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Introduction: Forces in Multiple Dimensions

Unit: Forces in Multiple Dimensions

Topics covered in this chapter:

Force Applied at an Angle 335
Ramp Problems 346

In this chapter you will learn about different kinds of forces and how they relate.

- *Force Applied at an Angle*, *Ramp Problems*, and *Pulleys & Tension* describe some common situations involving forces and how to calculate the forces involved.
- *Centripetal Force* describes the forces experienced by an object moving in a circle.
- *Center of Mass, Rotational Inertia,* and *Torque* describe the relationship between forces and rotation.

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This unit is part of *Unit 2: Force and Translational Dynamics* from the 2024 AP® Physics 1 Course and Exam Description.

Standards addressed in this chapter:

NGSS Standards/MA Curriculum Frameworks (2016):

HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-10(MA). Use free-body force diagrams, algebraic expressions, and Newton's laws of motion to predict changes to velocity and acceleration for an object moving in one dimension in various situations.

Use this space for summary and/or additional notes:

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AP® Physics 1 Learning Objectives/Essential Knowledge (2024):

2.2.A: Describe a force as an interaction between two objects or systems.

2.2.A.1: Forces are vector quantities that describe the interactions between objects or systems.

2.2.A.1.i: A force exerted on an object or system is always due to the interaction of that object with another object or system.

2.2.A.1.ii: An object or system cannot exert a net force on itself.

2.2.A.2: Contact forces describe the interaction of an object or system touching another object or system and are macroscopic effects of interatomic electric forces.

2.2.B: Describe the forces exerted on an object or system using a free-body diagram.

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2.2.B.1: Free-body diagrams are useful tools for visualizing forces being exerted on a single object or system and for determining the equations that represent a physical situation.

2.2.B.2: The free-body diagram of an object or system shows each of the forces exerted on the object by the environment.

2.2.B.3: Forces exerted on an object or system are represented as vectors originating from the representation of the center of mass, such as a dot. A system is treated as though all of its mass is located at the center of mass.

2.2.B.4: A coordinate system with one axis parallel to the direction of acceleration of the object or system simplifies the translation from free-body diagram to algebraic representation. For example, in a free-body diagram of an object on an inclined plane, it is useful to set one axis parallel to the surface of the incline.

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Skills learned & applied in this chapter:

- Solving chains of equations.
- Using geometry and trigonometry to combine forces (vectors).
- Using trigonometry to split forces (vectors) into components.

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