Total Page → 4 PHE, 9 → Elements of modern physics

2020

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Date :

Time → 3 Hours
Full marks → 70

UDHB – (IV)
CC – 9

Group A
(compulsory)

1. Answer the following multiple choice question $2 \times 10 = 20$

(i) The deBroglie wavelength of a particle having K.E = E_K is given by

(a) $\lambda = \frac{h}{\sqrt{E_K}}$ (b) $\lambda = \frac{h}{\sqrt{mE_K}}$ (c) $\frac{h}{\sqrt{2mE_K}}$ (d) $\frac{h}{\sqrt{3mE_K}}$

Ans (c) $\frac{h}{\sqrt{2mE_K}}$

(ii) matter waves are

(a) longitudinal (b) electromagnetic (c) show diffraction
(d) always travel with speed of light

Ans → (c) show diffraction

(iii) According to schrodinger, a particle is equivalent to a

(a) wave packet (b) single wave (c) light wave
(d) None

Ans → (a) wave packet

(iv) In momentum representation position operator $\hat{x}_p$ can be written as

(a) $i\hbar \frac{\partial}{\partial p}$ (b) $-i\hbar \frac{\partial}{\partial p}$ (c) $\hbar \frac{\partial}{\partial p}$ (d) $-\hbar \frac{\partial}{\partial p}$

Ans → (b) $-i\hbar \frac{\partial}{\partial p}$

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(v) The energy separation between two successive states for a infinite potential well is given by

(a) $\Delta E \propto (2n+1)$ (b) $\Delta E \propto n$ (c) $\Delta E \propto \sqrt{2n+1}$

(d) $\Delta E \propto (2n-1)$

Ans → (a) $\Delta E \propto (2n+1)$

(vi) Nuclear fusion requires very high temperature because

(a) all nuclear reactions absorb energy

(b) the binding energy must be supplied from an external source

(c) The mass deficit must be supplied

(d) None of above

Ans → (c) The mass deficit must be supplied.

(vii) Typical energies released in nuclear fission and a nuclear fusion reaction are

(a) 50 MeV and 1000 MeV

(b) 200 MeV and 1000 MeV

(c) 1000 MeV and 50 MeV

(d) 200 MeV and 10 MeV

Ans → (d) 200 MeV and 10 MeV

(viii) $_{92}U^{233}$ undergoes successively eight α decays and six β decays. what is the resulting nucleus

(a) $_{92}U^{238}$ (b) $_{82}Pb^{206}$ (c) $_{82}Pb^{210}$ (d) $_{82}Pb^{202}$

Ans → (c) $_{82}Pb^{210}$

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(ix) In a Ruby laser, population inversion is achieved by applying
(a) magnetic field (b) electronic field
(c) both magnetic and electric field
(d) optical pumping

Ans (d) optical pumping

(x) In a He-Ne laser, the laser transition takes place in
(a) He only (b) Ne only (c) Ne first, then in He
(d) He first, then in Ne

Ans → (b) Ne only

Group B

Answer any four question of the following $4 \times 5 = 20$

2. What is wave function? Write down its physical interpretation

3. What are matter waves? Derive de-Broglie wavelength of matter waves.

4. Define position, momentum and energy operator

5. What are eigen values and eigen function?

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6. write down the laws of Radioactive decay

7. what is nuclear fusion? Explain with eg

8. what are spontaneous and stimulated emissions?

9. write down the basic properties of a lasers?

Group C

Answer any two from the following $15 \times 2 = 30$

10. Discuss Davisson – Germer experiment. write down the outcome of this experiment 12+3

11. Derive schrodinger time independent and Time dependent equation. what are probability current densities? 12+3

12. Describe the principle, construction, working of Ruby laser

13. consider a potential barrier

$$V(x) = \begin{cases} V_0 & 0 < x < a \\ 0 & \text{elsewhere} \end{cases}$$

Discuss the solution for schrodinger equation for $E < V_0$. Find Reflection and Transmission coefficient