of the two particles is

(A) $m_A = m_B$

(B) $m_A > m_B$

(C) $m_A < m_B$

(D) The answer cannot be determined



53) Night vision devices depend on what the bodies emit of …………
(A) visible radiation
(B) X-rays
(C) UV radiation
(D) thermal radiation

54) When increasing the intensity of the incident light whose frequency is greater than the critical frequency of the surface of the cathode of a photoelectric cell on which the light is falling, ………………..

(A) the photoelectric current intensity increases.

(B) the energy of the incident photon increases.

(C) the maximum kinetic energy of the emitted photoelectrons increases.

(D) the work function of the metal increases.

55) light frequency (υ) of the light that falls on a metallic surface of work function 3.3125eV to **barely** free electrons from its surface is …(Knowing that: $h = 6.625\times10^{-34}$J.s, $e = 1.6\times10^{-19}$C)

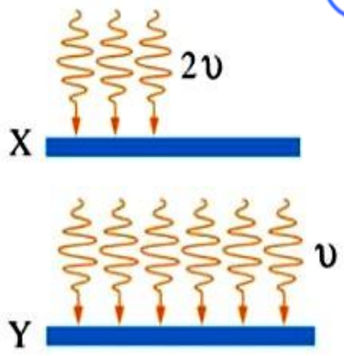
(A) 6×10^{14}Hz

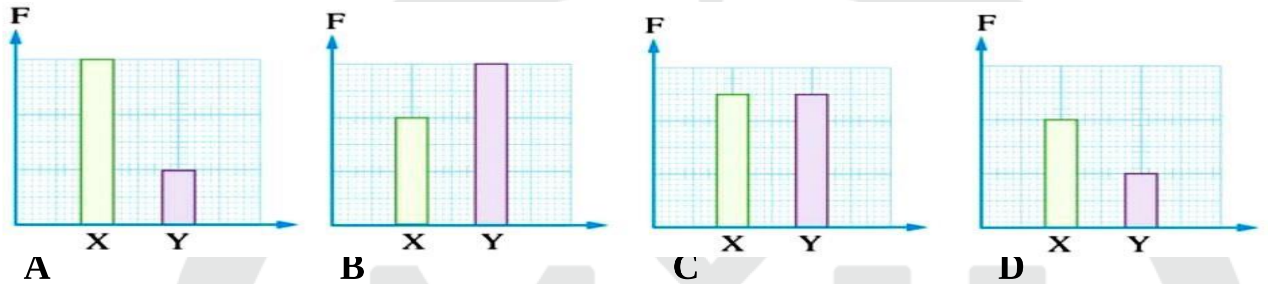
(B) 8×10^{14}Hz

(C) 4×10^{14}Hz

(D) 2×10^{14}Hz

56) In the opposite figure if two different light beams that have different frequencies and the **same power** have fallen on two reflecting surfaces (X) and (Y), then which of the following graphs represent the ratios of the forces by which each of them acts on the surface when it reflects from it?





57) According to experiment concerned with the photoelectric effect, which of the following will increase the kinetic energy of an electron ejected from a metal surface?

(A) Increasing the wavelength of the light striking the surface.

(B) Increasing the frequency of the light striking the surface

(C) Increasing the number of photons of the light striking the surface.

(D) Both B and C.

58) The slope in the opposite graph is:

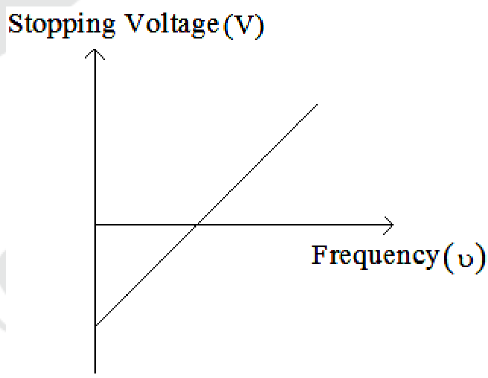
Knowing that: (e) Electron charge, (h) Planck's constant.

(A) e/h

(B) h/e

(C) h

(D) e



Atomic Spectra

The shell radius (r_n):

$r_n = \frac{n\lambda}{2\pi}$ $\qquad$ $r_n = \frac{nh}{2\pi m_e v}$

The energy of a shell in hydrogen atom:

$E_n = \frac{-13.6}{n^2}$ (eV) $\qquad$ $E_n = \frac{-13.6 \times e}{n^2}$ (Joule)

Transition between any two levels:

$E_{photon} = E_{higher} - E_{lower}$ **For all atoms** where $E_{photon} = h\upsilon = h\frac{c}{\lambda}$

$E_{photon} = -13.6 \times e \left(\frac{1}{n^2_{higher}} - \frac{1}{n^2_{lower}}\right)$ **For hydrogen only**

Transition between out and E_{Lower}:

$E_{photon} = -E_{lower}$ **For all atoms** where $E_{higher} = E_{outside} = 0$

$E_{photon} = -13.6 \times e \left(\frac{1}{n^2_{lower}}\right)$ **For hydrogen only**

Series of Hydrogen Atom

K (n = 1) Lyman (Ultraviolet range) (Highest frequency) (Shortest wavelength)
L (n = 2) Balmer (Visible range)
M (n = 3) Paschen (Infrared (IR) range)
N (n = 4) Brackett (Infrared (IR) range)
O (n = 5) Pfund (Far Infrared (IR) range (Lowest frequency)(Longest wavelength))

Number of spectral lines $= n \times \left(\frac{n-1}{2}\right)$ **(n): no of energy levels**

Types of Spectrum

Continuous spectrum
- All (υ) and (λ)
- Example: white light

Line Spectrum
- Specified (υ) and (λ)
- Example: hot gas emission

Line Spectrum

Absorption
- Dark lines in a bright background
- Some (υ) and (λ) are missing

Emission
- Bright lines in a dark background
- Missing (υ) and (λ) from absorption spectrum are emitted

Properties of X-rays

1. They can penetrate medium easily.
2. They affect sensitive photographic plates.
3. They diffract in crystals.
4. They can ionize gases.

X-Rays

- Source of heating (AC or DC) affects on → Intensity of electron (Number of electrons) affects on → Intensity of X-rays (Number of photons)
- High DC voltage affects on → Energy of electron affects on → Energy of X-rays
- P.D.(V) between target and filament → V ↑ v ↑ E_{photon} ↑ $\upsilon_{x\text{-}ray}$ ↑ $\lambda_{x\text{-}ray}$ ↓
- Atomic number of target material → (atomic no. of target) ↑ ΔE ↑ E_{photon} ↑ $\upsilon_{x\text{-}ray}$ ↑ $\lambda_{x\text{-}ray}$ ↓

Spectrum of X-Ray

Continuous Spectrum (Soft Radiation) (Braking Radiation)

$\Delta E_{photon} = K.E._e = \frac{1}{2} m_e v^2$ eV(Filament)

$E_{photon} = h\upsilon_{x\text{-}ray} = h\frac{c}{\lambda_{x\text{-}ray}}$

Depends on potential difference between filament and target

Electron → X-rays

$K.E._e = E_{X\text{-}rays}$

$\frac{1}{2} m_e v^2 = h\upsilon_{X\text{-}rays}$

$eV_B = h\frac{c}{\lambda_{X\text{-}rays}}$

Line Spectrum (Hard Radiation) (Characteristic Radiation)

$E_{photon} = \Delta E = E_{higher} - E_{lower}$ (Target)

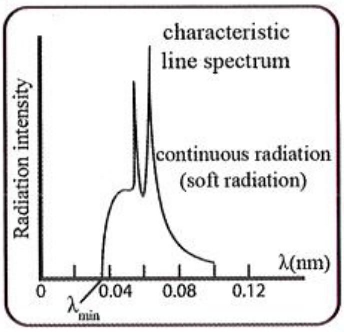
$E_{photon} = h\upsilon_{x\text{-}ray} = h\frac{c}{\lambda_{x\text{-}ray}}$

Depends on target material

$P_{Electric} = VI$

$P_{Heat} = P_{Electric} - P_{X\text{-}rays}$

$Efficiency_{X\text{-}rays} = \frac{P_{X\text{-}rays}}{P_{Electric}} \times 100$



Conditions to obtain

Soft radiation	Hard radiation
High potential difference between target and filament.	1. High potential difference between target and filament. 2. Electron collides with an electron close to the nucleus. 3. Target material of high atomic number.

Increase Energy

Soft radiation	Hard radiation
Increase potential difference between target and filament.	Use target element of higher atomic number.

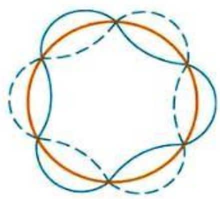
Applications of X-rays

1. Studying the crystalline structure of materials. (Diffract in Crystals)
2. Detect structural defects in material used in metallic industries because X-rays have a great penetrating power. (Penetrate media easily)
3. Imaging bones to identify fractures, cracks and some other medical diagnosis. (Affect sensitive photographing plates)

1) An electron in a hydrogen atom moves from an energy level of order (n) to the first energy level, emitting a photon of wavelength 9.51×10^{-8}m. If the energy of the first level is -2.176×10-^{18}J, so (n) equals …….

(A) 3 (B) 5 (C) 6 (D) 4

2) The opposite figure represents the standing wave that is associated with the motion of an electron in the hydrogen atom in one of the energy levels. If the wavelength of this wave is 9.98×10^{-10}m, then the radius of the energy level in which the electron is moving is ………………



(A) 5.24 A° (B) 4.76 A°

(C) 2.42 A° (D) 3.65 A°

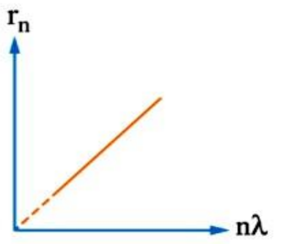
3) The opposite graph represents the relation between (nλ) and (r_n) where (n) is the order of the orbit in which the electron exists, (λ) is the wavelength of the wave associated with the electron's motion in its orbit according Bohr's model and (r_n) is the radius of the electron's orbit in the hydrogen atom, so the slope of the straight line equals ……..

(A) 2π

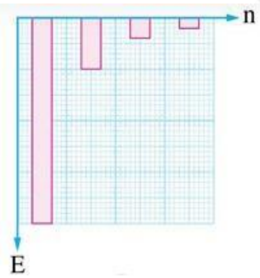
(B) 1/π

(C) π

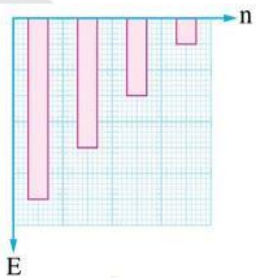
(D) 1/2π



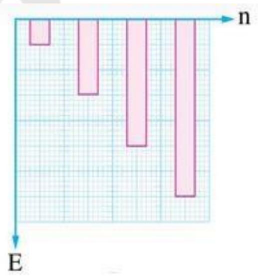
4) Which of the following graphs represents the relation between the energy of an electron (E) in one of the energy levels and level's order (n) for the hydrogen atom according to Bohr's model?



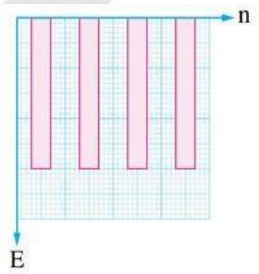
A



B



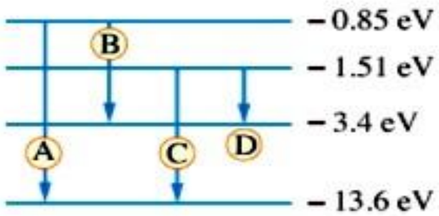
C



D

5) The opposite diagram represents some energy levels in the hydrogen atom, so the arrow that represents a transition that produces a photon of wavelength 657nm is

(Where: $e = 1.6\times10^{-19}$C, $c = 3\times10^{8}$m/s, $h = 6.625\times10^{-34}$J.s)



(A) C

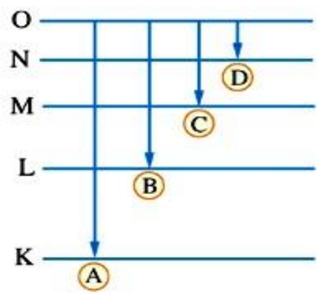
(B) B

(C) A

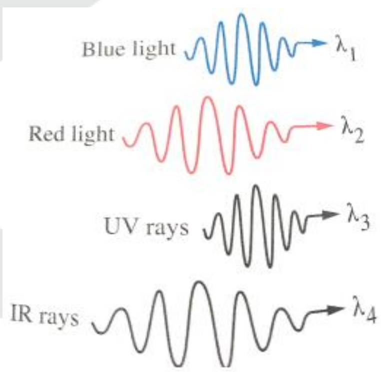
(D) D

6) The opposite figure represents multiple probable transition for the emission of a linear spectrum from the hydrogen atom, then ……

	Emission of a linear spectrum from the hydrogen atom, then	**Emission of a photon that has the longest wavelength**
A	$\lambda_A < \lambda_B$	D
B	$\lambda_B > \lambda_D$	D
C	$\lambda_A > \lambda_C$	C
D	$\lambda_A < \lambda_B$	A



7) The opposite figure shows the wavelength four photons (λ_1, λ_2 ,λ_3 ,λ_4)falling on a hydrogen atom at its aground state (n=1) , which of these photons can be absorbed by a hydrogen atoms to be excited to a higher level ?)



(A) Photon λ_1

(B) Photon λ_2

(C) Photon λ_3

(D) Photon λ_4

8) A Hydrogen atom in the ground state whose energy -13.6ev is exited by a photon of wavelength 975 A^{o} The order of excitation level and the number of the possible spectral line that could be emitted when the atom relax from

	Exited level order	**The number of the possible spectral line**
A	2	6
B	2	1
C	4	6
D	4	1

9) What is the result of each the following: Transition an electron from an excited level energy (n) to original energy level (n-1)………

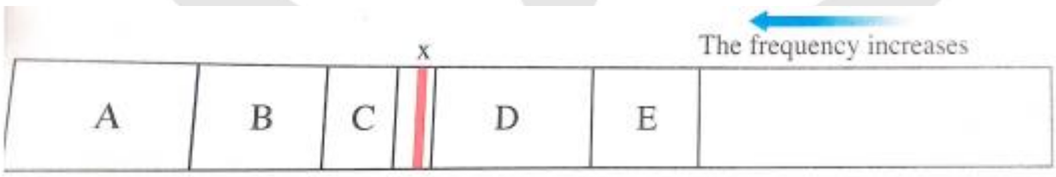
(A) Photon emitted with a longest wavelength

(B) Photon emitted with a minimum wavelength

(C) Two photons emitted with same wavelength

(D) Two photons emitted with same phase

10) The following figure represents the regions of the electromagnetic spectrum, if the line X represents a red spectrum of the hydrogen atom , then in which of the shown spectrum line of the hydrogen atom , then in which of the shown spectrum regions does the spectrum of hydrogen lie when an electron moves from the energy level (o) to the level (M)?



(A) Region A (B) Region B (C) Region C (D) Region D

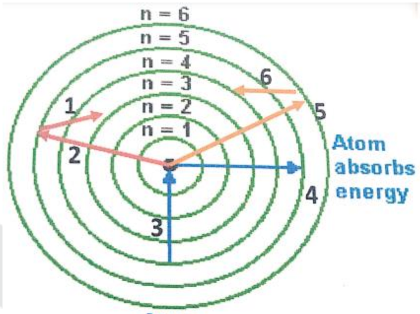
11) The electron transitions that gives off radtions are…

(A) 1&3&6

(B) 1&2&3

(C) 1&3&4

(D) 2&3&5

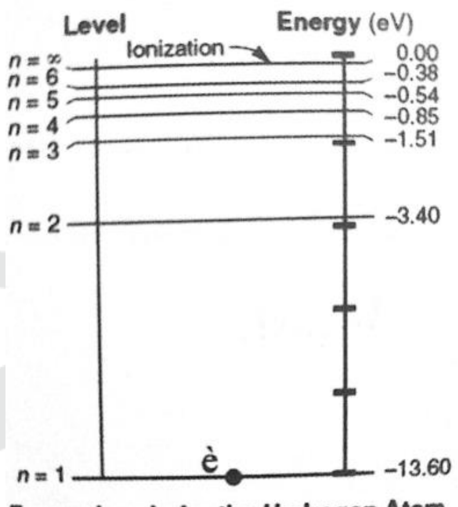


12) An example of the linear absorption spectrum of the elements is…………..

(A) x-rays
(B) Fraunhofer lines
(C) laser beams
(D) black body radiation

13) A hydrogen atom in normal state (the electron in the first level) as shown in the figure .what will happen to the atom when aphoton of energy

	8.2ev	10.2ev	13.6ev	15ev
A	The atom will not absorb this photon	The atom will absorb this photon	The electron freed without K.E	The electron freed with K.E
B	The atom will absorb this photon	The electron freed without K.E	The atom will not absorb this photon	The electron freed without K.E
C	The electron freed without K.E	The electron freed with K.E	The atom will absorb this photon	The atom will not absorb this photon
D	The electron freed with K.E	The atom will not absorb this photon	The electron freed with K.E	The atom will absorb this photon



Energy Levels for the Hydrogen Atom

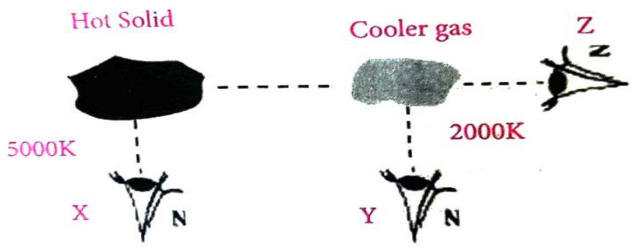
14) The diagram below shows a hot solid, at a temperature of 5000 K, emitting a continuous spectrum. (li) State the type of spectrum observed from: Position Z

a) Emission continuous spectrum

b) Absorption continuous spectrum

c) Emission line spectrum

d) Absorption line spectrum



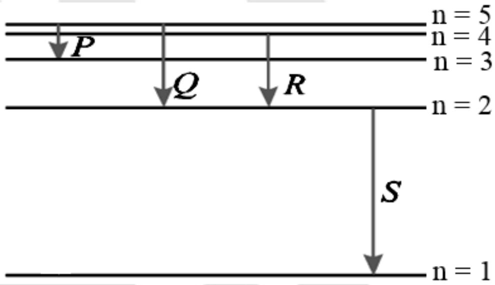
15) In the following energy level diagram of a hydrogen atom, which transition will give an emission of photon of the shortest wavelength?

(A) P

(B) Q

(C) R

(D) S



16) The figure represents one of electron transitions in hydrogen atom. Calculate the wavelength of the emitted photon

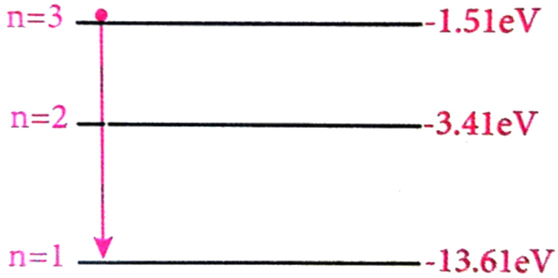
(Knowing: h = 6.625x1 034 J.s " c = 3x1 0° m/s and e =1.6x10-1°C)

a) 1.02×10^{-7} m

b) $1{,}93 \times 10^{-7}$ m

c) 247×10^{-7} m

d) 4.37×10^{-7} m

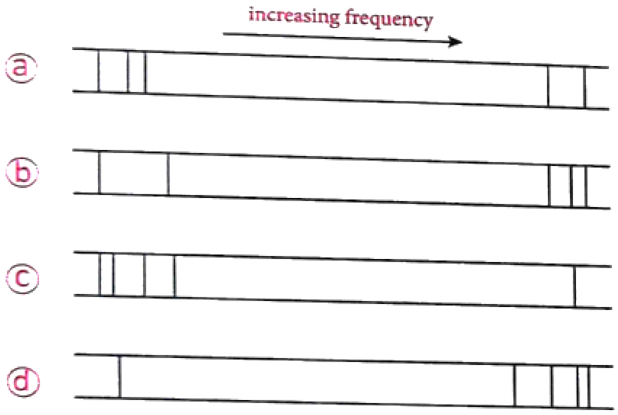


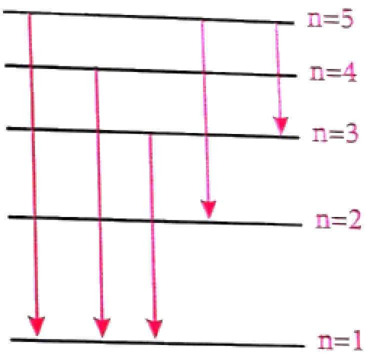
17) According in Bohr's model, if the wavelength of the wave associated with the motion of an electron in one of the energy levels of the hydrogen atom is equivalent to (πr) where (r) is the radius of that energy level, then the electron is rotating in energy level

(A) K (B) L

(C) M (D) N

18) The five energy levels of an atom are shown in the scale drawing the indicated lines represent five possible transitions between the energy levels. A photon of definite energy and frequency is produced by each transition. Which of the spectra best corresponds to the transitions**?**





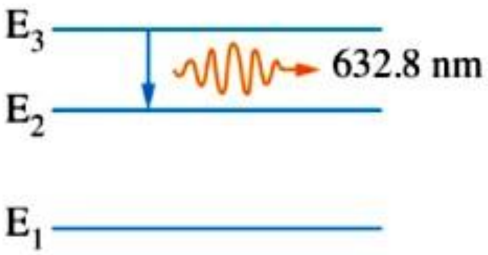
19) The opposite figure represents the energy levels of one of the atoms of a certain element. If the shown transition in the diagram produces a photon of wavelength 632.8nm, then the value $(E_3 - E_2)$ equals …… ,

(A) 3.92eV

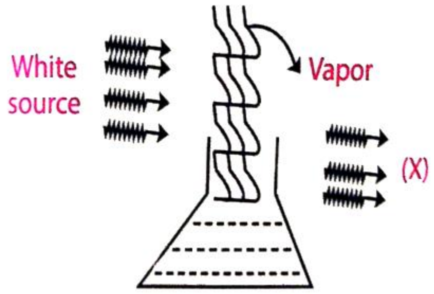
(B) 1.96eV

(C) 1.47eV

(D) 2.94eV



20) In the opposite figure, when analyzing the light (X) which shown in figure, we obtain......



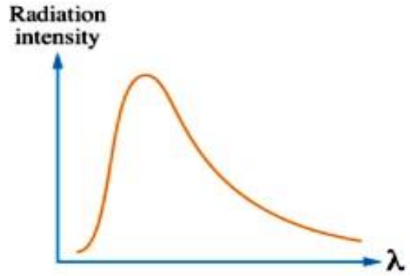
(A) Bright lines on a dark background represent the linear emission spectrum

(B) Dark lines on a bright background representing the linear emission spectrum

(C) Dark lines on a bright background represent the linear absorption spectrum

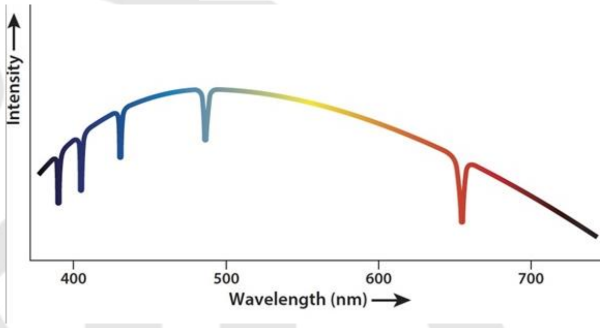
(D) Bright lines on a dark background represent a linear emission spectrum

21) The opposite graph represents........



(A) a continuous spectrum
(B) an absorption line spectrum
(C) an emission line spectrum
(D) a monochromatic spectrum

22) The opposite graph represents........



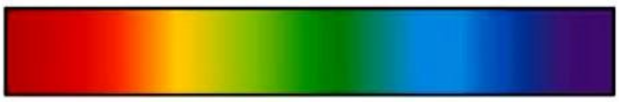
(A) a continuous spectrum

(B) an emission line spectrum

(C) an absorption line spectrum

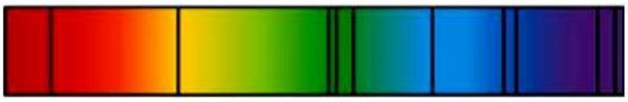
(D) a monochromatic spectrum

23) When a wight light enters a spectrometer which of the following images could be the spectrum comes out from spectrometer



A

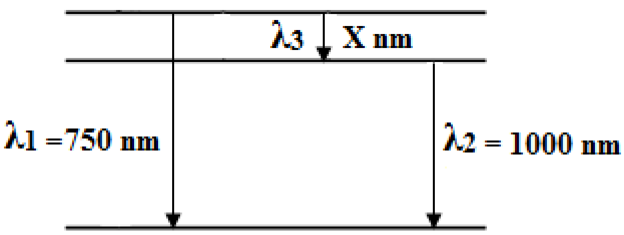
B



C

D

24) The opposite figure represents transitions in a sodium atom, what is the wavelength of transition (X)?



(A)1500 nm

(B)2250 nm

(C)3000 nm

(D)4500 nm

X-ray radiations vs variable P.D between Cathode and anode

Graph (1) **P.D = 25 kv**

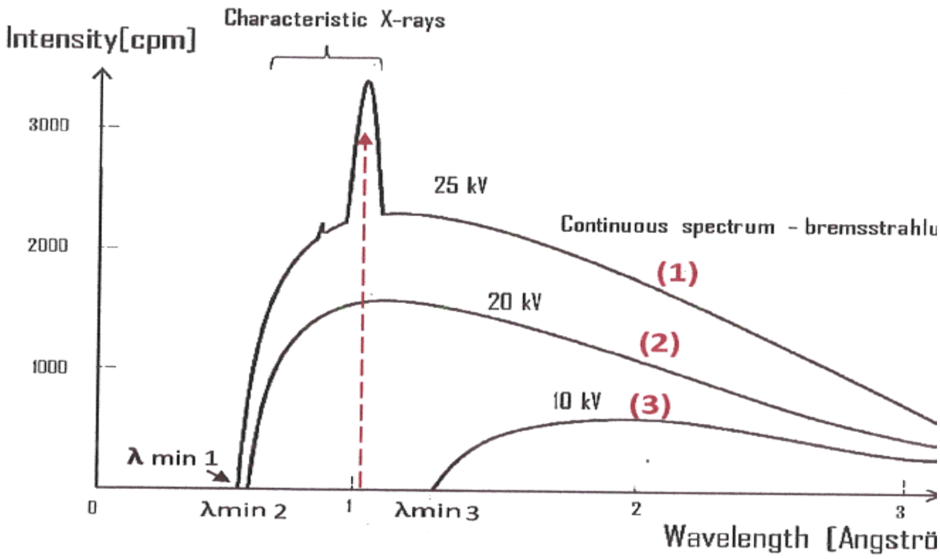
- Enough energy to produce charact. X-ray
- $\lambda_{min\ 1}$ = minimum wave length of all or max υ_1

Graph (2) **P.D = 20 kv**

- Not enough energy to produce charact. X-ray
- $\lambda_{min\ 1} < \lambda_{min\ 2}$

Graph (3) **P.D = 10 kv**

- Not enough P.D. to produce characteristic X-ray i.e $\lambda_{min\ 2} < \lambda_{min\ 3}$



- **In all above cases**, $\lambda_{min} = \frac{hC}{eV}$ **where** V = P.D. applied between cathode and anode

More Factors affecting X-ray continuous radiations;

- If we increase the filament current (mA) the number of the X-ray photons will increases.
- As **Z** number of target increases the amount of Bremsstrahlung (continuous radiation) produced also increases.

Characteristics X-ray

- The X-rays produced by transitions from **n = 2** to **n = 1** levels are called **(K-alpha x-rays)**

  E (K-alpha) or $K_\alpha = \Delta E = E_2 - E_1$

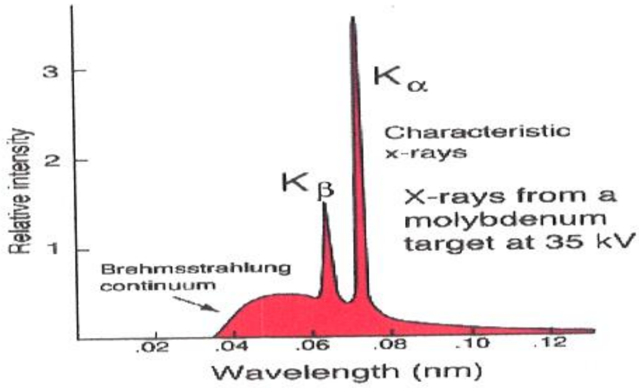
- Transitions of those from **n = 3** to **n = 1** transition are called **(K-beta)**

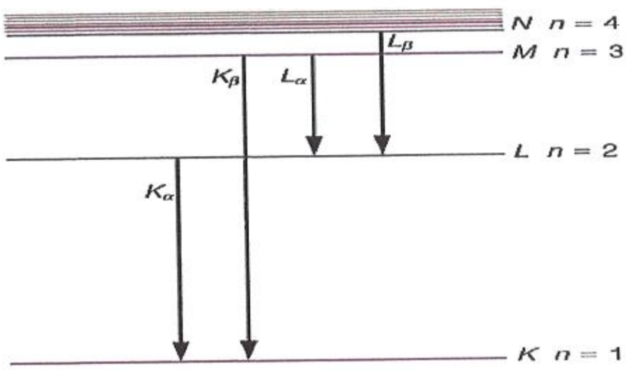
  E (K-beta) or $K_\beta = \Delta E = E_3 - E_1$

- Transitions to **n = 2** or **L-shell** are designated as;

  L - alpha rays (from n = 3 to n = 2 **and** **(L-beta)** rays (from n = 4 to n = 2;

  as shown in the opposite levels diagram





25) What is the difference between soft and hard *X*-rays

(A) Velocity

(B) Intensity

(C) Frequency

(C) Polarization

26) Penetrating power of *X*-rays can be increased by

(a) Increasing the potential difference between anode and cathode

(b) Decreasing the potential difference between anode and cathode

(c) Increasing the cathode filament current

(d) Decreasing the cathode filament current

27) *X*-rays are known to be electromagnetic radiations. Therefore, the *X*-ray photon has

(a) Electric charge

(b) Magnetic moment

(c) Both electric charge and magnetic moment

(d) Neither electric charge nor magnetic moment

28) On increasing the number of electrons striking the anode of an *X*-ray tube, which one of the following parameters of the resulting *X*-rays would increase

(A) Penetration power

(B) Frequency

(C) Wavelength

(C) Intensity

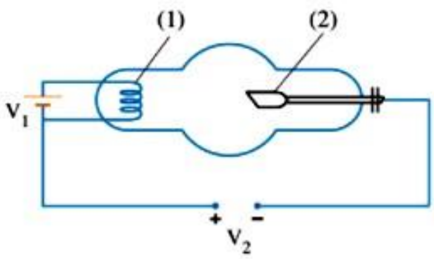
29) The opposite figure represents a Coolidge tube. Which of the following choices leads to a change in the linear spectrum of the produced X-ray?

(A) Changing the potential difference (V_1).

(B) Changing the material of component (2).

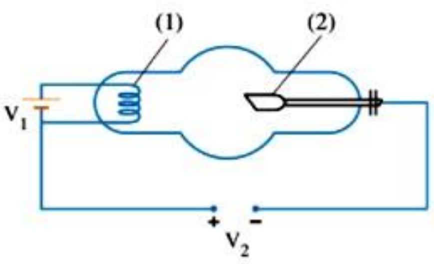
(C) Changing the material of component (1).

(D) Changing the potential difference (V_2).



30) The opposite figure represents a Coolidge tube. What is role of the potential difference (V_1) and the potential difference (V_2) concerning emitted electrons.

	The potential difference (V_1)	**The potential difference (V_2)**
A	Controls the K.E of emitted electrons	Controls the emission rate of the electrons
B	Controls the K.E of emitted electrons	Controls the K.E of emitted electrons
C	Controls the emission rate of the electrons	Controls the emission rate of the electrons
D	Controls the emission rate of the electrons	Controls the K.E of emitted electrons



31) in the Coolidge tube if the potential difference between anode and cathode increase to double the wavelength of line spectrum of x ray will be

(A) Doesn't change (B) Decrease to quarter

(C) Decrease to half (D) Increase to double

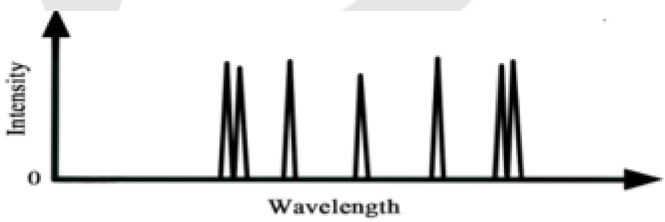
32) The opposite graph represents........

A) an emission line spectrum

B) a continuous spectrum

C) an absorption line spectrum

D) a monochromatic spectrum



33) In Coolidge tube in the figure , to produce X-rays. If the atomic number of the traget material is (42). So , to produce the longest wavelength for the characteristics X-rays radiation , we must change the target material to another element of atomic number :

A) 29 B) 74 C) 82 D) 55

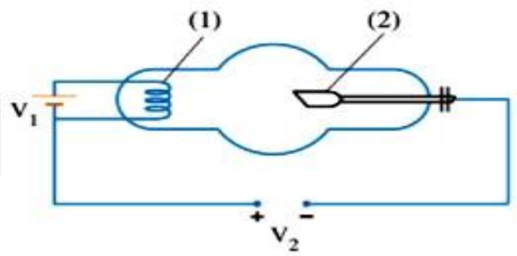
34) The opposite figure represents a Coolidge tube. Which of the following choices responsible acceleration the electrons which are emitted on filament?

(A) Efficiency of component (1).

(B) The material type of component (2).

(C) Changing the potential difference (V_1).

(D) Changing the potential difference (V_2).



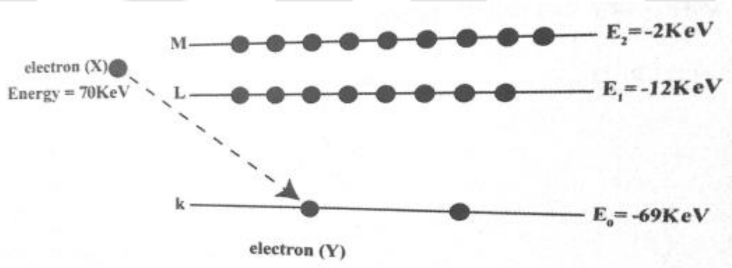
35) The figure shows some of the energy levels of the molybdenum atom that is used as a target in the Coolidge tube. If the collision between electron (X) and electron (Y) leads to the leaving of electron (Y) out its atom. Which one from the following probabilities are considered the energy of photons of the resulting characteristic X-rays spectrum?

(A) 57KeV, 10KeV

(B) 69KeV, 70KeV

(C) 68KeV, 14KeV

(D) 72KeV, 1KeV



36) If the potential difference between the anode and the cathode of a Coolidge tube is 13250V, then the minimum wavelength of the continuous X-rays spectrum is

(A) 3.752×10^{-11}m

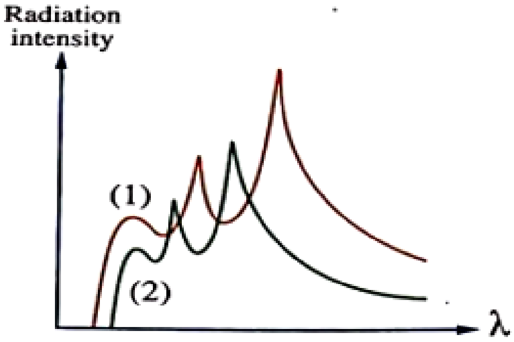
(B) 1.07×10^{-11}m

(C) 9.375×10^{-11}m

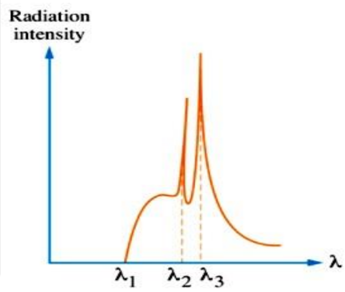
(D) 6.625×10^{-11}m

37) The opposite figure represents the relation between the intensity of X-ray and their wavelength (λ)for the two spectra that produce from two Coolidge tubes working with two different voltages V_1 and $V_2$and two different targets and two different targets materials whose atomic numbers are Z_1 and Z_2, so…

	The relation between V_1 and V_2	The relation between Z_1 and Z_2
A	$V_1 > V_2$	$Z_1 > Z_2$
B	$V_1 > V_2$	$Z_1 < Z_2$
C	$V_1 < V_2$	$Z_1 = Z_2$
D	$V_1 < V_2$	$Z_1 < Z_2$



38) The opposite graph represents the relation between the wavelength and the radiation intensity for the emitted X-rays spectrum from a Coolidge tube. If the potential difference between the anode and the cathode is increased, then ……..



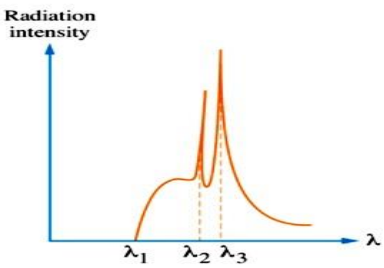
(A) ($λ_3$) will increase.

(B) ($λ_2$) will increase.

(C) ($λ_1$) will increase.

(D) the area under the curve will increase.

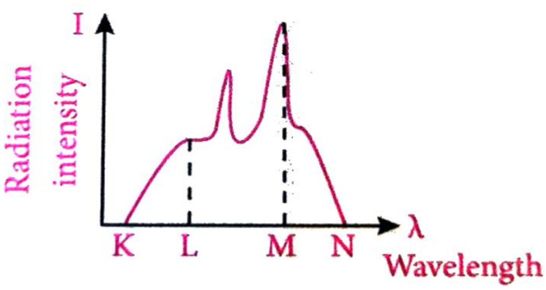
39) The opposite graph represents the relation between the wavelength and the radiation intensity for the emitted X-rays spectrum from a Coolidge tube. Which of the shown wavelengths represent the transition of an electron from higher energy level to level (k)



(A) $λ_3$ (B) $λ_2$

(C) $λ_1$ (D) $λ_1$ & $λ_2$

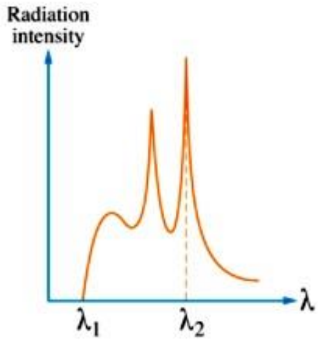
40) The graph represents X-rays spectrum produced from Coolidge tube. Which wavelength (K, L, M, or N) can be determined by the relation: Where (A E) is the energy difference between two levels in the target atom.



a) Wavelength at K b) Wavelength at L

c) Wavelength at M d) Wavelength at N

41) The opposite graph represents the relation between the radiation intensity and the wavelength of the X-rays spectrum which is produced from a Coolidge tube. Which of the following choices leads to the increase of (λ_1) while keeping the value of (λ_2) constant?



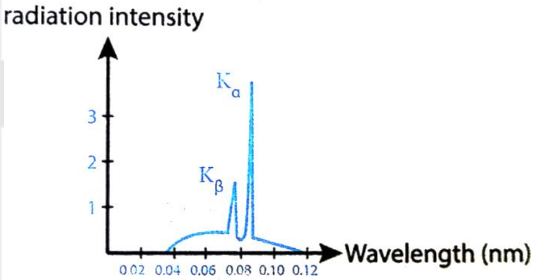
(A) decreasing the potential difference between the anode and the cathode.

(B) changing the target material by another of higher atomic number.

(C) increasing the potential difference between the anode and the cathode.

(D) increasing the intensity of the filament current.

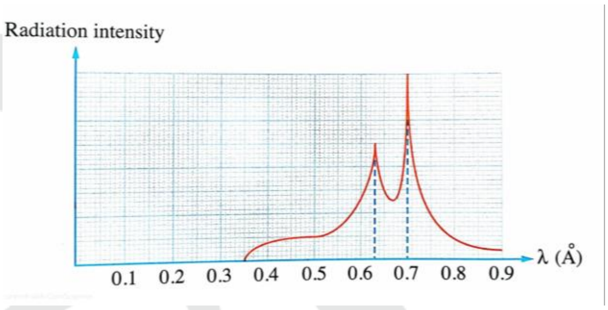
42) The opposite graph illustrates the spectrum of X- rays emitted when electrons are accelerated through a potential difference of 35kV and collided with a molybdenum target. The shortest wavelength X-rays produced by this process are of about 0.035 nm. If a larger atomic number element is used as a target, what will happen to both the wavelength of the Kα and The shortest wavelength X rays produced by this process?



Choice	The wavelength of the Kα line	The shortest wavelength X rays
A	It will decrease to a smaller wavelength than 0.074 nm	The wavelength will decrease to less than 0.035 nm
B	It will stay the same at about 0.074 nm.	The wavelength will stay the same at 0.035 nm.
C	It will increase to a greater wavelength than 0.074 nm.	The wavelength will increase to greater than 0.035 nm.
D	It will decrease to a smaller wavelength than 0.074 nm	The wavelength will stay the same at 0.035 nm.

43) The graph represents the relation between the radiation intensity and wavelength of the produced X-rays spectrum from Coolidge tube. from the graph:

The ratio : $\frac{\text{the least frequency of the characterstic spectrum}}{\text{the greatest frequency of the continuoius spectrum}}$ = ⋯ … … …..



(A)0.58 (B)1.75

(C)2 (D)0.5

44) X-ray spectrum which generated when emitted electrons from the filament loses its energy gradually when passes near the target atoms represents:

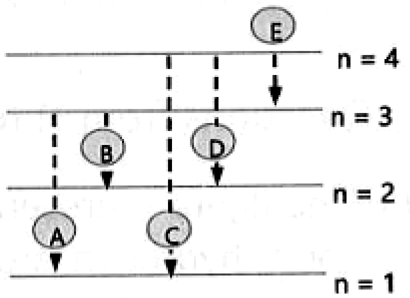
(A) Absorption line spectrum.

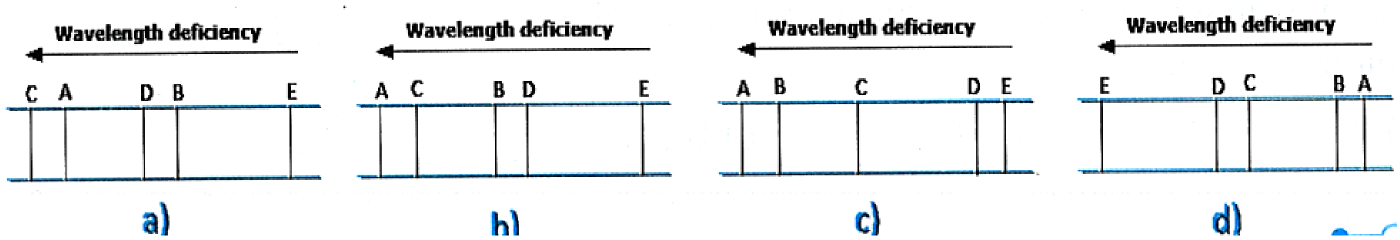
(B) Absorption continuous spectrum.

(C) Emission line spectrum.

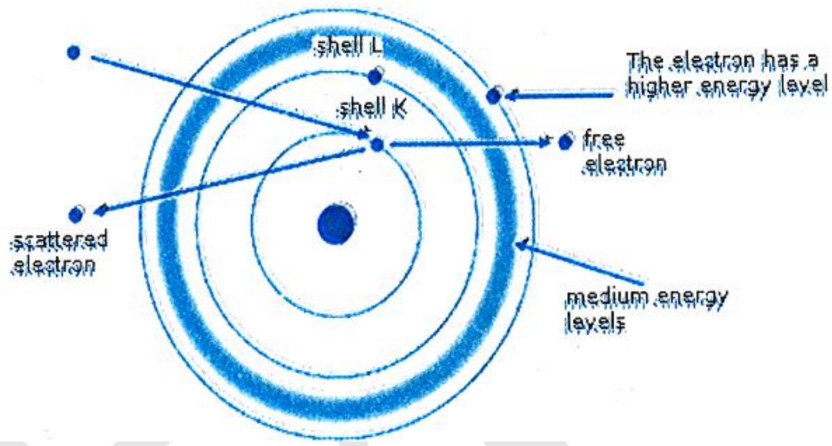
(D) Emission continuous spectrum.

45) The corresponding figure shows a diagram of five possible transitions between the energy levels of a hydrogen atom, which of the following spectra corresponds to those transitions?





46) This figure shows that in the target material in the Coolidge tube used to generate x-rays, an electron from the electron beam releases another electron from the K shell of an atom and it is scattered, so which of the electrons shown can produce an X-ray photon that is part of the characteristic of linear spectrum?



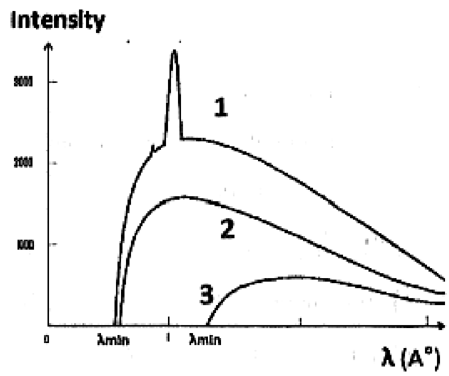
(A) scattered electron

(B) electron in shell L

(C) free electron

(D) The electron that has a high energy level.

47) The graph of X-ray shows intensity vs the wavelengths radiations λ



i. P.D. in graph 1 is……….

(A) Less than in 2

(B) Less than in 2 and 3

(C) More than in 2

(D) More than in 2 and 3

ii. No characteristic radiation in 2 and 3 because………

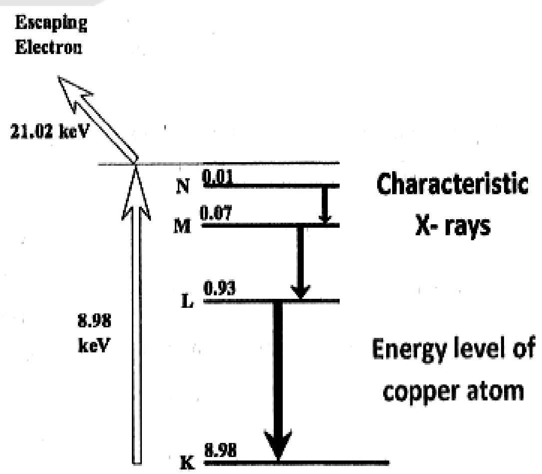
(A) In-sufficient P.D

(B) Low atomic number of the target

(C) High atomic number of the target

(D) All

48) If the energy levels of the copper as a target material is shown in the opposite diagram so; the minimum energetic characteristic X-ray Kα is………eV



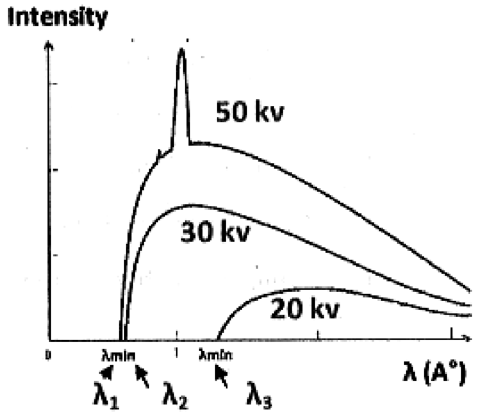
(A) 5.09

(B) 8.05

(C) 10.12

(D) 12.15

49) If 3 potential differences P.D.'s applied in Coolidge tube are respectively 50 kv, 30 kv and 20 kv to produce 3 of X-rays continuous spectrum, as shown in the graph so, Ratio between; λ_3(min) to λ_1(min) is……..



(A) 1.12

(B) 1.32

(C) 1.58

(D) 2.15

50) Electrons with an energy 80 keV are incident on the tungsten target of an X-ray tube. If K-shell of tungsten have 72.5 keV energy; so, X-rays emitted by the tube contains only……..

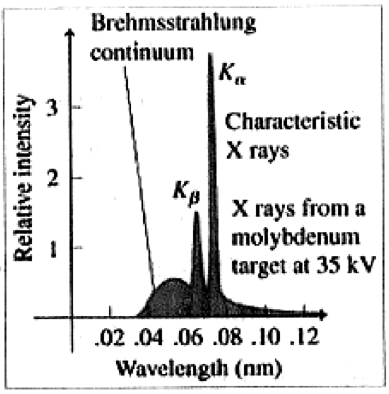
(A) Continuous X-ray spectrum with a minimum wavelength of λ_{min} = 0.155 A°

(B) Continuous X-ray spectrum with all wavelengths.

(C) The characteristic X-ray spectrum of tungsten.

(D) Continuous X-ray spectrum with λ_{min} = 0.155A° and characteristic X-ray of tungsten.

51) Kα characteristic X-ray due to falling an electron from level…….to level……..



(A) K – L

(B) L – K

(C) M – L

(D) M – K

52) Kβ characteristic X-ray due to falling an electron from level…….to level……..

(A) K – L

(B) L – K

(C) M – K

(D) N – K

53) X-ray is used to study the crystalline structure of material because of its ability to…….

(A) Reflects

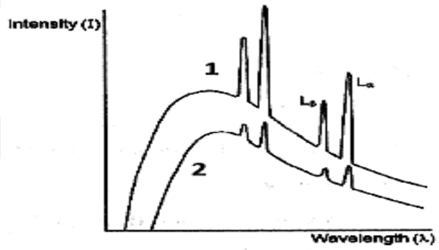
(B) Refracts

(C) Interferes

(D) **Diffracts**

54) The following graphs are spectra (1) and (2) refer to x-rays Intensity vs wavelengths λ.

i. Graph 1 has a smaller λ (minimum) than graph 2 because…….



(A) There is a higher P.D. between the filament and the target

(B) There is a smaller P.D. between the filament and target

(C) There is a smaller P.D. across the tungsten filament

(D) The target material has a higher atomic number.

ii. Graph 1 has an intense line spectrum than graph 2 because…….

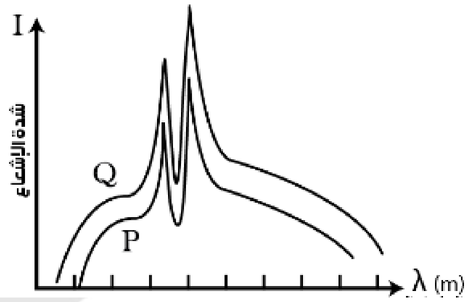
(A) There is a higher P.D. between the filament and target

(B) There is a smaller P.D. between the filament and target

(C) The target material has a higher atomic number

(D) There is a higher P.D. across the filament.

55) The opposite figure represent the resulting X-ray spectrum in Two Collage tubes so……..



(A) Potential difference in the tube Q is larger than that of P and the target user Different

(B) Potential difference in the tube Q is larger than that of P and the target user the same

(C) Potential difference in the tube Q is smaller than that of P and the target user Different

(D) Potential difference in the tube Q is smaller than that of P and the target user the same.

56) electron emitted from forth to first photon is produced and collides with the cathode of a photocell, so an electron is emitted the photocell cathode with maximum kinetic energy of 8.25 eV, so the work function of the surface of the photocell cathode equals……..

(A) 4.5 eV

(B) 4.75 eV

(C) 8 eV

(D) 6eV

Essay Questions

57) **Final Exams (2nd Session-23)**

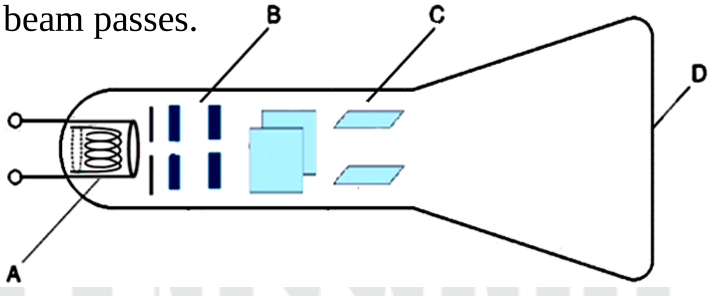
A monochromatic light beam of wavelength 4500 Å falls on the surface of a metal as a result photoelectrons are emitted, if the power of this incident light beam is 10W. **Calculate** the maximum rate of the photoelectrons emission from the surface of the metal.

58) This diagram shows Cathode Ray Tube:

a) **Which part** (A, B or C) is the source of the cathode rays? And **what** is the material that part (D) is coated with?

b) **Explain why** there is a need to be a vacuum inside the tube.

c) **Mention one result of:** Stopping the action of the electric and the magnetic fields in the cathode ray tube as the electron beam passes.



Answer:

a) **Part (A)** is the source of the cathode rays. **Part (D)** coated with fluorescent material.

b) Because the air resistance is very high due to collision of electrons with air molecules.

c) - The electron beam passes in a straight line and hits at the middle of the screen.

OR - A glowing point appears at the middle of the screen.

59) When the atomic spectrum of the hydrogen atom is analyzed, a blue spectral line in the visible region of wavelength 434.1 nanometer is obtained.

a) **Calculate** the energy of the shell to which the electron has transmitted to emit such spectral line. $(-5.44\times10^{-19}\,J)$

b) **Determine** the energy level from which the electron has transmitted to emit this wavelength. $(n=5)$

60) An X-ray tube operates at a potential of 25KV and a beam current of 30mA with an efficiency of 2%. **Calculate:**

a) The minimum wavelength of the X-ray produced. $(4.97\times10^{-11}m)$

b) The maximum velocity to accelerate the electrons from the cathode to the anode. $(93.76\times10^{6}m/s)$

c) The maximum momentum of the X-ray photons produced by the tube. $(1.33\times10^{-23}Kg.m/s)$

d) The electrical energy used by the tube each second. (750W)

e) The heat energy produced per second at the target. (735W)