WORK-ENERGY THEOREM   15 APRIL 2014

Lesson Description

In this lesson we:

- Revise different types of energy
- Define work
- Discuss the relationship between work and energy

Summary

Energy

There are two forms of energy:

- Potential Energy is a result of the object's position.
  $$E_p = mgh$$

- Kinetic Energy is the result of the object being in motion.
  $$E_k = \frac{1}{2}mv^2$$

Mechanical Energy is the sum of both Kinetic and Potential Energy

The Law of Conservation of Energy

In an isolated system, the total mechanical energy of a system will remain constant.

Work

Work is done when a force causes an object to change position.

$W = F.\Delta x.\cos\theta$, where θ is the angle between the force and the displacement

Work - Energy Theorem

The change in Kinetic Energy of a system is equivalent to the **sum of work done** (W_{net}) by all types of external forces acting on the system

$$W_{net} = \Delta E_k = Ef - Ei$$

Work is the transfer of energy from one form into another.

Test Yourself

Select the most correct answer from the options given. Write down only the correct letter

Question 1

Work is done on an object while it speeds up.

  A.   The net force acting on the object is zero newton
  B.   There is no frictional force acting on the object
  C.   The applied force and the displacement act in the same direction
  D.   The applied force and the displacement act in the opposite direction

Question 2

The S.I unit for work is equivalent to

  A. $kg.m.s^{-1}$
  B. $kg.m.s^{-2}$
  C. $kg.m^2.s^{-1}$
  D. $kg.m^2.s^{-2}$

Question 3

A box slides down an inclined slope at constant velocity. This means that

  A.   The magnitude of the force of friction is equal to the magnitude of the component of gravitational force acting parallel to the slope
  B.   The net work done on the box is negative
  C.   The net work done on the box is greater than zero
  D.   The force of friction acts down the slope

Question 4

When the force applied acts in the same direction as the change in position, the angle between these vectors is:

  A.   180°

  B.   90°

  C.   0°

  D.   depends on the angle of inclination of the slope

Question 5

When work is done on an object placed on a smooth horizontal surface, the object will

  A.   remain at rest

  B.   move a constant velocity

  C.   start moving and then reach constant velocity

  D.   accelerate

Improve your skills

Question 1

A motorbike of mass 800kg, travels across a smooth horizontal surface at a constant velocity of 12 m.s^{-1}. The biker applies brakes which exerts a force of 2 500N on the motorbike causing it to come to a stop.

a.)   What was the net work done on the motorbike while travelling at constant velocity?

b.)   What was the net work done on the motorbike while braking?

c.)   Calculate the distance the bike travelled while braking.

Question 2

An object is pulled at angle of 30° to a horizontal surface with a force of 40 N. The frictional force experienced by the object is 12 N. The object travels a distance of 3 m under these conditions.

a.)   Calculate the net work done on the object

b.)   If it was originally travelling at 1 m.s^{-1}, calculate its final velocity after travelling the 3 m.

Question 3

A 5 kg trolley moves along a horizontal frictionless surface at a constant velocity of 2,5m.s^{-1} until it comes to a ramp that is inclined at an angle of 12° to the horizontal. The surface of the ramp is rough. The trolley comes to rest after moving a distance of 1,2m up the ramp.

a.)   Calculate the work done by gravity on the trolley

b.)   Calculate the magnitude of the force of kinetic friction exerted on the trolley