Math 32 – Workshop #3

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1. Which of the following expression are meaningless (i.e. not defined)? For those that are meaningful (i.e. defined), state whether the expression is a scalar or a vector.

   (a) $\dfrac{1}{|\vec{\mathbf{v}}|}\vec{\mathbf{w}}$

   (b) $|\vec{\mathbf{v}}|\dfrac{1}{\vec{\mathbf{w}}}$

   (c) $\vec{\mathbf{v}} \cdot \vec{\mathbf{w}}$

   (d) $|\vec{\mathbf{v}}| \cdot \vec{\mathbf{w}}$

   (e) $(|\vec{\mathbf{v}}| + 4)\vec{\mathbf{w}}$

2. We have two vectors in $\mathbb{R}^2$, $\vec{\mathbf{v}} = \langle 9, 3\rangle$ and $\vec{\mathbf{w}} = \langle 1, 5\rangle$.

   (a) Carefully sketch these vectors. Find an expression for $\cos\theta$, where θ is the angle between $\vec{\mathbf{v}}$ and $\vec{\mathbf{w}}$.

   (b) On your picture, where is the projection of $\vec{\mathbf{w}}$ onto $\vec{\mathbf{v}}$? Sketch where it is on your picture.

   (c) Find a unit vector in the direction of this projection. What is this unit vector also parallel to?

   (d) Using trigonometry, what is the length of this projection?

   (e) Any vector can be expressed as a scalar multiplication:

   $$\textit{(length of vector)} \cdot \textit{(unit vector in the direction of that vector).}$$

   Use this, and your work above, to find the vector that represents the projection of $\vec{w}$ onto $\vec{v}$.

3. We have two vectors in $\mathbb{R}^3$, $\vec{\mathbf{v}} = \langle 1, 3, 2\rangle$ and $\vec{\mathbf{w}} = \langle -4, 2, 1\rangle$. Use only the dot product in this problem.

   (a) Prove or disprove: $\vec{\mathbf{v}} \perp \vec{\mathbf{w}}$.

   (b) There is a long way and a short way to do part (a), what are they?

   (c) Prove or disprove: $\vec{\mathbf{v}} \parallel \vec{\mathbf{w}}$.