

18.022 Recitation Handout
8 September 2014

1. (1.1.25 in *Colley*) Physical forces are quantities possessing both magnitude and direction and therefore can be represented by vectors. If an object has more than one force acting on it, then the resulting force can be represented by the sum of the individual force vectors. Suppose that two forces $\mathbf{F}_1 = (2, 7, -1)$ and $\mathbf{F}_2 = (3, -2, 5)$ are acting on an object.

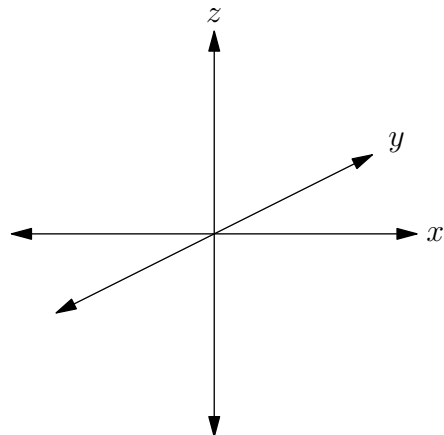
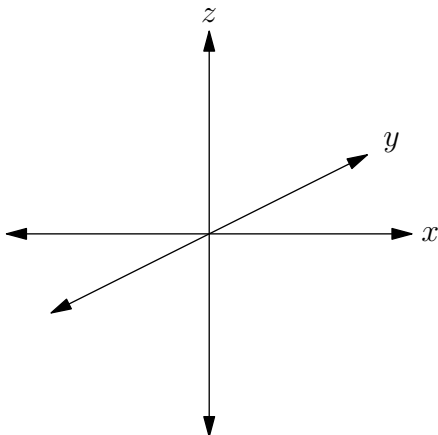
(a) What is the resultant force of \mathbf{F}_1 and \mathbf{F}_2 ?

(b) What force \mathbf{F}_3 is needed to counteract these forces, so that no net force results and the object remains at rest?

2. (a) Consider the vectors $u_1 = (1, 1, 0)$, $u_2 = (-1, 1, 0)$, and $u_3 = (0, 1, 1)$. Write $(3, -6, 4)$ as a linear combination of u_1 , u_2 , and u_3 . In other words, find real numbers c_1 , c_2 , and c_3 such that $(3, -6, 4)$ is equal to $c_1 u_1 + c_2 u_2 + c_3 u_3$.

(b) Consider the vectors $v_1 = (1, 1, 0)$, $v_2 = (-1, 1, 0)$, and $v_3 = (0, -2, 0)$. Can you write $(3, -6, 4)$ as a linear combination of v_1 , v_2 , and v_3 ?

(c) Sketch u_1, u_2, u_3 and v_1, v_2, v_3 on the axes below. What is the key difference between the two sets of vectors?



3. A chickadee starts at the point $(2, -4, 1)$ and flies in the direction of the vector $\left(\frac{3}{\sqrt{10}}, 0, \frac{1}{\sqrt{10}}\right)$ at a rate of $\sqrt{10}$ units per second. A hummingbird starts at the point $(8, 20, 7)$ and flies in the direction of the vector $\left(\frac{1}{\sqrt{5}}, -\frac{2}{\sqrt{5}}, 0\right)$ at a rate of $3\sqrt{5}$ units per second.

(a) Do the paths of the chickadee and the hummingbird intersect?

(b) Do the hummingbird and the chickadee collide?

(c) Suppose that the velocity of the hummingbird is k units per second. For what value of k do the hummingbird and the chickadee collide?

4. Suppose that a particle is revolving clockwise around the point $(4, 2)$ at a rate of 3 revolutions per second. Write parametric equations describing the location of the particle at time t , assuming that it starts at the point $(6, 2)$.