**Problem 1** If $\vec{u}$, $\vec{v}$, and $\vec{w}$ are vectors and all the other quantities are scalars which of the following expressions make sense

1. $\vec{u} \cdot (\vec{v} \times \vec{w})$
2. $(\vec{u} \cdot \vec{v}) \times \vec{w}$
3. $\vec{u} \times \vec{v} + k$
4. $\vec{u} \cdot \vec{v} + k$
5. $(\vec{u} \times \vec{v}) \times \vec{w}$
6. $(\vec{u} \cdot \vec{v}) \cdot \vec{v}$
7. $(\vec{u} \cdot \vec{v})\vec{w}$

**Problem 2** Show that for any two vectors $\vec{u}$ and $\vec{v}$ we have

$$|\vec{u} + \vec{v}|^2 + |\vec{u} - \vec{v}|^2 = 2\left(|\vec{u}|^2 + |\vec{v}|^2\right).$$

What geometric theorem about a parallelogram can you deduce from that?

**Problem 3*** Three vectors $\vec{u}$, $\vec{v}$, and $\vec{w}$. satisfy all the following properties:

$$|\vec{u}| = |\vec{w}| = 5, \qquad |\vec{v}| = 1, \qquad |\vec{u} - \vec{v} + \vec{w}| = |\vec{u} + \vec{v} + \vec{w}|.$$

If the angle between $\vec{u}$ and $\vec{v}$ is $\pi/8$, what is the angle between $\vec{v}$ and $\vec{w}$.

**Problem 4*** Either show that the statements are true or give a counterexample. In each case $\vec{w} \neq \vec{0}$.
**(a)** If $\vec{u} \cdot \vec{w} = \vec{v} \cdot \vec{w}$, then $\vec{u} = \vec{v}$.
**(b)** If $\vec{u} \times \vec{w} = \vec{v} \times \vec{w}$, then $\vec{u} = \vec{v}$.
**(c)** If If $\vec{u} \cdot \vec{w} = \vec{v} \cdot \vec{w}$ and $\vec{u} \times \vec{w} = \vec{v} \times \vec{w}$, then $\vec{u} = \vec{v}$.