

Scalar multiplication in the xy-coordinate system:

$$\text{Let } \vec{u} = (-5, 7). \text{ Then } 4\vec{u} = 4(-5, 7) = (4(-5), 4(7)) = (-20, 28)$$

$$-2\vec{u} = -2(-5, 7) = (-2(-5), -2(7)) = (10, -14)$$

$$\|\vec{u}\| = \sqrt{(-5)^2 + 7^2} = \sqrt{25+49} = \sqrt{74}$$

$$\|4\vec{u}\| = \sqrt{(-20)^2 + (28)^2} = \sqrt{400+784} = \sqrt{1184} = \sqrt{16(74)} = 4\sqrt{74}$$

$$\|-2\vec{u}\| = \sqrt{10^2 + (-14)^2} = \sqrt{100+196} = \sqrt{296} = \sqrt{4(74)} = 2\sqrt{74}$$

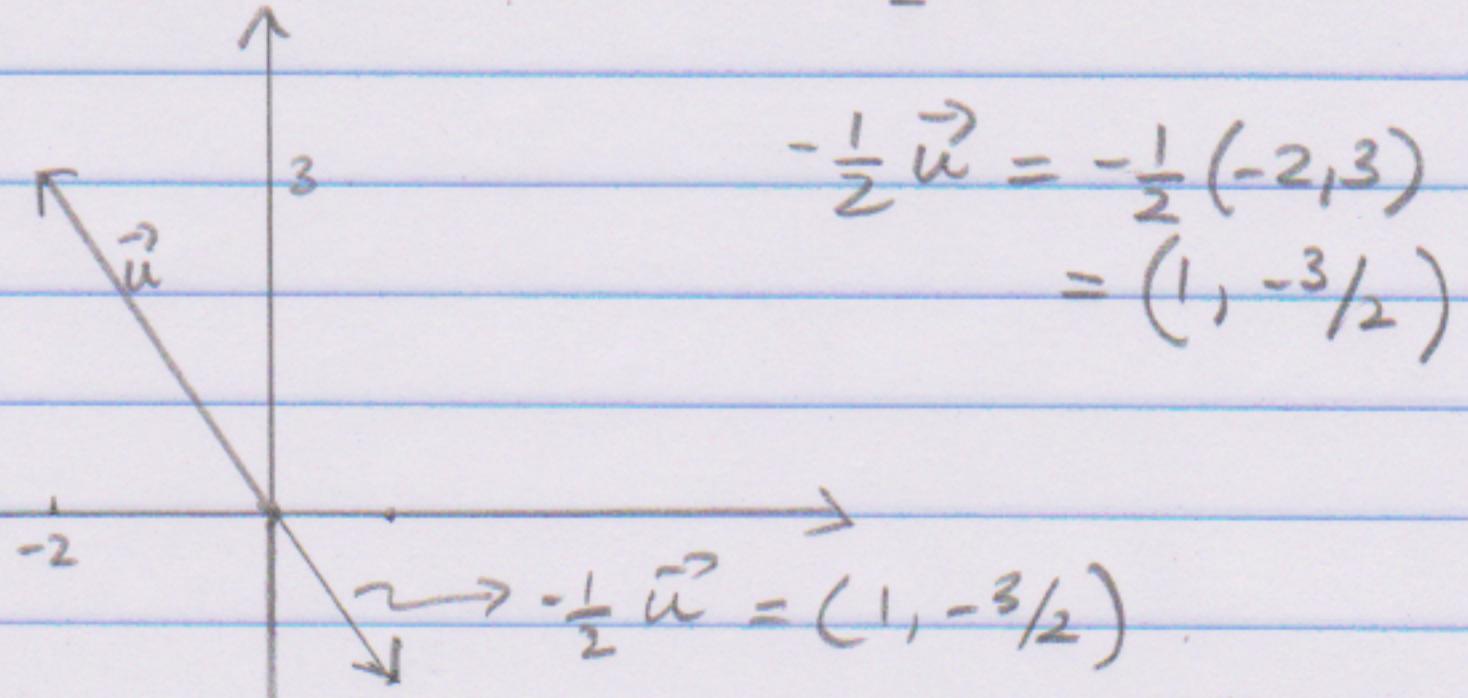
$$\text{As you can see } \|4\vec{u}\| = 4\|\vec{u}\|$$

$$\text{And } \|-2\vec{u}\| = |-2|\|\vec{u}\| = 2\|\vec{u}\|$$

In general, $\|k\vec{u}\| = |k|\|\vec{u}\|$ for any scalar k .

Example

Let $\vec{u} = (-2, 3)$. Find $-\frac{1}{2}\vec{u}$.



$$\begin{aligned}-\frac{1}{2}\vec{u} &= -\frac{1}{2}(-2, 3) \\ &= (1, -\frac{3}{2})\end{aligned}$$

$$\sim \rightarrow -\frac{1}{2}\vec{u} = (1, -\frac{3}{2})$$