Kavin's Physics Study Materials

TRB (SCERT-DIET)-2016

Classical Mechanics

Test –I

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Classical mechanics

1. The number of degrees of freedom of two particles constrained to move in a plane with fixed distance between them is
   a) 3
   b) 4
   c) 2
   d) 1

2. For a system described by the lagrangian $L = \frac{m}{2}(\dot{x}^2 + \dot{y}^2 + \dot{z}^2) - mgz$, where g is a constant
   a) X and z are cyclic coordinates
   b) y and z are cyclic coordinates
   c) X and y are cyclic coordinates
   d) Z is a cyclic coordinates

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3. In the description of an object rolling on a rough surface without slipping, the description of its motion involves
   a) a holonomic constraint
   b) a rhenomic constraint
   c) a non-holonomic constraint
   d) a scleronomic constraint

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4. The angular frequency of a particle with mass m executing a uniform circular motion under the influence of a central potential $V(r) = kr^2$
   a) $\sqrt{\frac{k}{2m}}$
   b) $\sqrt{\frac{k}{m}}$
   c) $\sqrt{\frac{3k}{2m}}$
   d) $\sqrt{\frac{2k}{m}}$

5. Lagranges equation of motion is
   a) a second order differential equation
   b) dependent on co-ordinates used
   c) Independent of time
   d) a first order diff, eqn

6. If the defining relations of the generalized coordinates do not depend explicitly on time and the potential is not velocity dependent, then the Hamiltonian is given by
   a) $H = T - V$
   b) $H = 2T - L$
   c) $H = 2T + L$
   d) $H = L - 2T$

7. A generalized force F acts on a system of particles. Then
   a) F will always have the dimensions of a force.
   b) F can sometimes have the dimensions of a force
   c) F will never have the dimensions of a force
   d) $\int Fdq$ will sometimes have dimensions of energy, where q is the generalized coordinate.

8. The number of generalized co-ordinates required to describes the position of the simple pendulum is
   a) 2
   b) 4
   c) 1
   d) 3

9. In the classical scattering of a particle in a central force field
   a) The angle of scattering increases when the impact parameter decreases.
   b) The angle of scattering increases when the impact parameter increases
   c) The angle of scattering first increases as the impact parameter increases then remains constant

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d) The angle of scattering is independent of the impact parameter.

10. A central force F acts on a particle. Then it Experiences a force directed along the radial direction only
   a) Always moves normal to the radial direction
   b) Always moves in the radial direction only
   c) Always moves in a circular orbit.

11. H represents the Hamiltonian and L represents the lagrangian of a system of particles. What can be said about the dependence of these quantities on the kinetic energy T and potential energy V of the system?
   a) H depends only on T and L depends only on V
   b) H depends only on V and L depends only on T
   c) H depends only on T but L depends on bot T and V
   d) Both H and L depends on T and V

12. Lagrange's equation of motion is described by
   a) Second order differential equation
   b) Energy consideration not by force
   c) Hamilton's principle of conservative system
   d) All the above

13. The Hamiltonian represents
   a. Potential energy
   b. total energy
   c. Kinetic energy
   d. difference in energy

14. The Hamilton canonical equation relates
   a) $p_j = \frac{\partial H}{\partial q_j}$
   b) $\dot{p}_j = \frac{\partial H}{\partial q_j}$
   c) $p_j = -\frac{\partial H}{\partial q_j}$
   d) none of these

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15. The angular momentum of a rotating body is said to be conserved if
    a) External force in zero
    b) external torque is zero
    c) Linear momentum is zero
    d) linear momentum is constant

16. Notation is rotation about
    a) Body axis
    b) line of nodes
    c) Space axis
    d) none specific

17. Newton's laws are not valid if
    a) Bodies are in contact with each other
    b) Observers are moving at constant velocity
    c) Reference frame is at rest of fixed
    d) Reference frame is rotating

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18. From Newton's II law of motion in the eqn $\frac{\overrightarrow{dp}}{dt} = \vec{F}$ linear momentum is conserved if
    a) Total force is zero
    b) total force is non-zero
    c) ang momentum changes
    d) ang.momentum doesn't changes

19. In phase space diagram of a dynamical system a point represents if n=df
    a) n, momentum coordinates p_i
    b) n, generalised coordinates q_i
    c) 2n momentum and generalize coordinates (p_j, q_j)
    d) 2n space and rotation coordinates.

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20. In phase space …..is invariant under canonical transformations.
    a) Momentum
    b) Energy
    c) Angular velocity
    d) Volume

21. In the laboratory a particle A has velocity v, another particle B has velocity –v, the velocity of A relative to B is
    a) $2v$
    b) $\frac{2v}{(1+v^2c^2)}$
    c) $\frac{2v}{(1-v^2c^2)}$
    d) $\frac{2v}{\sqrt{(1-v^2c^2)}}$

22. A cyclic coordinates does not explicity appear in
    a) Lagrangian only
    b) Hamiltonian only
    c) Both lagrangian and Hamiltonian
    d) Conjugate momentum

23. The impact parameter, s defined as the perpendicular distane between the centre of force and the incident velocity this parameter proportional to
    a) E
    b) $E^{\frac{1}{2}}$
    c) E^{-1}
    d) $E^{-\frac{1}{2}}$

24. The orbit is symmetric about the direction of peripsis, the scattering angle is given by
    a) $\Theta = \pi - 2\Psi$
    b) $\Theta = \pi + 2\Psi$
    c) $\Theta = 2\pi - \Psi$

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d) $\Theta = 2\pi + \Psi$

25. The desired relationship between the impact parameter and the scattering angle is
 a) $\frac{zz\prime e^2}{2E} cosec\ \frac{\theta}{2}$
 b) $\frac{zz\prime e^2}{2E} sin\ \frac{\theta}{2}$
 c) $\frac{zz\prime e^2}{2E} cot\ \frac{\theta}{2}$
 d) $\left(\frac{zz\prime e^2}{2E}\right)^2 cosec^4\ \frac{\theta}{2}$

26. In the frame Rutherford scattering cross section, differential scattering cross section is proportional to
 a) e
 b) e^2
 c) e^3
 d) e^4

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27. In Rutherford scattering cross section, the differential scattering cross section is inversely proportional to
 a) Sinθ
 b) $sin^2\theta$
 c) $sin^3\theta$
 d) $sin^4\theta$

28. The angle of recoil of the target particle relative to the incident direction of the scattered particle is
 a) $\frac{1}{2}(\pi - \theta)$
 b) $\frac{1}{2}(\pi + \theta)$
 c) $(\pi - \theta)$
 d) $(\pi + \theta)$

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29. The expression for central force motion is

a) $\vec{F}(r) = \hat{e}_r$

b) $\vec{F}(r) = \hat{e}_r m$

c) $\vec{F}(r) = \hat{e}_r F(r)$

d) $\vec{F}(r) = -\hat{e}_r$

30. The effective potential energy of a particle under central force field is

a) $v_e = \frac{k}{r}$

b) $v_e = \frac{k}{r} + \frac{L^2}{2\mu r^2}$

c) $v_e = -\frac{k}{r}$

d) $v_e = \frac{1}{2} k\mu + m\mu$

31. The force exerted by one particle on the other varies inversely as the square of the distance between them by

a) $F(r) = -\frac{k}{r^2}$

b) $F(r) = -\frac{k^2}{r^2}$

c) $F(r) = -\frac{kx}{r^2}$

d) $F(r) = \frac{k}{r^2}$

32. The equation of the orbit under central field is

a) $\theta - \theta_0 = -\int \frac{du}{\sqrt{\frac{2\mu E}{L^2} + \frac{2\mu K}{L^2} u - u^2}}$

b) $\theta_0 = \int \frac{du}{\sqrt{\frac{2\mu E}{L^2} + \frac{2\mu K}{L^2} u - u^2}}$

c) $\theta = \int \frac{du}{\sqrt{\frac{2\mu E}{L^2} - u^2}}$

d) $\theta - \theta_0 = \int \frac{du}{\sqrt{\frac{2\mu E}{L^2} + \frac{2\mu K}{L^2}}}$

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33. The essentricity of the particle moving under the central force held is

a) $\sqrt{1+\frac{2EL}{\mu}}$

b) $\sqrt{1+\frac{2EL^2}{\mu K^2}}$

c) $\sqrt{\frac{1+2EL^2}{\mu K^2}}$

d) *none of these*

34. A non-holonomic constraint can be expressed as

a) $r^2 - a^2 = 0$

b) $r^2 - a^2 > 0$

c) $r^2 - a^2 \leq 0$

d) none of these

35. Lagrangian L is expressed as

a) $L(q,p,t)$

b) L(q,t)

c) L($\dot{q}$,q,t)

d) none of these

36. The moment of the inertia coefficient is expressed as

a) Ixx

b) Ixy

c) Iyz

d) Izx

37. A system consists of 1000 Particles with constraints' expressed by 10 equations. Then the number of degrees of freedom of the system is

a) 3000

b) 2900

c) 2990

d) 2970

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38. The products of inertia of a body about the principle axes are
   a) Zero
   b) non-zero finite and positive
   c) Non zero, finite, negative
   d) Infinite

39. Which of the following statements is wrong? in the case of Euler's angles
   a) The initial system of axes is rotated anticlockwise
   b) The second rotation is made anticlockwise
   c) The final rotation is made anticlockwise in this case
   d) The rotation are made clockwise + anticlockwise alternately

40. The phase space is
   a) 6 N dimensional space
   b) 3N dimensional space
   c) minkowski's space
   d) Momentum space

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41. The Hamiltonian represents
   a) Potential energy
   b) total energy
   c) Kinetic energy
   d) difference in energy

42. The lagrangian represents the
   a) K.E of a system
   b) P.E. of a system
   c) Sum of K.E and P.E
   d) diff between K.E and P.E

43. Generation of body set of axes from space set of axes through three successive rotations gives
   a) Lorentz transformations
   b) Euler angles

c) a non-orthogonal transformations
d) none of these

44. The no.of independent ways in which a mechanical system can move without vilating any constraint which may be imposed is caused
   a) No. of degrees of freedom of the system
   b) holonmomic constraint
   c) scieronomic constraint
   d) and. momentum doesn’t change

45. If H,L and T represent the Hamiltonian, lagrangian and kinetic energy respectively, the value of (H+L)/T is
   a) Zero
   b) one
   c) two
   d) three
46. For equilibrium of a system, virtual work of the applied forces is
   a) Infinity
   b) Zero
   c) Non-zero
   d) Negative
47. The motion in which the distance between two bodies never exceeds a finite limit is
   a) Unbound motion
   b) Bound motion
   c) Fixed motion
   d) Rotational motion
48. Number of possible modes of the linear symmetric triatomic molecule is
   a) One
   b) Two
   c) Three
   d) Four
49. If the total energy of a particle in a conservative force field is zero, then the velocity obtained in such case is
   a) Zero

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b) Escape velocity
c) Recoil velocity
d) None of these

50. The distance between the two bodies in infinite initially and finally in
a) Unbounded motion
b) Rotational motion
c) Bounded motion
d) Translational motion

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