TEST

JEE Mains PYQs Dual nature of radiation and matter (Physics Master Academy)

QUESTIONS

SECTIONS

1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

SECTION INSTRUCTIONS

This section contains 25 mCQs. +4 for every correct answer, -1 for every incorrect answer.

1 The temperature of an ideal gas in 3 dimensions is 300K. The corresponding de-Broglie wavelength of the electron approximately at 300K is [Me = mass of electron = 9×10^{-31}kg; h = Planck's constant = 6.6×10^{-34}Js; kB = Boltzmann constant = $1.38\times10^{-23}JK^{-1}$]

- 6.26nm
- 8.46nm
- 2.26nm
- 3.25nm

Correct: +4 · Incorrect: -1

2 A particle of mass 4M at rest disintegrates into two particles of mass M and 3M respectively having non zero velocities. The ratio of de-Broglie wavelength of particle of mass M to that of mass 3M will be

- 1: 3
- 3:1
- 1:√ 3
- 1:1

Correct: +4 · Incorrect: -1

3 Given below are two statements: one is labeled as Assertion A and other is labeled a Reason R.
Assertion A: An electron microscope can achieve better resolving power than an optical microscope.
Reason R: The de-Broglie's wavelength of the electrons emitted from an electron gun is much less than wavelength of visible light.

In the light of the above statements choose the correct answer from the options given below:

- A is false but R is true
- Both A and R are true and R is the correct explanation of A
- Both A and R are true and R is not the correct explanation of A
- A is true but R is false

Correct: +4 · Incorrect: -1

4 An α particle and a proton are accelerated from rest by a potential difference of 200V. After this de Broglie wavelengths are λ_α and λ_P respectively. The ratio λ_P/λ_α is

- 8
- 2.8
- 3.8
- 7.8

Correct: +4 · Incorrect: -1

5 An electron of mass me and proton of mass $m_p = 1.836\ m_e$ are moving with the same speed. The ratio of their de-Broglie wavelength

$$\frac{\lambda_{electron}}{\lambda_{proton}}$$

will be

- 1/1836
- 918
- 1
- 1836

Correct: +4 · Incorrect: -1

6 An electron, a doubly ionized helium ion (He^{++}) and a proton are having the same kinetic energy. The relation between their respective de-Broglie wavelengths

$\lambda_e, \lambda_{He^{++¿}} \wedge \lambda_p ¿$

is

- $\lambda_e > \lambda_{He^{++¿} > \lambda_p ¿}$
- $\lambda_e < \lambda_{He^{++¿} = \lambda_p ¿}$

- $\lambda_e > \lambda_p > \lambda_{He^{++¿}}$
- $\lambda_e < \lambda_p ¿ \lambda_{He^{++¿}}$

Correct: +4 · Incorrect: -1

7 A particle moving with kinetic energy E has de Broglie wavelength λ. If energy ΔE is added to its energy, the wavelength becomes $\lambda/2$. Value of ΔE is

- E
- 4E
- 3E
- 2E

Correct: +4 · Incorrect: -1

8 A particle 'P' is formed due to a completely inelastic collision of particles 'x' and 'y' having de-Broglie wavelengths 'γ_s' and 'γ_y' respectively. IF x an y were moving in opposite directions, then the de-Broglie wavelength of 'P' is

- $\frac{\gamma_x \gamma_y}{\gamma_x + \gamma_y}$
- $\frac{\gamma_x \gamma_y}{¿\gamma_x - \gamma_y \vee ¿¿}$
- $\gamma_x - \gamma_y$
- $\gamma_x + \gamma_y$

Correct: +4 · Incorrect: -1

9 Two particles move at right angle to each other. Their de Broglie wavelengths are $\lambda_1$and λ_2 respectively. The particles suffer perfectly inelastic collision. The de Broglie wavelength λ, of the knal particle is given by

- $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$
- $\lambda = \sqrt{\lambda_1 + \lambda_2}$
- $\lambda = \frac{\lambda_1 + \lambda_2}{2}$

○ $\frac{2}{\lambda}=\frac{1}{\lambda_1}+\frac{1}{\lambda_2}$

Correct: +4 · Incorrect: -1

10 If the de-Broglie wavelength of an electron is equal to 10^{-3} times the wavelength of a photon of frequency 6×10^{14} Hz, then the speed of electron is equal to (Speed of light = 3×10^{8}m/s; Planck's constant = 6.63×10^{-34}Js; Mass of electron = 9.1×10^{-31}kg)

○ 1.1×10^{6}m/s

○ 1.7×10^{6}m/s

○ 1.8×10^{6}m/s

○ 1.45×10^{6}m/s

Correct: +4 · Incorrect: -1

11 The K_a X-ray of molybdenum has wavelength 0.071nm. If the energy of a molybdenum atoms with a K electron knocked out is 27.5 keV, the energy of this atom when an L electron is knocked out will be___keV. (Round off to the nearest integer)[h = 4.14×10^{-15} eVs, e = 3×10^{8} ms^{-1}]

○ 5

○ 10

○ 15

○ 20

Correct: +4 · Incorrect: -1

12 The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation:

○ intensity

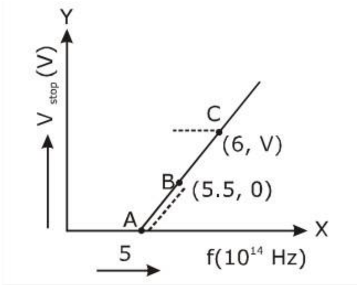
○ amplitude

○ frequency

○ phase

Correct: +4 · Incorrect: -1

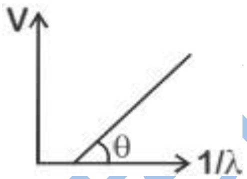
13 Given kgure shows few data points in a photo electric effect experiment for a certain metal. The minimum energy for ejection of electron from its surface is (Planck's constant, h = 6.62×10^{-14}J)



- 2.27eV
- 2.59eV
- 1.93eV
- 2.10eV

Correct: +4 · Incorrect: -1

14 In a photoelectric effect experiment, the graph of stopping potential V versus reciprocal of wavelength obtained is shown in kgure. As the intensity of incident radiation is increased



- Straight line shifts to right
- Slope of the straight line get more steep
- Straight line shifts to left
- Graph does not change

Correct: +4 · Incorrect: -1

15 When the wavelength of radiation falling on a metal is changed from 500nm to 200nm, the maximum kinetic energy of the photoelectrons becomes three time larger. The work function of the metal is close to

- 0.81eV
- 1.02eV
- 0.52eV
- 0.61eV

Correct: +4 · Incorrect: -1

16 Two sources of light emit X rays of wavelength 1nm and visible light of wavelength 500nm. Both the sources emit light of the same power 200W. The ratio of the number density of photons of X rays to the number density of photons of the visible light of the given wavelengths is

- ◯ 1/500
- ◯ 250
- ◯ 1/250
- ◯ 500

Correct: +4 · Incorrect: -1

17 Radiation with wavelength 6561Å falls on a metal surface to produce photoelectrons. The electrons are made to enter a uniform magnetic keld of 3×10^{-4}T. If the radius of the largest circular path followed by the electrons is 10mm, the work function of the metal is close to

- ◯ 1.1eV
- ◯ 0.8eV
- ◯ 1.6eV
- ◯ 1.8eV

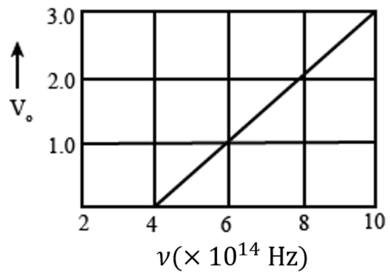
Correct: +4 · Incorrect: -1

18 A beam of electromagnetic radiation of intensity 6.4×10^{-5} W/cm^2 is comprised of wavelength, λ = 310nm. It falls normally on a metal (work function φ =2eV) of surface area of 1cm^2. If one in 10^3 photoelectrons ejects an electron, total number of electrons ejected in 1s is 10^x. (hc = 1240 eVnm, 1eV = 1.6×10^{-19}J), then x is ____

- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 8

Correct: +4 · Incorrect: -1

19 The stopping potential V_0 (in volts) as a function of frequency (v) for a sodium emitter, is shown in kgure. The work function of sodium, from the data plotted in the kgure, will be (Given Planck's constant (h) = 6.63×10^{-34}Js, electron charge, e = 1.6×10^{-19}C)



1.82eV

1.66eV

1.95eV

2.12eV

Correct: +4 · Incorrect: -1

20 In a photoelectric effect experiment the threshold wavelength of light is 380nm. If the wavelength of incident light is 260nm, the maximum kinetic energy of emitted electrons will be :
Given E (in eV) =

1.5eV

3.0eV

4.5eV

15.1eV

Correct: +4 · Incorrect: -1

21 A metal plate of area 1×10^{-4} m^2 is illuminated by a radiation of intensity 16m W/m^2. The work function of the metal is 5eV. The energy of the incident photons is 10eV and only 10% of its produces photo electrons. The number of emitted photo electrons per second and their maximum energy, respectively will be [$1eV = 1.6\times10^{-19}J$]

10^{14} and 10eV

10^{12} and 5eV

10^{11} and 5eV

10^{10} and 5eV

Correct: +4 · Incorrect: -1

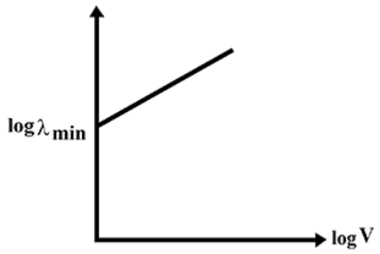
22 Surface of certain metal is krst illuminated with light of wavelength λ_1 = 350nm and then, by light of wavelength λ_2 = 540nm. It is found that the maximum speed of the photoelectrons in the two cases differ by a factor of (2). The work function of the metal (in eV) is close to (Energy of photon =

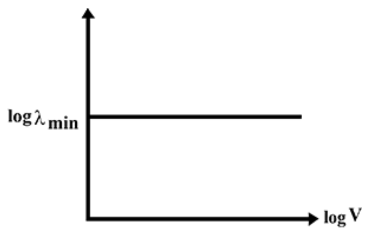
$\frac{1240}{\lambda(¿nm)}eV$)

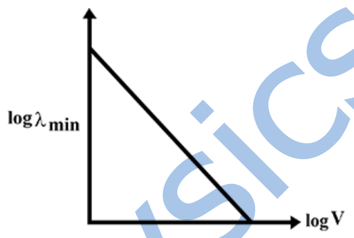
- 1.8
- 2.5
- 5.6
- 1.4

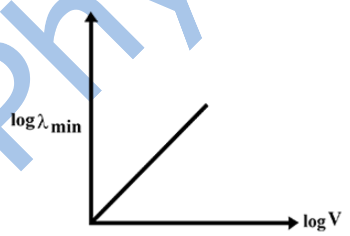
Correct: +4 · Incorrect: -1

23 An electron beam is accelerated by a potential difference V hit a metallic target to produce X rays. It produces continuous as well as characteristic X rays. If λ_{min} is the smallest possible wavelength of X ray in the spectrum, the variation of log λ_{min} with log V is correctly represented in

- 

- 

- 

- 

Correct: +4 · Incorrect: -1

24 Match List I (Fundamental experiment) with List II (its conclusion) and select the correct option from the choices given below the list:

List I	List II
A. Franck Hertz experiment	(i) Particle nature of light
B. Photo electric experiment	(ii) Discrete energy levels of atom
C. Davision Germer experiment	(iii) Wave nature of electrons
	(iv) Structure of atom

- ◯ A-ii; B-i; C-iii
- ◯ A-iv; B-iii; C-ii
- ◯ A-i; B-iv; C-iii
- ◯ A-ii; B-iv; C-iii

Correct: +4 · Incorrect: -1

25 This equation has statement 1 and statement 2. Of the four choices given after the statements, choose the one that describes the two statements.

Statement 1: Davission Germer experiment established the wave nature of electrons.

Statement 2: IF electrons have wave nature, they can interfere and show diffraction

- ◯ Statement 1 is false, Statement 2 is true
- ◯ Statement 1 is true, Statement 2 is false
- ◯ Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.
- ◯ Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

Correct: +4 · Incorrect: -1

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ANSWERS

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Section 1 : Section A - 25 Questions

1 6.26nm

2 1:1

3 Both A and R are true and R is the correct explanation of A

4 2.8

5 1836

6 $\lambda_e > \lambda_p > \lambda_{He^{++¿}¿}$

7 3E

8 $\frac{\gamma_x \gamma_y}{¿\gamma_x - \gamma_y \vee ¿¿}$

9 $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$

10 1.45×10^6m/s

11 10

12 frequency

13 2.27eV

14 Graph does not change

15 0.61eV

16 1/500

17 1.1eV

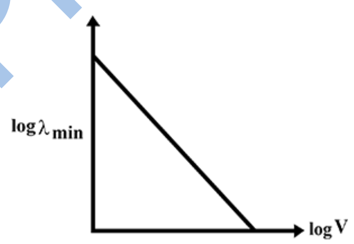
18 11

19 1.66eV

20 1.5eV

21 10^{11} and 5eV

22 1.8

23 

24 A-ii; B-i; C-iii

25 Statement 1 is false, Statement 2 is true

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