K20U 1842

Reg. No. : .....

Name : .....

III Semester B.Sc. Degree CBCSS (OBE) – Regular Examination, November 2020
(2019 Admission Only)
CORE COURSE IN PHYSICS
3B03 PHY : Mechanics – II

Time : 3 Hours Max. Marks : 40

PART – A

(Short answer questions, answer **all** questions, **each** question carries **1** mark.)

1. What is meant by fictitious forces ?
2. Briefly explain the general properties of central force motion.
3. Establish the differential equation of a harmonic oscillator and write down its general solution.
4. Write down the general expression for a plane progressive wave traveling in (a) positive x direction (b) negative x direction.
5. State the postulates of special theory of relativity.
6. Elucidate the salient feature of relativistic Doppler effect. **(6×1=6)**

PART – B

(Short essay questions, answer **any 6** questions, **each** question carries **2** marks.)

7. Two particles are interacting under a central force. Explain how a two body problem can be reduced to a one body problem.
8. Explain the principle of equivalence.
9. Consider two frames of references S and S′, having same origin and S is rotating with an angular velocity Ω with reference to S. Using the operator identity, show that $\left(\frac{dB}{dt}\right)_S = \left(\frac{dB}{dt}\right)_{S'} + \Omega \times B$ where B is some fixed vector.

P.T.O.

10. State Fourier theorem. What are the conditions to apply Fourier theorem ?

11. Obtain an expression for the velocity of longitudinal waves in rods.

12. Write down the formula for the relativistic addition of velocities. Two electrons move towards each other, the speed of each being 0.9c in a Galilean frame of reference. What is their speed relative to each other ?

13. Write down the Lorentz coordinate transformation equation. Show that Lorentz coordinate transformation reduce to Galilean transformation when $u << c$.

14. Obtain an expression for the relativistic kinetic energy and relativistic total energy. **(6×2=12)**

PART – C

(Problems, answer **any 4** questions, **each** question carries **3** marks.)

15. A small weight of mass m hangs from a string in a car which accelerates at a rate A. What is the static angle of the string from the vertical and what is its tension ? Analyze the problem both in an inertial frame and in a frame accelerating with the car.

16. Halley's Comet is in an elliptic orbit about the Sun. The eccentricity of the orbit is 0.967 and the period is 76 years. The mass of the Sun is 2×10^{30} kg and $G = 6.67 \times 10^{-11}$ N.m^2/kg^2.

    a) Using these data, determine the distance of Halley's Comet from the Sun at perihelion and at aphelion.

    b) What is the speed of Halley's Comet at aphelion if its speed at perihelion is 5.45×10^4 m/s ?

17. Calculate the quality factor Q for the following cases and comment on the results (a) A Musician's tuning fork rings at middle frequency 440 Hz. A sound level meter indicates that sound intensity decreases by a factor of 5 in 4 seconds. (b) A paper weight suspended from a rubber band had a period of 1.2 seconds and amplitude of oscillation decreased by a factor of 2 after three periods.

18. If the velocity of sound in hydrogen at a certain temperature is 1300 m/s. Calculate the velocity at the same temperature in a diatomic gas of molecular weight 32.

19. An electron having rest mass energy 511 keV is moving with a total energy 1.3 MeV. Find its momentum and speed.

20. A particle is in a circular orbit under the action of an attractive central force given by $f(r) = k/r^3$, where k is a constant. Obtain an expression for the angular momentum and show that it is a constant. **(4×3=12)**

PART – D

(Long essay questions, answer **any 2** questions, **each** question carries **5** marks.)

21. State and explain Kepler's laws of planetary motion. Prove second and third law.

22. Establish the differential equation of motion for a damped harmonic oscillator and write down the general solution for displacement for oscillatory motion and sketch it. Show that the energy falls exponentially with time.

23. Explain Michelson-Morley experiment and explain the results obtained from the experiment. Write a short note on any two experimental tests of special theory of relativity.

24. Justify the statement "there is no such thing as absolute length or absolute time in relativity". Briefly explain (a) time dilation, (b) length contraction, (c) twin paradox. **(2×5=10)**
