Energy transfer in a falling object – transcript

Energy cannot be destroyed. It is transferred from one form to another. When an object falls, it loses its gravitational potential energy and gains kinetic energy. This is known as mechanical work.

The speed of a freely falling object increases very quickly. Its accelerates at nearly ten metres per second per second.

The GPE stored by an object is at a maximum at its maximum height and its KE is zero because it is not moving. When the object falls to its rest, its GPE is at its minimum and has been transferred to its KE, which is then at its maximum.

The mechanical energy is the sum of the GPE and the KE.

The GPE depends on mass, height and the gravitational strength of the planet that the object is on. The KE depends on its mass and its speed (velocity).

In this experiment, a falling object is simulated by dropping a card from a known height. We will measure its speed just above the ground before it lands.

First, a straight line is drawn across the middle of the card. This helps to identify the exact height that it will be dropped from. Then the mass of the card is measured and recorded.

The metre rule is attached against one stand and light gate is attached to another stand towards the bottom end at 0.1 m (10 cm) above the table top.

The light gate is setup to measure a width of 0.05 m (5 cm). The pin is attached at 0.2 m (20 cm) horizontally with the table top using sticky tack.

The middle line of the card is aligned with the pin. It is kept vertical and held at the middle so to minimise the rotation and air resistance as it falls.

The card is dropped five times. Each time the speed values are recorded and the height difference between the light gate and the pin is calculated. The average speed is then calculated for each case.

The kinetic energy is calculated using the equation: KE = ½ × mass × $(\text{speed})^2$

And the change in gravitational potential energy is calculated using the equation: mass × gravitational strength × height.

The height of the pin is increased by 0.01 m (1 cm) and the card is dropped from this new height five times. This is repeated for each additional height increase of the pin.

A graph of change in GPE *versus* KE is then plotted once all data points have been recorded or calculated.

The change in GPE is almost equal to the gain in KE. The gradient of the graph is almost one and the *y* intercept is almost zero.

When the piece of card is let go, the gravitational pull starts doing some mechanical work on the card; transferring some of the gravitational potential energy into kinetic energy.

Just before it hits the ground, its gravitational potential energy is almost zero due to almost zero height. Almost all the stored gravitational potential energy has been transferred into kinetic energy.

The kinetic energy of an object depends on its mass and speed. By finding the speed of the card just before it hits the ground, its kinetic energy can be determined.

GPE is transferred during the fall into KE. In this investigation air resistance was negligible. Therefore, the gravitational force transferred almost all available GPE into KE by doing some mechanical work.

If it is assumed that all the change in GPE is transferred into KE, the energy transfer can be mathematically shown like this.