A Pythagorean Triple is three positive integers $x, y, z$ such that $x^2 + y^2 = z^2$. The value $z$ is the hypotenuse; the other two values are the legs. A triple is said to be primitive if the three values do not have a common factor. For example, $(3, 4, 5)$, $(5, 12, 13)$, and $(8, 15, 17)$ are primitive Pythagorean Triples (PPTs). The trio $(6, 8, 10)$ is a Pythagorean triple which is not primitive.

1. Prove that the hypotenuse of a PPT is odd.

2. Find all PPTs where one of the legs is 12.

3. Show that if $P = (x, y, z)$ is a Pythagorean triple, then so is the triple $Q = (x + 2y + 2z, 2x + y + 2z, 2x + 2y + 3z)$.

4. Continuing the previous question, show that $P$ is a PPT if and only if $Q$ is. (Hint: the reverse process is $(x' + 2y' - 2z', 2x' + y' - 2z', -2x' - 2y' + 3z')$.)