① Which expression makes sense; where · is dot-product

   a) $\left(\vec{a} \cdot \vec{b}\right)\vec{c}$ b) $\|\vec{a}\| \left(\vec{b} \cdot \vec{c}\right)$ c) $\vec{a} \cdot (\vec{b} + \vec{c})$

   d) $\vec{a} \cdot \vec{b} + \vec{c}$ e) $\|\vec{a}\| \cdot (\vec{b} + \vec{c})$

② Find dot product of two vectors if their lengths

   are 6 and $\frac{1}{3}$ and the angle between them is $\pi/4$.

③ Find $\vec{a} \cdot \vec{b}$ for

   a) $\vec{a} = \langle -2, \frac{1}{3}\rangle$, $\vec{b} = \langle -5, 12\rangle$

   b) $\vec{a} = \langle 4, 1, \frac{1}{4}\rangle$, $\vec{b} = \langle 6, -3, -8\rangle$

④ Find angle between $\vec{a}$ and $\vec{b}$ for:

   a) $\vec{a} = \langle \sqrt{3}, 1\rangle$, $\vec{b} = \langle 0, 5\rangle$

   b) $\vec{a} = \langle 4, 0, 2\rangle$, $\vec{b} = \langle 2, -1, 0\rangle$

   c) $\vec{a} = i + 2j - 2k$, $\vec{b} = 4i - 3k$

⑤ Are the vectors orthogonal, parallel, or neither?

   a) $\vec{a} = \langle -5, 3, 7\rangle$, $\vec{b} = \langle 6, -8, 2\rangle$

   b) $\vec{a} = \langle -3, 9, 6\rangle$, $\vec{b} = \langle 4, -12, -8\rangle$

   c) $\vec{a} = \langle 7, 0, -2\rangle$, $\vec{b} = \langle 2, 5, 7\rangle$

⑥ For what values of b are the vectors $\langle -6, b, 2\rangle$ and $\langle b, b^2, b\rangle$ orthogonal?

⑦ Find the directional an (cosines) of $\langle 3, 4, 5\rangle$

⑧ Find $\text{proj}_{\vec{a}}(\vec{b})$ and $\text{comp}_{\vec{a}}(\vec{b})$ for

a) $\vec{a} = \langle 3, -4\rangle$ and $\vec{b} = \langle 5, 0\rangle$

b) $\vec{a} = \langle 3, 6, -2\rangle$ and $\vec{b} = \langle 1, 2, 3\rangle$

⑨ The vector $\text{orth}_{\vec{a}}(\vec{b}) = \vec{b} - \text{proj}_{\vec{a}}(\vec{b})$ is called the orthogonal projection of $\vec{b}$. Show that $\text{orth}_{\vec{a}}(\vec{b})$ is orthogonal to $\vec{a}$.

⑩ Find the work done by a force $\vec{F} = 8i - 6j + 9k$ that moves an object from the point $(0, 10, 8)$ to the point $(6, 12, 20)$ along a straight line.

⑪ A sled is pulled along a level path through snow by a rope. A 30 lb force acting at an angle of $40°$ moves sled 80 feet. Find the work done by the force.

⑫ Find the angle between a diagonal of a cube and one of its edges.

⑬ If $\vec{r} = \langle x, y, z \rangle$, $\vec{a} = \langle a_1, a_2, a_3 \rangle$ and $\vec{b} = \langle b_1, b_2, b_3 \rangle$, show that the equation

$$(\vec{r} - \vec{a}) \cdot (\vec{r} - \vec{b}) = 0$$

is a sphere. Find its center and radius.

⑭ Show that if $\vec{u} + \vec{v}$ and $\vec{u} - \vec{v}$ are orthogonal, then $\vec{u}$ and $\vec{v}$ must have the same length.