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Reg. No. : .....

Name : .....

Second Semester B.Sc. Degree Examination, May 2020.

First Degree Programme under CBCSS

PHYSICS

Foundation Course – II

PY 1221 – CLASSICAL MECHANICS

(2014-2017 Admns)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in one or two sentences. Each carries **1** mark.

1. Lagrangian of a system is given by L, where T is kinetic energy and U is potential energy of the system, then L = ————————.

2. If the generalized coordinate is angle θ, the corresponding generalized force has the dimension of ————————.

3. What is impulse?

4. The electron, proton, alpha particle and neutron have same kinetic energy. The momentum Will be maximum for ————————.

5. What do you mean by degree of freedom?

6. What are the condition for the orbit be hyperbola, parabola, ellipse and circle?

7. What is impact parameter?

P.T.O.

8. Elastic force is non conservative force. (State whether true or false).

9. A particle is under influence of force F and has instantaneous velocity v, the rate at which its kinetic energy is changing is (dK/dt) _____.

10. A shell of mass m is moving with velocity v suddenly explodes into two pieces, one pact of is m/4 remains stationary. The velocity of the other part will be _____.

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. What are constraints? Explain holonomic and nonholonomic constraints?

12. Is the Lagrangian formulation more advantageous than Newtonian formulation? Why?

13. State Newton's laws of motion.

14. Distinguish between centre of mass and centre of gravity?

15. What is meant by an 'inertial mass' and 'gravitational mass'? Is there any difference between these two?

16. When a force field is said to be conservative? Give illustration.

17. Sketch the trajectory of a charged particle placed in uniform magnetic field when

    (a) velocity and magnetic field are perpendicular

    (b) velocity have one component along magnetic field direction.

18. Show that rotational invariance of space requires motion under a central force and leads to the conservation of angular momentum.

19. Distinguish between elastic and inelastic collisions.

20. Show that angular momentum is conserved in motion under central force.

21. Show that work done is equal to change in kinetic energy.

22. Distinguish between differential and total cross section.

(8 × 2 = 16 Marks)

SECTION – C

Answer **any six** questions. Each Carries **4** Marks.

23. Obtain equation of motion of a simple pendulum using Lagrangian method and hence deduce the formula for its time period for small amplitude oscillations.

24. Obtain the equation of motion of a system of two masses, connected by an inextensible string passing over a small smooth pulley.

25. The centre of masses of 3 kg, 2kg and 1 kg is at the point (3,3,3). Where could be a mass of4 kg to be placed so that the centre shifts to (1, 1, 1)?

26. How does a two-body problem reduce to a one-body problem?

27. The earth is moving around the sun under gravitational force and its orbit has semi- major axis 1.495×10^6 km. When the earth passes closest to the sun at its perihelion its distance is 1.47×10^8 km and its orbital velocity is 0.303 km/s. Find the velocity of the earth at the aphelion and its angular velocities at these points.

28. Check the force $F = (y - x^2)\hat{i} + 3xy\hat{j}$ is conservative or not?

29. A particle of mass m1 and moving with a velocity u, is elastically scattered from another particle of mass m_2 at rest. After the collision, the two particles move in opposite direction with the same speed. Find the mass of the target in terms of the mass of incident particle.

30. The Scattering angle for a heavy particle of mass m_1 colliding elastically with a light target of mass m_2 is found to be ϕ in the lab system and θ in the CM system. Show that ϕ will be maximum when $\cos\theta = m_2/m_1$ and that

$$\tan\phi_{max} = \left[\frac{m_2}{m_1 - m_2}\right]$$

31. An electron is accelerated through a potential difference of 1.0 *kV* and directed into a region between two parallel plates separated by 20 mm with a potential difference of 100 *V* between them. The electron is moving perpendicular to the electric field of the plates when it enters the region between the plates. What uniform magnetic field, applied perpendicular to both the electron path and the electric field, will allow the electron to travel in a straight line?

(6 × 4 = 24 Marks)

SECTION – D

Answer **any two** questions. Each carries **15** Marks.

32. What are generalized coordinates? Derive Lagrange's equation from d' Alemberts Principle.

33. State and prove the Kepler's laws of planetaiy motion.

34. Derive an expression for elastic scattering cross section.

35. Derive the equation of motion of a particle and discuss the motion of a particle

    (a) under constant force

    (b) subjected to resistive force

(2 × 15 = 30 Marks)
