Problem 30.1

$$T(r, \theta) = (2r, \theta)$$

a) Yes, T is a linear transformation

$T(v) = 2r$, so $T(v_1 + v_2) = 2v_1 + 2v_2$

$= T(v_1) + T(v_2)$

$T(cv) = 2cr = cT(v)$

b) $T(x, y) = (2x, 2y)$

$$\left\| \begin{bmatrix} x \\ y \end{bmatrix} \right\| = \sqrt{x^2 + y^2} \quad \therefore T \left\| \begin{bmatrix} x \\ y \end{bmatrix} \right\| = \begin{bmatrix} 2x \\ 2y \end{bmatrix}$$

$$= \sqrt{4(x+y)^2} = 2 \left\| \begin{bmatrix} x \\ y \end{bmatrix} \right\|$$

$\therefore T$ doubles the length vectors

(c) Matrix T is $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$

Problem 30.2

(See solution)