

B.Sc. PHYSICS
FOURTH SEMESTER
ELEMENTS OF MODERN PHYSICS
BSP – 402
[USE OMR FOR OBJECTIVE PART]

SET
A

Duration: 3 hrs.

Full Marks: 70

Time: 30 min.

(Objective)

Marks: 20

Choose the correct answer from the following:

1X20=20

- The probability of finding a particle within a distance dx along the x axis is given by?
a. 1
b. ψ^*
c. $\psi^*\psi$
d. $\psi^*\psi dx$
- The energy of a radiation emitted in quanta is (symbols have usual meaning)
a. $h^2\nu$
b. $h\nu^2$
c. $h^3\nu$
d. $h\nu$
- Which of the following represents the photoelectric equation (symbols have their usual meaning)
a. $h\nu = h\nu_0 + E_k$
b. $h\nu = h\nu_0 + \Phi$
c. $h\nu = \Phi - E_k$
d. $h\nu = h\nu_0 - \Phi$
- Who of the following explained photoelectric effect?
a. Niels Bohr
b. Erwin Schrodinger
c. Max Planck
d. Albert Einstein
- Compton effect reveals the nature of electromagnetic radiation
a. Wave
b. Particle
c. Both
d. None
- Length Contraction happens for whom?
a. Traveller
b. Observer
c. Both
d. None
- When the scattering angle $\phi=0^\circ$, Compton shift $\Delta\lambda$ will be equal to
a. 0.024 \AA
b. 0.048 \AA
c. 0.072 \AA
d. 0
- Which one of the following is the correct form of mass-energy relationship?
a. $E = m^2c$
b. $E = mc^{1/2}$
c. $E = mc^2$
d. $E = m^{1/2}c$
- When a particle is inside a box, the potential inside the box is
a. infinite
b. Finite but not zero
c. 0
d. Equal to total energy

10. Which of the forces can only be found in the nucleus?
 a. Gravitational
 b. Strong
 c. Electromagnetic
 d. None of the Above
11. In 'Ultraviolet catastrophe', Rayleigh-Jeans law fails in the region of
 a. Low frequency
 b. High Frequency
 c. Intermediate frequency
 d. None
12. The mass of an electron under relativistic motion is than the rest mass.
 a. Greater
 b. smaller
 c. equal
 d. unpredictable
13. The De-Broglie wavelength associated with a material particle is (symbols have usual meaning)
 a. $\frac{p}{h}$
 b. $\frac{h}{p}$
 c. $\frac{1}{hp}$
 d. $\frac{p}{h^2}$
14. A free particle has
 a. definite energy, indefinite momentum
 b. definite momentum, indefinite energy
 c. definite energy, definite momentum
 d. indefinite energy, indefinite momentum
15. Which of the following is not a characteristic of a wavefunction?
 a. continuous
 b. single valued
 c. differentiable
 d. physically significant
16. Zeeman effect occurs due to which field?
 a. Electric
 b. Magnetic
 c. Both Electric and Magnetic
 d. None of the Options
17. What is the diameter of an atomic nucleus?
 a. $\sim 10^{-9}\text{m}$
 b. $\sim 10^{-10}\text{m}$
 c. $\sim 10^{-15}\text{m}$
 d. None of the Options
18. Which of the following are the considerations of Schrodinger wave equation?
 a. Classical plane wave equation
 b. De-Broglie's hypothesis
 c. conservation of energy
 d. All of these
19. Schroedinger's wave equation for a moving particle contains
 a. First order time derivative
 b. second order time derivative
 c. both A and B
 d. no time derivative

20. Which pair amongst the following will require the minimum energy input for initiating fusion
- a. H-H
 - b. D-T
 - c. H-He
 - d. None of the Options

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[3]

(Descriptive)

Time : 2 hrs. 30 mins.

Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. Obtain the expression for the energy eigenvalue of a particle confined in an infinite potential well. 10

2. a. What is black body radiation? 3+7=10
b. Describe how Planck's quantum theory explained blackbody radiation.

3. a. Explain photoelectric effect with an appropriate figure. 5+5=10
b. How did Einstein explain the observations of photoelectric effect experiment?

4. a. What is time-dilation? Explain with a figure. 5+5=10
b. Explain length contraction with a figure.

5. a. Explain probability density and normalization of a wave function. 5+5=10
b. Explain the concept of wave-particle duality. Also calculate the wavelength of a material particle based on this hypothesis.

6. a. Explain Zeeman effect with its two types. 6+4=10
b. Prove that it is impossible for an electron to reside within a nucleus

7. a. How will you calculate the semi-empirical mass formula of a nucleus? 6+4=10
b. Differentiate between nuclear fusion and nuclear fission with examples.

8. a. What is a wave function? 3+4+3
b. Explain its significance. =10
c. Write both Schroedinger's time-dependent and time-independent wave equations

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