

# The Theoretical Minimum

## Classical Mechanics - Solutions

I01E02

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**Exercise 1.** *Work out the rule for vector subtraction.*

This exercise is about getting a (visual) feel for vector manipulation; it is *not* about vector coordinates manipulation. We were previously taught how to multiple vectors by a negative scalar:

For example,  $-2\vec{r}$  is the vector that is twice as long as  $\vec{r}$ , but points in the opposite direction.

And how to add vectors:

To add  $\vec{A}$  and  $\vec{B}$ , place them as shown in Figure 13 to form a quadrilateral (this way the directions of the vectors are preserved). The sum of the vectors is the length and angle of the diagonal

So, by observing that (we'll use a **bold** font to denote vectors instead of arrows, e.g.  $\mathbf{v}$  is a vector):

$$\mathbf{u} - \mathbf{v} = \mathbf{u} + (-1\mathbf{v})$$

We conclude that we first need to reverse the direction of the vector to be subtracted, and add this to the other vector. Visually:

