Rayat Shikshan Sanstha's

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Department of Physics

Question Bank

Paper **I**- DSC- A-1 **Mechanics-I**

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Unit-1 Chapter-I Vector Algebra and Elementary Calculus

- **Multiple Choice Questions (Correct answer is shown in red color)**

1. The process of determining the result of number of vectors is called.....

a) vector resolution b) vector addition c) vector multiplication d) vector division

2. The Triangle Law of vector addition can be used to find the resultant of.....

a) only two vectors b) parallel vectors

c) unit vectors only d) more than two vectors

3. The scalar product of a vector with itself is equal to....

a) its magnitude b) square of its magnitude b) zero c) infinity

4. If the vector product of two non- zero vectors is zero the factors must be.....

a)either parallel or anti parallel b) perpendicular

c) incline at an angle 45^o with each other d) always antiparallel

5. If magnitude of, $\vec{A} \times \vec{B} = AB$ then the two vectors must be

a)parallel to each other b) anti parallel to each other

c) perpendicular to each other d) coplanar

6.The relation between linear velocity $\vec{v}$and the radius vector $\vec{r}$ and angular velocity $\vec{\omega}$of a particle is.....

a)$\vec{v} = \vec{r} \times \vec{\omega}$ b) $\vec{v} = \vec{\omega} \times \vec{r}$ c) $\vec{\omega} = \vec{v} \times \vec{r}$ d) $\vec{\omega} = \vec{r} \times \vec{v}$

7.The magnitude of the resultant of two unit vectors $\vec{\imath}$and $\vec{j}$

a)0 b)$\sqrt{2}$ c) 2 d) $\sqrt{3}$

8.Velocity $\vec{v}$is a…. order derivative of position vector with respect to the parameter time t.

a) first b) second c) third d) fourth

9. Acceleration $\vec{a}$is a... derivative of position vector with respect to the parameter time t.

a) first b) second c) third d) fourth

10. If $\vec{P}$and $\vec{Q}$are two vectors inclined at an angle θ, then the magnitude of their resultant $\vec{R}$is given by

a) $R = P^2 + Q^2 + 2PQ\cos\theta$

b) $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$

c)$R = P^2 + Q^2$

d)$R = 2PQ\cos\theta$

11. Work and kinetic energy are.....quantities.

a) vector b) constant c) negative d) scalar

12. Identify the correct vector identity

a)$i \cdot i = j \cdot j = k \cdot k = 0$

b)$i \times j = j \times k = k \times i = 1$

c)$i \times i = j \times j = k \times k = 0$

d)$i \cdot j = j \cdot k = k \cdot i = 1$

13. Which of the following is wrong identity?

a)$i \cdot i = j \cdot j = k \cdot k = 1$

b)$i \times j = k, j \times k = i, k \times i = j$

c)$i \times i = j \times j = k \times k = 0$

d)$i \cdot j = j \cdot k = k \cdot i = 1$

14. Which of the following is a vector quantity?

a) Surface Tension

b) Moment of Inertia

c) Pressure

d) Force

Which of the following is a scalar quantity?

a) Acceleration

b) Electric Field

c)Work

d) displacement

- **Short answer questions**

1. State and explain the triangle law of vector addition.
2. State some characteristics of vector addition.
3. Illustrate with an example how a vector can be subtracted from another vector.
4. What is a unit vector? How $\hat{a}$ unit vector along the direction of a given vector can be obtained?

5. Define scalar or dot product of two vectors. State its characteristics.

6. State some characteristics of cross product of two vectors.

7. Give the interpretation of magnitude of A x B.

8. Two vectors P and Q are inclined to each other at an angle Θ. Obtain the expressions for the magnitude and direction of their resultant.

9. Define scalar product of two vectors and obtain an expression for work, done by a force in displacing a body. Hence obtain the relation for the power consumed during the displacement.

10. Show that an instantaneous velocity of a particle is a derivative of position vector of the particle with respect to the time.

11. Show that an instantaneous acceleration of a particle is a derivative of instantaneous velocity of the particle with respect to the time.

12. Show with usual notations, a= dt2

13. Define scalar triple product and explain its physical significance.

14. Define scalar triple product and derive formula for it.

- **Long answer questions**

1. State and explain scalar triple product and discuss the properties of scalar product with special reference to the work done by a force.

2. State and explain the vector product and discuss the properties of vector product with a special reference to the torque.

3. Define and discuss the physical significance and properties of scalar triple product.

4. Define and obtain expressions for instantaneous velocity and acceleration of a particle as the time derivatives of position vector of a particle.

5. State and explain the law of parallelogram of vector addition.

6. Define vector product or cross product of two vectors. State right hand rule and right handed screw rule about the direction of the resultant vector.

7. Define vector triple product and obtain an expression for the same. Discuss the properties of vector triple product.

Unit I- Chapter-II Ordinary Differential Equations

- **Multiple Choice Questions (Correct answer is shown in red color)**

1.The number of independent variables in an ordinary differential equation

a)1 b)2 c)3 d)4

2.Ordinary Differential Equation involved

a)only dependent variables b) only independent

c) total derivatives d) Partial derivatives

3.Order and degree of differential equation $\frac{d^3y}{dx^3} + x\left(\frac{d^2y}{dx^2}\right) + y\left(\frac{dy}{dx}\right)^4 = 0$are

a) 3, 1 b) 3, 2 c) 3, 4 d)1, 4

4.The order and degree of differential equation $\frac{d^2y}{dx^2} = \sqrt{1 + \left(\frac{dy}{dx}\right)^3}$ are

a)1, 1 b)2, 2 c)2, 3 d)1, 3

5. The equation $\frac{dy}{dx} = sin\, x$ is.....

a)linear b) non-linear c) homogeneous d) first order nonlinear

6. The differential equation $\frac{1}{x}\frac{d^2y}{dx^2} + y = e^x$ is.....

a) second order, linear b) second degree, linear

c) second order non-linear d)second degree non-linear

7.The differential equation $\frac{y - x\frac{dy}{dx}}{\frac{dy}{dx}} = \left(\frac{dy}{dx}\right)^2$

a)first order, second degree b) first order, third degree

c)first order, linear d)second order, linear

8. The order of differential equation $y = x\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3$ is

a)1 b)2 c)3 d)0

9.The degree of linear differential equation is

a)1 b)2 c)3 d)0

10. The solution of second order differential equation with real and unequal roots is....

a) $y = Ae^{ax} + Be^{bx}$ b) $y = Ae^{ax} + Be^{ax}$

c) $y = (A + B)e^{ax}$ d) $y = (A + B)e^{-ax}$

11.The solution of second order differential equation with

complex conjugate pair of roots is....

a) $y = (A + B)e^{(\alpha + i\beta)x}$ b) $y = (A + B)e^{(\alpha - i\beta)x}$

c) $y = Ae^{(\alpha+i\beta)x} + Be^{(\alpha-i\beta)x}$ d) $y = Ae^{(\alpha+i\beta)x} + Be^{(\alpha+i\beta)x}$

12.The solution of second order differential equation with real and

equal roots is....

a) $y = Ae^{ax} + Be^{ax}$ b) $y = (Ax + B)e^{ax}$

c) $y = (Ax + B)e^{-ax}$ d) $y = (A + B)xe^{ax}$

13. The solution of differential equation is $\frac{d^2y}{dx^2} + 9y = 0$

a) $y = A\cos 3x + B\sin 3x$ b) $y = A\cos 3x - B\sin 3x$

c) $y = (A + B)\sin 3x$ d) $y = (A + B)\cos 3x$

14. The solution of differential equation is $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 0$

a) $y = (A + B)e^{-2x}$ b) $y = (A + Bx)e^{-2x}$ c) $y = (A + B)e^{2x}$ d) $y = (A + Bx)e^{2x}$

15. The solution of differential equation is $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = 0$

a) $y = Ae^{2x} + Be^{3x}$ b) $y = Ae^{-2x} + Be^{-3x}$ c) $y = Ae^{2x} + Be^{-3x}$ d) $y = Ae^{-2x} + Be^{3x}$

- **Short answer questions**

1. What is the differential equation? Define order, degree and linearity of a differential equation.

2. Give an example of first order homogeneous differential equation and obtain its solution.

- **Long answer questions**

1. Define first order homogeneous differential equation and discuss variable separation method to obtain its solution.

2. Define second order homogeneous differential equation with constant coefficients and discuss a method of obtaining its solution. Discuss different cases.

3. Define second order homogeneous differential equation with constant coefficients. Give an example and obtain its solution.

Unit II- Chapter-I Conservation Theorems

1. If the total force acting on a particle or a system of a particles is zero, then…. of the particle or system is conserved

a)linear momentum b)angular momentum

c)kinetic energy d)potential energy

2. If the total torque acting on a particle or a system of particles is zero, then….. of the particle or system of particle is conserved

a)linear momentum b) angular momentum

c)potential energy d)kinetic energy

3. The time rate of change of linear momentum is

a)linear acceleration b)angular acceleration c)force d) torque

4. The time rate of change of angular momentum is

a)linear acceleration b)angular acceleration **c)** force d)torque

5. The angular momentum of the system of particles is conserved

if torque acting on it is....

a)zero b)small c)large d)infinity

6. The energy possessed by the body by virtue of its motion is.....

a) kinetic energy b)potential energy c) mechanical energy d)total energy

7. The energy possessed by the body by virtue of its position

a)kinetic energy b) potential energy c)mechanical energy d) total energy

8. The total mechanical energy is conserved if the force acting on the system...

a)conservative b)non-conservative c)frictional d)electromagnetic

9. Dynamics of a body can be studied in a more simple way by assuming that the whole mass of body is concentrated at a point called…..

a)geometrical centre b)centre of gravity c) centre of mass d)centre of force

10. If the frame of reference is changed then....

a)the value of physical quantity is not change b)the physical laws are changed

c)the conservation laws are not obeyed d) the conservation laws are obeyed

11.The centre of mass of a body is located ...

a)outside the body b) inside or outside the body

c)inside the body d)at the centre of body

12. The linear momentum of single particle is defined as product of mass and…..

a)acceleration b)speed c) velocity d)time

13. Total force acting on the system is equal to....

a)total internal force b)sum of internal and external force

c)total external force d)zero

14. If mass of the rocket decreases, its speed …..

a) increases b)decreases

c)remains constant d)becomes zero

15. A 3 Kg bowling ball is sliding with a speed of 4 m/s. Its K.E. is

a) 48 Joules b)24 Joules

c)12 Joules d)36 Joules

- **Short answer questions**

1. State and prove work energy theorem.
2. State and prove the law of conservation of energy in case of a single particle.
3. State and prove the law of conservation of energy of a system of particles.

- **Long answer questions**

1. State and prove laws of conservation of linear and angular momentum of a particle.
2. Define centre of mass of a system of particles. How the co-ordinates of centre of mass are obtained? Discuss the physical significance of centre of mass.
3. State and prove conservation of linear and angular momentum of a system of particles.
4. State and prove law of conservation of linear momentum for a particle and a system of particles.
5. State and prove the law of conservation of angular momentum for a particle and a system of particles.

Unit II- Chapter-II Rotational Motion

1. The relation between the torque $\vec{\tau}$ and angular momentum $\vec{L}$ a body rotating with angular velocity $\vec{\omega}$is

a)$\vec{\tau} = \frac{d\vec{L}}{dt}$ b)$\vec{\tau} = \frac{d\vec{L}}{d\vec{\omega}}$ c)$\vec{\tau} = \vec{L} \cdot \vec{\omega}$ d)$\vec{\tau} = \vec{L} \times \vec{\omega}$

2.Moment of inertia in rotational motion is analogous to the…. in translational motion

a) momentum b) mass c)force d)torque

3. Just as force produces linear motion,... produces rotational motion

a) torque b) moment of inertia c)angular momentum d)angular acceleration

4. Mass is the measure of..... in linear motion

a)moment of inertia b) inertia c)force d) acceleration

5. Moment of inertia of a spherical shell about its diameter

a)$\frac{2}{3}MR^2$ b)$\frac{3}{2}MR^2$ c)$\frac{5}{3}MR^2$ d)$\frac{1}{2}MR^2$

6. Acceleration of a body rolling down an inclined plane is independent of…. of the body.

a)radius b)radius of gyration **c) mass** d)inclination Θ

7. Greater the value of K,.... is the acceleration of the body rolling down an incline plane.

a)greater b) smaller c)faster d)stronger

8. Greater the value of K,.... is the time it takes in rolling down an incline plane

a) larger b)smaller c) faster d)weaker

9. The pure rotation kinetic energy is expressed as

a)$E_k = I\omega^2$ b)$E_k = \frac{1}{2}I\omega$ c)$E_k = \frac{1}{2}I\omega^2$ d)$E_k = I\omega^2$

10. The relation between linear momentum $\vec{P}$ and the radius vector $\vec{r}$ and angular momentum of $\vec{L}$ a particle

a)$\vec{L} = \vec{r} \times \vec{P}$ b)$\vec{L} = \vec{P} \times \vec{r}$ c)$\vec{P} = \vec{L} \times \vec{r}$ d)$\vec{P} = \vec{r} \times \vec{L}$

11. The relation between torque $\vec{\tau}$ and the radius vector $\vec{r}$ and force $\vec{F}$

a)$\vec{F} = \vec{\tau} \times \vec{r}$ b)$\vec{\tau} = \vec{F} \times \vec{r}$ c)$\vec{\tau} = \vec{r} \times \vec{F}$ d)$\vec{F} = \vec{r} \times \vec{\tau}$

12. Unit of moment of inertia is kg/m^2

a)kg/m^2 b) kgm^2 c)kg/m d)kgm

13. Dimensions of moment of inertia are

a)[$M^1L^2T^0$] b)[$M^1L^2T^1$] c)[$M^{-1}L^2T^0$] d)[$M^1L^{-2}T^0$]

14. The term moment of momentum is called

a)Momentum b)Force c)Torque d) Angular momentum

15. The torque acting is 2000 Nm with an angular acceleration of 2 rad/s^2. The moment of inertia of body is

a)1200 kgm^2 b)900 kgm^2 **c)1000 kgm^2** d)800 kgm^2

- **Short answer questions**

1. Define angular momentum of a particle and obtain an expression for angular momentum of a rotating body.
2. Define torque and obtain an expression for it in terms of angular momentum for a particle rotating about a point.
3. Find an expression for kinetic energy of a body rotating about an axis and hence explain the analogy between translation and rotational motions.
4. Define moment of inertia and radius of gyration. Explain the physical significance of moment of inertia.
5. Derive an expression for moment of inertia of a spherical shell about one of its diameter.
6. Derive an expression for moment of inertia of a solid cylinder about its own axis of symmetry.

- **Long answer questions**

1. Obtain expressions for moment of inertia of a solid cylinder about its axes of symmetries.
2. Define and obtain and expressions for angular velocity, angular momentum and moment of inertia and thereby establish a relation among them.
3. Define and obtain expressions for angular momentum and torque and thereby establish a relation between them.
4. Define and obtain expressions for kinetic energy of rotation and moment of inertia of a rotating rigid body. Find the moment of inertia of a spherical shell about its axis of symmetry.