PHYSICS

BOOKS - GK PUBLICATIONS PHYSICS (HINGLISH)

X-RAYS

Illustrative Example

1. An X-ray tube operates at $20kV$. Find the maximum speed of the electron strinking the

anode , given the charge of electron is 1.6×10^{-19} coulomb and mass of electron is $9 \times 10^{-31} kg.$

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2. (a) An X-ray tube produces a continuous spectrum of radiation with its shorts wavelength end ate0.45Å. What is the maximum energy of the photon in the radiation? (b) From your answer to (a) , guess

what order of accelerating voltage (for electrons) is required in such a tube?

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3. The wavelength of the characteristic X-ray K_α line emitted from Zine $(Z = 30) is 1.415 Å$. Find the wavelength of the K_α line emitted from molybdenum $Z = 42)$.

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4. If the shorts series limit of the balmer series for hydrogen is 3644Å, find the atomic number of the element which gives X-ray wavelength down to 1Å. Identify the element.

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5. A material whose K -absorption edge is 0.2Å is irradiated by X-ray of wavelength 3644Å , find the maximum energy of the photoelectrons that are emitted from the K shell.

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6. Calculate the wavelength of the emitted characteristic X-ray from a tungsten $(Z = 74)$ target when an electrons drops from an M shell to a vacancy in the shell.

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7. A potential diffrence , the $20kv$ is applied across an X- ray s tube . The minimum

wavelength of x- ray generated is .....Å .

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8. The wavelength of k_α X- rays produced by an X - rays tube is $0.76Å$. The atomic number of the anode material of the tube is .....

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9. The K-absorption edge of an unknown element is $0.171Å$

a. Identify the element.

b. Find the average wavelength of the $K_\alpha, K_\alpha, K_\beta, K_\gamma$ lines.

c.

If a $100eV$ electron strikes the target of this element , what is the minimum wavelength of the x-ray emitted?

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10. The K_α X-ray emission line of lungsten accurs at $\lambda = 0.021nm$. What is the energy

difference between K and L levels in the atom?

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Practise Exercise

1. Find the energy, the frequency and the momentum of an X-ray photon of wavelength 0.10 nm.

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2. What potential difference should be applied across an X-ray tube to get X-ray of wavelength not less than 0.10 nm? What is the maximum energy of a photon of this X-ray in joule?

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3. Find the maximum potential difference which may be applied across an X-ray tube with tungsten target without emitting any characteristics K or L X-ray. The energy levels of the tungsten atom with an electron knocked

out are as follows.

Cell containing vacancy K L M

Energy in keV 69.5 11.3 2.3

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4. A free atom of iron emits K_α X-rays of energy 6.4 keV. Calculate the recoil kinetic energy of the atom. Mass of and iron atom $= 9.3 \times 10^{-26} kg.$

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5. Iron emits K_α X-ray of energy 6.4 keV and Calcium emits K_α X-ray of energy 3.69 keV. Calculate the times taken by an iron K_a photon and a calcium K_a photon to cross through a distance of 3 km.

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6. The wavelength of K_α X-ray of tungsten is 21.3 pm. It takes 11.3 keV to knock out an electron from the L shell ofa tungsten atom. What should be the minimum accelerating

voltage across an X-ray tube having tungsten target which allows production of k_α X-ray ?

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7. The energy of a silver atom with a vacancy in K shell is 25.31 keV, in L shell is 3.56 keV and in M shell is 0.530 keV higher than the energy of the atom with no vacancy. Find the frequency of K_α, K_β and L_α X-rays of silver.

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Discussion Question

1. In a Coolidge tube, electrons strike the target and stop inside it. Does the target get more and more negatively charged as time passes?

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2. can X-rays be used for photoelectric effect?

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3. X-ray and visible light travel at the same speed in vacuum. Do they travel at the same speed in glass?

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4. Characteristics X-rays may be used to identify the element from which they are coming. Can continuous X-rays be used for this purpose?

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5. Is it possible that in a Coolidge tube characterstic L_α X-rays are emitted but not K_α X-rays?

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6. Can L_α X-ray of one material have shorter wavelength than K_α X-ray of another?

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7. Can a hydrogen atom emit characteristic X-ray?

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8. Why is exposure to X-ray injurious to health but exposure to visible light is not, when both are electromagnetic waves?

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9. When a Coolidge tube is operated for some time it becomes hot. Where does the heat come from?

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10. Can X-rays be polarized?

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11. In termsof biological damage, ionization does more damage when you stand in front of a very weak (low power) beam of X-ray radiation than infront of astronger beam of red light. How does the photon concept explain this paradoxical situation?

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12. Why should a radiologist be extremely cautions about X-ray doses when treating pregnant women ?

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13. Does the concept of photon energy shed any light (no punintended)on the question of why X rays are so much more penetrating than visible light? Explain.

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14. What is the basic distinction between x-ray energy levels and ordinary energy levels ?

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15. Assertion: X-rays cannot be obtained in the emission spectrum of hydrogen atom.

Reason: Maximum energy of photons emitted form hydroen spectrum is 13.6 eV.

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16. How are x- rays produced ? Explain the origin of the line spectra and the continuous

spectra . What limits the minimum size of X - ray wavelengths ?

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17. When a sufficient number of visible light photons strike a piece of photographic film, the film becomes exposed. An X-ray photon is more energetic than a visible light photon. Yet, most photographic films are not exposed by the X-ray machines used at airport security check points. Explain what these observations imply

about the number of photons emitted by the X-ray machines.

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18. In the production of X-rays, it is possible to create Bremsstrahlung X-rays without producing the characteristic X-rays. Explain how this can be accomplished by adjusting the electric potential difference used to operate the X-ray tube.

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19. The short wavelength side of X-ray spectra ends abruptly at a cut off wavelength λ_0. Does this cut off wavelength depend on the target material used in the X-ray tube $>$ Give your reasoning.

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Conceptual Mcq S

1. X-rays are produced when an element of high atomic weight is bombarded by high energy:

A. Protons

B. Electrons

C. Neutrons

D. Photons

Answer:

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2. Which of the following principle is involved in the generation of X - rays ?

A. Conversion of kinetic energy into potential energy

B. Conversion of mass into energy

C. Conversion of electric energy into radiant energy

D. Conversion of electric energy into em waves

Answer:

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3. In X-ray tube , when the accelerating voltage V is halved, the difference between the wavelength of K_α line and minimum wavelength of continuous X-ray spectrum

A. Remains constant

B. Becomes more than two times

C. Becomes half

D. Becomes less than two times

Answer:

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4. The shorted wavelength of X- rays emitted from an X- rays tube depends on

A. The current in the tube

B. The voltage applied to the tube

C. The nature of the gas in the tube

D. The atomic number of the target material

Answer:

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5. To produce hard X - rays in coolidge tube we should increase :

A. Current in filament

B. Potential difference across the filament

C. Potential difference across cathode and anticathode

D. None of above

Answer:

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6. Molybdenum is used as a target element for production of X - rays because it is

A. Heavy element with high melting point

B. Heavy element capable of deflecting electrons

C. Possesses high melting point and can easily absorb the electrons

D. High melting point and high thermal conductivity

Answer:

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7. X-rays from a given X-ray tube operating under specified conditions have a sharply

defined minimum wavelength. The value of this minimum wavelength could be reduced by

A. Increasing the temperature of the filament

B. Increasing the potential difference between the cathode and the target

C. Reducing the pressure in the tube

D. Using a target material of higher relative atomic mass

Answer:

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8. Mosley's law relates the frequencies of line X-rays with the following characteristics of the target element

A. Density

B. Atomic weight

C. Atomic number

D. Interatomic space

Answer:

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9. X- rays are produced in an X- rays tube operating at a given accelerating voltage . The wavelength of the continuous X- rays has values from

A. 0 to ∞

B. $\lambda_{\min}$ to ∞ where $\lambda_{\min} > 0$

C. 0 to $\lambda_{\min}$ where $\lambda_{\max} < \infty$

D. $\lambda_{\min}$ to $\lambda_{\max}$ where

$$0 < \lambda_{\min} < \lambda_{\max} < \infty$$

Answer:

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10. The wavelengths of K_α X-rays from lead isotopes Pb^{204}, Pb^{206} and Pb^{208} are λ_1, λ_2 and λ_3 respectively. Choose the correct alternative.

A. $\lambda_1 = \lambda_2 = \lambda_3$

B. $\lambda_1 > \lambda_2 > \lambda_3$

C. $\lambda_1 < \lambda_2 < \lambda_3$

D. $\lambda_2 = \sqrt{\lambda_1 \lambda_3}$

Answer:

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11. X-rays are used to irradiate sodium and copper surfaces in two separate experiments and stopping potential are determined. The stopping potential is

A. The stopping potential is more for copper than for sodium

B. The stopping potential is more for sodium than for copper

C. The stopping potential is the same for sodium and copper

D. The stopping potential for both will vary as $1/v$

Answer:

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12. Increase in which of the following increases the penetrating power of the X-rays ?

A. Intensity

B. Frequency

C. Wavelength

D. Velocity

Answer:

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13. Which of the following are the characteristics required for the target of produce X - rays ?

	Melting point	Atomic number
A.	High	Low
B.	Melting point	Atomic number
	High	High
C.	Melting point	Atomic number
	Low	Low
D.	Melting point	Atomic number
	Low	High

Answer:

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14. The continuous X - ray spectrum is produced due to :

A. Acceleration of electrons towards the nuclei of the target atoms

B. Retardation of energetic electrons when they approach the nuclei of the target atoms

C. Fall of the electrons of the target atoms from higher energy level to lower energy levels

D. Knocking out of the electrons from the target atoms by the fast moving incident electrons

Answer:

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15. X- rays will not show the phenomenon of

A. Diffraction

B. Polarization

C. Deflection by electric field

D. Interference

Answer:

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16. An X-ray photon of wavelength λ and frequency v colliders with an initially stationary electron (but free to move and bounces off. If λ and v are respectively the wavelength and frequency of the sacattered photon, then:

A. $\lambda' = \lambda, v' = v$

B. $\lambda' < \lambda, v' > v$

C. $\lambda' > \lambda, v' > v$

D. $\lambda' > \lambda, v' < v$

Answer:

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17. Why do we not use X - rays in the RADAR?

A. They can damage the target

B. They are absorbed by the air

C. Their speed is low

D. They are not reflected by the target

Answer:

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18. In a X - ray tube , electrons accelerated through a very high potential difference strike a metal target . If the potential difference is increased , the speed of the emitted X - rays :

A. Increases

B. Decreases

C. Remains unchanged

D. is always equal to $3 \times 10^8 ms^{-1}$ in space

Answer:

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19. X-rays region lies between

A. Visible and short radio waves

B. Ultraviolet and visible region

C. Gamma rays and ultraviolet region

D. Short radio waves and long radio waves

Answer:

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20. A direct X-ray photograph of the intestines is not generally taken by the radiologists because

A. Intestines would burst on exposure to X-rays

B. The X-rays would not pass through the intestines

C. The X-rays would pass through the intestines without casting a good shadow for any useful diagnosis

D. A very small exposure of X-rays causes cancer in the intestine

Answer:

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21. Hydrogen atom does not emit X-rays because

A. Its energy levels are too close to each other

B. Its energy levels are too far apart

C. It is too small in size

D. It has a single electrons

Answer:

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22. When X rays pass through a strong uniform magnetic field. Then they

A. Get deflected along the direction offield

B. Get deflected opposite to the direction offield

C. Get deflected perpendicular to the direction of field

D. Do not get deflected at all

Answer:

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23. White X-rays are called 'white' due to the fact that:

A. they are electromagnetic radiations having nature same as that of white light

B. they are produced most abundantly in X-ray tubes

C. they have a continuous wavelength range

D. they can be converted to visible light using coated screens and photographic plates are affected by them just like light

Answer:

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24. In the X- ray tube before striking the target we accelerate the electrons through a potential difference of volt.For which of the following value of V, we will have X-rays of largest wavelength ?

A. 10 kV

B. 20 kV

C. 30 kV

D. 40 kV

Answer:

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25. In a characteristic X-ray spectra of some atom superimposed on continuous X-ray spectra :

A. P represents K_α line

B. Q represents K_β line

C. Q and P represent K_α and K_β lines respectively

D. Position of K_α and K_β depend on the particular atom

Answer:

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26. For the structural analysis of crystals, X-rays are used because

A. X - rays have wavelength of the order of the interatomic spacing

B. X - rays are highly penetrating radiations

C. Wavelength of X - rays is of the order of nuclear size

D. X - rays are coherent radiations

Answer:

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27. The intensity of X - rays from a Coolidge tube is plotted against wavelength λ as shown in figure -3.8 . The minimum wavelength as found is λ_C and wavelength of the K_α- line is $\lambda_{K'}$. As the accelerating voltage is increased :

A. $(\lambda_K - \lambda_C)$ increases

B. $(\lambda_K - \lambda_C)$ decrease

C. λ_K increase

D. λ_K decrease

Answer:

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Numerical Mcqs Single Options Correct

1. The binding energy of the innermost electron in tungsten is $40keV$. To produce characteristic X - rays using a tungsten target in an X - rays tube the potential difference V between the cathode and the anti - cathode should be

A. 4 kV

B. 40 kV

C. 400 kV

D. 4000 kV

Answer:

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2. When a beam of accelerated electrons hits a target , a continuous X - ray spectrum is emitted from the target. Which of the

following wavelength is absent in X - ray spectrum , if the X - ray tube is operating at $40,000 \text{volts}$?

A. 15Å

B. 0.5Å

C. 0.25Å

D. 1.0Å

Answer:

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3. Electrons with energy $80keV$ are incident on the tungsten target of an X - rays tube , k- shell electrons of tungsten have $72.5keV$ energy X-rays emitted by the tube contain only

A. A continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of about 0.155Å

B. A continuous X-ray spectrum (Bremsstrahlung) with all wavelengths

C. The characteristic X-ray spectrum of tungsten

D. A continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of about 0.155Å and the characteristics X-ray spectrum of tungsten

Answer:

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4. The wavelength of the K_α line for an element of atomic number 57 is λ . What is the wavelength of the K_α line for the element of atomic number29 ?

A. λ

B. 2λ

C. 4λ

D. 8λ

Answer:

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5. An X-raytube is working at potential of 20 KV. The potential difference is decreased to 10 KV. It is found that the difference of the wavelength of K_α X-ray and the most energetic continuous X-ray becomes 4 times the difference before the change ofvoltage.Find the atomic number of the target element.

Take b=1 and $\frac{1}{\sqrt{3.4}} = 0.54$

A. 28

B. 55

C. 56

D. none of these

Answer:

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6. The K_α X-ray emission line of lungsten accurs at $\lambda = 0.021nm$. What is the energy difference between $K$and L levels in the atom?

A. $0.51MeV$

B. $1.2MeV$

C. $59keV$

D. $136eV$

Answer:

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7. In a discharge tube when 200 volt potential difference is applied 6.25×10^{18} electrons move from cathode to anode and 3.125×10^{18} singly charged positive ions move from anode

to cathode in one second. Then the power of tube is:

A. 100 watt

B. 200watt

C. 300watt

D. 400watt

Answer:

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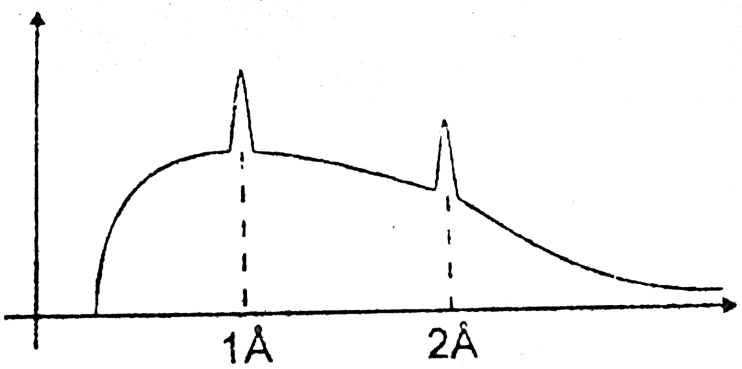
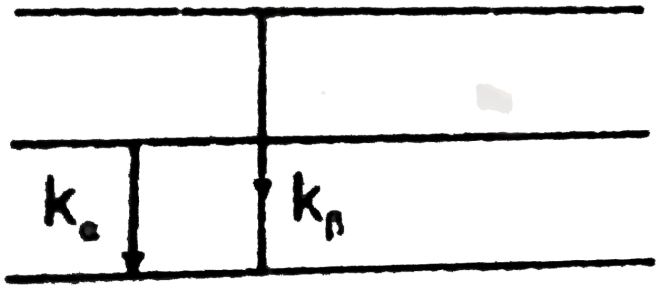
8. Figure shows K_α& K_β X-rays along with continuous X-ray. Find the energy of L_α X-ray. (Use hc = 12420 evÅ)





A. 3.10KeV

B. 4.63 KeV

C. 6.21 KeV

D. 8.42 KeV

Answer:

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9. An element of atomic number 9 emits K_α X-ray of wavelength λ. Find the atomic number of the element which emits K_α X-ray of wavelength 4λ.

A. 25

B. 26

C. 100

D. 99

Answer:

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10. The minimum wavelength of X-rays produced in an X-ray tube is λ when the operating voltage is V. What is the minimum

wavelength of the X-rays when the operating voltage is V/2?

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

B. λ

C. 2λ

D. 4λ

Answer:

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11. The wavelength of k_α X- rays produced by an X - rays tube is 0.76Å . The atomic number of the anode material of the tube is .....

A. 38

B. 40

C. 41

D. 42

Answer:

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12. The voltage applied to an X-ray tube is $18kV$. The maximum mass of photon emitted by the X-ray tube will be

A. 2×10^{-13} kg

B. 3.2×10^{-36} kg

C. 3.2×10^{-32} kg

D. 9.1×10^{-31} kg

Answer:

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13. The battery connected across a coolidge tube operates at a power level of 1 W when the no. of electrons hitting the target in 1 second is 6.25×10^{13}. Find the minimum wavelength in the resulting X-rays spectrum:

A. 0.06 A

B. 0.12 A

C. 0.18 A

D. 0.24A

Answer:

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14. The wavelength of the characteristic X - ray k_α line emitted by a hydrogens like element is 0.32λ . The wavelength of the K_β line emitted by the same element will be .....

A. 0.18 Å

B. 0.27Å

C. 0.38Å

D. 0.48Å

Answer:

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15. An X-raytube produces a continuous spectrum of radiation with its short-wavelength end at 0.33Å. What is the maximum energy of a photon in the radiation?

A. 35.3 k eV

B. 37.6 keV

C. 40.4 keV

D. 42.5 keV

Answer:

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16. The element which has a K_α X-rays line of wavelength 1.8Å is

$\left(R = 1.1 \times 10^7 m^{-1}, b = 1 \text{ and } \sqrt{5/33} = 0.39\right)$

A. Co,Z=27

B. Iron,Z=26

C. Mn,Z=25

D. Ni,Z=28

Answer:

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17. In a coolidge tube, the tungsten (Z=74) target is bombarded by electrons. What is the minimum value of the accelerating potential to enable emission of characteristic K_α and K_β lines of tungsten. (The K,L & M levels of

tungsten have Binding energies of 69.5, 11.3 & 2.30 keV respectively.)

A. 2.3keV

B. 1.3keV

C. 69.5keV

D. 72 keV

Answer:

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18. The potential different across the Coolidge tube is $20kV$ and $10mA$ current flows through the voltage supply. Only $0.5\,\%$ of the energy carried by the electrons striking the largest is converted into X-ray. The power carried by the X-ray beam is p. Then

A. P=0.1 W

B. P=1W

C. P=2W

D. P=10W

Answer:

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19. When the accelerating voltage applied on the electrons, in an X-rays tube, is increased beyond a critical value:

A. The spectrum of white radiation is unaffected

B. Only the intensities of various wavelength are increased

C. Only the wavelength of characteristics radiation is affected

D. The intensities of characteristic lines relative to the white spectrum are increased but there is no change in their wavelength

Answer:

20. The wavelength of K_α X-rays of two metals A and B are $4/1875R$ and $1/675R$, respectively , where R is rydberg 's constant. The number of electron lying between A and B according to this lineis

A. 3

B. 6

C. 5

D. 4

Answer:

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21. A cobalt (atomic no. =27) target is bombereded with electrons and the wavelength of its characteristic x-rays spectrum are measured. A second weak characteristic spectrum is also found due to an impurity in the target. The wavelength of the K_α lines $225.0 \pm$ (cobalt) and $100.0 \pm$ (impurity). Atomic number of the impurity is $(takeb = 1)$

A. 39

B. 40

C. 59

D. 60

Answer:

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22. An X-rays tube is operated at $66kV$. Then , in the continous spectrum of the emitted X-rays :

A. Wavelengths 0.01nm and 0.02nm will both be present

B. Wavelengths 0.01nm and 0.02 nm will both be absent

C. Wavelengths 0.01 nm will be present but wavelength 0.02 nm will be absent

D. Wavelength 0.01nm will be absent but wavelength 0.02nm will be present

Answer:

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23. An X-ray tube is operating at 150 kV and 10 mA. If only 1% of the electric power supplied is converted into X-rays, the rate at which the target is heated in calories per second is

A. 3.55

B. 35.5

C. 355

D. 3550

Answer:

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24. The potential difference applying to an X-ray tube is $5kV$ and the current through it is $3.2mA$. Then the number of electrons striking the target per second is

A. 2×10^{16}

B. 5×10^{6}

C. 1×10^{17}

D. 4×10^{15}

Answer:

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25. A metal block is exposed to beams of X-rays of different wavelength. X-rays of which wavelength penetrate most

A. 2Å

B. 4Å

C. 6Å

D. 8Å

Answer:

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26. The energy ratio of two k_α photons obtined in x -ray from two metal targets of atomic numbes, Z_1 and Z_2 is ,

A. $\frac{Z_1}{Z_2}$

B. $\left(\frac{Z_1}{Z_2}\right)$

C. $\left(\frac{Z_1-1}{Z_2-1}\right)^2$

D. $\sqrt{\frac{(Z_1-1)}{(Z_2-1)}}$

Answer:

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Advance Mcq With One Or More Options Correct

1. Which of the following pairs constitute very similar rediations?

(i) Hard ultraviolet rays and soft X-rays

(ii) Soft ultraviolet rays and hard X-rays

(iii) Very hard X-rays and low-frequency γ-rays

(iv) Soft X-rays and γ-rays

A. Hard ultraviolet rays and soft X-rays

B. Soft'ultraviolet rays and hard X-rays

C. Very had X-rays andlow-frequency y-rays

D. Soft X-rays and y-rays

Answer:

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2. Let $\lambda_{\alpha}{}', \lambda_{\beta}, \text{ and } \lambda'_{\alpha}$ denote the wavelength of the X-ray of the

$K_\alpha, K_\beta,$ and L_α lines in the characteristic X-rays for a metal. Then.

A. $\lambda_\alpha > \lambda_\alpha > \lambda_\beta$

B. $\lambda_\alpha > \lambda_\beta > \lambda_\alpha$

C. $\frac{1}{\lambda_\beta} = \infty$

D. $\frac{1}{\lambda_\alpha} + \frac{1}{\lambda_\beta} = \frac{1}{\lambda_\alpha}$

Answer:

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3. Two electrons starting from rest are accelerated by equal potential difference.

A. They will have same kinetic energy

B. They will have same linear momentum

C. They will have same de Broglie wave length

D. They will produce X-rays of same minimum wave length when they strike different targets.

Answer:

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4. When an electron moving at a high speed strikes a metal surface, which of the following are possible?

(i) The entire energy of the electron may be converted into an X-ray photon

(ii) Any fraction of energy of the electron may be converted into an X-ray photon

(iii) The entire energy of the electron may get

converted to heat

(iv) The electron may undergo elastic collision with the metal surface

A. The entire energy of the electron may be converted into an X-rayphoton.

B. Any fraction of the energy of the electron may beconverted into an X-ray photon

C. The entire energy of the electron may get converted to heat

D. The electron may undergo elastic collision with the metal surface

Answer:

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5. Mark correct statement(s):

A. circumference of orbit of an electron in Bohr's model is equalto an integer

multiple of de Broglie wavelength of the electron

B. Kinetic energy of electron increases with increase of principle quantum number

C. when an X-rayphoton is emitted, only energy conservation law is satisfied

D. none of these

Answer:

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6. In an X-ray tube, the voltage applied is $20kV$. The energy required to remove an electron from$Lshellis19.9keV$ In the X-rays emitted by the tube.

A. Minimum wavelength will be 62.1pm

B. Energy of the characterstic X-rays will be equalto or less than 19.9 KeV

C. L_α X-ray may be emitted

D. L_α X-raywillhaveenergy 19.9KeV

Answer:

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7. In a Coolidge tube experiment, the minimum wavelength of the continuous X-rays pectrum is equal to 66.3 pm,then

A. electrons accelerate through apotential difference of about 12.75 kV in the Coolidge tube

B. electrons accelerate through apotential difference of about 18.75 kV in the

Coolidge tube

C. de-Broglie wavelength of the electrons reaching the anticathode is of the order of 10 mm

D. de-Brgolie wavelength of the electrons reaching the anticathode is 0.01Å

Answer:

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8. The potential difference applied to an X-ray tube is increased. As a result, in the emitted radiation,

A. the intensity increases

B. the minimum wavelength increases

C. the intensity decreases

D. the minimum wavelength decreases

Answer:

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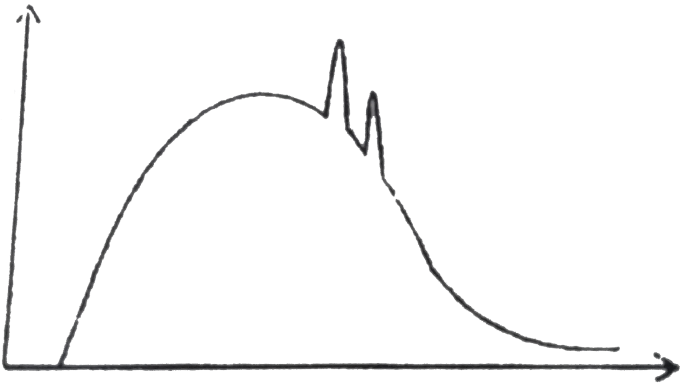
9. 

A beam of electrons striking a cooper target produces X-rays. Its spectrum is as shown. Keeping the voltage same if the copper target is replaced with a different metal, the cut-off wavelength and characteristic lines of the new spectrum will change in comparison with old as:

A. Cut-off wavelength may remain unchanged while characteristic lines may be different.

B. Both cut-off wavelength and characteristic lines may remain unchanged.

C. Both cut-off wavelength and characteristic lines may be different .

D. Cut-off wavelength will be different while characteristic lines may remain

unchanged.

Answer:

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10. Which of the following statements is/are correct for an X-ray tube?

A. on increasing potential difference between filament and target, photon flux of X-rays increases

B. on increasing potential difference between filament and target, frequency of X-rays increases

C. on increasing filament current, cut off wavelength increases

D. on increasing filament current, intensityof X-rays increases

Answer:

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11. The intensity of X-rays from a coollidge tube is plotted against wavelength λ as shown in the figure-3.12. Which ofthe following statements is/are correct:

A. On increasing the Z(atomic number) of target λ_λ decreases

B. On increasing the accelerating voltage of tube $\lambda_k - \lambda_c$ increases

C. On increasing the power of cathode, I_0 increases

D. On increasing the power of cathode, λ_k decreases

Answer:

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12. For a given material, the energy and wavelength of characterstic X-rays satisfy

A. $E(K_\alpha) > E(K_\beta) > E(K_\gamma)$

B. $E(M_\alpha) > E(L_\alpha) > E(K_\alpha)$

C. $\lambda(K_\alpha) > \lambda(K_\beta) > \lambda(K_\gamma)$

D. $\lambda(M_\alpha) > \lambda(L_\alpha) > \lambda(K_\alpha)$

Answer:

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13. The potential difference applied to an X-ray tube is increased. As a result, in the emitted radiation,

A. The intensity increases

B. The minimum wavelength increases

C. The intensity remains unchanged

D. The minimum wavelength decreases

Answer:

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14. X-ray incident on a material

A. Exerts a forceon it

B. Transfer energy to it

C. Transfers momentum to it

D. Transfers impulse to it

Answer:

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15. Regarding X-ray spectrum, which of the following statements is are correct:

A. The characteristic X-ray spectrum is emitted due to excitation of inner electrons of atom

B. Wavelength of characteristic spectrum depend on potential difference across the tube

C. Wavelength of continuous spectrum is dependent on the potential difference across tube

D. None of these

Answer:

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16. Which of the following statements is/are false ?

A. The energy of photoelectrons emitted from agiven metal by soft X-rays have less energy than those emitted by hard X-rays

B. To increase the intensity of X-rays, the filament current should be increased

C. The characteristic X-rays have continuous range of wavelengths

D. X-rays were named so because of their my sterious nature at the time of discovery

Answer:

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17. Which of the following statements is/are true ?

A. The wavelength of soft X-rays is less than that of hard X-rays.

B. X-rays areproduced during acceleration of electron

C. The anticathode is a metal of low atomic weigh

D. The wavelength of the characteristic X-rays depends upon the nature of the

metal of the target

Answer:

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Unsolved Numerica Problem For Preparation

1. The X-ray coming from a Coolidge tube has a cutoff wavelength of 80 pm. Find the kinetic energy of the electrons hitting the target.

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2. If the operating potential in an X-ray tube is increased by 1%, by what percentage does the cutoff wavelength decrease?

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3. The distance between the cathode (filament) and the target in an X-ray tube is 1.5 m. If the cutoff wavelength is 30 pm, find the electric field between the cathode and the target.

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4. The short-wavelength limit shifts by 26 pm when the operating voltage in an X-ray tube is increased to 1.5 times the original value. What was the original value of the operating voltage?

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5. The electron beam in a colour TV is accelerated through 32 kV and then strikes the

screen. What is the wavelength of the most energetic X-ray photon?

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6. When 40 kV is applied across an X-ray tube, X-ray is obtained with a maximum frequency of 9.7×10^{18} Hz. Calculate the value of Planck constant from these data.

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7. The K_β X-ray of argon has a wavelength of 0.36 nm. The minimum energy needed to ionize an argon atom is 16 eV. Find the energy needed to knock out an electron from the K shell of an argon atom.

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8. An X-ray tube operates at 40 kV. Suppose the electron converts 70% of its energy into a photon at each collision. Find the lowest three wavelengths emitted from the tube. Neglect

the energy imparted to the atom with which the electron collides.

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9. The Ka X-ray of molybdenum has wavelength 71 pm. If the energy of a molybdenum atom with a K electron knocked out is 23:32 keV, what will be the energy of this atom when an L electron is knocked out?

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10. The electric current in an X-ray tube (from the target to the filament) operating at $40kV$ is $10mA$. Assume that on an average, 1% of the total kinetic energy of the electrons hitting the target are converted into X-rays (a) what is the total power emitted as X-rays and (b) how much heat is produced in the target every second?

11. The k_α X-rays of aluminium (Z = 13) and zinc (Z = 30) have wavelengths 887 pm and 146 pm respectively. Use Moseley\'s law $\sqrt{v} = a(Z - b)$ to find the wavelength of the K_α X-ray of iron (Z = 26).

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12. A certain element emits K_α X-ray of energy 3.69 keV. Use the data from the previous problem to identify the element.

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13. The k_β X-rays from certain elements are given below. Draw a Moseley-type plot of $\sqrt{v}$ versus Z for K_β radiation

Element Ne P Ca Mn Zn Br

Energy (keV) 0.858, 2.14, 4.02, 6.51, 9.57, 13.3.

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14. Use Moseley's law with b = 1 to find the frequency of the K_α X-ray of $La(Z = 57)$ if the

frequency of the K_α X-ray of $Cu(Z = 29)$ is known to be $1 \cdot 88 \times 10^{18}$ Hz.

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15. The K_α and K_β X-rays of molybdenum have wavelengths $0.71A$ and $0.63A$ respectively. Find the wavelength of L_α X-ray of molybdenum.

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16. The wavelength of K_α and L_α X-rays of a meterial are 21.3 pm and 141 pm respectively. Find the wavelength of K_β X-ray of the material.

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17. Heat at the rate of 200 W is produced in an X-ray tube operating at 20 kV. Find the current in the circuit. Assume that only a small fraction of the kinetic energy of electron is converted into X-rays.

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18. In an X- ray tube , electrons accelerated through a potential difference of 15000 volts strike a copper target . The speed of the emitted X - ray inside the tube is â€¦â€¦ m / s

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19. Suppose a monochromatic X-ray beam of wavelength 100 pm is sent through a Young\'s

double slit and the interference pattern is observed on a photographic plate placed 40 cm away from the slit. What should be the separation between the slits so that the successive maxima on the screen are separated by a distance of 0.1 mm?

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20. The wavelength of the characteristic X - ray k_α line emitted by a hydrogens like element is

0.32λ . The wavelength of the K_β line emitted by the same element will be .....

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21. A potential diffrence , the $20kv$ is applied across an X- ray s tube . The minimum wavelength of x- ray generated is .....Å .

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22. Frequency of a photon emitted due to transition of electron of a certain element from $L \rightarrow K$shell is found to be $4.2 \times 10^{18} Hz$ Using Moseley 's law, find the atomic number of the element , given that the Rydberg's constant $R = 1.1 \times 10^{7} m^{-1}$

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23. An x-ray tube is operated at $20kV$ and the current through the tube is $0 \cdot 5mA$. Find (a) the number of electrons hitting the target per

second, (b) the energy falling on the target per second as the kinetic energy of the electrons and the cutoff wavelength of the X-rays emitted.

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