CITY COLLEGE
Internal Examination 2020
Physics (Hons.) CBCS Semester 4
Paper: CC-9 (Elements of Modern Physics)
Time: 2 Hours; Full Marks: 50

Group-A

*Answer any **five** questions from the following:*   [5×2=10]

1. (a) What is a matter wave?

    (b) If the uncertainty in the position of a particle be determined up to an accuracy of 10^{-10} cm. What is the corresponding uncertainty in the momentum?

    (c) What do you mean by normalization of a wave function?

    (d) The average nuclear binding energy in the range 30<A<170 is almost constant. Explain why this is so.

    (e) What do you mean by 'charge symmetry' and 'chare independence' of nuclear force?

    (f) Is the kinetic energy of the emitted alpha particle from a nucleus equals to the disintegration energy? Explain.

Group-B

*Answer any **five** questions from the following:*   [5×5=25]

2. (a) What do you mean by wave-particle duality? (b) What is the importance of Davisson-Germer experiment?   [3+2]

3. (a) Show that the momentum operator $P_x = -i\hbar \frac{\partial}{\partial x}$ is Hermitian in nature. (b) What is the physical significance of $[x, P_y] = 0$.   [4+1]

4. Prove Ehrenfest theorem $\frac{d}{dt}\langle x \rangle = \frac{\langle p_x \rangle}{m}$.   [5]

5. (a) Explain the origin of asymmetry energy in liquid drop model. (b) Show that the law of conservation of angular momentum is not violated in β-decay if the intrinsic spin of the neutrino is $\frac{1}{2}\hbar$.   [3+2]

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6. (a) Write down the Bethe-Weizsäcker formula for binding energy of a nucleus, explaining all the terms therein. (b) Explain graphically how the binding energy per nucleon varies with mass number on an average, as a result of the various terms mentioned.   [3+2]

7. (a) State and explain Geiger Nuttal law in relation with α-decay. (b) Define mass defect and packing fraction of a nucleus.   [3+2]

Group-C

*Answer any **five** questions from the following:*   [5×3=15]

8. (a) What is photoelectric effect? (b) Define the terms: work function and threshold frequency.   [1+2]

9. (a) What do you mean by 'quanta'? (b) What is the fundamental importance of Planck's constant in quantum mechanics?   [1+2]

10. (a) What is ionization potential? (b) What causes high ionization energy?   [1+2]

11. (a) What is the value of e/m ratio for an electron? (b) What is the physical significance of e/m ratio?   [1+2]

12. (a) Explain tunneling effect in a tunnel diode. (b) Draw the I-V characteristics curve for a tunnel diode.   [2+1]

13. (a) Write down Rydberg's formula for wavelength of the spectral lines of hydrogen atom spectrum. (b) Mention to which series in the emission spectrum of hydrogen, H-alpha line belongs?   [2+1]

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Answer scripts must be emailed to **sem4hcityphysics@gmail.com** within 15 minutes of the end of the examination.