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D – 2590

Reg. No. : .....

Name : .....

Fifth Semester B.Sc. Degree Examination, December 2017
First Degree Programme Under CBCSS
Physics
Core Course – V
PY 1541 – METHODOLOGY IN PHYSICS AND RELATIVISTIC MECHANICS
(2014 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

All Saints' College Trivandrum

SECTION – A

Answer **all** questions in **one** or **two** sentences. **Each** question carries **one** mark.

1. What is the significance of standard deviation of a set of measurements ?
2. What are spurious measurements ? How are they taken care of ?
3. Define generalized momentum.
4. Give the dimensions of the Hamiltonian function.
5. Can earth be considered as an inertial frame.
6. By performing an experiment, can we determine whether a frame is at rest or is moving with uniform velocity ? Explain.
7. What is meant by rest mass ?
8. Explain the mass-energy equivalence in special relativity.
9. Moving clocks go slow. Explain.
10. Distinguish between space-like and time-like intervals. **(10×1=10 Marks)**

SECTION – B

Answer **eight** questions **not** exceeding a paragraph. **Each** question carries **two** marks.

11. Comment on the statement "Error is inevitable in physical measurement".
12. Distinguish between random errors and systematic errors.
13. Explain absolute error and relative error.
14. Describe how the error in measuring length using a marked scale is estimated.
15. Write down the Hamiltonian for a one dimensional harmonic oscillator.
16. Compare Hamiltonians formalism with Lagrangian formalism.
17. What is a fictitious force ? Give an example.
18. Using Galilean transformations, show that the distance between two points is same in all inertial frames.
19. Using the velocity addition rule of special relativity, show that the maximum possible velocity is that of light.
20. Explain length contraction. Does it impose an upper limit on velocity of a particle ?
21. Give the relativistic expression for kinetic energy. Show that for small velocities, it reduces to the non-relativistic expression $\frac{1}{2}mv^2$.
22. Define the components of momentum four-vector. **(8×2=16 Marks)**

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SECTION – C

Answer **any six** questions. **Each** question carries **four** marks.

23. What are the objectives of research ?
24. Explain null hypothesis.
25. Give the number of significant figures in the following results : i) 0.05 mm ii) 1.08 V iii) 3.0×10^8 m/s; iv) 6.625×10^{-34} Js.

26. In an experiment to measure the resistance of a coil, the following results were obtained : 4.615Ω, 4.638Ω, 4.597Ω, 4.634Ω, 4.613Ω, 4.623Ω, 4.659Ω, 4.623Ω . Calculate :
    i) The mean value of resistance.
    ii) Standard deviation of the measured values.

27. Derive Hamilton's equations of motion.

28. Set up the Hamiltonian for a two dimensional harmonic oscillator in Cartesian coordinate system. Hence obtain its equations of motion.

29. A bullet is fired horizontally in the north direction with a velocity of 500 m/s at 30° N latitude. Calculate the horizontal component of Coriolis acceleration and the consequent deflection of the bullet as it hit a target 250 m. away.

30. What is time dilation ? Describe an experiment in support of time dilation.

31. Show that the quantity $x^2 + y^2 + z^2 - c^2t^2$ is invariant under Lorentz transformation.

(6×4=24 Marks)

SECTION – D

Answer **any two** questions. **Each** question carries **fifteen** marks.

32. List the important features of scientific method. Describe the various steps involved in scientific research.

33. Explain what is meant by experimental research. Discuss repeatability and replication in experimental design. Describe the importance of documentation of experiments.

34. Outline the general format of thesis writing with elaborate description of different components.

35. State the postulates of special theory of relativity. Hence deduce the Lorentz transformation equations.

(2×15=30 Marks)

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