# Vector Problems

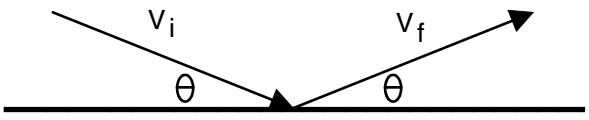
1. A bird has a velocity of 15**i** – 7**j** m/s. What is its speed and direction?

2. A tennis ball hits a wall with a velocity of 35 m/s at an angle of 25° above the horizontal. What is its velocity in component form?

3. The initial position of a dancer is –6**i** + 12**j**. The dancer travels for 15 seconds, and has a final position of 4**i** + 18**j.**
   a. What was the displacement vector? (Worded another way, what was the change in position?)

   b. What was the average velocity of the dancer?

4. A pool ball bounces off the side of the pool table as shown. If $v_i = v_f = 5$ m/s and $\theta_i = \theta_f = 30°$,
   a. In unit-vector form, what is the change in velocity of the pool ball?




   b. Draw a vector diagram showing $\Delta\mathbf{v}$.

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5. Another pool ball hits the side of the table. Its final velocity is 4 m/s at an angle of 25°, as shown in the previous diagram. If its change in velocity was $-1\mathbf{i} + 4\mathbf{j}$ m/s, what was the ball's initial velocity?

6. A plane is flying due north at 100 m/s. It makes a nice smooth turn, ending with a final velocity of 100 m/s due east.
   a. What was its change in velocity?

   b. If the turn took 30 seconds, what was the average acceleration of the plane?

7. A soccer ball is kicked with an initial velocity of 25 m/s at an angle of 70° above the horizontal.
   a. What is its initial velocity in component form?

   b. If it undergoes a constant acceleration of $0\mathbf{i} - 10\mathbf{j}$ m/s$^2$ for 3 seconds, what is its final velocity?

8. If in question 4, the ball was in contact with the side of the table for only 0.05 seconds, what was the average acceleration of the ball?

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9. The position as a function of time for a mouse is given by $\mathbf{r}(t) = (3t)\mathbf{i} + (0.5t^2)\mathbf{j}$.
   a. At time t = 3, where is the mouse?

   b. What is the function that would represent the velocity of the mouse?

   c. What is the function that would represent the acceleration of the mouse?

*Answers:*

*1) 16.6 m/s @–25°* *2) 31.7**i** + 14.8**j** m/s* *3 a) 10**i** + 6**j** m* *b) 0.67**i** + 0.4**j** m/s*
*4 a) 0**i** + 5**j** m/s* *5) 4.63**i** – 2.31**j** m/s* *6 a) 100**i** – 100**j** m* *b) 3.3**i** – 3.3**j** m/s²*
*7 a) 8.55**i** + 23.49**j** m/s* *b) 8.55**i** – 6.51**j** m/s* *8) 0**i** + 100**j** m/s²*
*9 a) 9**i** + 4.5**j** m* *b) **v**(t) = 3i + t**j*** *c) **a**(t) = 0**i** + 1**j***