

(6 pages)

Reg. No. :

Code No. : 20601 E Sub. Code : EMPH 31

B.Sc.(CBCS) DEGREE EXAMINATION,
APRIL 2025.

Third Semester

Physics – Core

MECHANICS

(For those who joined in July 2023 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choosing the correct answer.

1. What does the area under the velocity-time graph represent?
(a) Velocity (b) Displacement
(c) Force (d) Acceleration
2. Force is measured in _____.
(a) Newton (b) Kilogram
(c) Meter (d) Kilogram Meter

3. Which of the following quantity remains conserved when the moon revolves around the earth?
(a) Velocity
(b) Angular momentum
(c) Linear momentum
(d) None
4. Which of the following is not a conservative force?
(a) Frictional force (b) Electric force
(c) Gravitational (d) Spring force
5. When a positive charge is moved to wards another positive charge, the work done is.
(a) Positive (b) Negative
(c) Zero (d) None of the above
6. Power is expressed in _____.
(a) Watt (b) Joule per second
(c) Both (a) and (b) (d) Joule

7. $(\mathbf{r} \times \mathbf{p})$ is
- Torque
 - Force
 - Angular momentum
 - None
8. Solid sphere is rolling without slipping on a horizontal surface. The ratio of its rotational kinetic energy and translational kinetic energy is:
- 2/9
 - 2/5
 - 2/7
 - 7/2
9. Configuration space of n particles with k constraints would have the following number of dimensions.
- $(n - k)$
 - $3n$
 - $(3n + k)$
 - $(3n - k)$
10. Work done by the force of constraint, during virtual displacement is.
- Infinity
 - Imaginary
 - Heat
 - Zero

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Define gravitational potential and gravitational potential energy. Deduce an expression for gravitational potential.
Or
(b) State Kepler's Laws of Planetary motion.
12. (a) Define center of mass and deduce an expression for center of mass of a system.
Or
(b) What is torque due to internal forces? Find an expression for torque to gravity.
13. (a) Derive work – energy theorem.
Or
(b) Define work, power and energy.
14. (a) State prove parallel axes theorem.
Or
(b) Obtain an expression for total kinetic energy of a body rolling on a smooth horizontal plane.

15. (a) Define D'Alembert's principle.
Or

- (b) Explain degrees of freedom.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Derive an expression for time of flight of a projectile and its range on a horizontal plane under the action of uniform gravitational field.

Or

- (b) Define velocity and acceleration. Derive the three equations of motion.

17. (a) Derive expressions for final velocities due to direct collision of two smooth spheres of different mass. Also calculate the impulse on one sphere due to the other.

Or

- (b) What is a rocket? Considering rocket and the ejected burned fuel during rocket motion as a single closed and isolated system, derive an expression for thrust of the rocket engine. Also calculate the increase of speed of rocket due to change of its mass from initial mass to final mass.

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18. (a) Explain conservative force. Prove conservative force property.

Or

- (b) State and prove the law of conservation of energy. Give an application.

19. (a) Derive an expression for acceleration of uniform body rolling down an inclined plane. Discuss the special cases.

Or

- (b) Obtain an expression for rotational kinetic energy of rotating body. Also find the relation connecting kinetic energy and angular momentum of a rotating rigid body.

20. (a) Derive Lagrange's equation of motion, starting from D'Alembert's principle.

Or

- (b) Set up Lagrange's equation for Atwood's machine and obtain the equation of motion of the system.

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