1. If $\mathbf{a} = \langle 2, 3, 8 \rangle$ and $\mathbf{b} = \mathbf{i} - 3\mathbf{k}$, what is $\mathbf{a} \cdot \mathbf{b}$?

2. Find the vector equation of a line that passes through the points $(10, 2, 7)$ and $(8, 18, -1)$.

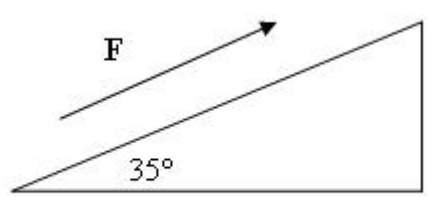
3. What is the angle between the vectors $\mathbf{a} = 4\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = 13\mathbf{i} + \mathbf{j} - 2\mathbf{k}$?

4. What is the distance between $(2, 14, -8)$ and the yz-plane?

5. If $\mathbf{a} = 3\mathbf{i} - \frac{1}{2}\mathbf{j} + \mathbf{k}$, find $|\mathbf{a}|$.

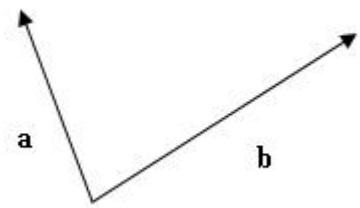
6. What are the parametric equations for a circle, centered at the origin, which
   - starts at $(2, 0)$
   - has radius of 2
   - traces *twice* in a counterclockwise direction?

7. If a box is pushed up a ramp at a $35°$ angle with a force of 20N, what is the force vector? (i.e. what are the x and y components of the force?)



8. What two things are required in order to find the equation of a line in $\mathbb{R}^3$?

9. Which way does $\mathbf{a} \times \mathbf{b}$ point?



10. Suppose a triangle has vertices at the points $A = (2, 3, 1)$, $B = (4, 7, 13)$, and $C = (-4, 3, 2)$. Show that the angle at vertex A is a *right angle*.

11. A particle travels through space along the curve

$$x = t^2 + 7,\ y = 2e^{t-1},\ z = t - 3,$$

where t represents time in seconds. At what time does the particle reach the point $(8, 2, -2)$?

12. Find the parametric equations for a line in $\mathbb{R}^3$ that passes through the point $(1, 7, 4)$ and is parallel to the vector $2\mathbf{i} - \mathbf{j} + \mathbf{k}$.

13. By hand, compute $\text{proj}_{\mathbf{a}}\mathbf{b}$ if $\mathbf{a} = \langle 1, 4, 8\rangle$ and $\mathbf{b} = \langle -2, 3, 1\rangle$.

14. Johnny and Amy are at the beach, and their dads are pulling them each on sleds through the sand. Johnny's path follows the curve

$$J(t) = \langle t^2 + 5t - 1, 17t\rangle,$$

and Amy's path follows the curve

$$A(t) = \langle 10\cos t, 20\sin t\rangle,$$

where t is measured in minutes. Will the paths traced by Johnny and Amy's sleds ever meet? If so, where, and who gets there first?

15. What is the equation of the sphere which passes through the point $(3, 4, 10)$ and whose center is $(1, -2, 7)$?

16. An innertube is pulled by a rope at a $30°$ angle with a force of 100N. If the innertube moves 5 meters, how much work is done?

17. Find a vector of length 5 that is orthogonal to both $\mathbf{a} = \langle -1, 2, 4 \rangle$ and $\mathbf{b} = \langle 3, 0, 18 \rangle$.