

**B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2019****SEMESTER – 6: PHYSICS (CORE COURSE)****COURSE: 15U6CRPHY12: RELATIVITY AND SPECTROSCOPY**

*(Common for Regular - 2016 Admission / Supplementary-Improvement 2015/2014 admissions)*

Time: Three Hours

Max. Marks: 60

**Part A (Very short answer questions).**

*(Answer **all** questions) Each question carries 1 Mark*

1. An inertial frame is one in which a body moves with ..... velocity.
2. According to relativity, .....is independent of the relative motion of the observer and source.
3. What is rest energy?
4. The orbital angular momentum of an s-electron is.....
5. Spin quantum number of an electron is -----
6. The fine structure of atomic spectra originate due to -----
7. NMR spectrum belongs to .....region of the electromagnetic spectrum
8. Pure vibrational spectrum of a diatomic molecule consists only of .....
9. Distinguish between Stoke's lines and anti- Stoke's lines.
10. Give the resonance condition for electron spin resonance (ESR).

(1 x 10 = 10)

**Part B (Short answer)**

*(Answer **any seven** questions) Each question carries 2 Marks*

11. Write down the Galilean transformation equations.
12. Discuss the importance of the Michelson-Morley experiment.
13. Find the velocity at which the kinetic energy of a particle becomes equal to its rest energy.
14. Give the features of Rutherford's atom model.
15. What is Paschen – Back effect?
16. Explain the principle of ESR. Discuss the need of microwave sources in ESR spectroscopy.
17. What are the different types of energies possessed by a molecule?
18. Homo-nuclear diatomic molecules do not show vibrational spectra. Why?
19. Distinguish between fluorescence and phosphorescence.

(2 x 7 = 14)

**Part C (Problem/Derivations)**

*(Answer **any four** question) Each question carries 4 Marks*

20. Calculate the mean life time of a particle moving with a velocity  $2.4 \times 10^8 m/s$  . Proper life time of the particle is  $2.5 \times 10^{-8} s$ .
21. At what speed is a particle moving if its mass is two times its rest mass?

22. What is spatial quantization? Draw the possible orientations of the orbital angular momentum vector for  $L = 2$  case.
23. A free electron gives resonance at 9.3 GHz. Find the strength of the field that gives resonance. Given  $g = 2.0023$ . Bohr magneton  $\mu_B = 9.274 \times 10^{-24} J$ .
24. The first line in the rotation spectrum of CO appears at  $3.8424 \text{ cm}^{-1}$ . Calculate the hence the bond length of CO molecule. Mass of carbon atom  $m_C = 1.99 \times 10^{-26} kg$ ; mass of oxygen atom  $m_O = 2.66 \times 10^{-26} kg$ .
25. Calculate the energy of the ground vibrational state of  $H_2$  molecule which has a force constant of 573 N/m. Mass of hydrogen atom =  $1.67 \times 10^{-27} kg$ .

(4 x 4 = 16)

**Part D (Long answer questions)**(Answer **any two** questions). Each question carries 10 Marks

26. Starting from the postulates of special theory of relativity, obtain the Lorentz transformation equations.
27. Using the conservation of momentum, arrive at the relativistic expression for variation of mass with velocity.
28. Distinguish between normal Zeeman effect and anomalous Zeeman effect. Explain anomalous Zeeman effect on the basis of vector atom model.
29. Discuss the theory of rotational spectrum of a diatomic molecule treating it as a rigid rotator.

(10 x 2 = 20)

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