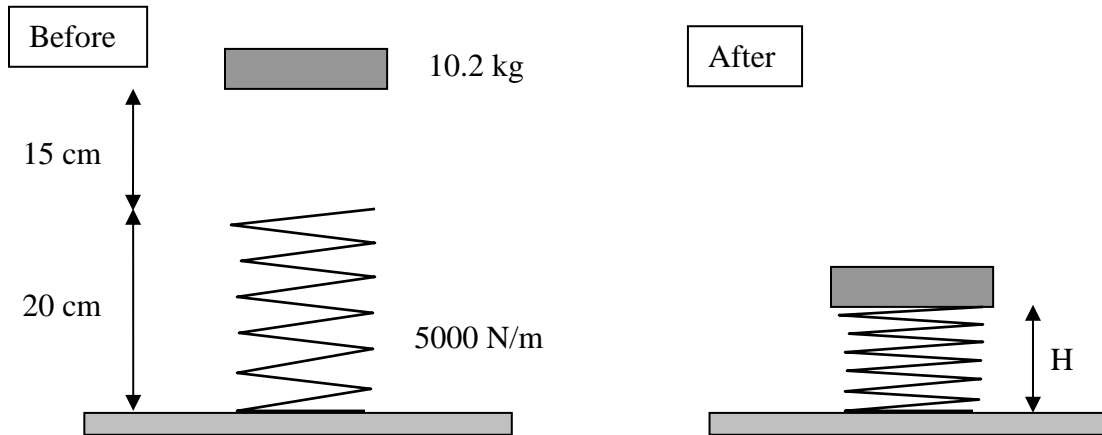**Example 1 :**

A 20-cm-tall spring with spring constant 5000 N/m is placed vertically on the ground. A 10.2 kg block is held 15 cm above the spring. The block is dropped, hits the spring, and compresses it. What is the height of the spring at the point of maximum compression?

Before

10.2 kg

After

15 cm

20 cm

5000 N/m

H

Example 2:
Consider the potential energy graph shown below

U(J)

4

3

2

1

x (m)

1   2   3   4
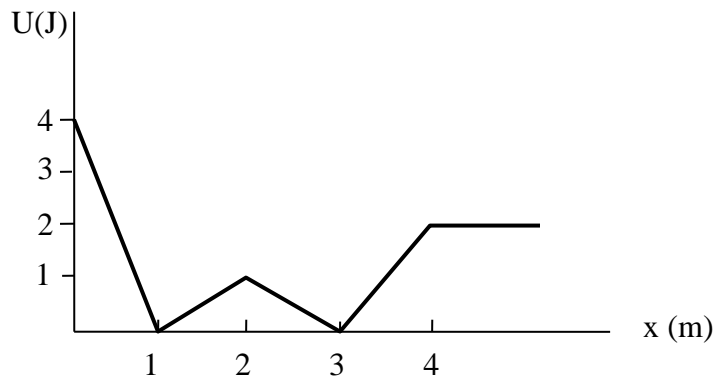
1) For a particle of total energy 1.5 J, answer the following questions:
   - Where does the particle speed up?
   - Where does the particle slow down?
   - Where are the turning points in the motion?
   - What is the kinetic energy graph?
   - What is the graph of the force acting on the particle?

2) Where could be a particle at rest be located? Is the equilibrium stable or unstable?

3) A particle with total energy E = 1.5 J is moving to the left. Just as it passes x = 2m, it is hit from behind by a marble that has been launched from a slingshot. The collision increases the particle's energy by 1.0 J. Describe the subsequent motion of the particle.

Answers

Example 1: H = 10 cm

Example 2: Draw the horizontal line at 1.5 J. The difference 1.5 – U = K is the kinetic energy. Where K increases the particle speeds up (e.g. moving right from 2 m to 3m). Where K decreases the particle slows down (e.g. moving left from 3 m to 2 m). The turning points are the points where U = 1.5 J (approximately at 0.5 m and 3.5 m). The kinetic energy graph is defined between 0.5 m and 3.5 m. It is given by 1.5 – U. The force at any location is given by $-dU/dx$ (= negative slope of the graph).

A particle is at rest if $dU / dx = 0$ (force is 0) and K = 0. A particle with total 0 J energy can be located at 1 m and 3 m. The equilibrium is stable at these locations (minimum of U). A particle with total 1 J energy can be at rest at 2 m. But the equilibrium is unstable at that location (maximum of U). A particle with total energy 2 J could be at rest anywhere beyond 4m. The equilibrium would be unstable anywhere beyond 4 m.