

YOUR NAME: \_\_\_\_\_

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Read each problem **very carefully** before starting to solve it. Each problem is worth around 5 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points. GOOD LUCK!!

1. Consider the two vectors  $\mathbf{u} = \langle -2, 7 \rangle$  and  $\mathbf{v} = \langle -1, -3 \rangle$ . Compute the following:

(a)  $2\mathbf{u} - 3\mathbf{v}$

(b)  $\|\mathbf{u}\|$

- (c) The unit vector  $\mathbf{k}$  in the direction of  $\mathbf{v}$ .

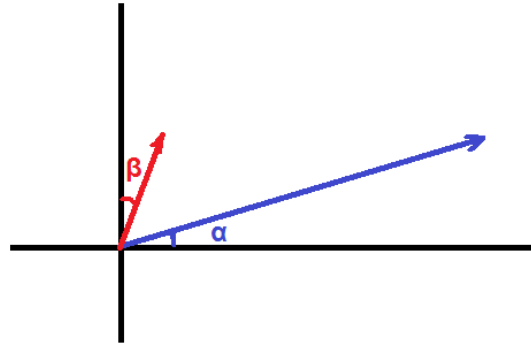
2. Consider the two vectors  $\mathbf{u} = \langle 2, 7 \rangle$  and  $\mathbf{v} = \langle 5, 1 \rangle$ . Compute the following:

(a)  $\mathbf{u} \cdot \mathbf{v}$

- (b)  $\cos \alpha$ , where  $\alpha$  is the smallest positive angle between  $\mathbf{u}$  and  $\mathbf{v}$ .

- (c) The scalar projection  $\text{proj}_{\mathbf{v}}\mathbf{u}$ .

3. A plane is flying at an airspeed of 300 mph forming an angle  $\alpha = 30^\circ$  with the horizontal, as shown in the diagram. A wind of 50 mph is blowing forming an angle  $\beta = 20^\circ$  with the vertical, also shown in the diagram. Find the following:



- (a) The ground velocity of the plane (as a vector in component form).
- (b) The ground speed of the plane (this is the magnitude of the velocity vector).