Question Paper

Exam Date & Time: 15-Nov-2019 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATIONS
NOVEMBER-2019
I SEMESTER B.Sc. (Applied Sciences) in Engg.
PHYSICS - I [IPH 111 - S2]

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

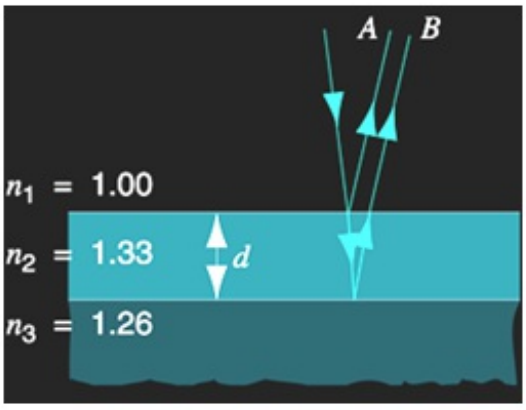
Physical Constants:
Elementary charge: 1.6×10^{-19} C
Mass of electron: 9.1×10^{-31} kg
Boltzmann constant: 1.38×10^{-23} J/K
Planck's constant: 6.625×10^{-34} J.s
Stefan-Boltzmann constant: 5.67×10^{-8} W/m2K4
Speed of light in vacuum: 3.0×10^{8} m/s

1) Discuss qualitatively, the Fraunhofer diffraction at a single-slit with necessary diagram. (4)

A)

B) Give the schematic plot of the intensity of light in a double-slit interference against phase-difference. (2)

C) The wavelength of the incident light is λ= 572 nm, rays A and B in figure are out of phase by 1.50 λ. Find the thickness d of the fllm. (4)



2) Using the energy and momentum conservation, derive an expression for the wavelength of the scattered photon (λ') in Compton effect experiment. (5)

A)

B) A beam of light is linearly polarized in the vertical direction. The beam falls at normal incidence on a polarizing sheet with its polarizing direction at 58.8° to the vertical. The transmitted beam falls, also at normal incidence, (2)

on a second polarizing sheet with its polarizing direction horizontal. The intensity of the original beam is 43.3 W/m^2. Find the intensity of the beam transmitted by the second sheet.

C) Light of wavelength 500 nm is incident normally on a diffraction grating. If the third-order maximum of the diffraction pattern is observed at 32.0° (a) what is the number of rulings per centimeter for the grating? (b) Determine the total number of primary maxima that can be observed in this situation. (3)

3) Give a brief account of tunneling of a particle through a potential energy barrier. (4)

A)

B) Electrons are ejected from a metallic surface with speeds ranging up to 4.60 x 10^5 m/s when light with a wavelength of 625 nm is used. (a) What is the work function of the surface? (b) What is the cut-off frequency for this surface? (4)

C) Find the minimum kinetic energy of a proton (assume non-relativistic situation) confined within a nucleus having a diameter of 1.0 x 10^{-15} m. (2)

4) Calculate the most probable value of r for an electron in the ground state of H-atom. (5)

A) The wave function for an electron in H-atom is

$$\psi_{1S}(r) = \frac{1}{\sqrt{\pi a_0^3}} \exp\left(-\frac{r}{a_0}\right)$$

B) Sketch schematically, the lowest two energy states, wave-functions, probability densities for the particle in a potential well of finite height. (2)

C) Give the physical interpretation of the three integral quantum numbers. (3)

5) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids. (3)

A)

B) Write down Fermi-Dirac distribution function and hence define fermi energy. (2)

C) (i) Each atom of gold contributes one electron to the metal. Compute the Fermi energy for gold. (ii) Calculate the energy of a conduction electron in silver at 800 K, assuming the probability of finding an electron in that state is 0.950. The Fermi energy is 5.48 eV at this temperature. Given : electron concentration in gold =5.90 x 10^{28}/m^3 (5)

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