

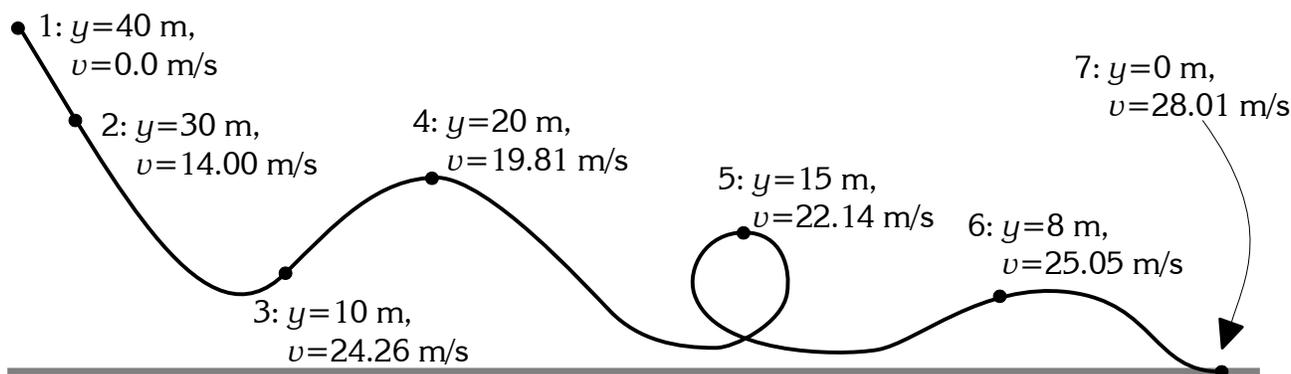
Energy Exercises

The two forms of energy discussed most often are **kinetic energy** (which is based on the motion of matter) and **potential energy** (based on arrangements of matter). One type of potential energy is gravitational potential energy (GPE). The “arrangement” in GPE is based on how high up something is above your reference point. You can calculate them with these formulas:

| | |
|---------------------------------|--------------------------------------|
| Kinetic energy: | $KE = \frac{1}{2} \cdot m \cdot v^2$ |
| Gravitational potential energy: | $GPE = m \cdot g \cdot y$ |

A roller coaster!

The height of a (frictionless) roller coaster track is shown at several points, as well as the speed of the car at each point. Find the KE and PE for each point, as well as the sum of the two. The mass of the ride's car is 800.0 kg. (The unit for energy is “J” for Joules!!)



$g = 9.81 \text{ N/kg}$

| Point | KE | GPE | Total Energy |
|-------|----|-----|--------------|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |

1) What do you notice about the total energy column?

2) Why does this happen?

- 3) Regulation baseballs have a mass of 0.140 kg. A pretty good fastball pitch has a velocity of 44.0 m/s (around 98 mph).
- A) What's the kinetic energy of a ball going this speed?

 - B) If the ball were thrown at that speed straight up, use energy equations to figure out what its maximum height would be.

 - C) Find the maximum height again, this time using only motion equations, without any energy stuff! (Hopefully you get the same answer...)
- 4) During the Red Bull Stratos Jump in October 2012, Felix Baumgartner jumped out of a balloon from 38,969.4 m above the ground. (Roughly 24 miles.) We can approximate his total mass -- including gear like the space suit, parachute, etc -- at 100. kg.
- A) What was Baumgartner's GPE at the start of the jump?

 - B) Baumgartner's maximum velocity during the Stratos jump was 377 m/s (over 800 mph). What was his KE at that time?

 - C) If we assume that no thermal energy was created by air resistance, how much GPE would Baumgartner have had at the moment he reached his maximum speed?

 - D) What altitude would this correspond to?

 - E) His ACTUAL altitude when he reached 377 m/s was 27,833 m. How much thermal energy had been generated?