Highlights

KEY IDEAS

Section 1 Introduction to Vectors
- A scalar is a quantity completely specified by only a number with appropriate units, whereas a vector is a quantity that has magnitude and direction.
- Vectors can be added graphically using the triangle method of addition, in which the tail of one vector is placed at the head of the other. The resultant is the vector drawn from the tail of the first vector to the head of the last vector.

Section 2 Vector Operations
- The Pythagorean theorem and the inverse tangent function can be used to find the magnitude and direction of a resultant vector.
- Any vector can be resolved into its component vectors by using the sine and cosine functions.

Section 3 Projectile Motion
- Neglecting air resistance, a projectile has a constant horizontal velocity and a constant downward free-fall acceleration.
- In the absence of air resistance, projectiles follow a parabolic path.

Section 4 Relative Motion
- If the frame of reference is denoted with subscripts ($\mathbf{v_{ab}}$ is the velocity of object or frame a with respect to object or frame b), then the velocity of an object with respect to a different frame of reference can be found by adding the known velocities so that the subscript starts with the letter that ends the preceding velocity subscript: $\mathbf{v_{ac}} = \mathbf{v_{ab}} + \mathbf{v_{bc}}$.
- If the order of the subscripts is reversed, there is a change in sign; for example, $\mathbf{v_{cd}} = -\mathbf{v_{dc}}$.

KEY TERMS

scalar (p. 82)

vector (p. 82)

resultant (p. 83)

components of a vector (p. 90)
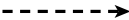
projectile motion (p. 96)

PROBLEM SOLVING

See **Appendix D: Equations** for a summary of the equations introduced in this chapter. If you need more problem-solving practice, see **Appendix I: Additional Problems**.

Variable Symbols

Quantities		Units	
d (vector)	displacement	m	meters
v (vector)	velocity	m/s	meters/second
a (vector)	acceleration	m/s^2	meters/second^2
Δx (scalar)	horizontal component	m	meters
Δy (scalar)	vertical component	m	meters

Diagram Symbols

→	displacement vector
→	velocity vector
⇒	acceleration vector
- - - →	resultant vector
⇒	component