Derivation of Potential Energy

1. When a child on a swing reaches the highest point, how does the gravitational potential energy (GPE) at this point compare to when they are at the lowest point?

   A) GPE is higher at the highest point

   B) GPE is lower at the highest point

   C) GPE is the same at both points

   D) GPE is zero at the highest point

2. A soccer ball is kicked vertically upwards. At the peak of its trajectory, how does the elastic potential energy (EPE) compare to its gravitational potential energy (GPE)?

   A) EPE is at its maximum, GPE is at its minimum

   B) EPE is at its minimum, GPE is at its maximum

   C) Both EPE and GPE are at their maximum

   D) The soccer ball does not have elastic potential energy

3. If you stretch a rubber band, holding it still before releasing, what happens to the elastic potential energy?

   A) Increases as you stretch it

   B) Decreases as you stretch it

   C) Remains constant while stretching

   D) Becomes zero at maximum stretch

4. A hiker carries a backpack up a mountain. How does the gravitational potential energy of the backpack change as the hiker ascends?

   A) Increases

   B) Decreases

   C) Remains constant

   D) Initially increases, then decreases

5. In a physics experiment, a spring is compressed with a force F and then released. How does the elastic potential energy change upon release?

    A) Increases

    B) Decreases

    C) Remains the same

    D) Becomes zero immediately after release

6. A book falls off a table and lands on the floor. How does the gravitational potential energy at the moment before impact compare to when it was on the table?

    A) Higher on the table

    B) Lower on the table

    C) The same as on the table

    D) Zero on the floor

7. A child pulls back a slingshot before letting go. At the moment before release, how is the elastic potential energy related to the distance the slingshot is stretched?

    A) Directly proportional

    B) Inversely proportional

    C) No relation

    D) Square of the distance

8. An apple detaches from a tree and falls. How does this scenario illustrate the conversion of potential energy types?

    A) From kinetic to gravitational

    B) From gravitational to kinetic

    C) From elastic to gravitational

    D) From gravitational to elastic

9. A diver stands on a high diving board. How does her potential energy change if she climbs higher?

    A) Increases

    B) Decreases

    C) Remains constant

    D) First decreases, then increases

10. When compressing a spring in a toy gun before shooting, how does the potential energy at full compression compare to before compression?

A) Higher at full compression

B) Lower at full compression

C) The same at full compression

D) Becomes zero at full compression

Answers UnCubed

1. **A) GPE is higher at the highest point**
    - Explanation: The gravitational potential energy of the child on the swing is highest at the highest point due to the increase in elevation above the reference point (lowest point), directly correlating to an increase in GPE.
2. **D) The soccer ball does not have elastic potential energy**
    - Explanation: A soccer ball primarily has gravitational potential energy when kicked upwards. Elastic potential energy applies to systems that can deform and return to their original shape, like springs, which does not apply to the soccer ball's trajectory.
3. **A) Increases as you stretch it**
    - Explanation: The elastic potential energy stored in a stretched rubber band increases with the amount of stretch, as it is directly proportional to the square of the distance stretched.
4. **A) Increases**
    - Explanation: As the hiker ascends the mountain with a backpack, the gravitational potential energy of the backpack increases due to the increase in height above the Earth's surface, elevating the potential energy in relation to a reference level.
5. **B) Decreases**
    - Explanation: Upon release, the elastic potential energy stored in the compressed spring converts into kinetic energy, causing a decrease in elastic potential energy
6. **A) Higher on the table**
    - Explanation: The gravitational potential energy of the book is higher when it is on the table because potential energy is directly related to its height above the ground. When the book falls, this energy is converted into kinetic energy, reducing its gravitational potential energy just before impact.
7. **A) Directly proportional**
    - Explanation: The elastic potential energy stored in a stretched slingshot is directly proportional to the square of the stretch distance. This relationship indicates that doubling the stretch distance would quadruple the stored elastic potential energy, following the formula for elastic potential energy, U = 1/2kx^2, where *x* is the stretch distance.
8. **B) From gravitational to kinetic**
    - Explanation: As the apple falls from the tree, its gravitational potential energy, which is maximum at the point of detachment, is converted into kinetic energy as it accelerates towards the ground. This illustrates the conservation of mechanical energy in a system where potential energy converts into kinetic energy.

9. **A) Increases**

    - Explanation: Climbing higher on the diving board increases the diver's elevation relative to the water surface, thereby increasing her gravitational potential energy. The increase is due to the direct proportionality between potential energy and height in a gravitational field.

10. **A) Higher at full compression**

    - Explanation: Compressing a spring in a toy gun stores elastic potential energy in the spring. The potential energy at full compression is higher than before compression because work is done on the spring to compress it, storing energy in the form of elastic potential energy. This stored energy is what propels the toy when the spring is released.