NCERT Solutions Class 9 Science Chapter 10: Using the NCERT Solutions Class 9 Science Chapter 10 Work and Energy, you may prepare well for the CBSE test. Regular use of NCERT Solutions Class 9 Science Chapter 10 by students benefits them from the thorough methodology and the exhaustive, step-by-step technique that will help them score well on their board exams.

Students can practice and develop greater confidence in their preparations with the aid of the NCERT Solutions Class 9 Science Chapter 10 Work and Energy. Our team of subject matter specialists has meticulously created all of the NCERT Solutions Class 9 Science Chapter 10, which include goals, diagram-based explanations, and both short- and long-form problems that can be helpful in competitive exams such as the CBSE test.

NCERT Solutions Class 9 Science Chapter 10 Overview

NCERT Solutions Class 9 Science Chapter 10 , "Work and Energy," introduces students to fundamental concepts related to work, energy, and their interplay in various physical scenarios. It begins by defining what work means in the context of physics, emphasizing that work is done when a force causes displacement of an object in the direction of the force.

The chapter explores different types of energies such as kinetic energy and potential energy, and how they are related to the work done on an object.

NCERT Solutions Class 9 Science Chapter 10

Below we have provided NCERT Solutions Class 9 Science Chapter 10 for the ease of the students -

1. A force of 7 N acts on an object. The displacement is, say 8 m, in the direction of the force. Let us take it that the force acts on the object through the displacement. What is the work done in this case?

Solution:

When a force F acts on an object to move it in its direction through a distance S, work is done.

The work on the body is done by force.

Work done = Force × Displacement

$W = F \times S$

Where,

F = 7 N S = 8 m

So, work done,

W = 7 × 8

W = 56 Nm

W = 56 J

Exercise-11.2 Page: 149

1. When do we say that work is done?

Solution:

Work is finished as soon as the following requirements are met:

(i) The body is subject to a force.

(ii) The body is moved by exerting force in the force's direction or the opposite direction.

2. Write an expression for the work done when a force is acting on an object in the direction of its displacement.

Solution:

The work done W on a body when a force F moves it over a distance S in the direction of the applied force is expressed as follows:

3. Define 1 J of work.

Solution:

An object undergoes 1 J of work when a force of 1 N moves it 1 m along the force's line of action.

4. A pair of bullocks exert a force of 140 N on a plow. The field being ploughed is 15 m long.

How much work is done in ploughing the length of the field?

Solution:

Work done by the bullocks is given by the expression:

W= F × d

Where,

Applied force, F = 140 N

Displacement, d = 15 m

W = 140 x 15 = 2100 J

Therefore, 2100 J of work is done in ploughing the length of the field.

Exercise-11.3 Page: 152

1. What is the kinetic energy of an object?

Solution:

The energy that a body possesses as a result of motion is referred to as kinetic or mechanical energy. Everything in motion has mechanical energy. The body tries to function by using mechanical energy. A nail is driven into a log of wood using the kinetic energy of the hammer, windmills are operated by the mechanical energy of air, etc.

2. Write an expression for the kinetic energy of an object.

Solution:

If a body of mass m is moving with a speed v, then its K.E. E_k is given by the expression,

$E_k = 1/2\ m\ v^2$

Its SI unit is Joule (J).

3. The kinetic energy of an object of mass, m moving with a velocity of 5 ms^{-1} is 25 J. What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?

Solution:

Given

K.E. of the object = 25J

Velocity of the object (v) = 5 m/s

K.E. = (½) mv^2

25 = (½) m $(5)^2$

50 = 25 x m

m = 50/25

m = 2 kg

Now, when velocity is doubled

v = 10 m/s

m = 2 kg

K.E. = (½) x 2 x $(10)^2$

K.E. = 10^2

K.E. = 100 J

When velocity is increased three times, then

v = 15 m/s

m = 2 kg

K.E. = (½) x 2 x $(15)^2$

K.E. = $(15)^2$

K.E. = 225 J

Exercise-11.4 Page: 156

1. What is power?

Solution:

Power is defined as the rate of doing work or the rate of transfer of energy. If an agent does a work W in time t, then power is given by:

$$Power = \frac{Work}{Time}$$

P = W/T

It is expressed in watt (W).

2. Define 1 watt of power.

Solution:

A body is claimed to possess power of one watt if it works at the speed of 1 joule in 1 s.

That is,

One W = 1 J/1 S

3. A lamp consumes 1000 J of electrical energy in 10 s. What is its power?

Solution:

Power = Work/Time

P = W/T

Time = 10 s

Work done = Energy consumed by the lamp = 1000 J

Power = 1000/10 = 100 Js^{-1} =100 W

Hence, the power of the lamp is 100 W

4. Define average power.

Solution:

Average power is defined as the ratio of total work done by the body to the total time taken by the body.

$$\text{Average Power} = \frac{\text{Total Work Done}}{\text{Total Time Taken}}$$

Exercises – 11.5 Page: 158

1. Look at the activities listed below. Reason out whether or not work is done in the light of your understanding of the term 'work'.

(a) Suma is swimming in a pond.

(b)A donkey is carrying a load on its back.

(c) A windmill is lifting water from a well.

(d) A green plant is carrying out photosynthesis.

(e) An engine is pulling a train.

(f) Food grains are getting dried in the sun.

(g) A sailboat is moving due to wind energy.

Solution:

When both of the following two requirements are met, the work is completed:

(i) The body is subject to a force.

(ii) The body is moved by exerting force in the force's direction or the opposite direction.

(a) Suma uses force to push the water backward when swimming. As a result of the water's forward reaction, Suma swims in that direction. Here there is a displacement due to the force. Thus, Seema completes the task while swimming.

(b) The donkey must exert force upwards when it is carrying a load. Nonetheless, the load is being displaced forward. There is no labor done because displacement is perpendicular to force.

(c) A windmill raises water by defying gravity. Water is raised by the windmill by exerting force upward, which causes the water to move in the same upward direction. Thus, the windmill works to raise the water level in the well.

(d) When a green plant is performing photosynthesis, no force is needed. The plant moves without using any force. since neither force nor displacement exists. So, nothing is accomplished.

(e) An engine exerting force forward is what happens when it pulls a train. It is therefore travelling ahead. given that the direction of displacement and force is the same. Thus, the engine does the labor.

(f) Food grains dry in the sun without the use of force, and they remain still during the process. since neither force nor displacement exists. So, nothing is accomplished.

(g) A sailboat exerts force forward when it moves as a result of wind energy. It is therefore travelling ahead. given that the direction of displacement and force is the same. So, the task is completed.

2. An object thrown at a certain angle to the ground moves in a curved path and falls back to the ground. The initial and the final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object?

Solution:

Work done by the force of gravity on an object depends solely on vertical displacement. Vertical displacement is given by the distinction in the initial and final positions/heights of the object which is zero.

Work done by gravity is given by the expression,

$W = m \times g \times h$

Where,

h= Vertical displacement = 0

$W = m\,g \times 0 = 0$ J

Hence, the work done by the gravity on the given object is zero joule.

3. A battery lights a bulb. Describe the energy changes involved in the process.

Solution:

The energy in a battery is converted into voltage when a light is connected to it. The voltage is converted into heat and light energy by the lightbulb once it has received it. As a result, the energy transformation in the given scenario can be represented as follows:

Chemical Energy → Electrical Energy → Light Energy + Heat Energy.

4. Certain force acting on a 20 kg mass changes its velocity from 5 m s^{-1} to 2 m s^{-1}. Calculate the work done by the force.

Solution:

Given

Initial velocity u = 5 m/s

Mass of the body = 20kg

Final velocity v = 2 m/s

The initial kinetic energy

$E_i = (1/2)\, mu^2 = (1/2) \times 20 \times (5)^2$

$= 10 \times 25$

= 250 J

Final kinetic energy

$E_f = (1/2)\ mv^2 = (1/2) \times 20 \times (2)^2$

$= 10 \times 4$

$= 40$ J

Therefore,

Work done = Change in kinetic energy

Work done = $E_f - E_i$

Work done = 40 J – 250 J

Work done = -210 J

5. A mass of 10 kg is at point A on a table. 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.

Solution:

Work done by gravity depends solely on the vertical displacement of the body. It doesn't rely on the trail of the body. Therefore, work done by gravity is given by the expression,

$W = m\ g\ h$

Where,

Vertical displacement, $h = 0$

$\therefore\ W = m \times g \times \text{zero} = 0$

Therefore the work done on the object by gravity is zero.

6. The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?

Solution:

The energy conservation law is not broken by this procedure. This is because the body gradually transforms its potential energy into kinetic energy when it descends from a height. The body's kinetic energy increases in proportion to a decrease in potential energy. The body's whole mechanical energy is conserved during the process. As a result, the law of energy conservation remains intact.

7. What are the various energy transformations that occur when you are riding a bicycle?

Solution:

The muscle energy of a bicycle rider is converted into mechanical energy and heat during the ride. The bicycle is propelled by kinetic energy, while our bodies are heated by thermal energy.

Muscular energy → mechanical energy + heat

8. Does the 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?

Solution:

There is no muscle energy transfer to the stationary rock when we push a large boulder. Additionally, since muscular energy is converted into heat energy, which raises our body's temperature, there is no energy loss.

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

Solution:

1 unit of energy = 1kWh

Given

Energy (E) = 250 units

1 unit = 1 kWh

1 kWh = 3.6×10^{6} J

Therefore, 250 units of energy = $250 \times 3.6 \times 10^{6}$

= 9×10^{8} J.

10. An object of mass 40 kg is raised to a height of 5 m above the ground. What is its potential energy? If the object is allowed to fall, find its kinetic energy when it is halfway down.

Solution:

Given Mass (m) = 40 kg

Acceleration due to gravity (g)= $10 m/s^2$

Height (h)= 5m

Potential energy= m × g× h

P.E= 40 × 10 × 5 = 2000J

Potential energy = 2000J (2000 joules)

At a height of 5 meters, the object has a potential energy of 2000 J.

When this object is allowed to fall and it is halfway down, its height above the ground will be half of 5 m= 5/2= 2.5m.

P.E at Halfway down= m× g×h

P.E= 40× 10 × 2.5= 1000J

[h= 2.5 m]

Potential Energy halfway down= 1000 joules.

According to the law of conservation of energy:

Total potential energy potential energy halfway down kinetic energy halfway down

2000 = 1000 + K.E halfway down

K.E at halfway down= 2000- 1000= 1000 J

Kinetic energy at halfway down 1000 joules.

11. What is the work done by the force of gravity on a satellite moving around the earth? Justify your answer.

Solution:

When both of the following two requirements are met, work is considered finished:

(i) The body is subject to a force.

(ii) The body is moved by exerting force in the force's direction or the opposite direction.

The work done is 0 if the force's direction is perpendicular to the displacement. The force of gravity acting on a satellite throughout its orbit around the Earth is perpendicular to the spacecraft's displacement. As a result, Earth has done zero work on the satellite.

12. Can there be displacement of an object in the absence of any force acting on it? Think. Discuss this question with your friends and teacher

Solution:

In the absence of any force acting on an object, displacement is indeed possible. An object accelerates when subjected to a single force. An object is subject to a force if it accelerates.

Let's say that an object is traveling at a constant speed. There is no net force acting on it. However, the thing moves, and with it, a displacement. Consequently, a displacement is possible in the absence of a force.

13. A person holds a bundle of hay over his head for 30 minutes and gets tired. Has he done some work or not? Justify your answer.

Solution:

When the two requirements are met, the work is finished.

(i) The body is subject to a force.

(ii) The body is moved by exerting force in the force's direction or the opposite direction.

There isn't any movement in a hay bundle when someone holds it above their head. The bundle is being affected by the force of gravity, but the individual is not exerting any effort on it. Consequently, the person's work on the bundle is zero in the absence of force.

14. An electric heater is rated 1500 W. How much energy does it use in 10 hours?

Solution:

Given,

Power of the heater = 1500 W = 1.5 kW

Time taken = 10 hours

Energy consumed by an electric heater can be obtained with the help of the expression,

Power = Energy consumed / Time taken

Hence,

Energy consumed = Power x Time taken

Energy consumed = 1.5 x 10

Energy consumed = 15 kWh

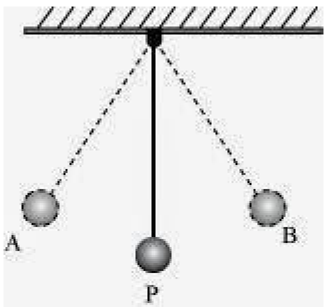
Therefore, the energy consumed by the heater in 10 hours is 15 kWh.

15. Illustrate the law of conservation of energy by discussing the energy changes that occur when we draw a pendulum bob to one side and allow it to oscillate. Why does the

bob eventually come to rest? What happens to its energy eventually? Is it a violation of the law of conservation of energy?

Solution:

Consider the case of an oscillation pendulum.



An apparatus rises via a height h on top of the mean level P when it moves from its mean position P to either of its extreme locations A or B. At this point, the bob's K.E. completely transforms into P.E. When this happens, the K.E. drops to zero and the bob just has P.E. As it advances in the direction of goal P, its P.E. steadily drops. As a result, the K.E. will rise. The bob's P.E. drops to zero when it achieves goal P, and it likewise just has K.E. For as long as the device oscillates, this technique is perpetual.

The bob does not continuously oscillate. Because of the air resistance preventing it from moving, it comes to rest. To overcome this friction, the device occasionally stops and loses its K.E. The energy wasted by the device to overcome friction is recovered by its surroundings, therefore the rule of conservation of energy is not violated. As a result, the apparatus's total energy as well as the surrounding system is maintained.

16. An object of mass, m is moving with a constant velocity, v. How much work should be done on the object to bring the object to rest?

Solution:

The kinetic energy of an object of mass m, moving with a velocity, v, is given by the expression,

K.E = $1/2\ mv^2$

To bring it to rest, its velocity has to be reduced to zero, and to accomplish that, the kinetic energy has to be drained off and sent somewhere else.

An external force has to absorb energy from the object, i.e. do negative work on it, equal to its kinetic energy, or

$-1/2\ mv^2$.

17. Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h.

Solution:

Given data:

The mass of the body = 1500kg

Velocity v = 60km/hr

$$= \frac{60 \times 1000m}{3600s}$$
$$= \frac{50}{3} m/s$$

The work required to stop the moving car = change in kinetic energy.

Benefits of NCERT Solutions Class 9 Science Chapter 10

NCERT Solutions Class 9 Science Chapter 10 on Work and Energy offers several benefits to students:

Concept Clarity: The NCERT Solutions Class 9 Science Chapter 10 provide a clear explanation of fundamental concepts like work, energy, kinetic energy, potential energy, and the conservation of energy. This helps students build a strong foundation in these principles.

Problem Solving Skills: By solving the NCERT exercises and problems, students enhance their problem-solving abilities. They learn how to apply theoretical knowledge to numerical problems involving work, energy, and power.

Exam Preparation: NCERT Solutions Class 9 Science Chapter 10 are aligned with the CBSE curriculum, making them ideal for exam preparation. Students can familiarize themselves with the type of questions likely to appear in exams and practice answering them effectively.

Comprehensive Coverage: The solutions cover all topics and subtopics of Chapter 10 comprehensively. This ensures that students don't miss any important concepts or formulas required for exams.

Self-Assessment: After solving the exercises, students can use the solutions to assess their understanding and identify areas where they may need further practice or clarification.

Enhanced Understanding: Detailed explanations and step-by-step solutions help students understand the logic and reasoning behind each concept. This promotes deeper learning and retention of knowledge.

Application-Oriented Learning: NCERT Solutions often include real-life examples and applications of work and energy concepts, helping students connect theoretical knowledge to practical scenarios.