1.2.10

$$|p+q|^2 + |p-q|^2 = 2|p|^2 + 2|q|^2$$

$$(|p+q| \cdot |p+q|) + (|p-q||p-q|) =$$

$$(|p|^2 + 2\cancel{|pq|} + |q|^2) + (|p|^2 - 2\cancel{|pq|} + |q|^2)$$

$$|p|^2 + |q|^2 + |p|^2 + |q|^2$$

$$2|p|^2 + 2|q|^2 = 2|p|^2 + 2|q|^2$$

let $p = (1,0)$ $q = (0,1)$

$|p| = \sqrt{2}$ $|q| = \sqrt{2}$

$p+q = (1,1)$ $p-q = (1,-1)$

now prove the parallelogram

$$|p+q|^2 + |p-q|^2 = 2|p|^2 + 2|q|^2$$

$$(\sqrt{2})^2 + (\sqrt{2})^2 = 2(\sqrt{1})^2 + 2(\sqrt{1})^2$$

$$2 + 2 = 2 + 2 \quad \text{so} \quad 4 = 4$$

now prov the nonparalleogram

let $p = (1,0)$ $q = (1,1)$

$|p| = \sqrt{1}$ $|q| = \sqrt{2}$

$p+q = (2,1)$ $p-q = (0,1)$

now $|p+q|^2 + |p-q|^2 = 2|p|^2 + 2|q|^2$

$$(\sqrt{5})^2 + (\sqrt{1})^2 = 2(\sqrt{1})^2 + 2(\sqrt{2})^2$$

$$5 + 1 = 2 + 4$$

$$5 \neq 6$$