UNIT-2 QUANTUMPHYSICS

PART-A QUESTION

Level-I

1) Explain Planck'shypothesis (or)what are the postulates of Planck's quantum theory?

(i) Theelectronsintheblackbodyareassumedassimpleharmonicoscillators.
(ii) Theoscillatorswillnotemitenergycontinuously.
(iii) Theyemitradiationintermsofquanta'sofmagnitude'hv'discreetly. i.e., E=n hvwhere n=1,2,3…

2) What is a black body radiation?

Aperfectblackbodyistheonewhichabsorbsandalsoemitstheradiationscompletely.

In practice no body is perfectly black. We have to coat the black colour over the surface to make a black body.

Black body is said to be a perfect absorber, since it absorbs all the wavelength of the incident radiation.Theblackbodyisaperfectradiator,becauseitradiatesallthewavelengthabsorbedbyit.This phenomenon is also called black body radiation.

3) DefineRayleigh-jeanslaw.Giveitslimitation.

Itisdefinedas"Theenergy(E)isdirectlyproportionaltotheabsolutetemperatureandinversely proportional to the fourth power of the Wavelength"

$$E_\lambda \propto \frac{T}{\lambda^4}$$

$$E_\lambda = \frac{8\pi K_b T}{\lambda^4}$$

Limitation.Itholdsgoodonlyforlongerwavelength.

4) DefineWien'sdisplacementlaw.Giveitslimitation.

Itisdefinedas"TheProductofthewavelength(λ_m)ofmaximumenergyemittedandthe absolute temperature (T) is a constant".

λ_mT=Constant

Limitation.Itholdsgoodonlyforshorterwavelength.

5) DefineComptonEffectandComptonshift.

When a photon of energy 'hv' collides with a scattering element, the scattered beam has two components, viz one of the same frequency (or) wavelength as that of the incident radiation and the other has lower frequency (or) higher wavelength compared to incident frequency (or) wavelength. This effect is called Compton Effect. The change in wavelength is called Compton shift.

6) Statetheprincipleofelectronmicroscope.

In an electron microscope a stream of electron are passed through the object and the electron which carry the information about the object are focused by electric and magnetic lenses (or) electromagnetic lenses.

7) Mentiontheapplicationofelectronmicroscope

[i] Ithasaverywideareaofapplicationsinthefieldofphysics,chemistry,medicineand engineering.

[ii] Itisusedtodeterminethecomplicatedstructureofcrystals.

[iii] Itisusedtodeterminethestructureofmicroorganismssuchasvirus,bacteria,etc

8) StatetheprincipleofSEM?

Electron beam is made to fall on the various portions of the specimen by the scanning coils for scanning the sample. From the secondary electron or back scattered electrons or X-rays that are produced by incoming incident electrons are used to get the information about the specimen's surface, topography, composition etc

9) MentiontheapplicationofScanningelectronmicroscope

[i] Thismicroscopealsohas wide rangeof applications invarious fieldsof physics, chemistry, biology, industry and engineeringetc.

[ii] Itisusedtoexaminethestructureofspecimensinathreedimensionalview.

Level-II

10) WhatisComptonWavelength?Giveitsvalue.

Theshiftinwavelengthcorrespondingtothescatteringangleof90°iscalledCompton wavelength.

WeknowComptonshift$\Delta\lambda = \frac{h}{m_0 c}(1-cos\theta)$

Whenθ=90°; cosθ=0

$\Delta\lambda = \frac{6.625X10^{-34}}{(9.11X10^{-31})(3X10^{8})}$

Δλ=0.02424Å

11) Statede-Broglie'shypothesis(or)Explaintheconceptofwavenature

The light exhibits the dual nature (i.e) it can behave both as a particle and the wave debrogliesuggested that an electron, which is particle can also behave as a wave and exhibits the dual nature.

Thusthewavesassociatedwithamaterialparticlearecalledasmatterwaves.

Ifvisthevelocity andm isthemassoftheparticlethen

de-Brogliewavelength$\lambda = \frac{h}{mv}$

12) Whatisthephysicalsignificanceofawavefunction?

[i] Theprobabilityoffindingaparticleinspaceatanygiveninstantoftimeischaracterizedbya function (x.y,z), called wave function.

[ii] Itrelatestheparticleandthewavestatistically.

[iii] Itgivestheinformationabouttheparticlebehavior.

[iv]It is a complex quantity.

[v]$|\Psi|^2$representstheprobabilitydensityoftheparticle,whichisrealandpositive.

13) Writedowntheschroedingerwaveequationandgiveanytwoapplicationofit.

[i] schroedingertimedependentwaveequation,given by

E=HWhereE

=Totalenergyoftheparticle

H=Hamiltonianoperator

=Wave function

[ii] schroedingertimeindependentwaveequation,given by

$$\Delta^2 + \frac{2m}{}[E-v]=0$$

Where E= Total energy of the particle

V=Potentialenergyoftheparticle m

=Mass of the particle

Application

[i] Itisusedtofindtheelectroninthemetal.

[ii] Itisusedtofindtheenergylevelofanelectroninaninfinitedeeppotential well.

14) Whatismeantbydegenerateandnon-degeneratestate?

Degenerate state

Forvariouscombinationsofquantumnumbersifwegetsame Eigenvaluebutdifferent Eigen function, then it is called degenerate state.

Non-degeneratestate

Forvariouscombinationsofquantumnumbersifwegetsame Eigenvaluebutsame Eigenfunction, then it is called Non -degenerate state.

Level-III

15) Whatismeantbyphoton?Giveanytwoproperties.

Photonsarediscreteenergyvaluesintheformofsmallquanta'sofdefinitefrequency (or) wavelength.

Properties

[i] Theydonothaveanychargeandtheywillnotionize.

[ii] Theenergyandmomentumofthephotonisgivenby

E=hvandp=mc

Where v=frequency h=Planck'sconstant

m-Massof photon c=velocityof photon

16) Whatismeantbywavefunction?

Wave function is a variable quantity that is associated with a moving particle at any position (x.y, z) and at any time‘t’. It relates the probability of finding the particle at that point at that time.

17) Writedowntheonedimensionalschroedingertimeindependentequationandwritethesamefor a free particle.

Theonedimensionalschroedingertimeindependentequationisgivenby

$$\frac{d^2}{dx^2} + \frac{2}{}[E-v]=0$$

Forafreeparticle,thepotentialenergyiszero.Thereforeit becomes

$$\frac{d^2}{dx^2} + \frac{2m}{}E=0$$

18) Definenormalisationprocessandwritedownthenormalisedwavefunctionforanelectronina one dimensional potential well of length ‘a’ metres

Normalisationistheprocessbywhichtheprobabilityoffindingaparticleinsideany potential well can be done.

Foraonedimensionalpotentialwelloflength‘a’metrethenormalisedwavefunctionis givenby

$$_n = \sqrt{\frac{2}{a}} \sin\frac{n\pi x}{a}$$

19) DefineEigenvalueandEigenfunction.

Eigenvalueisdefinedasenergyoftheparticle(E_n).

Eigenfunctionisdefinedaswavefunctionoftheparticle($_n$).

20) DefineMagnifyingpower

$$\text{Magnifyingpower(M)} = \frac{\text{Anglesubtendedbythefinalimageateye}(\beta)}{\text{Anglesubtentedbytheobjectateyekeptatthenearpoint}(\boldsymbol{\alpha})}$$

QUANTUMPHYSICS PART–CQUESTION

Withtheconceptofquantumtheoryofblackbodyradiationderiveanexpressionforenergy distribution and use it to prove wine's displacement law and Rayleigh –Jeans law

What are matterwaves? Explainde-Brogliewaves.

Deduceschroedinger'stimeindependentandtimedependentequation

Listoutthephysicalsignificanceofwavefunction.Explaintheapplication of Schroedinger wave equation to one dimensional potential well

Explain the construction and working of an electron microscope. Mention their merits and application.

TheapplicationofSchrodingerwaveequationtoonedimensionalpotential well.