

$$\frac{\partial}{\partial x} \left(\frac{\partial}{\partial x} \right) = \frac{\partial^2}{\partial x^2}$$

1.1 Scalars and Vectors in One Dimension

- ## 1.2 Displacement, Velocity, and Acceleration

- ### 1.3 Representing Motion

- ## 1.4 Reference Frames and Relative Motion

- ## 1.5 Vectors and Motion in Two Dimensions

- ## 2. Force and Translational Dynamics

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2.1 Systems and Center of Mass

- ## 2.2 Forces and Free-Body Diagrams

- ## 2.3 Newton's Third Law

- ## 2.4 Newton's First Law

- ## 2.5 Newton's Second Law

- ## 2.6 Gravitational Force

- ## 2.7 Kinetic and Static Friction

- ## 2.8 Spring Forces

- ## 2.9 Circular Motion

- ### 3. Work, Energy, and Power

3.1 Translational Kinetic Energy

- ### 3.2 Work

- ### 3.3 Potential Energy

- ### 3.4 Conservation of Energy

- ### 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 a 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 interacting only via gravitational forces.

7. Oscillations

7.1 Defining Simple Harmonic Motion (SHM) (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.

8. Fluids

8.1 Internal Structure and Density

☐☐☐ Describe the properties of a fluid.

8.2 Pressure

☐☐☐ Describe the pressure exerted on a surface by a given force.

☐☐☐ Describe the pressure exerted by a fluid.

8.3 Fluids and Newton's Laws

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

☐☐☐ Describe the buoyant force exerted on an object interacting with a fluid.

8.4 Fluids and Conservation Laws

☐☐☐ Describe the flow of an incompressible fluid through a cross-sectional area by using mass conservation.