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Name.....................................

Reg. No...............................

THIRD SEMESTER B.Sc. DEGREE (SUPPLEMENTARY) EXAMINATION NOVEMBER 2016

(UG—CCSS)

Physics/Applied Physics

PH 3B 05/AP 3B 05—MECHANICS

(2009—2012 Admissions)

Time : Three Hours

Maximum : 30 Weightage

Section A

Answer all **twelve** *questions.*
Each question carries ¼ weightage.

1. In view of Lorentz Transformation, if two events at two different points are simultaneous in one inertial frame, they are ————— in another frame in constant relative motion with respect to first frame.

2. Generalized co-ordinates :

    (a) Depend on each other.

    (b) Are independent of each other.

    (c) Are necessarily spherical co-ordinates.

    (d) May be Cartesian co-ordinates.

3. If Langrangian does not depend on time explicitly :

    (a) The Hamiltonian is constant.   (b) The Hamiltonian cannot be constant.

    (c) The kinetic energy is constant.   (d) The potential energy is constant.

4. Escape velocity from earth is 11.2 km/sec. If a body is to be projected in a direction making an angle 45° to the vertical, then the escape velocity is :

    (a) 11.2×2 km/sec.   (b) 11.2 km/sec.

    (c) $11.2 \times \dfrac{1}{\sqrt{2}}$ km/sec.   (d) $11.2 \times \sqrt{2}$ km/sec.

5. The angular speed of a body changes from ω_1 to ω_2 without applying a torque, but due to change in moment of inertia. The ratio of radii of gyration in two cases is :

    (a) $\omega_2 : \omega_1$.   (b) $\sqrt{\omega_1} : \sqrt{\omega_2}$.

    (c) $\sqrt{\omega_2} : \sqrt{\omega_1}$.   (d) $\omega_1 : \omega_2$.

Turn over

6. Two identical solid spheres of radius r are touching each other. The force of attraction between them is proportional to :

    (a) r^6.
    (b) r^4.

    (c) r^2.
    (d) r^{-2}.

7. An electron gains energy so that is mass becomes $2\,m_0$. Its speed is :

    (a) $\dfrac{\sqrt{3}}{2}\,c$.
    (b) $\dfrac{3}{4}\,c$.

    (c) $\dfrac{3}{2}\,c$.
    (d) $\sqrt{\dfrac{3}{2}}\,c$.

8. In Minkovski space :

    (a) The space interval between two points is invariant.

    (b) The time between two points is invariant.

    (c) The space-time interval between two points is invariant.

    (d) The space-time interval between two points is different for different observers.

9. Roulette dancer while performing stretches out his hands, then :

    (a) He loses balance and falls down.

    (b) His motion becomes faster.

    (c) His motion slows down.

    (d) Nothing happens.

10. Which of the following is not associated with central force ?

    (a) Hookes Law.
    (b) Coulomb's law.

    (c) Newton's Law of gravitation.
    (d) Stefan's Law.

11. Energy of Gamma-radiation is of the order of :

    (a) eV.
    (b) meV.

    (c) keV.
    (d) MeV.

12. The gravitational potential inside a solid sphere is :

    (a) Constant everywhere.

    (b) Zero everywhere.

    (c) A linear function of distance from center.

    (d) An inverse square law function of distance from centre.

Section B

Answer all questions.
Each carries 1 weightage.

13. What do you mean by frame of reference ?

14. What are transformation equations ?

15. What is the significance of negative results of Michealson-Morley experiment ?

16. Give concept of length contraction.

17. What are Holonomic Constraints ? Give an example.

18. State the law of conservation of angular momentum and three examples.

19. State Kepler's Laws of planetary motion.

20. Write the expression for final velocity of a rocket and comment on its value at any instant of its motion with reference to the rocket parameters.

21. What is meant by Hamiltonian of a system ? Write the expression relating Hamiltonian and Langrangian of a system.

$(9 \times 1 = 9$ weightage)

Section C

Answer any five questions.
Each carries 2 weightage.

22. Show that $x^2 + y^2 + z^2 - c^2 t^2$ is invariant under Lorentz Transformation.

23. Show that the work done by a conservative force around a closed path is always zero.

24. The homogeneity of space implies that the linear momentum is a constant of motion. Substantiate.

25. Two bodies identical mass, one with a kinetic energy while the other at rest undergoes elastic collision. Comment on the kinematics of these bodies using appropriate equations.

26. A mass of 50 kg is raised to a height of 2R from earth's surface ; calculate the change in potential energy, $(g = 9.8$ ms $^{-2} : R = 6.5 \times 10^6$ m$)$

27. A simple pendulum of length l and having a bob of mass m is suspended from a rigid support and oscillating. Obtain the expression for Langrangian of this system and equation of motion of simple pendulum.

28. What is meant by Four-Vector in Mechanics ? Show that a four vector is unchanged under Lorentz Transformation.

$(5 \times 2 = 10$ weightage$)$

Section D

Answer any **two** *questions.*
Each carries 4 weightage.

29. A reference frame "*a*" rotates with respect to another reference frame "*b*" with uniform angular velocity "*ω*." If the position, velocity and acceleration of frame "*a*" is represented by R, V$_a$, f$_a$ respectively, show that the acceleration of that particle in the frame "*b*" is given by f$_b$, where

$$f_b = f_a + 2\omega \times V_a + \omega \times (\omega \times R).$$

30. Derive the expressions for the gravitational potential and field due to a hollow sphere at a point

    (i)   Outside the sphere.

    (ii) On the surface of the sphere ; and

    (iii) Inside the sphere.

Substantiate your answer with proper labeled diagrams and graphs.

31. (i) Explain with proper diagram the geometrical interpretation of Lorentz Transformation.

    (ii) Discuss the principle of covariance.

(2 × 4 = 8 weightage)