

PHYSICS 11

KINETIC AND POTENTIAL ENERGY

KINETIC ENERGY is the energy of an object associated with the object's motion.

$$KE = \frac{1}{2} m v^2$$

m = mass

v = speed



Kinetic energy is a scalar.

Units: JOULE = J

Kinetic energy is never *negative*.

POTENTIAL ENERGY is the energy of an object associated with the object's position relative to the reference level.

Reference level is usually the ground but it does not have to be.

$$PE = m g h$$

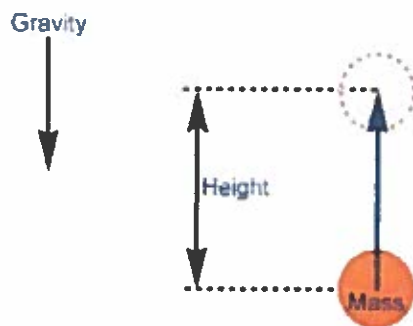
g = acceleration due to gravity

m = mass

h = height above the reference level

You can think of potential energy as energy stored in the object through the merit of being above the reference level.

Potential energy is equal to work that needs to be done by gravity in order to bring the object to the reference level.



Potential energy is a scalar.

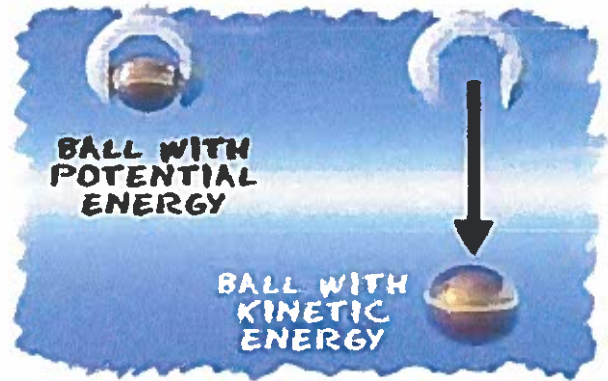
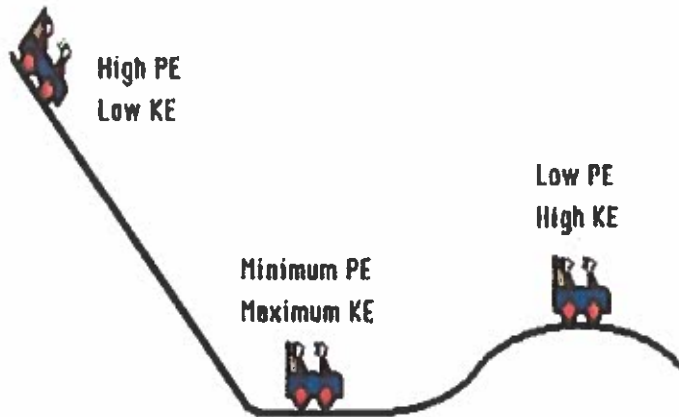
Units: JOULE = J

PE can be negative if the object is below the reference level. (For example if the reference level is the street level, than your potential energy is negative if you are in the basement)

ALL UNITS HAVE TO BE IN m, m/s, kg, s, and J

Potential and kinetic energy are examples of MECHANICAL ENERGY.

Kinetic energy can be transferred into potential energy and vice versa.



As a coaster car loses height, it gains speed; PE is transformed into KE. As a coaster car gains height it loses speed; KE is transformed into PE. The sum of the KE and PE is a constant.

TOTAL MECHANICAL ENERGY

$$E_{\text{tot}} = PE + KE$$

WORK-ENERGY THEOREM

Work can be defined as change in kinetic energy.

$$W = \Delta KE \quad \text{or} \quad W = KE_f - KE_i$$

$$W = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

Examples:

1. Find the kinetic energy of a 50 – kg object that travels at 5 km/h.

2. How fast does a 10g marble move if it has 50 J of kinetic energy?

3. a) Find the mass of an object that moves at 25km/h and has kinetic energy of 1500J.

b) What is the object's weight? What assumptions do you make?

4. What work was needed to stop an 8.0-kg object that originally moved with speed of 20 m/s?

5. What is the potential energy of a 2.5 kg rock that lies on a 300m high cliff?

6. What is the potential energy of a person whose weight is 784 N and they on top of a CN Tower? (350 m)

7. What is the mass of an object that is at rest in a room on the tenth floor of a hotel and their total energy is 25 000J?

Assume that each floor is 6 m high and the street level is the reference level.

8. What is the total mechanical energy of a 1200-kg car that stopped on a cliff that is 80 m above the sea level?

9. How much does the total mechanical energy of the car from question 8 changed if it now moves with average speed of 65 km/h on the road that is 120 m above the sea level?

10. What is your total mechanical energy when you drive to school?

11. What is your total mechanical energy when you walk home from school?

12. What is your mechanical energy when you are sitting in the physics class? What did you choose as the reference level?