

Tick one box per statement: ☐ not yet ☐ nearly ☐ confident. / /

1. Kinematics

1.1 Scalars and Vectors

- ☐☐☐ Describe a scalar or vector quantity using magnitude and direction, as appropriate.

1.2 Displacement, Velocity, and Acceleration

- ☐☐☐ Describe a change in an object's position.
- ☐☐☐ Describe the average velocity and acceleration of an object.
- ☐☐☐ Describe the instantaneous position, velocity, and acceleration of an object as a function of time.

1.3 Representing Motion

- ☐☐☐ Describe the position, velocity, and acceleration of an object using representations of that object's motion.

1.4 Reference Frames and Relative Motion

- ☐☐☐ Describe the reference frame of a given observer.
- ☐☐☐ Describe the motion of objects as measured by observers in different inertial reference frames.

1.5 Motion in Two or Three Dimensions

- ☐☐☐ Describe the motion of an object moving in two or three dimensions.

2. Force and Translational Dynamics

2.1 Systems and Center of Mass

- ☐☐☐ Describe the properties and interactions of a system.
- ☐☐☐ Describe the location of a system's center of mass with respect to the system's constituent parts.

2.2 Forces and Free-Body Diagrams

- ☐☐☐ Describe a force as an interaction between two objects or systems
- ☐☐☐ Describe the forces exerted on an object or system using a free-body diagram.

2.3 Newton's Third Law

- ☐☐☐ Describe the interaction of two objects or systems using Newton's third law and a representation of paired forces exerted on each object or system.

2.4 Newton's First Law

- ☐☐☐ Describe the conditions under which a system's velocity remains constant.

2.5 Newton's Second Law

- ☐☐☐ Describe the conditions under which a system's velocity changes.

2.6 Gravitational Force

- ☐☐☐ Describe the gravitational interaction between two objects or systems with mass.
- ☐☐☐ Describe situations in which the gravitational force can be considered constant.
- ☐☐☐ Describe the conditions under which the magnitude of a system's apparent weight is different from the magnitude of the gravitational force exerted on that system.
- ☐☐☐ Describe inertial and gravitational mass.
- ☐☐☐ Describe the gravitational force exerted on an object by a uniform spherical distribution of mass.

2.7 Kinetic and Static Friction

- ☐☐☐ Describe kinetic friction between two surfaces.
- ☐☐☐ Describe static friction between two surfaces.

2.8 Spring Forces

- ☐☐☐ Describe the force exerted on an object by an ideal spring.
- ☐☐☐ Describe the equivalent spring constant of a combination of springs exerting forces on an object.

2.9 Resistive Forces

- ☐☐☐ Describe the motion of an object subject to a resistive force.

2.10 Circular Motion

- ☐☐☐ Describe the motion of an object traveling in a circular path.
- ☐☐☐ Describe circular orbits using Kepler's third law.

3. Work, Energy, and Power

3.1 Translational Kinetic Energy

- ☐☐☐ Describe the translational kinetic energy of an object in terms of the object's mass and velocity.

3.2 Work

- ☐☐☐ Describe the work done on an object or system by a given force or collection of forces.

3.3 Potential Energy

- ☐☐☐ Describe the potential energy of a system.

3.4 Conservation of Energy

- ☐☐☐ Describe the energies present in a system.
- ☐☐☐ Describe the behavior of a system using conservation of mechanical energy principles.
- ☐☐☐ Describe how the selection of a system determines whether the energy of that system changes.

3.5 Power

- ☐☐☐ Describe the transfer of energy into, out of, or within a system in terms of power.

4. Linear Momentum

4.1 Linear Momentum

- ☐☐☐ Describe the linear momentum of an object or system.

4.2 Change in Momentum and Impulse

- ☐☐☐ Describe the impulse delivered to an object or system.
- ☐☐☐ Describe the relationship between the impulse exerted on an object or system and the change in momentum of the object or system.

4.3 Conservation of Linear Momentum

- ☐☐☐ Describe the behavior of a system using conservation of linear momentum.
- ☐☐☐ Describe how the selection of a system determines whether the momentum of that system changes.

4.4 Elastic and Inelastic Collisions

- ☐☐☐ Describe whether an interaction between objects is elastic or inelastic.

5. Torque and Rotational Dynamics

5.1 Rotational Kinematics

- ☐☐☐ Describe the rotation of a system with respect to time using angular displacement, angular velocity, and angular acceleration.

5.2 Connecting Linear and Rotational Motion

- ☐☐☐ Describe the linear motion of a point on a rotating rigid system that corresponds to the rotational motion of that point, and vice versa.

5.3 Torque

- ☐☐☐ Identify the torques exerted on a rigid system.
- ☐☐☐ Describe the torques exerted on a rigid system.

5.4 Rotational Inertia

- ☐☐☐ Describe the rotational inertia of a rigid system relative to a given axis of rotation.
- ☐☐☐ Describe the rotational inertia of a rigid system rotating about an axis that does not pass through the system's center of mass.

5.5 Rotational Equilibrium and Newton's First Law in Rotational Form

- ☐☐☐ Describe the conditions under which a system's angular velocity remains constant.

5.6 Newton's Second Law in Rotational Form

- ☐☐☐ Describe the conditions under which a system's angular velocity changes.

6. Energy and Momentum of Rotating Systems

6.1 Rotational Kinetic Energy

- ☐☐☐ Describe the rotational kinetic energy of a rigid system in terms of the rotational inertia and angular velocity of that rigid system.

6.2 Torque and Work

- ☐☐☐ Describe the work done on a rigid system by a given torque or collection of torques.

6.3 Angular Momentum and Angular Impulse

- ☐☐☐ Describe the angular momentum of an object or rigid system.
- ☐☐☐ Describe the angular impulse delivered to an object or rigid system by a torque.
- ☐☐☐ Relate the change in angular momentum of an object or rigid system to the angular impulse given to that object or rigid system.

6.4 Conservation of Angular Momentum

- ☐☐☐ Describe the behavior of a system using conservation of angular momentum.
- ☐☐☐ Describe how the selection of a system determines whether the angular momentum of that system changes.

6.5 Rolling

- ☐☐☐ Describe the kinetic energy of a system that has translational and rotational motion.
- ☐☐☐ Describe the motion of a system that is rolling without slipping.
- ☐☐☐ Describe the motion of a system that is rolling while slipping.

6.6 Motion of Orbiting Satellites

- ☐☐☐ Describe the motions of a system consisting of two objects or systems interacting only via gravitational forces.

7. Oscillations

7.1 Defining Simple Harmonic Motion (SHM)

- ☐☐☐ Describe simple harmonic motion.

7.2 Frequency and Period of SHM

- ☐☐☐ Describe the frequency and period of an object exhibiting SHM.

7.3 Representing and Analyzing SHM

- ☐☐☐ Describe the displacement, velocity, and acceleration of an object exhibiting SHM.

7.4 Energy of Simple Harmonic Oscillators

- ☐☐☐ Describe the mechanical energy of a system exhibiting SHM.

7.5 Simple and Physical Pendulums

- ☐☐☐ Describe the properties of a physical pendulum.