CBSE

WORK AND ENERGY WS 2

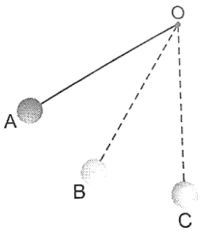
Class 09 - Science

Section A

1. Match the following: **[2]**

(a) Power	(i) $\frac{Q}{t}$
(b) Potential difference	(ii) I^2Rt
(c) Current	(iii) $\frac{W}{Q}$
(d) Heat	(iv) $\frac{W}{t}$

2. Which would have greater effect on kinetic energy of an object - doubling the mass, or doubling the velocity? **[2]**
3. The weight of a person on a planet A is about half of that on the Earth. He can jump up to 0.4 m high on the Earth. How high can he jump on planet A? **[2]**
4. Explain why it is difficult to push a tin can into water keeping its mouth upwards than when its mouth is kept downwards towards the water? **[2]**
5. A rocket is moving up with a velocity v. If the velocity of this rocket is suddenly tripled, what will be the ratio of two kinetic energies? **[2]**
6. A light body and a heavy body have the same kinetic energy. Which one will have the greater momentum? **[2]**
7. Write an expression for the kinetic energy of an object. **[2]**
8. Can any object have momentum even if its mechanical energy is zero? Explain. **[2]**
9. The diagram below shows a pendulum which was released from position A. **[2]**



a. What form(s) of energy did the pendulum have at

i. A?

ii. B?

iii. C?

b. Eventually, the pendulum would stop moving. Explain what has happened to the initial energy of the pendulum.

10. A certain household has consumed 250 units of energy during a month. How much energy is this in joule? **[2]**
11. What is the relationship between the commercial unit and SI unit of energy? **[2]**
12. If a solid of the same density as that of a liquid is placed in it, what will happen to the solid? **[2]**
13. The speed of a vehicle of mass 500 kg increases from 36 km/h to 72 km/h. Calculate the increase in its kinetic energy. **[2]**
14. A mass of 10 kg falls from a height of 50 cm. Calculate (i) Velocity of the body (ii) Kinetic energy of body when **[2]**

it just reaches the ground level. Does the velocity depend upon the mass of the particle? Explain. (Take g = 10 ms^{-2})

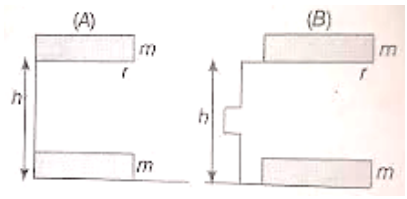
15. Why cutting instruments are sharpened? **[2]**
16. Give reason : Ice bergs floating in the sea are dangerous for the ship. **[2]**
17. Can any object have mechanical energy even if its momentum is zero? Explain. **[2]**
18. Two bodies of equal masses move with the uniform velocities v and 3v respectively. Find the ratio of their kinetic energies. **[2]**
19. A battery lights a bulb. Describe the energy changes involved in the process? **[2]**
20. Suppose a hammer which falls freely on a nail placed on a piece of wood of mass 1 kg, if it falls from a height of 1 m, how much kinetic energy it will have just before hitting the nail? Take g = 10 ms^{-2}. **[2]**
21. The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why? **[2]**
22. What is the work to be done to increase the velocity of a car from 30 km h^{-1} to 60 km h^{-1} if the mass of the car is 1500 kg? **[2]**
23. Why is the bottom part of the foundation of a building made wider? **[2]**
24. The volume of 50 g substance is 20 cm^3. If the density of water is 1 g cm^{-3}, will the substance float or sink? **[2]**
25. 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 half way down. **[2]**
26. 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 to three times? **[2]**
27. A body of mass 4 kg initially at rest is subjected to a force of 16 N. What is the kinetic energy acquired by the body at the end of 10 s? **[2]**
28. A man drops a 10 kg rock from the top of a 5 m ladder. What is its kinetic energy when reaches the ground? What is its speed just before it hits the ground? **[2]**
29. A balloon of volume 50 m^3 is filled with hot air of density 0.4 kgm^{-3}, if the weight of the fabric of balloon is 12 kgf and equipment 'P' is attached to it, such that balloon is in the state of equilibrium. Calculate:i) Weight of hot air,ii) Weight of hot air, balloon and equipmentiii) Upthrust,iv) Weight of equipment. **[2]**
30. A rocket of 3×10^6 kg mass takes off from a launching pad and acquires a vertical velocity of 1 kms^{-1} at an altitude of 25 km. **[2]**

    Calculate

    a. Potential energy

    b. Kinetic energy. (Take the value of g = 10 ms^{-2})
31. How are kinetic energy and momentum related? **[2]**
32. A light and a heavy object have the same momentum, find out the ratio of their kinetic energies. Which one has a larger kinetic energy? **[2]**
33. The velocity of a body moving in a straight line is increased by applying a constant force F, for some distance in the direction of the motion. Prove that the increase in the kinetic energy of the body is equal to the work done by the force on the body. **[2]**
34. A battery lights a bulb. Describe the energy changes involved in the process. **[2]**

Section B

35. 

[3]

i. What is meant by potential energy of a body?

ii. A body of mass m is raised to a vertical height h through two different paths A and B.
What will be the potential energy of the body in the two cases? Give reason for your answer.

36. Anil lives in a village and his school is 8 km away from his home. His father suggests buying a motor cycle to go to school. Anil opposes the idea and opts for a bicycle instead. **[3]**

a. Write the energy transformation taking place while Anil rides his bicycle.

b. Justify (the stand taken by Anil in your own words.

c. How can he convince his friends to do the same?

37. Give reason : An iron nail sinks in water, but a ship made of iron floats. **[3]**

38. Due to heavy rains and speedy winds a tree broke and fell on the road. Two persons from local shops came and begin to remove that broken part of the tree, but in vain as the log was too heavy. A passerby came to their help with a few solid heavy sticks. Consequently, the heavy log was put aside and the commutation on the road began as usual. **[3]**

(a) Comment upon the value(s) displayed by the passerby?

(b) Name the energy stored when the heavy log of the tree was lifted to some height?

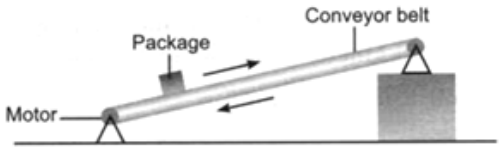
39. Shyam and his friends were playing with a catapult (gulel) in his garden. Several mangoes were dislodged and fell with the help of catapult. One of his friend was aiming the catapult on a bird. Shyam prevented him from doing so. **[3]**

a. Name the energy possessed by the stretched string of the catapult.

b. What will happen if the stone is thrown without stretching the string of a catapult?

c. Why did Shyam prevent his friend from aiming at the bird? Which quality is highlighted in Shyam's behaviour?

40. Figure shows a conveyor belt transporting a package to a raised platform. The belt is driven by a motor. **[3]**



i. State three types of energy, other than gravitational potential energy, into which the electrical energy supplied to the motor is converted.

ii. The mass of the package is 36 kg. Calculate the increase in the gravitational potential energy (p.e.) of the package when it is raised through a vertical height of 2.4 m.

iii. The package is raised through the vertical height of 2.4 m in 4.4 s. Calculate the power needed to raise the package.

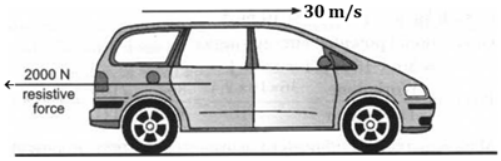
iv. Assume that the power available to raise package is constant. A package of mass greater than 36 kg is raised through the same height. Suggest explain the effect of this increase in mass on the operation of the belt.

41. Avinash can run at a speed of 8 ms^1 against the frictional force of 10 N, and Kapil can move at a speed of 3 ms^{-1} against the frictional force of 25 N. Who is more powerful and why? **[3]**

Section C

Question No. 42 to 45 are based on the given text. Read the text carefully and answer the questions: **[4]**

A car of mass 900 kg is travelling at a steady speed of 30 m/s against a resistive force of 2000 N, as illustrated in figure.



42. Calculate the kinetic energy of the car.
43. Calculate the energy used in 1.0 s against the resistive force.
44. What is the minimum power that the car engine has to deliver to the wheels?
45. What form of energy is in the fuel, used by the engine to drive the car?

Question No. 46 to 49 are based on the given text. Read the text carefully and answer the questions: **[4]**

The commercial unit of energy is kilowatt-hour which is written as kWh. The SI unit of electrical energy is joule.

A joule is the amount of electrical energy consumed when an appliance of 1 watt power is used for one second. Joule represents a very small quantity of energy so we use a bigger unit called kilowatt hour.

One kilowatt hour is the amount of electrical energy consumed when an electrical appliance with a power rating of 1 kilowatt is used for 1 hour.

1 kW h is the energy used in one hour at the rate of 1000 J s - 1 (or 1 kW).

1 kW h = 1 kW $\times$ 1 h

= 1000 W $\times$ 3600 s

= 3600000 J

1 kW h = 3.6 $\times$ 106 J.

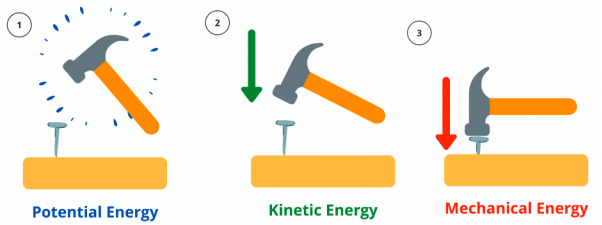
The energy used in households, industries and commercial establishments are usually expressed in kilowatt hour. For example, electrical energy used during a month is expressed in terms of ‘units’. Here, 1 ‘unit’ means 1 kilowatt hour.

The electricity meter installed in our home records the electrical energy consumed by us in kilowatt-hours.

46. What is the commercial unit of energy?
47. What is the SI unit of electrical energy?
48. How is electrical energy used during a month expressed and recorded?
49. Find out the relation between Kilowatt-hour and joule.

Question No. 50 to 53 are based on the given text. Read the text carefully and answer the questions: **[4]**

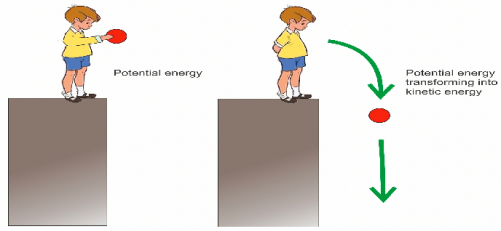
In physics, work is the energy transferred to or from an object via the application of force along with a displacement. In its simplest form, it is often represented as the product of force and displacement. A force is said to do positive work if (when applied) it has a component in the direction of the displacement of the point of application. A force does negative work if it has a component opposite to the direction of the displacement at the point of application of the force.



50. State the law of conservation of energy.
51. Define mechanical energy.
52. Calculate the energy in kWh consumed in 5 hours by four devices of power 600 W each.
53. Can a body have energy, without having momentum? If yes, why?

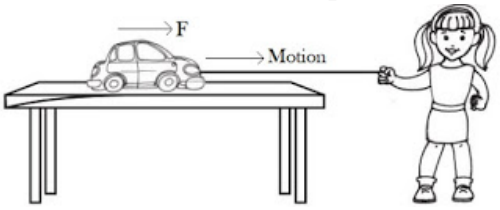
Question No. 54 to 57 are based on the given text. Read the text carefully and answer the questions: **[4]**

Potential energy is stored energy that depends upon the relative position of various parts of a system. Spring has more potential energy when it is compressed or stretched. A steel ball has more potential energy raised above the ground than it has after falling to Earth.



54. If a mass of 10 kg is dropped from a height of 50 cm, then find potential energy just before dropping.
55. If a mass of 10 kg is dropped from a height of 50 cm, then what is kinetic energy just on touching the ground?
56. Also, what is the velocity with which it hits the ground? (take, q = 10 ms^{-2})
57. Can a body have energy, without having momentum ? If yes, why?
58. **Read the passage and answer any four questions:** **[4]**

A speeding car, a rolling stone, a flying aircraft, flowing water, blowing wind, a running athlete, etc. possess kinetic energy. In short, kinetic energy is the energy possessed by an object due to its motion. The kinetic energy of an object increases with its speed. The kinetic energy of a body moving with a certain velocity is equal to the work done on it to make it acquire that velocity. Kinetic energy possessed by an object of mass, m and moving with a uniform velocity, v is $\frac{1}{2}mv^2$. The work done is equal to the change in the kinetic energy of an object.



i. If the speed of a car becomes 2 times, its kinetic energy becomes

a. 4 times
b. 8 times
c. 16 times
d. 12 times

ii. Work is done by friction

I. increases the kinetic energy of the body
II. decreases the kinetic energy of the body
III. increases the potential energy of the body
IV. decreases the potential energy of the body.
V. Choose the correct option among the following

a. (I) and (III)
b. (I) and (IV)
c. Only (II)
d. (II) and (IV)

iii. If the object is starting from its stationary position, that is, u = 0, then work is equal to

a. $\frac{1}{2}mv$
b. 2mv
c. 3mv

d. $\frac{1}{4}mv$

iv. An object of mass 15 kg is moving with a uniform velocity of $4ms^{-1}$. What is the kinetic energy possessed by the object?

a. 230J

b. 130J

c. 120J

d. 240J

v. A flying coconut posses:

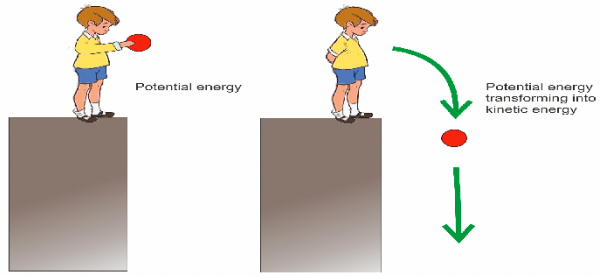
a. kinetic energy

b. potential energy

c. both (a) and (b)

d. none of these

59. **Potential energy** is stored energy that depends upon the relative position of various parts of a system. Spring has more potential energy when it is compressed or stretched. A steel ball has more potential energy raised above the ground than it has after falling to Earth. **[4]**



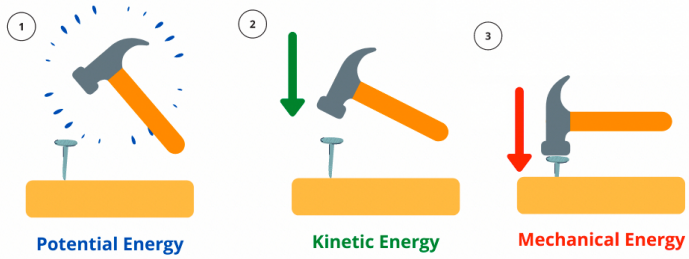
If a body falls from a height bounces from the ground and again goes upwards with loss of a part of its energy.

i. How will its potential energy change?

ii. What are various energy conversions taking place?

iii. What will be its ultimate energy?

60. In physics, work is the energy transferred to or from an object via the application of force along with a displacement. In its simplest form, it is often represented as the product of force and displacement. A force is said to do positive work if (when applied) it has a component in the direction of the displacement of the point of application. A force does negative work if it has a component opposite to the direction of the displacement at the point of application of the force. **[4]**

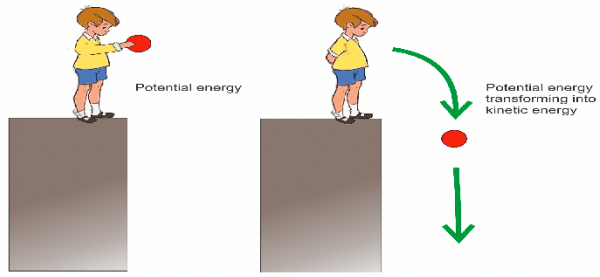


i. State the law of conservation of energy.

ii. Define mechanical energy.

iii. Calculate the energy in kWh consumed in 5 hours by four devices of power 600 W each.

61. **Potential energy** is stored energy that depends upon the relative position of various parts of a system. Spring has more potential energy when it is compressed or stretched. A steel ball has more potential energy raised above the ground than it has after falling to Earth. **[4]**



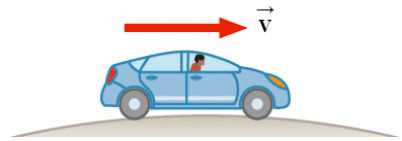
A mass of 10 kg is dropped from a height of 50 cm. Find its

i. potential energy just before dropping.

ii. kinetic energy just on touching the ground.

iii. velocity with which it hits the ground. (take, q = 10 ms^{-2})

62. In physics, potential energy is the energy held by an object because of its position relative to other objects, stresses within itself, its electric charge, or other factors. The kinetic energy of an object is the energy that it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its stated velocity. A car is moving on a levelled road and gets its velocity doubled. **[4]**



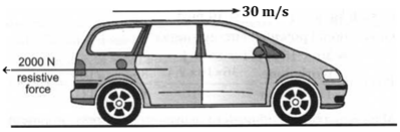
In this process,

i. How would the potential energy of the car change?

ii. How would the kinetic energy of the car change?

iii. How will its momentum change? Give reasons for your answer.

63. A car of mass 900 kg is travelling at a steady speed of 30 m/s against a resistive force of 2000 N, as illustrated in figure. **[4]**



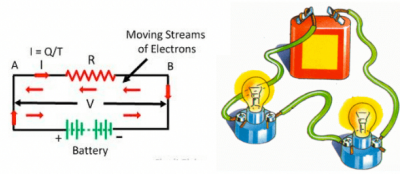
i. Calculate the kinetic energy of the car.

ii. Calculate the energy used in 1.0 s against the resistive force.

iii. What is the minimum power what the car engine has to deliver to the wheels?

iv. What form of energy is in the fuel, used by the engine to drive the car?

64. Electrical energy is energy derived as a result of the movement of electrically charged particles. When used loosely, electrical energy refers to the energy that has been converted from electric potential energy. **[4]**



i. When 1 Joule of work is said to be done?

ii. An electric oven is rated 5000 W. How many units of electrical energy does it use in 2 hours?

iii. When a carpet is beaten with a stick, dust comes out of it. Explain.

Section D

65. i. A body has a mass m and velocity v. If the mass is increased four times and velocity is decreased two times, calculate the ratio of the kinetic energies in the above cases. **[5]**

ii. What kind of energy transformation takes place when sparkle is lighted?

66. i. Define kinetic energy of an object. Can kinetic energy of an object be negative? Give reason. **[5]**

ii. A car weighing 1200 kg is uniformly accelerated from rest and covers a distance of 40m in 5 s. Calculate the work the car engine had to do during this time.

67. Derive an expression for the kinetic energy of the body? Calculate the kinetic energy for a body of mass 5 Kg moving a velocity 2.5 m/s^2 **[5]**

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68. i. Define work. State two factors on which the magnitude of work depends. **[5]**

ii. A car and a truck have the same speed of 30 m/s. If their masses are in the ratio 2 : 3; find the ratio of kinetic energy.

69. Show that when a body is dropped from a certain height, the sum of its kinetic energy at any instant during its fall is constant. **[5]**

70. Briefly describing the gravitational potential energy, deduce an expression for the gravitational potential energy of a body of mass m placed at a height h, above the ground. **[5]**

71. a. Give one example of each of the following: **[5]**

i. Small mass but high kinetic energy

ii. Large mass but low kinetic energy

b. Prove mathematically that the total mechanical energy of a freely falling body in air is conserved.

72. A car is moving with uniform velocities: 18 km h^{-1}, 36 km h^{-1}, 54 km h^{-1} and 72 km h^{-1} at some intervals. Find the KE of the boy of 40 kg sitting in the car at these velocities. Draw a graph between the KE and the velocities. Also, find the nature of the curve. **[5]**

73. The area of cross-section of the stem of a hydrometer is 0.32 cm^2 and its length is 20 cm. Its mass is 22.8 g and volume of the bulb is 10 cm^3. **[5]**

Find.

i) The density of the liquid in which it floats upto its midpoint.

ii) The density of the liquid in which it is completely immersed.

74. Show that total energy is conserved if the ball of mass 'm' is the thrown downwards from a height 'h'. **[5]**