1. Suppose $\vec{u} = \langle -2, 1 \rangle$ and $\vec{v} = \langle 3, 1 \rangle$.
   a) Find $\vec{u} \cdot \vec{v}$.

   b) Find the angle (in degrees) between $\vec{u}$ and $\vec{v}$.

   c) Find the component of $\vec{u}$ along $\vec{v}$.

   d) Find the projection of $\vec{u}$ onto $\vec{v}$.

   e) Decompose $\vec{u}$ into $\overrightarrow{u_1}$ and $\overrightarrow{u_2}$, where $\overrightarrow{u_1}$ is parallel to $\vec{v}$ and $\overrightarrow{u_2}$ is orthogonal to $\vec{v}$.

2. Are $\langle 2, -5 \rangle$ and $\langle 10, -4 \rangle$ orthogonal?

3. A 200-lb box is on a ramp. If a force of 80 lb is just sufficient to keep the box from sliding, find the angle of inclination of the ramp. (Assume no friction on the ramp.)

Q: What question can someone ask all day long, always get completely different answers, and yet all the answers could be correct?

4. Suppose $\vec{u} = \langle 3, -2 \rangle$ and $\vec{v} = \langle -1, -5 \rangle$.
   a) Find $\vec{u} \cdot \vec{v}$.

   b) Find the angle (in degrees) between $\vec{u}$ and $\vec{v}$.

   c) Find the component of $\vec{u}$ along $\vec{v}$.

   d) Find the projection of $\vec{u}$ onto $\vec{v}$.

   e) Decompose $\vec{u}$ into $\overrightarrow{u_1}$ and $\overrightarrow{u_2}$, where $\overrightarrow{u_1}$ is parallel to $\vec{v}$ and $\overrightarrow{u_2}$ is orthogonal to $\vec{v}$.

5. Suppose $\vec{u} = \langle 7, -2 \rangle$ and $\vec{v} = \langle 0, 3 \rangle$.
   a) Find $\vec{u} \cdot \vec{v}$.

   b) Find the angle (in degrees) between $\vec{u}$ and $\vec{v}$.

c) Find the component of $\vec{u}$ along $\vec{v}$.

d) Find the projection of $\vec{u}$ onto $\vec{v}$.

e) Decompose $\vec{u}$ into $\overrightarrow{u_1}$ and $\overrightarrow{u_2}$, where $\overrightarrow{u_1}$ is parallel to $\vec{v}$ and $\overrightarrow{u_2}$ is orthogonal to $\vec{v}$.

6. Are $\langle 4, -1\rangle$ and $\langle -2, -8\rangle$ orthogonal?

7. Are $\langle 5, 3\rangle$ and $\langle -1, 2\rangle$ orthogonal?

8. Suppose $\vec{u} = \langle -1, 5\rangle$ and $\vec{v} = \langle 3, -2\rangle$. Decompose $\vec{u}$ into $\overrightarrow{u_1}$ and $\overrightarrow{u_2}$, where $\overrightarrow{u_1}$ is parallel to $\vec{v}$ and $\overrightarrow{u_2}$ is orthogonal to $\vec{v}$.

9. Suppose $\vec{u} = \langle 6, 3 \rangle$ and $\vec{v} = \langle -4, 0 \rangle$. Decompose $\vec{u}$ into $\overrightarrow{u_1}$ and $\overrightarrow{u_2}$, where $\overrightarrow{u_1}$ is parallel to $\vec{v}$ and $\overrightarrow{u_2}$ is orthogonal to $\vec{v}$.

10. A 50-lb wagon is on a hill that is inclined 7° to the horizontal. Find the magnitude of the force required to keep the wagon from rolling down the hill. (Assume no friction on the hill.) Also, find the magnitude of the force experienced by the hill due to the weight of the wagon.

11. An 800-lb elephant on roller skates is on a ramp with a 25° angle of inclination. Find the magnitude of the force required to keep the elephant from rolling down the ramp. (Assume no friction on the ramp.) Also, find the magnitude of the force experienced by the ramp due to the weight of the elephant.

12. A 300-lb wagon is on a ramp. If a force of 40 lbs is just sufficient to keep the wagon from rolling down the ramp, find the angle of inclination of the ramp. (Assume no friction on the ramp.)

13. A 2000-lb car is on a hill. If a force of 500 lbs is just sufficient to keep the car from rolling down the hill, find the angle of inclination of the hill. (Assume no friction on the hill.)

Optional exercises from the Sullivan book if you'd like more practice:
9.5 (p.615) #9-17 odd, 21-25 odd, 33, 35