# Conserved Quantities

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Leave answers in terms of the variables given and any constants.

1. In comparison to Patrick's mass, Matthew's mass is negligible. Patrick and Matthew approach each other, both going at speed $v$. After the collision, what speed should Matthew be going at?

2. Patrick is on top of a cliff with a bungee cord at his feet of length $\ell$ and spring constant $k$. Matthew pushes him off the cliff, assume that the bungee will stretch a bit by a distance $x$. What is the max height below the top of the cliff that Patrick will descend to?

3. Matthew falls from a building of height $h$ and Patrick attempts to catch him with a spring bed that he has engineered. However, Patrick is terrible at engineering and physics and does not know what spring constant to construct so that Matthew will land safely and not be shot back into the air. Find the spring constant.

4. Consider four masses arranged in a tetrahedral configuration. What is the gravitational potential of the system of 4 masses.

5. Patrick of mass $m$ and height $\ell$ has come back alive from visiting a nearby black hole. Due to the "spaghetti effect" Patrick is now a string-like. Suppose his feet dangle from the top of a building and is shoved off. Find the equation for how much of Patrick has fallen below the building at some time $t$.