

B.SC. PHYSICS
FIRST SEMESTER
MECHANICS
BSP – 102 [REPEAT]
[USE OMR FOR OBJECTIVE PART]

SET
A

Duration : 3 hrs.

Full Marks : 70

(Objective)

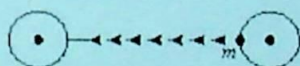
Time : 30 min.

Marks : 20

Choose the correct answer from the following:

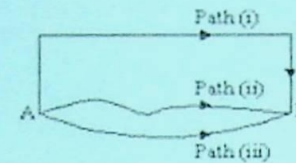
1 × 20 = 20

- A solid sphere rolls down two different inclined planes of the same heights but different angles of inclination. In each case, the ball will
 - Reach the bottom at the same time
 - Will take longer time to roll down one plane
 - Reach the bottom at an unpredictable time
 - Reach the bottom at the same time and keeps rolling
- A smooth sphere A is moving on a frictionless horizontal plane with angular speed ω and the centre of mass velocity u . It collides elastically and head on with an identical sphere B at rest. Neglect friction everywhere. After the collision, their angular speeds are $\omega_{(A)}$ and $\omega_{(B)}$ respectively. Then,
 - ω_A is lesser than ω_B
 - $\omega_A = \omega_B$
 - $\omega_A = \omega$
 - $\omega_B = \omega$
- Moment of inertia of a circular wire of mass M and radius R about its diameter is
 - $1/2 MR^2$
 - $1/4 MR^2$
 - $2MR^2$
 - MR^2
- Two identical spherical masses are kept at some distance as shown. Potential energy when a mass m is taken from surface of one sphere to the other :



- increase continuously
 - decreases continuously
 - first increases then decreases
 - first decreases then increases
- A point mass m_0 is placed at distance $R/3$ from the centre of a spherical shell of mass m and radius R . The gravitational force on the point mass m_0 is :
 - $\frac{4Gmm_0}{R^2}$
 - Zero
 - $\frac{9Gmm_0}{R^2}$
 - none of the above

6. If a particle of mass 'm' follows the paths from point A to point B as shown in the figure given below, and the work done by the particle is W_1 , W_2 , and W_3 respectively, then what is the relation between them



- a. $W_1 > W_2 > W_3$
 b. $W_1 = W_2 = W_3$
 c. $W_1 < W_2 < W_3$
 d. None of the above
7. There is no atmosphere on the moon because
 a. it is closer to the earth
 b. it revolves round the earth
 c. it gets light from the sun
 d. the escape velocity of gas molecules is less than their root mean square velocity here
8. What is parallel axis theorem and to whom it is applied?
 a. Theorem used to add the two mutually perpendicular moment of inertias for areas
 b. Theorem used to add the two mutually perpendicular moment of inertias for volumes
 c. Theorem used to add the two mutually perpendicular moment of inertias for linear distances
 d. Theorem used to add the two mutually perpendicular moment of inertias for vectors
9. The calculation of the moment of the body due to the loadings involve a quantity called
 a. Moment
 b. Inertia
 c. Moment of Inertia
 d. Rotation
10. The period of geostationary artificial satellite is
 a. 24 hours
 b. 6 hours
 c. 12 hours
 d. 48 hours
11. In inelastic collision, there is conservation of
 a. Linear momentum
 b. Kinetic energy
 c. Total energy
 d. Angular momentum
12. Which one of the following is invariant under Galilean transformation?
 a. Velocity
 b. Length
 c. Momentum
 d. Potential energy
13. Which one of the following is the unit of spring constant?
 a. N.m
 b. Nm^2
 c. N/m^2
 d. N/m
14. The condition for a conservative force is
 a. $\vec{F} = -\nabla^2 U$
 b. $\vec{F} = \vec{\nabla} \times U$
 c. $\vec{F} = -\vec{\nabla} U$
 d. $F = \vec{\nabla} U$

15. Impulse of a force is
- a. Change of force
 - b. Change of momentum
 - c. Change of kinetic energy
 - d. Change of potential energy
16. Which one of the following is the coefficient of restitution for a perfectly elastic collision?
- a. 0-1
 - b. 0
 - c. 1
 - d. Greater than 1
17. For which angle of projection, a projectile has the maximum horizontal range?
- a. $\pi/6$
 - b. $\pi/5$
 - c. $\pi/4$
 - d. $\pi/3$
18. Gravitational forces are
- a. Strong
 - b. Weak
 - c. Non- central
 - d. Central
19. A frame of reference is moving with an acceleration of 5 m/s^2 downward. What is the apparent force on a body of mass 10 kg falling freely?
- a. 50 N upward
 - b. 50 N downward
 - c. 98 N upward
 - d. 98 N downward
20. The number of coordinates required to describe a collision in laboratory frame is
- a. 3
 - b. 6
 - c. 4
 - d. 5
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(Descriptive)

Time : 2 hrs. 30 min.

Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. Derive the equation of motion of a variable mass system. 10

2. a. Define center of mass. Find the expression for velocity of center of mass for a system of particles. 1+4+5
=10
b. Show that for a perfectly inelastic collision, there is a decrease in energy after collision.

3. a. What are Coriolis and centrifugal forces? 4+6=10
b. Show that length remains invariant under Galilean transformation.

4. a. Obtain an expression for restoring force as a function of position for a particle moving in a potential energy field $U = A - Bx + Cx^2$. At what point does the force vanish? Is this a point of stable equilibrium? If so, obtain the value of force constant. 6+4=10
b. The distance between carbon and oxygen atom in CO molecule is 1.12 \AA . Find the center of mass of CO molecule with respect to the carbon atom. C mass= 12 u, O mass= 16 u

5. a. Find the relation between angular momentum and torque for system of particle. State and prove conservation of angular momentum. Define radius of Gyration for a system of particles. Find the moment of inertia about an axis through one end of of the rod having length 1m and mass 6 kg. 5+5=10
b. State and prove principle of parallel axis theorem for rigid body.

6. a. Find out the moment of inertia for for a hollow sphere about a tangent. 3+4+3
=10
b. Find out the kinetic energy and acceleration of a body rolling down an inclined plane.
c. If the body rolls down 5m along the inclined plane, calculate its kinetic energy. Given $g=10\text{m/s}^2$, radius of the body 1m, angle of inclination 30°

7. a. What is gravitational potential? What is the relation between gravitational potential and gravitational field? (establish the relationship) 5+5=10
- b. Draw the gravitational potential energy and gravitational field vs distance graph for a hollow sphere of Mass M and radius R . Also show the maximum values for both cases.
8. a. Find out the expression for escape velocity. What is geostationary satellite? Find out the velocity of a geostationary satellite. 5+5=10
- b. If the radius of earth doubled and mass of earth remained same, then find out the total change of velocity of geostationary satellite

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