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"Question Bank: Physics"

[B.Sc. Part – I, Physics]

Semester: I – IV

Paper: I – IV

DSC - A Mechanics - I (Paper I)

DSC- 2A Mechanics - II (Paper II)

DSC- B Electricity And Magnetism -I (Paper III)

DSC- 2B Electricity And Magnetism -II (Paper IV)

Question Bank

DSC - A Mechanics - I (Paper I)

1 Select the most correct alternative.

(1) The process of determining the resultant 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) 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) $R = 2PQ\cos\,\theta$

(4) The scalar product of a vector with itself is equal to .....

(a) its magnitude (b) square of its magnitude

(c) zero (d) infinity

(5) If the vector product of two non-zero vectors is zero, the vectors must be.....

(a) either parallel or antiparallel (b) perpendicular

(c) inclined at an angle $45°$ with each other (d) always antiparallel

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

(a) parallel to each other (b) antiparallel to each other

(c) perpendicular to each other (d) co-planer

(7) The relation between linear velocity $\vec{v}$, 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) $\vec{\omega} = \vec{r} \times \vec{v}$

(8) The magnitude of the resultant of two-unit vectors $\vec{\imath}$ and $\vec{\jmath}$ is.....

(a) 0 (b) $\sqrt{2}$

(c) 2 (d) $\sqrt{3}$

(9) Velocity $\vec{v}$ is a ..... order derivative of position vector $\vec{r}$ with respect to the parameter time t.

(a) first (b) second

(c) third (d) fourth

(10) Acceleration $\vec{a}$ is a ... . order derivative of position vector $\vec{r}$ with respect to the parameter time t.

(a) first (b) second

(c) third (d) fourth

(11) The number of independent variables in an ordinary differential

(a) 1 (b) 2

(c) 3 (d) 4

(12) Ordinary differential equation involves .....

(a) only dependent variables (b) only independent variables

(c) total derivatives (d) partial derivatives

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

(a) 3,1 (b) 3,2

(c) 3,4 (d) 1,4

(14) The order and degree of the 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

(15) The equation, $\frac{dy}{dx} = \sin x$ is .....

(a) linear (b) non-linear

(c) homogeneous (d) first order non-linear

(16) 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

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

(a) first order, second degree
(b) first order, third degree
(c) first order, linear
(d) second order. Linear

(18) Newton's first law of motion is known as law of …….

(a) momentum
(b) inertia
(c) energy
(d) force

(19) Acceleration of inertial frame of reference is .....

(a) zero
(b) constant
(c) infinite
(d) variable

(20) Non-inertial frame of reference is frame of reference,

(a) accelerated
(b) unaccelerated
(c) inertial
(d) mechanical

(21) The state of rest is also a state of uniform motion with zero ……

(a) mass
(b) acceleration
(c) velocity
(d) momentum

(22) Newton's second law of motion is given by

(a) $F = mv$
(b) $F = mt$
(c) $F = m/a$
(d) $F = ma$

(23) The dimensions of impulse of force are same as dimensions of

(a) force
(b) momentum
(c) velocity
(d) acceleration

(24) 1 newton = dyne

(a) 10^2
(b) 10^3
(c) 10^4
(d) 10^5

(25) The dimensions of force are

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

(26) According to Newton's second law of motion Force acting on a body is proportional to its rate of change of .....

(a) velocity
(b) momentum

(c) acceleration (d) displacement

(27) According to Newton's third law of motion action and reaction act along ..... directions.

(a) the same (b) opposite

(c) the perpendicular (d) any random

(28) If the total force acting on a particle or a system of particles is zero, then ..... of the particle or system is conserved.

(a) linear momentum (b) angular momentum

(c) kinetic energy (d) energy

(29) If total torque acting on a particle or system of particles is zero, then of the particle or system of particles is conserved.

(a) linear momentum (b) angular momentum

(c) potential energy (d) energy

(30) The time rate of change of linear momentum is

(a) linear acceleration (b) angular acceleration

(c) force (d) torque

(31) The time rate of change of angular momentum is

(a) linear acceleration (b) angular acceleration

(c) force (d) torque

(32) The energy possessed by the body by virtue of its motion is .

(a) kinetic energy (b) potential energy

(c) mechanical energy (d) total energy

(33) The energy possessed by the body by virtue of its position is

(a) kinetic energy (b) potential energy

(c) mechanical energy (d) total energy

(34) The total mechanical energy is conserved if the force acting on the system is

(a) conservative (b) non-conservative

(c) frictional (d) electromagnetic

(35) Dynamics of a body can be studied in a simpler way by assuming that the whole mass of the body is concentrated at a point called

(a) geometrical center (b) center of gravity

(c) center of mass (d) center of force

(36) If the frame of reference is changed then

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

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

(37) The relation between the torque $\vec{\tau}$ and the angular momentum $\vec{L}$ ' a body rotating with angular velocity $(\vec{\omega})$ is

(a) $\vec{\tau} = \frac{d\vec{L}}{dt}$ (b) $\vec{\tau} = \frac{d\vec{L}}{d\omega}$

(c) $\vec{\tau} = \vec{L} \cdot \vec{\omega}$ (d) $\vec{\tau} = \vec{L} \times \vec{\omega}$

(38) A solid cylinder of mass 500 g and radius 10 cm has moment of inertia about its own axis as, ...

(a) 2.5×10^{-3} kg. m^2 (b) 2×10^{-3} kg $\cdot$ m^2

(c) 5×10^{-3} kg $\cdot$ m^2 (d) 4×10^{-3} kg $\cdot$ m^2

(39) Moment of inertia in rotational motion is analogous to the ..... in translational motion.

(a) momentum (b) mass

(c) force (d) torque

(40) Just as force produces linear motion, ... produces rotational motion.

(a) torque (b) moment of inertia

(c) angular momentum (d) angular acceleration

(41) Mass is the measure of ..... in linear motion.

(a) moment of inertia (b) inertia

(c) force (d) acceleration

(42) Moment of inertia of a spherical shell about is diameter ....

(a) $\frac{2}{3}MR^2$ (b) $\frac{3}{2}MR^2$

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

(43) 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

(44) Greater the value of K, ... is the acceleration of the body rolling down an inclined plane.

(a) greater (b) smaller

(c) faster (d) stronger

(45) Greater the value of K, ... is the time it takes in rolling down an inclined plane.

(a) larger (b) smaller

(c) faster (d) weaker

(46) The rate of change of velocity of a particle is called its …….

(a) momentum (b) acceleration

(c) displacement (d) speed

(47) The partial differential equation is those which contains partial derivatives with respect to ……..... or …… independent variable

(a) one, more (b) two, more

(c) three, more (d) none of these

(48) The frame of reference in which Newtons law of motion hold true is called as …… frame of reference

(a) non-inertial (b) inertial

(c) both (d) none of these

(49) The tendency of a body not to change its state of rest or state of uniform motion in straight line is called its …….

(a) motion (b) momentum

(c) inertia (d) velocity

(50) The work done by resultant force acting on the particle is equal change in ……. of particle.

(a) kinetic energy (b) potential energy

(c) mechanical energy (d) total energy

2 Short answer question.

1. State and explain the triangle law of vector addition.

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

3. Two vectors $\vec{P}$ and $\vec{Q}$ are inclined to each other at an angle θ. Obtain the expressions for the magnitude and direction of their resultant.

4. State some characteristics of vector addition.

5. Illustrate with an example how a vector can be subtracted from another vector.

6. What is a unit vector? How a unit vector along the direction of a given vector can be obtained?

7. 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.

8. If $\vec{A} = \vec{\imath}\, A_x + \vec{\jmath}\, A_y + \vec{k}\, A_z$ and $\vec{B} = \vec{\imath}\, B_x + \vec{\jmath}\, B_y + \vec{k}\, B_z$ then show that.

$$\vec{A} \times \vec{B} = \begin{vmatrix} \vec{\imath} & \vec{\jmath} & \vec{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

9. Give the interpretation of magnitude of $\vec{A} \times \vec{B}$.

10. Show with usual notations, $\vec{a} = \frac{d^2\vec{r}}{dt^2}$.

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

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

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

14. What is a frame of reference? What are its types?

15. What is an inertial frame of reference? Explain with suitable examples.

16. Explain the term fictitious force or pseudo force.

17. Explain the term inertia.

18. Obtain units and dimensions of force.

19. State and prove laws of conservation of linear and angular momentum of a single particle.

20. State and prove work-energy theorem.

21. State and prove law of conservation of energy in case of a single particle.

22. State and prove conservation of linear and angular momenta of a system of particles.

23. Discuss the working principle of a rocket.

24. State and prove law of conservation of linear momentum for a single particle and a system of particles.

25. State and prove the law of conservation of angular momentum for a single particle and a system of particles.

26. Define angular momentum of a particle and find an expression for angular momentum of a rotating body.

27. Define torque and obtain an expression for it in terms of angular momentum, for a particle rotating about a point.

28. Find an expression for kinetic energy of a body rotating about an axis and hence explain the analogy between translational and rotational motions.

29. Define moment of inertia and radius of gyration. Explain the physical significance of moment of inertia.

3 Long answer question.

1. Define scalar or dot product of two vectors. State its characteristics.
2. Obtain an expression for work done by a force in displacing a body. Hence obtain the relation for the power consumed during the displacement.
3. State some characteristics of cross product of two vectors.
Show that an instantaneous velocity of a particle is a derivative of position vector of the particle with respect to the time.

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

5. Define first order linear differential equation and obtain general solution for the same.
6. Define second order homogeneous differential equation with constant coefficients and discuss a method of obtaining its solution. Discuss different cases.
7. Define second order homogeneous differential equation. Give an example and obtain its solution.

8. What is a non-inertial frame of reference? Give some examples of it.
9. State and explain Newton's first law of motion. Why is it called the law of inertia?
10. State and explain the Newton's second law of motion. Hence derive the equation $\vec{F} = ma$.
11. Show that the dimensions of momentum and impulse of a force are the same.
12. State and explain Newton's third law of motion.

13. Define center of mass of a system of particles. How the coordinates of center of mass are obtained? Discuss the physical significance of center of mass.

14. State and prove the law of conservation of energy of a system of a particle.

15. Derive an expression for moment of inertia of a spherical shell about one of its diameters.

16. Derive an expression for moment of inertia of a solid cylinder about its own axis of symmetry.

17. Obtain an expression for moment of inertia of a solid cylinder about an axis passing through its center and perpendicular to its own axis.

18. Derive expressions for velocity and acceleration of bodies rolling down an inclined plane. Apply the results for rolling spherical shell and solid cylinder.

19. If a solid cylinder and a spherical shell at rest are set rolling down an inclined plane simultaneously, which will reach the bottom first? Why?