Two-Dimensional Motion and Vectors

Introduction to Vectors, p. 13

1. {**A, C, E, H, I**}; {**D, G**}, {**B, F, J**}

2. {**A, D, H**}, {**B, C, G**}, {**I, J**}

3. {**A, H**}

4. Both diagrams should show a vector **A** that is twice as long as the original vector **A,** but still pointing up. The first diagram should have the tip of 2**A** next to the tail of **B.** The second diagram should have the tip of **B** next to the tail of 2**A.** The resultant vectors should have the same magnitude and direction, slanting towards the upper right.

5. Both diagrams should show a vector **B** that is half as long as the original vector **B.** The first diagram should have the tip of **A** next to the tail of −**B**/2, and −**B**/2 should be pointing to the left. The second diagram should have the tip of **B**/2 next to the tail of −**A,** and −**A** should be pointing down. The resultant vectors should have the same magnitude but opposite directions. The first will slant towards the upper left. The second will slant towards the lower right.

Vector Operations, p. 14

1. Check students' graph for accuracy.

2. Shot 1: 45 m; 45 m

Shot 2: 110 m; 64 m

Shot 3: 65 m; 33 m

Shot 4: 0 m; 14.89 m

3. 220 m

Projectile Motion, p. 15

1. $\Delta t = v_i \sin \theta / g$

2. $h = v_i^2 (\sin \theta)^2 / 2g$

3. $x = v_i (\cos \theta)(\Delta t) = \dfrac{v_i^2 \sin \theta \cos \theta}{g}$

4. $R = \dfrac{2v_i^2 \sin \theta \cos \theta}{g}$

5.

Launch angle	Maximum height (m)	Range (m)
15°	8.5	130
30°	32	220
45°	64	250
60°	96	220
75°	119	130

Relative Motion, p. 16

1. $\mathbf{v_{BL}} = \mathbf{v_{BW}} + \mathbf{v_{WL}}$

2. Student diagrams should show $\mathbf{v_{BW}}$ twice as long as $\mathbf{v_{WL}}$ but both are in the same direction as $\mathbf{v_{BL}}$, which is long as both together.

3. Student diagrams should show $\mathbf{v_{WL}}$ and $\mathbf{v_{BW}}$, longer and opposite in direction. The vector $\mathbf{v_{BL}}$ should be as long as the difference between the two, and in the same direction and in the same direction as $\mathbf{v_{BW}}$.

4. Student diagrams should show $\mathbf{v_{WL}}$ and $\mathbf{v_{BW}}$ at a right angle with $\mathbf{v_{BL}}$ forming the hypotenuse of a right triangle.

5. a. 6.0 km/h, due east

b. 2.0 km/h, due west

c. 4.5 km/h, $\theta = 26.6°$

Mixed Review, pp. 17–18

1. a. The diagram should indicate the relative distances and directions for each segment of the path.

b. 5.0 km, slightly north of northwest

c. 11.0 km

2. a. The same

b. Twice as large

c. 1.58

3. a. 2.5 m/s, in the direction of the sidewalk's motion

b. 1.0 m/s, in the direction of the sidewalk's motion

c. 4.5 m/s, in the direction of the sidewalk's motion

d. 2.5 m/s, in the direction opposite to the sidewalk's motion

e. 4.7 m/s, $\theta = 32°$

4. a. 4.0×10^1 seconds

b. 6.0×10^1 seconds

III