NCERT SOLUTIONS CLASS IX-SCIENCE
CHAPTER 11- WORK AND ENERGY

Q1) A force 9N acts on a stone which has a displacement of 6 m, in the direction of the force. Considering that the force acts on the stone with the displacement. Determine the work done in this case?

Ans.)

Given Displacement = 6m, Force = 9N

Now as we know that, Work done = Force x Displacement

= 9 x 6 =54J

Q2) When is it actually considered that work has been done?

Ans.)

Work is said to be done when a force causes displacement of an object in the direction of applied force.

Q3) Write an equation for: work done when force A acts on object B in the direction of displacement C.

Ans.) Force x Displacement = A x C

Q4) What is 1J of Work?

Ans.)

When a force of 1N is applied on an object and it causes a displacement of 1m, in the same direction where the force is applied and the work done is said to be 1J.

Q5) A dozen of cattle exerts a force of 130N in ploughing. The field that's is being ploughed, has a length of 16 m. Find the total work done for ploughing the field.

Ans.) Work Done= Force x Displacement = 130 x 16 = 2080 J

Q6) Define kinetic energy for an object.

Ans.)

Kinetic energy is the energy of motion, it is the energy that an object possesses due to its motion.

Q7) Give an expression: to explain kinetic energy of an object

Ans.)

The expression is $\frac{1}{2}mv^2$ where 'm' is the mass and 'v' is the velocity of the body.

Q8) The kinetic energy for an object of mass (m), is moving at a velocity of $5ms^{-1}$ is 25 J. Considering the velocity is doubled determine the kinetic energy? What will be the kinetic energy when the velocity has been increased three times?

Ans.)

Given v= $5ms^{-1}$,m=? ,KE = 25 J

Using expression KE= $\frac{1}{2}mv^2$, we have

$m = \frac{2\times KE}{v^2} = \frac{2\times 25}{5^2} = 2kg$

i) When velocity is double i.e., v= $10ms^{-1}$,then we have $KE = \frac{1}{2}mv^2 = \frac{1}{2}\times 2\times(10)^2 = 100J$

ii) When velocity is tripled i.e., v=$15ms^{-1}$,then we have

KE = $\frac{1}{2}mv^2 = \frac{1}{2}\times 2\times(15)^2 = 225J$

NCERT Textbook page 156

Q9) Define Power?

Ans.) Power is defined as the rate at which the work is done.

Q10) What is one watt in terms of power?

Ans.) When the work done in 1 second is 1 Joules, the power is said to be one watt.

Q11) A lamp consumes 1500 J of energy in 15sec. What is its power?

Ans.)

Given W= 1500 J, t=15s, P=?

We know, P=W/t =1500/15 = 100W

Q12) Define average power.

Ans.)

When a machine does different amounts of work or uses energy in different intervals of time, the ratio between the total work done or energy consumed to the total time is average power.

Q13) Explain, whether work is done as per your understanding of the term 'work', by analyzing the following list:

i) Seema is swimming in a lake.

ii) A horse is carrying a man on its back.

iii) A windmill is lifting oil from a reservoir.

iv) The leaves of the tree are carrying out photosynthesis.

v) A crane is pulling a car.

vi) Clothes are being dried in the sun.

vii) A yatch is moving due to the wind.

Ans)

i) Work is done because the displacement of swimmer takes place in the direction of applied force.

ii) If the horse is not moving, no work is done as the displacement of load does not take place in the direction of applied force.

iii) Work is done, as the displacement takes place in the direction of force.

iv) No work is done because no displacement takes place.

v) Work is done because displacement takes place in the direction of applied force.

vi) No work is done because displacement does not take place.

vii) Work is done because displacement takes place in the direction of applied force.

Q14) A boomerang that is thrown at an angle to the ground, it moves in a curved path and falls back to the ground. The initial and final point of the path of the boomerang lie on the same horizontal line. What is the work done by the force of gravity on the object?

Ans.)

Since the body returns to a point which is on the same horizontal line through the point of projection, no displacement has taken place against the force of gravity, therefore, no work is done by the force due to gravity.

Q15) A battery lights a tubelight. Describe the energy changes involved in the process.

Ans.)

Within the electric cell of the battery, the chemical energy changes into electrical energy. The electric energy that is flowing through the filament of the tubelight first changes into heat energy and then into light energy.

Q16) A certain force which is acting on a 20 kg mass. The velocity changes from $5ms^{-1}$ to $2ms^{-1}$. Calculate the work done by the force?

Ans.)

Work done by the force is equal to change in the kinetic energy of the body

Now ,m=20kg, u=5ms^{-1} ,v= $2ms^{-1}$,W=?

Using the expresssions W= $\frac{1}{2}mv^2 - \frac{1}{2}mu^2$,

We have W= $\frac{1}{2}m(v^2 - u^2) = \frac{1}{2} \times 20((2)^2 - (5)^2)$

W= -210 J

Negative sign indicates work has been done in slowing the body.

Q17) A mass of 14 kg is at a point A on a rack. It is moved to a point B. If the line joining A and B is horizontal, what is the work done on the object by the gravitational force? Explain your answer.

Ans.)

The work done is zero. This is because the gravitational force and displacement are perpendicular to each other.

Q18) The potential energy of a freely falling object is decreased progressively. Is this violating the law of conservation of energy? Why?

Ans.)

It does not violate the law of conservation of energy. Whatever the decrease in potential energy is due to loss of height, it is the increase in the kinetic energy due to increase in velocity of the body.

Q19) When riding the bicycle: write about the energy transformation that will occur.

Ans.)

The chemical energy of the food changes into heat and then to muscular energy. On paddling, the muscular energy changes into mechanical energy.

Q20) Does transfer of energy take place when you push a huge rock with all your might and fail to move it? Where is the energy you spend going?

Ans)

Energy transfer does not take place as no displacement takes place in the direction of applied force. The energy spent is used to overcome the inertia of the rock.

Q21) A certain household has consumed 250 units of energy during a month. How much energy is this in joules?

Ans.)

Energy consumed in month is 250 units

=250kWh

=250kW x 1hr

=250 x 1000W x 3600sec

=900,000,000 J= $9.0 \times 10^8 J$

Q22) An object of mass 30 kg is raised to a height of 6 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is half-way down.

Ans.)

As we know that U=mgh ,where m=mass ,g= acceleration of gravity = $9.8ms^2$

U= 30 x 9.8 x 6 =1764 J

Half height= 3m

$v^2 = u^2 + 2gh$ = 0 + 2*9.8*3= $v^2 =$ =58.8

Now kinetic energy = $\frac{1}{2}mv^2 = \frac{1}{2} \times 30 \times 58.8 = 882J$

Q23) What is the work done by the force of gravity on a satellite moving round the earth? Justify with reasons.
Ans.)

Work is done when two conditions are satisfied

1. i) A force is acted on a body
2. ii) Displacement of the body takes place by the application of force in the same or opposite direction

If the direction of force is perpendicular to displacement, then work done is zero.

When the satellite moves around the earth, then the direction of theforce of gravity on the satellite is perpendicular to its displacement. Therefore, the work done on the satellite is zero.

Q24) If there is an absence of forces, which act on an object can there be any displacement?

Ans.)

Yes, there can be displacement even in the absence of any force because when an object is moving in deep space from one point to another point in a straight line, the displacement takes place, without the application of force. This happens due to the Newton's first law of motion which is also called as the law of inertia.

Q25) A person is holding a bundle of books over his head for 40 minutes and gets tired. Is he doing some work or not?

Ans)

The person has not done any work because there is no displacement that has taken place in the direction of applied force as the force acts in a vertically upward direction.

Q26) An electric iron is rated 1600 W. How much energy does it use in 15 hours?

Ans.)

As we know that energy= (Power) x (time) =1600 x 15 watt-hr

= 24000 watt-hr =24 Kilo watt-hrs

Q27) what is the relation to the law of conservation of energy for the change of energy that, occurs when we move a pendulum bob to one side, and allow it to oscillate. Why does bob slow down to rest? What is the effect on its final energy? Is there any violation of the "law of conservation of energy"?

Ans.)

When the pendulum bob is pulled (say towards left), the energy supplied is stored in it is the form of Potential energy(PE) on account of its higher position. When the pendulum is released so that it starts moving towards its right, then its PE changes into Kinetic energy(KE) such that in its mean position, it has maximum KE, and Zero PE. As the pendulum moves towards extreme right, its KE changes into PE such that at the extreme position, it has maximum PE and zero KE. When it moves from this extreme position to mean position, its PE again changes to KE. This illustrates the law of conservation of energy. Eventually, the bob comes to rest, because during each oscillation, a part of the energy of the bob is transferred to air and in overcoming friction at the point of suspension. Thus, the energy of the pendulum is dissipated in the air. The law of conservation of energy is not violated because the energy not even changes its form and is not destroyed.

Q28) If mass of object and the constant velocity is m and v respectively, how much work has to be done on the object so that it has brought to rest?

Ans.)

Work needs to be done in the opposite direction of the force applied that is $-\frac{1}{2}mv^2$ because here we will apply a friction force that is opposite to the direction of motion of the object so that it comes to rest.

Q29) Calculate the work required to be done to stop a car of 1600 kg moving at a velocity of 50 km/h.

Ans.)

Given:

Mass of the car 1600kg, Velocity = 50km/hr = 13.8m/sec

Therefore in order to stop the car, work required can be calculated as

Work Done= change in kinetic energy

Therefore, Work Done= Final Kinetic energy- Initial Kinetic energy

Work done= $\frac{1}{2}mv^2 - \frac{1}{2}mu^2$

m= mass,v=final velocity=0 ,u=initial velocity=13.8m/sec

work= $\left|\frac{1}{2} \times 1600 \times [(0)^2 - (13.9)^2]\right|$ =152352 J =152.352 kJ.

Q30) The acceleration of an object is zero even when several forces are acting on it. Do you think this statement is correct if so why?

Ans.)

Yes, because when the object is at rest, its velocity is zero,which means acceleration is also zero. Several forces may act on it but they cancel out each other. When the object is motion and it is moving with a constant velocity, its acceleration is zero.

Q31) Find the energy in kWh consumed in 12 hours by five devices of power 400 W each.

Ans.)

Power of each device = 400 W

Power of 5 devices= 5 x 400 = 2000W

Time taken= 12hrs

Energy consumed = Power x Time taken = 2000 x 12 = 24000 Wh =24kWh

Q32) What happens to the kinetic energy when a free falling object stops by hitting and stops at the ground?

Ans.)

When a free falling body eventually stops on reaching the ground,its kinetic energy appears in the form of

(i) Heat since the body and the ground become warmer due to the collision.

(ii) Sound since some sound is produced due to collision with the ground.

(iii) the potential energy of the body and the ground since the body may lose its actual shape and the ground may be depressed at the place of collision.