Problem 9.1

A body of mass "m" and velocity magnitude "v" has momentum "p" and kinetic energy "KE." Express the kinetic energy in terms of momentum "p."

$$|\vec{p}| = mv$$
$$\Rightarrow \quad p^2 = m^2v^2$$
$$KE = \frac{1}{2}mv^2$$
$$\Rightarrow \quad = \frac{1}{2m}m^2v^2$$
$$= \frac{1}{2m}p^2$$
$$= \frac{p^2}{2m}$$

b.) Going the other way, what is the kinetic energy "KE" in terms of momentum "p?"

$$KE = \frac{p^2}{2m}$$
$$\Rightarrow \quad |\vec{p}| = \sqrt{2m(KE)}$$

NOTE: As fun as this all is, the only relationships you need to memorize are:

$$|\vec{p}| = m|\vec{v}| \text{ and } KE = \frac{1}{2}mv^2$$