An Example Using the Power Function: Kinetic Energy

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What is Kinetic Energy?

- The kinetic energy of an object is the energy that it possesses due to its motion.
- It is defined as the work needed to accelerate a body of a given mass from rest to its stated velocity.

Kinetic Energy Expressed as a Power Function

- Mathematically, kinetic energy (E) of an object of mass m (kg) moving at a velocity v (m/s) can be expressed as such

$$E = f(v) = \frac{1}{2} m v^2$$

Units of Kinetic Energy

- The units of kinetic energy are Joules (J)

$$1\,J = 1\,kg \times \frac{m^2}{s^2}$$

Example: Consider a 625-kg roller coaster That travels at speeds in the range 0-20 m/s.

- Express the kinetic energy of the roller coaster as a function of velocity.
- Create a Table with columns for velocity and kinetic energy.
- Plot the kinetic energy of the roller coaster.

Kinetic Energy as a Function of Velocity

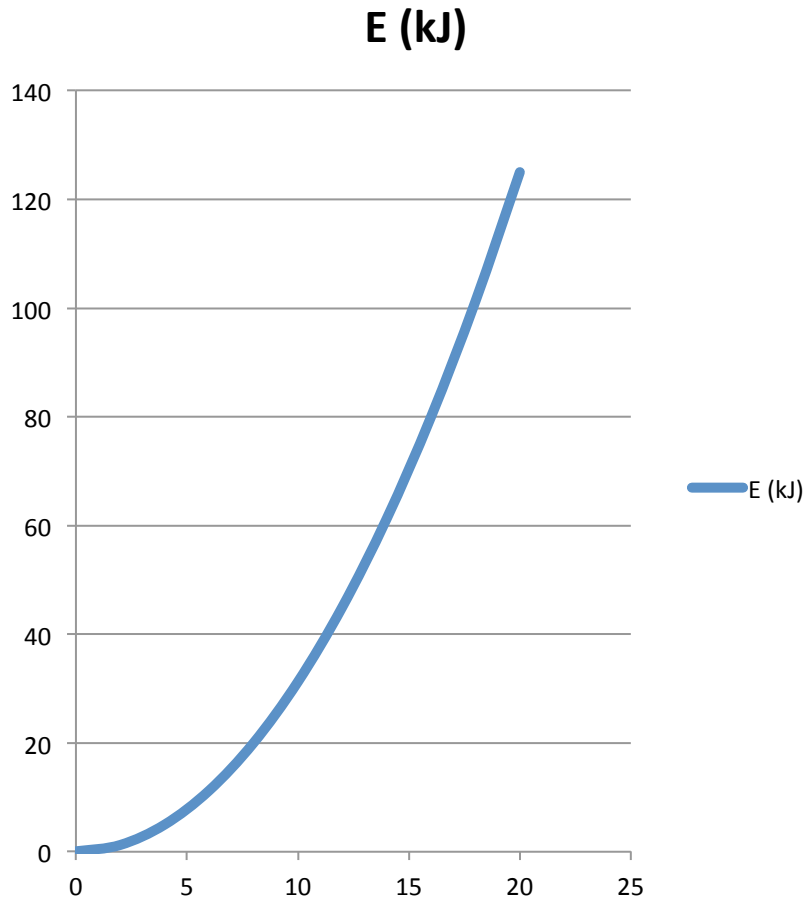
$$E = \frac{1}{2}(625)(v^2) \quad J$$

$$E = (312.5)(v^2) \quad J$$

$$E = 0.3125\, v^2 \quad kJ$$

Table and Plot

v (m/s)	E (kJ)
0	0
2	1.25
4	5
6	11.25
8	20
10	31.25
12	45
14	61.25
16	80
18	101.25
20	125



Inverse Function

- For the roller coaster example, we may express the velocity as the inverse function of kinetic energy.

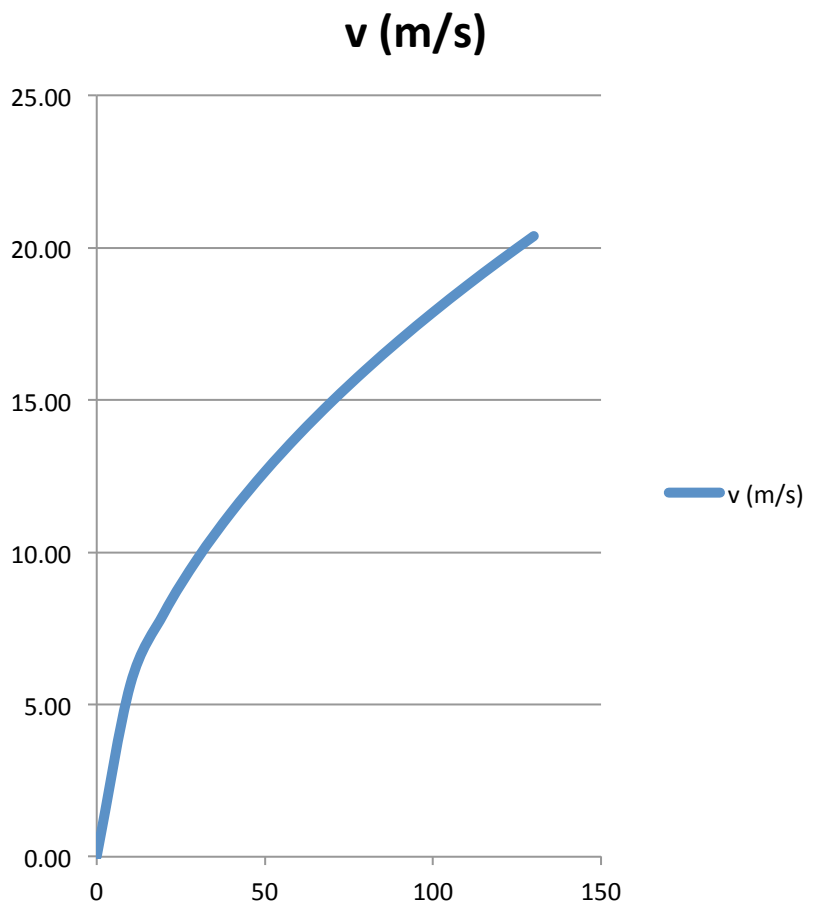
$$E = 0.3125v^2$$

$$v^2 = \frac{1}{0.3125}E$$

$$v \approx 1.788\left(E\right)^{\frac{1}{2}} = f^{-1}(E)$$

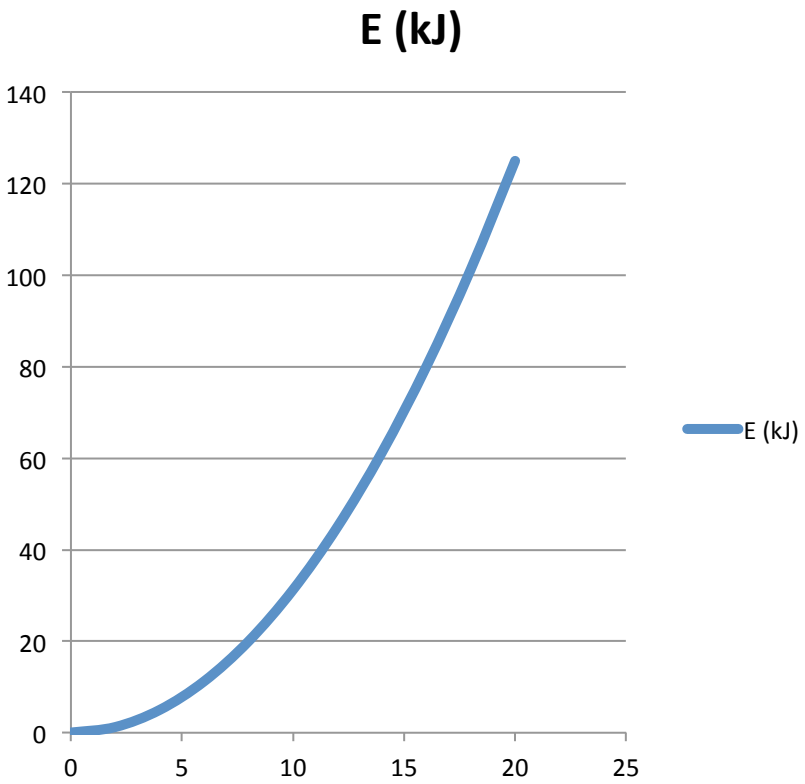
Inverse Function

E(kJ)	v (m/s)
0	0.00
10	5.65
20	8.00
30	9.79
40	11.31
50	12.64
60	13.85
70	14.96
80	15.99
90	16.96
100	17.88
110	18.75
120	19.59
130	20.39



Comparison

Function



Inverse Function