Program : M.A./M.Sc. (Mathematics)
M.A./M.Sc. (Previous)
Paper Code:MT-05
Mechanics
Section – A
(Very Short Answers Questions)

Note : Each question caries 2 marks and maximum word limit will be thirty to fifty words.

1. Define the impressed forces.

A The external forces acting on a body are called impressed forces.

2. Write the Newton's second Law of motion.

A Newton's second law of motion state that applied force=effective force i.e. F=mf where F is applied force, m is mass of particle, f being the acceleration.

3. Write the moment of Inertia of a circular disc of mass M and radius 'a' about a diameter.

A $\frac{1}{4}Ma^2$

4. Write the product of Inertia of rectangular plate of Mass M and length of sides 2a, 2b about its sides ox and oy.

A Mab

5. Define the centroid of the system.

A Let $\overline{r}$ be the position vector of any particle of Mass m of the system (regid body) relative to a point), then the point with position vector $\overline{r} = \frac{\sum m\overline{r}}{\sum m}$ is defined as the centrod of the system.

6. Write the moment of all the effective forces about oz (axis of rotation).

A $MK^2 = \frac{d^2\theta}{dt^2}$

7. Write the Radial acceleration

A $\ddot{r} - r\dot{\theta}^2$

8. Write the Transverse velocity.

A $\dot{r}\dot{\theta}$

9. Write the principle of angular momentum.

A $MK^2 = \frac{d^2\theta}{dt^2} = i$

10. Write the principle of conservation of Energy.

A Kinetic Energy + Potential Energy = Constant

11. Name two types of independent motion related to motion of a rigid body?

A Motion of translation & motion of rotation

12. What is Friction?

A Friction is a self adjusting force which tends to present the relative motion of the point at which it acts.

13. What is the condition for pure sliding?

A F = 0 $\Longrightarrow \mu = 0$, so motion is on smooth surface. It is the case of pure sliding.

14. What is the condition for pure rolling?

A $F < \mu R$

15. What is the relation between μ (Coefficient of friction) and λ

(angle of friction)

A $\mu = \tan\lambda$

16. Define moving a,xes and fixed axes.

A Sippose a regid body is moving about a fixed point O of itself. We take OA< DB, OC the principal axes, which are fixed in the body and moving with the body; and OX, OY, OZ be axes fixed in space.

17. Write the Euler's Dynamical equations of motion.

A $Aw_1 - \dot{(}B - C)w_2w_3 = L, Bw_2 - (\dot{C} - A)w_3w_1 = M, Cw_3 - (\dot{A} - B)w_1w_2 = N$

18. Write vector form of Euler's equation of motion.

A $\frac{d\overrightarrow{H}}{dt} + \overrightarrow{W} + \overrightarrow{H} = \overrightarrow{G}$

19. Write Euler's Geomatrical equation of motion.

A $w_1 = \dot{\theta}\sin\phi - \dot{\Psi}\sin\theta\cos\phi, w_2 = \dot{\theta}\cos\phi + \dot{\Psi}\sin\theta\sin\phi, w_3 = \dot{\phi} + \dot{\Psi}\cos\theta$

20. What are the Euleran angles?

A Suppose a rigid body turns about affixed point O. To know the position of a body in space, at any time t, with reference to initial position, three angles

θ, ϕ, Ψ are choosen to define the position of the principal axes and therefore the body itself. The angle θ, ϕ, Ψ are called Eulerian angles.

21. Define the Invariable line.

A When a rigid body turns about a fixed point O under no forces the angular momentum about every axis through O fixed in space is constant. Thus the rigid body has a constant angular momentum (H). The axis of H is fixed in space and is known as Invariable line.

22. Write the Euler's equations of motion for impulsive forces.

A $A(w'_1 - w_1) =:, B\ (w'_2 - w_2) = M, C\ (w'_3 - w_3) = N$

23. Write the equation of Locus of an Invariable line.

A $x^2\left(1 - \frac{H^2}{2AT}\right) + y^2\left(1 - \frac{H^2}{2BT}\right) + z^2\left(1 - \frac{H^2}{2CT}\right) = 0$

24. What happens to kinetic energy and angular momentum under no forces situation?

A They remain constant.

25. Write the principle of conservation of Linear momentum.

A "If a rigid body is moving under the action of some external forces whose sum of resolved parts parallel to a line is zero, throughout the motion, the momentum of the body parallel to that line remains constant throughout the motion."

26. Write the principle of conservation of angular momentum.

A "If a rigid body is moving under the action of external forces the sum of whose moments about a given line is zero throughout the motion, the moment of momentum of a body about that line remain unchanged during the motion."

27. Define the conservation forces.

A The forces acting in a system are called conservative when work done by the forces $viz \int (Xdx + Y\, dy + Zdz)$ is independent of the path followed from initial to the final position of the body and depends only on the configuration of the body at times $t_1 and\ t_2$.

28. Write the principle of conservation of Energy.

A "If a system moves under the action of finite forces and if the geometric relations of the system do not contain time explicitly, the change in the kinetic energy of the system in passing from one.

29. Define the generalized co-ordinates.

A Al those independent variables which determine the position of dynamical system or a material system on a body a any given instant are called its generalized co-ordinates.

30. What is the degree of Freedom for a single particle moving in space at any time t?

A 3

31. Define the Halonomous system.

A A system in which functions which do not contain derivation of generalized coordinates with respect to time are called Halonomous.

32. Define a conservative system.

A If all the forces acting on a system and doing work are derivable from a potential function (or potential energy), then the system is called conservative.

33. What is the necessary condition for a steady motion of a top?

A $c^2n^2 > 4A\, mg\, h \cos\alpha$

34. Define a top.

A A rigid body which is symmetrical about an axis and teminates at one end of the axis in a sharp point is known as a top.

35. Define spin for a top.

A The general motion of the top about its fixed vertex O is a combination of nutation and precession. When it is given a constant angular velocity called spin about its axis.

36. What are the limits of θ for a motion of a top?

A $i \leq \theta \leq cos^{-1}\{P - \sqrt{P^2 - 2P\cos i + 1}\}$

37. Write the equations of motion of the top.

A $A\ddot{\theta}\; A\Psi^2 \sin\theta \dot{\cos}\,\theta + Cn\,\dot{\Psi}\sin\theta = mgh\sin\theta$

$A\dot{\Psi}sin^2\theta + Cn\;Cos\;\theta = D$

$\&\; A(\theta^2 + \dot{\Psi}^2\; sin^2\,\theta) \dot{+} 2\,mgh\cos\theta = E$

38. Write the Hamilton's principle.

A "If the time from one configuration to another is prescribed, the principal function S has a stationery value in the actual path as compared to a contiguous path.

39. Write the principle of Least Action.

A "If the total energy of a system is prescribed as it passes from one configuration to another the action in the actual path is a minimum, when compared with a contiguous path.

40. Write the Lagrange's function.

A L = T - V

41. Write the Lagrange's equation of motion for conservative system in terms of Lagrange' function.

A $\frac{d}{dt}\left(\frac{\partial L}{\delta \dot{\theta}_r}\right) - \frac{\partial L}{\partial \theta_r} = 0, \;\; r = 1, 2, 3, \dots \dots . n$

42. .Write the total energy of a system.

A Total energy = kinetic energy + potential energy

i.e. E = T + V

43. Define the pressure.

A When a fluid is contained in a vessel, it exsets a force at each point of the inner side of the vessel. Such a force per unit area is called pressure.

$P = \lim_{\delta A \to 0} \frac{\delta F}{\delta A}$

44. Define an Ideal fluid.

A The fluid which have no viscosity surface tension and incompressibility are known as Ideal fluids.

45. Define an Isotropic fluid.

A Fluid in which the relation between the components of stress and rate of strain remains uncharged by a rotation of the coordinate system are called Isotropic fluid.

46. Define Laminar flow.

A A flow in which each fluid particle traces out a definite curve and the curves traced out by any two different fluid particles do not intersect is said to be laminar flow.

47. Define a stagnation point.

A The two stream lines cannot intersect except at a point where the velocity is zero and that point is called the stagnation point.

48. Write the velocity of fluid at the point ϕ(x, y, z)

A $\vec{q} = \vec{\nabla}\phi = grad\ \phi$

49. Give te condition under which the fluid motion is irrotational.

A $Curl\,\vec{q} = 0$

50. What is the condition for a possible liquid motion?

A Satisfies the equation of continuity.

51. Write the equation on continuity for incompressible fluid.

A $div\,\vec{q} = 0$

52. Write the equation of continuity in Lagrangian form.

A $PJ = P_0$

53. Give the equation of continuity in Cartesian coordinates system.

A $\frac{\partial P}{\partial t} + \frac{\partial (pu)}{\partial x} + \frac{\partial (pv)}{\partial y} + \frac{\partial (pw)}{\partial z} = 0$

54. Give the equation of contiuity if the fluid is homohenous and incompressible.

A $\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$

55. Write the equation of continuity in cylindrical polar coordinate.

A $\frac{\partial p}{\partial t} + \frac{1}{r}\frac{\partial}{\partial r}\ (Pur) + \frac{1}{r}\frac{\partial}{\partial \theta}\ (Pv) + \frac{\partial}{\partial z}(Pw) = 0$

56. Give the equation of continuity of a liquid flow through a pipe.

A SV = Constant where S is sectional area and V is the velocity.

57. Write down the condition for a surface representing a boundary surface.

A $\frac{\partial F}{\partial t} + u\frac{\partial F}{x} + v\frac{\partial F}{\partial y} + w\frac{\partial F}{\partial z} = 0$

58. Write the Euler's dynamical equation in vector notation.

A $\frac{\partial \vec{q}}{\partial t} + (\vec{q}.\nabla)\vec{q} = \vec{F} - \frac{1}{\rho}\nabla P$

59. Write the Euler's dynamical equation of motion in Cartesian coordinate.

A $\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} = X - \frac{1}{\rho}\frac{\partial P}{\partial x}, u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z} = Y - \frac{1}{\rho}\frac{\partial P}{\partial y}\ and\ \frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z} = Z - \frac{1}{\rho}\frac{\partial P}{\partial z}$

60. Define the conservative field of force.

A A field of force having components X,Y and Z parallel to axes is called conservative if the work done by the force per unit mass from one point to the other is independent of the path of the motion.

61. Write the bernoulli's equation for the unsteady-irrotational motion of an incompressible fluid.

A. $\frac{P}{\rho} - \frac{\partial \phi}{\partial t} + \frac{1}{2}q^2 + v = constant$

62. Write the Bernoulli's equation if motion is steady.

A $\frac{P}{\rho} + v + \frac{1}{2}q^2 = c$

63. How is impulse related to momentum?

A Impulse = change in momentum

64. The Cauchy's integrals are the integral of which equation?

A Halm voltz equation

65. In the absence of extraneous impulses the impulsisce pressure at any point of a liquid satisfies which equation.

A Laplace's equation

66. Write the equation of motion under impulsive forces in vector form

A $\overrightarrow{q_2} - \overrightarrow{q_1} = I - \frac{1}{\rho}\nabla\overrightarrow{w}$

67. Write the Cauchy's Integrals.

A $\frac{\xi}{\rho} = \frac{\xi_0}{\rho_0}\frac{\partial x}{\partial a} + \frac{\eta_0}{\rho_0}\frac{\partial x}{\partial b} + \frac{\tau_0}{\rho_0}\frac{\partial x}{\partial c}$, $\frac{\eta}{\rho} = \frac{\xi_0}{\rho_0}\frac{\partial y}{\partial a} + \frac{\eta_0}{\rho_0}\frac{\partial y}{\partial b} + \frac{\tau_0}{\rho_0}\frac{\partial y}{\partial c}$ *and*

$\frac{\tau}{\rho} = \frac{\xi_0}{\rho_0}\frac{\partial z}{\partial a} + \frac{\eta_0}{\rho_0}\frac{\partial z}{\partial b} + \frac{\tau_0}{\rho_0}\frac{\partial z}{\partial c}$

68. Write the complex potential due to a doublet which makes an angle α with x-axis.

A $w = \frac{\mu e^{i\alpha}}{z}$

69. Define a doublet.

A A combinations of a source of strength m and a sink of strength m at a small distance δS a parts where in the limit m is taken infinitely large a and δS infinitely small such that the product m δS remains finite and equal to μ then it is called a doublet of strength μ.

70. Write the complex potential for a doublet.

A $w = \frac{\mu}{r}e^{i\theta} = \frac{\mu}{re^{i\theta}} = \frac{\mu}{z}$

71. Write the complex potential when a source of strength m and a sink a strength (-m) at a point (a, 0) and (o, a) respectively.

A $w = m\log(z-a) + m\log(z-aj)$

72. What happens to the velocity potential when the motion is not irrosational?

A Velocity potential does not exists.