



Roll No :  
Date : 2026-01-16

School : ACHIEVERS  
FOUNDATION  
Assessment : Work and Energy  
Subject : Physics  
Class : CBSE -IX

Time : 00:00  
Marks: 152

- 1 Give an example in each case where work done by a force is: 3  
(a) zero (b) positive (c) negative

**Ans :**(a) Work done by gravity on a rolling ball.  
(b) Hitting a stationary ball.  
(c) Work done by friction on a rolling ball.

- 2A student lifts an object in the upward direction. In doing so, he applies 3  
the force on the object in the upward direction and displaces it in that  
direction: (However, the force of gravity is also acting on the object.)  
(a) State the direction in which force of gravity is acting on it.  
(b) Which one of these forces is doing positive work? Give reason.  
(c) Which one of these forces is doing negative work? Give reason.

**Ans :**  
(a) Downward direction.  
(b) Applied force as force and displacement are in the same direction.  
(c) Force of gravity as force and displacement are in opposite direction.

- 3 (a) When is the work done by a body said to be negative? 3  
(b) An object of mass 5 kg is dropped from a height of 10 m. Find its  
kinetic energy, when it is half way down.

**Ans :**  
(a) Work done is said to be negative when the displacement produced in  
the body is in opposite direction to the force applied.  
(b) Mass,  $m = 5$  kg; height,  $h = 10$  m;  $g = 9.8$  m/s<sup>2</sup>  
 $W = mgh = 5 \times 9.8 \times 10 = 490$  J  
Half-way down,  $h$  reduces to  $\frac{h}{2}$ .. Thus, the potential energy becomes half.  
 $\therefore$  Loss in potential energy = Gain in kinetic energy =  $\frac{490}{2} = 245$  J

- 4A body of mass 5 kg is thrown vertically upwards with a speed of 10 m/s. 3  
What is its kinetic energy when it is thrown? Find its potential energy

when it reaches at the highest point. Also find the maximum height attained by the body. ( $g = 10 \text{ m/s}^2$ )

**Ans :**

Given: Mass,  $m = 5 \text{ kg}$ ; Initial velocity,  $u = 10 \text{ ms}^{-1}$

$$\text{Kinetic energy} = \frac{1}{2}mv^2 = \frac{1}{2} \times 5 \times (10)^2 = 250 \text{ J}$$

At highest point, potential energy = Kinetic energy at lowest point = 250 J

$$\text{Height attained, } h = \frac{\text{Potential energy}}{mg} = \frac{250 \text{ J}}{5 \text{ kg} \times 10 \text{ ms}^{-2}} = 5 \text{ m}$$

- 5 A force of 10 N acts on a body of 2 kg for 3 seconds. Find the kinetic energy acquired by the body in 3 seconds. 3

**Ans :**

Kinetic energy = Work done on the body

Given: mass,  $m = 2 \text{ kg}$ ; Time,  $t = 3 \text{ s}$ ;  $u = 0$ ;  $F = 10 \text{ N}$

$$\text{Acceleration, } a = \frac{F}{m} = \frac{10 \text{ N}}{2 \text{ kg}} = 5 \text{ ms}^{-2}$$

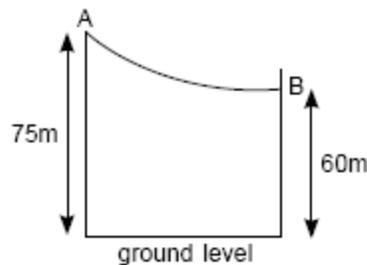
$$\text{Displacement, } s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 5 \times (3)^2 = 22.5 \text{ m}$$

$$\text{Work done} = Fs = 10 \text{ N} \times 22.5 \text{ m} = 225 \text{ J}$$

- 6 (a) Define 'potential energy'. 3

(b) Give an example where potential energy is acquired by a body due to change in its shape.

(c) A skier of mass 50 kg stands at A at the top of a ski jump. He takes off at A for his jump to B. Calculate the change in his gravitational potential energy between A and B.



**Ans :**

(a) The energy possessed due to the position of a body is called potential energy.

(b) Stretching of a bow.

(c) P.E. at A =  $mg \times 75 = 75 mg$

P.E. at B =  $mg \times 60 = 60 mg$

So, difference in P.E. =  $mg (75 - 60) = 15 mg = 15 \times 50 \times 10 = 7500$  joules  
= 7.5 kJ

7 (a) Define kinetic energy.

3

(b) A stone of mass 2 kg is falling from rest from the top of a steep hill.

What will be its kinetic energy after 5 s? ( $g = 10 \text{ ms}^{-2}$ )

**Ans :**

(a) The energy possessed by a body by virtue of its motion is called kinetic energy.

(b) Given: Mass,  $m = 2$  kg; Time,  $t = 5$  s

Velocity after 5 s =  $v = 0 + 10 \times 5 = 50$  m/s

$\therefore$  K.E. =  $\frac{1}{2} \times 2 \times (50)^2 = 2500$  joules = 2.5 kJ

8 A truck of mass 1800 kg is moving with a speed 54 km/h. When brakes are applied, it stops with uniform negative acceleration at a distance of 200 m. Calculate the force applied by the brakes of the truck and the work done before stopping.

3

**Ans :**

Given: Mass,  $m = 1800$  kg; Velocity,  $u = 54 \text{ km/h} = 54 \times \frac{5}{18} \text{ m/s} = 15 \text{ m/s}$ ;  $v = 0$ ;  
Distance,  $s = 200$  m

$$\text{Retardation, } a = \frac{v^2 - u^2}{2s} = \frac{0 - (15)^2}{2 \times 200} = \frac{-9}{16} \text{ m/s}^2$$

$$\text{Force, } F = ma = 1800 \times \left(\frac{-9}{16}\right) = -1012.5 \text{ N}$$

The negative sign indicates force acts in the opposite direction to motion.

$$\text{Work done} = Fs = 1012.5 \times 200 = 202500 \text{ J}$$

9 (a) Define kinetic energy.

3

(b) The masses of scooter and bike are in the ratio of 2 : 3, but both are moving with the same speed of 108 km/h. Compute the ratio of their kinetic energy.

**Ans :**

(a) The energy possessed by a body by virtue of its motion is called kinetic energy.

(b) Kinetic energy  $\propto$  Mass of body

Let mass of scooter =  $m_s = 2m$

and mass of bike =  $m_b = 3m$

$$\therefore \frac{\text{Kinetic energy of scooter}}{\text{Kinetic energy of bike}} = \frac{m_s}{m_b} = \frac{2m}{3m} = 2 : 3$$

10 A car weighing 1200 kg is uniformly accelerated from rest and covers a distance of 40 m in 5 seconds. Calculate the work done by the engine of car during this time. What is the final kinetic energy of car? 3

**Ans :**

Given: Mass,  $m = 1200$  kg; Initial velocity,  $u = 0$ ; Displacement,  $s = 40$  m; Time,  $t = 5$  s

By second equation of motion,  $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}at^2$

or 
$$a = \frac{2s}{t^2} = \frac{2 \times 40}{(5)^2} = 3.2 \text{ ms}^{-2}$$

$$\begin{aligned} \text{Work done} &= \text{Force} \times \text{Displacement} \\ &= mas = 1200 \times 3.2 \times 40 = 153600 \text{ J} \\ \text{Final K.E} &= \text{Work done} = 153600 \text{ J} \end{aligned}$$

11(a) An object of mass  $m$  is moving with a constant velocity  $v$ . How much work should be done on the object to bring it to rest? 3

(b) Earth is revolving round the sun. What is the work done by the gravitational force exerted by the sun on earth? Justify your answer.

**Ans :**

(a) Work done is equal to the K.E. possessed by the object, i.e.  $\frac{1}{2}mv^2$ .

(b) Work done is zero as the direction of force of attraction is perpendicular to displacement.

12 A heavy ball falls on a thick bed of wet sand from different heights 50 cm, 1 m and 2 m respectively and the depressions created in the wet sand are carefully measured. 3

(a) Which impression is the deepest and why?

(b) Which impression is the shallowest and why?

**Ans :**

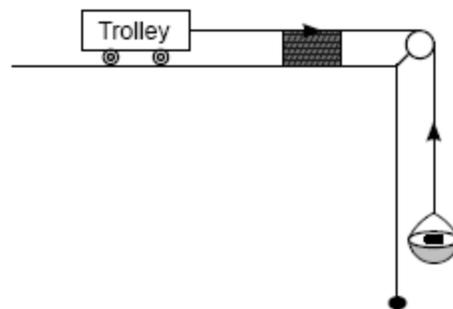
The potential energy of the ball at height 2 m is maximum and that at height 50 cm is minimum.

(a) The impression made when ball was dropped from 2 m height is the deepest because it transfers the maximum energy on hitting the wet sand.

(b) The impression made when ball was dropped from 50 cm height is the shallowest because it transfers the least energy to wet sand.

13 A block of known mass is placed in front of a trolley as shown in the figure. When a known mass is kept on the pan, the trolley moves and hits the block and the block gets displaced.

3



(a) Where does the block get energy from?

(b) If mass on pan is increased, will there be more work done?

(c) What type of energy is possessed by the trolley?

**Ans :**

(a) The block gets energy because work is done on it by the moving trolley.

(b) Yes, more work will be done on the block as trolley moves faster.

(c) Kinetic energy

14 Explain the following phenomena in the light of your understanding of energy conversions:

3

(a) How do green plants prepare food?

(b) How does air move from place to place?

(c) How are fossil fuels formed?

**Ans :**

(a) Green plants prepare food by converting light energy from the sun into chemical energy of food (in the form of sugars).

(b) Thermal energy from the sun gets converted into kinetic energy of air, so convection currents are set up in air due to uneven heating of the earth by the sun.

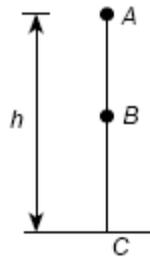
(c) Fossil fuels are formed when solar energy is stored in plants as chemical energy. These remain buried in the earth over millions of years and eventually get converted into fossils.

15 With the help of an example explain the law of conversion of energy.

3

Or

State Law of Conservation of Energy and express it in the form of an equation for a body of mass  $m$  falling from a point A at height  $h$ , above the ground at (a) A, (b) B at a height from ground, (c) C.



**Ans :**

The law of conservation of energy states that energy can neither be created nor destroyed. It can only be converted from one form into another.

Consider a stone of mass  $m$  dropped from a height  $h$ .

At A  $P.E. = mgh, K.E = 0$

$\therefore$  Total energy =  $mgh$

At B  $P.E. = mg(h - x)$

$K.E. = \frac{1}{2} mv^2, \text{ where } v^2 = 2gx$

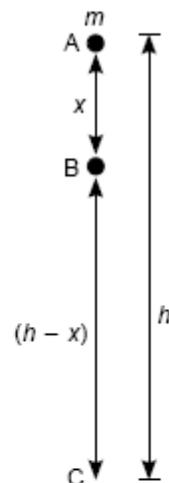
$\frac{1}{2} m \times 2gx = mgx$

Total energy  $mgx + mg(h - x) = mgh$

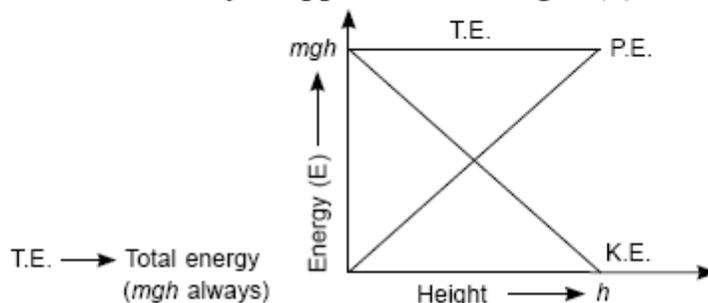
At C  $P.E. = 0$

$K.E. = \frac{1}{2} mv^2 = \frac{1}{2} m (2gh) = mgh$

Total energy =  $mgh$ .



Variation of P.E. and K.E. for a body dropped from a height ( $h$ ):



It does not violate the conservation of energy since total energy remains constant, law of conservation of energy holds true.

16 Define power. State commercial unit and SI unit of electrical energy. An electric heater of 400 W works for 2 hours. Find the electrical energy units consumed in a day. 3

**Ans :** Power of a device is defined as work done by it per unit time.

Commercial unit of energy : kilowatt hour (kWh)

SI unit of energy : joule (J)

Given: power,  $P = 400 \text{ W} = 0.4 \text{ kW}$ ; Time,  $t = 2 \text{ h}$

Energy unit consumed in a day =  $Pt = 0.4 \text{ kW} \times 2 \text{ h} = 0.8 \text{ kWh}$

17 In a house 5 bulbs of 25 W each are used for 6 hours a day. Calculate the units of electricity consumed in a month for 30 days. Also find the total expenditure if 1 unit of electricity costs ₹ 1.5. 3

**Ans :**

Total power consumed in 1 day = 25 W × 5 bulbs = 125 W = 0.125 kW  
 Hours for which bulbs work in 30 days = 6 hours × 30 days = 180 hours  
 Electricity consumed = Power × Time = 0.125 kW × 180 h = 22.5 units  
 ∴ Cost of 1 unit = ₹ 1.5  
 ∴ Cost of 22.5 units = 22.5 × ₹1.5 = ₹ 33.75

18A lamp consumes 500 J of electrical energy in 20 seconds. What is the power of the lamp? Also find the electrical energy consumed in units if the lamp operates for 2 hours daily for 15 days. 3

**Ans :**

Energy consumed,  $E = 500 \text{ J}$ ; Time,  $t = 20 \text{ s}$

$$P = \frac{E}{t} = \frac{500 \text{ J}}{20 \text{ s}} = 25 \text{ W} = 0.025 \text{ kW}$$

Total time in 15 days at the rate 2 h/day =  $t = 15 \times 2 = 30 \text{ h}$

Number of units consumed =  $Pt = 0.025 \times 30 = 0.750 \text{ units}$

19(a) Define power. Give its unit. 3

(b) A moving body of mass 20 kg has 40 joules of kinetic energy.

Calculate its speed.

(c) A person carrying a load of 20 kg climbs 4 m in 10 seconds.

Calculate the work done and his power. ( $g = 10 \text{ m/s}^2$ )

**Ans :**

(a) Power is defined as work done per unit time. The unit of power is watt (W).

(b) Given: Mass,  $m = 20 \text{ kg}$ ; Kinetic energy,  $E_k = 40 \text{ J}$ ;

$$\text{Speed, } v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{2 \times 40}{20}} = 2 \text{ m/s}$$

(c) Given: Mass,  $m = 20 \text{ kg}$ ; Height,  $h = 4 \text{ m}$ ; Time,  $t = 10 \text{ s}$ ;  $g = 10 \text{ ms}^{-2}$

Work done,  $W = mgh = 20 \times 10 \times 4 = 800 \text{ J}$

and 
$$P = \frac{W}{t} = \frac{800}{10} = 80 \text{ W}$$

20(a) Give one situation where force is applied but no work is done. 3

Explain why.

(b) A pump is used to raise water to a height of 20 m. It transfers 2000

kg of water in 15 minutes. Calculate power of the pump. [ $g = 10 \text{ ms}^{-2}$ ]

**Ans :**

(a) When a body moves along a circular path, work done is zero but force is not zero.

(b) Given:  $m = 2000 \text{ kg}$ ;  $t = 15 \text{ minutes} = 15 \times 60 = 900 \text{ s}$ ,  $h = 20 \text{ m}$

$$P = \frac{mgh}{t} = \frac{2000 \times 10 \times 20}{15 \times 60} = \frac{2 \times 10^4}{45} = 4.44 \times 10^2 \text{ W} = 0.444 \text{ kW}$$

- 21 Water is falling on the blades of a turbine at the rate of  $8 \times 10^2$  kg per minute, height of fall is 50 m. Calculate the power given to turbine. ( $g = 10 \text{ m/s}^2$ ) 3

**Ans :**

Given:  $h = 50 \text{ m}$ ,  $g = 10 \text{ m/s}^2$ ,  $m = 8 \times 10^2 \text{ kg}$ ,  $t = 1 \text{ min} = 60 \text{ s}$

$$\therefore P = \frac{W}{t} = \frac{mgh}{t} = \frac{8 \times 10^2 \times 10 \times 50}{60} = 6.67 \times 10^3 \text{ W}$$

- 22 A force applied on a body of mass 4 kg for 5 seconds changes its velocity from 10 m/s to 20 m/s. Find the power required. 3

**Ans :**

Given:  $m = 4 \text{ kg}$ ,  $t = 5 \text{ s}$ ,  $u = 10 \text{ m/s}$ ,  $v = 20 \text{ m/s}$

$$W = \frac{1}{2}m(v^2 - u^2) = \frac{1}{2} \times 4 \times (400 - 100) = 600 \text{ J}$$

$$\text{Power} = \frac{W}{t} = \frac{600 \text{ J}}{5 \text{ s}} = 120 \text{ W}$$

- 23 Calculate the electricity bill amount for a month of April, if 4 bulbs of 40 W for 5 hrs, 4 tube lights of 60 W for 5 hrs, a T.V. of 100 W for 6 hrs, a washing machine of 400 W for 3 hrs are used per day. The cost per unit is ₹ 1.80. 3

**Ans :**

Energy consumed (kWh) = Power(kW)  $\times$  Time (h)

S.No.	Item	Wattage	Number	Power	in kW	Time	Energy (units)
1.	Bulb	40 W	4	$40 \times 4 = 160 \text{ W}$	0.16 kW	5 h	$0.16 \times 5 = 0.8 \text{ unit}$
2.	Tube lights	60 W	4	$60 \times 4 = 240 \text{ W}$	0.24 kW	5 h	$0.24 \times 5 = 1.20 \text{ unit}$
3.	TV	100 W	1	100 W	0.1 kW	6 h	$0.1 \times 6 = 0.6 \text{ unit}$
4.	Washing machine	400 W	1	400 W	0.4 kW	3 h	$0.4 \times 3 = 1.2 \text{ unit}$

Electricity consumed in 1 day =  $0.8 + 1.20 + 0.6 + 1.20 = 3.8 \text{ units}$

Electricity consumed in 30 days =  $3.8 \times 30 = 114 \text{ units}$

Cost per unit = ₹ 1.80

Total cost =  $114 \times 1.80 = ₹ 205.2$

- 24 Two women Shanti and Kamla each of mass 50 kg and 60 kg respectively climb up through a height of 10 m. Shanti takes 20 s while Kamla takes 40 s to reach. Calculate the difference in the power expended by Shanti and Kamla. (Assuming  $g = 10 \text{ ms}^{-2}$ ) 3

**Ans :**

$$P = \frac{mgh}{t}$$

$$\text{Power of Shanti} = P_{\text{sh}} = \frac{50 \times 10 \times 10}{20} = 250 \text{ watt}$$

$$\text{Power of Kamla} = P_{\text{K}} = \frac{60 \times 10 \times 10}{40} = 150 \text{ watt}$$

$$\text{Difference in power expended} = 250 - 150 = 100 \text{ W}$$

25A lamp consumes 500 J of electrical energy in 20 seconds. What is the power of the lamp? Also find the electrical energy consumed in units if the lamp operates for 2 hours daily for 15 days.

3

**Ans :**

$$\text{Given: Energy} = 500 \text{ J, Time} = 20 \text{ s} \quad \text{Power} = \frac{\text{Energy}}{\text{Time}} = \frac{500 \text{ J}}{20 \text{ s}} = 25 \text{ W}$$

$$\text{Total time for 15 days at the rate 2 h per day} = 15 \times 2 = 30 \text{ h}$$

$$\text{Power} = 25 \text{ W} = 0.025 \text{ kW}$$

$$\text{Units of energy consumed} = Pt = 0.025 \times 30 = 0.750 \text{ kWh} = 0.75 \text{ units}$$

26An old coolie carries heavy luggage on his head at a railway station.

4

Manoj watches it from a distance and reaches to help him out. They

took the luggage at its place. The coolie thanks Manoj for his help.

Manoj asks him to be careful in future.

(a) What work was done by coolie on the luggage from Physics point of view?

(b) Give reason for your reply in above question.

(c) What are the qualities of Manoj?

**Ans :**

(a) Zero.

(b) Displacement of luggage is in perpendicular direction to force applied on it.

(c) Helpful and caring.

27Mohina was sitting in her room and preparing for the exam. She had planned to finish her syllabus by studying whole night. By morning she accomplished the task, but was very tired. She then packed her bag and went to school.

4

(a) How much work was done by Mohina from Physics point of view and why?

(b) In what form did energy of food get converted while Mohina was studying?

(c) Throw light on qualities of Mohina.

**Ans :**

- (a) Zero work, because the displacement was zero.
- (b) Potential energy of Mohina (while sitting), kinetic energy of her hands (while writing) and muscular contractions.
- (c) Hard working, strong determination, possesses good time management skills and is a good planner.

28 Archana is very keen on saving electricity. She switches off appliances when not in use and tries to use as much natural light as possible. Archit makes fun of her habits. He claims that energy in the universe is constant. Thus, it can't be consumed. Archana, however, still sticks to her habits.

4

- (a) Why is it necessary to save energy, though energy of universe is constant?
- (b) Which law states that energy of universe is constant?
- (c) Compare the characteristic values possessed by Archana and Archit.

**Ans :**

- (a) It is necessary to take care that energy stored in fuels is not converted into usable forms. So one should save fuel and use renewable source of energy. The unusable forms of energy into which we convert the energy of fuel, include heat, light etc., which once lost to environment cannot be replenished back.
- (b) Universal law of conservation of energy gives this statement.
- (c) Archana is considerate and environment concerned. Archit, though is logical, but stubborn and non-considerate about saving electricity.

29 What do you mean by work? Give an example of negative work done.

5

What is the work to be done to increase the velocity of a car from 18 km/h to 90 km/h if the mass of the car is 2000 kg?

**Ans :**

Work is said to be done if an applied force displaces an object in its own direction.

Example of negative work : When an object is sliding on a surface, work done by force of friction is negative.

Given:  $m = 2000$  kg,  $u = 18$  km/h = 5 m/s,  $v = 90$  km/h = 25 m/s

Work done to increase velocity,

$$\begin{aligned} W &= \frac{1}{2} m (v^2 - u^2) = \frac{1}{2} \times 2000 (25^2 - 5^2) \\ &= 1000 (625 - 25) = 6 \times 10^5 \text{ J} \end{aligned}$$

30(a) Define work. Give SI unit of work. Write an expression for positive work done.

(b) Calculate the work done in pushing a cart through a distance of 50 m against the force of friction equal to 250 N. Also state the type of work done.

(c) Sarita lives on 3rd floor of building at the height of 15 m. She carries her school bag weighting 5.2 kg from the ground floor to her house. Find the amount of work done by her and identify the force against which she has done work ( $g = 10 \text{ ms}^{-2}$ )

**Ans :**

(a) Work is said to be done if an applied force displaces a body in its own direction.

Its SI unit is joule (J).

Positive work done,  $W = F \cdot s$ , where  $F$  = force;  $s$  = displacement in direction of force.

(b) Given: Distance,  $s = 50 \text{ m}$ ; Force,  $f = 250 \text{ N}$  (opposite to direction of friction)

Work,  $W = F \cdot s = 250 \text{ N} \times 50 \text{ m} = 12500 \text{ J}$

Work done by applied force is positive and by friction is negative.

(c) Given: Mass,  $m = 5.2 \text{ kg}$ ;  $g = 10 \text{ ms}^{-2}$ ; height  $h = 15 \text{ m}$

Work done =  $mgh = 5.2 \times 10 \times 15 = 780 \text{ J}$

Work is done against the force of gravity acting on the bag.

31(a) Define kinetic energy of an object. Can kinetic energy of an object be negative? Give reason.

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

**Ans :**

(a) The energy possessed by an object by virtue of its motion is called kinetic energy.

Consider a mass  $m$  moving with a speed  $u$  and a force  $F$  applied on it, which changes its velocity to  $v$  on displacing by  $s$ .

$$\text{Work done, } W = ma \cdot \left( \frac{v^2 - u^2}{2a} \right)$$

$$\text{So, } W = \frac{1}{2} m (v^2 - u^2)$$

$$\text{If initial velocity, } u \text{ is zero, then } W = \frac{1}{2} mv^2.$$

$$\text{or } \text{K.E.} = \frac{1}{2} mv^2$$

K.E. cannot be negative as it has all positive quantities. It is a scalar quantity, so no direction is taken into consideration.

(b) Given:  $m = 1200 \text{ kg}$ ,  $s = 40 \text{ m}$ ,  $t = 5 \text{ s}$

$$\text{Using } s = ut + \frac{1}{2} at^2 \text{ and } u = 0,$$

$$\text{we get } a = \frac{2s}{t^2} = \frac{2 \times 40}{(5)^2} = \frac{80}{25} \text{ m/s}^2$$

$$\begin{aligned} \therefore \text{Work done} &= F \cdot s = ma \times s = 1200 \times \frac{80}{25} \times 40 \\ &= 153600 \text{ joule} = 153.6 \text{ kJ} \end{aligned}$$

32(a) Derive an expression for kinetic energy possessed by an object of mass  $m$ , moving with velocity  $v$ . Also state the SI unit of kinetic energy. 5

(b) A ball of mass  $400 \text{ g}$  rolls on a ground with uniform speed of  $25 \text{ m/s}$ . Find the kinetic energy possessed by it.

**Ans :** (a) Refer to Ans. 72.

(b) Given:  $m = 400 \text{ g} = 0.4 \text{ kg}$ ,  $v = 25 \text{ ms}^{-1}$ .

$$\text{Energy} = \frac{1}{2} mv^2 = \frac{1}{2} \times 0.4 \times 25 \times 25 = 125 \text{ J}$$

33(a) Justify that "a body at a greater height has larger energy". 5

(b) A body of mass  $2 \text{ kg}$  is thrown up at a velocity of  $10 \text{ m/s}$ . Find the kinetic energy of the body at the time of throw. Also, find the potential energy of the body at the highest point. The value of  $g = 10 \text{ m/s}^2$ .

**Ans :**

(a) Potential energy =  $mgh$

$\therefore$  Potential energy  $\propto h$ .

or Greater the height of the body, more is its potential energy.

(b) Given:  $m = 2$  kg,  $v = 10$  m/s

$$\text{Kinetic energy} = \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times (10)^2 = 100 \text{ J}$$

At highest point,  $v = 0$ .

$\therefore$  K.E. = 0

Thus, potential energy = 100 J.

Because energy is conserved and K.E. gets converted to P.E.

34(a) Give reason for the following:

5

(i) The kinetic energy of a freely falling object increases, yet it holds law of conservation of energy.

(ii) A girl fills up 10 pages of a notebook in order to practise sums, yet she has not done 'work' in terms of Science/Scientific concept.

(iii) Work done by gravitational force on an object moved along a horizontal path, is zero.

(b) Find the energy in kWh consumed in 24 hours by two electric devices, one of 100 W and other of 500 W.

**Ans :**

(a) (i) The kinetic energy gained is due to loss in P.E., so the conservation of energy holds good.

Gain in K.E. = Loss in P.E.

(ii) Work done is zero as force applied by girl has not displaced the pages from its place.

Since displacement = 0, so work = 0.

(iii) Because gravitational force is perpendicular to displacement.

(b) Energy consumed by two electric devices

$$= P_1 t_1 + P_2 t_2$$

$$= [100 \times 24 + 500 \times 24] = [100 + 500] \times 24$$

$$= 600 \times 24 = 14400 \text{ Wh} = 14.4 \text{ kWh}$$

35(a) State the principle of conservation of energy. What are the various energy transformations that occur when you are riding a bicycle?

5

(b) A body of mass 25 g has a momentum of 0.40 kg m/s. Find its kinetic energy.

**Ans :**

(a) Energy can neither be created nor destroyed. It can only be transformed from one form to another.

While riding a bicycle, following energy transformations take place:

Muscular energy of rider → Kinetic energy of bicycle

(b) Given:  $m = 25 \text{ g} = 0.025 \text{ kg}$ ,  $p = 0.40 \text{ kg m/s}$

$$\text{Kinetic energy} = \frac{p^2}{2m} = \frac{(0.40)^2}{2 \times 0.025} = 3.2 \text{ J}$$

36 What is meant by energy? How is energy related to work done? A person pushes a wall and fails to move it. What is the work done? Why does he get tired?

5

**Ans :**

A body possessing energy applies a force and moves an object in the direction of force. Energy and work are related as energy is nothing but capacity of an object to do work.

The person does zero work because there is no displacement in the wall, so work done is zero. He gets tired because he has expended energy in the form of muscular contractions, some heat etc.

37(a) Two bodies of equal masses move with uniform velocities  $v$  and  $3v$  respectively. Find the ratio of their kinetic energies.

5

(b) Define power. An electric heater is rated 1500 W. How much energy does it use in 10 h? Express your answer in (i) kWh (ii) joules

**Ans :**(a) Kinetic energy  $\propto v^2$ .

∴ For energies  $KE_1$  and  $KE_2$ ,

$$\frac{KE_1}{KE_2} = \frac{v_1^2}{v_2^2} = \frac{v^2}{(3v)^2} = \frac{v^2}{9v^2}$$

$$\therefore \frac{KE_1}{KE_2} = \frac{1}{9}$$

(b) Power is defined as work done by an object per unit time.

Given:  $P = 1500 \text{ W} = 1.5 \text{ kW}$ ,  $t = 10 \text{ h}$

$$(i) \quad E = Pt = 1.5 \times 10 = 15 \text{ kWh}$$

$$(ii) \quad 1 \text{ kWh} = 3.6 \times 10^6 \text{ J}$$

$$15 \text{ kWh} = 15 \times 3.6 \times 10^6 \text{ J} = 5.40 \times 10^7 \text{ J}$$

38(a) A ball thrown vertically upwards returns to the thrower. How do the kinetic and potential energies of the ball change?

5

(b) Calculate the power of a pump which lifts 100 kg of water to a water tank placed at a height of 20 m in 10 s. (Given  $g = 10 \text{ ms}^{-2}$ )

**Ans :**

(a) (i) The energy possessed by a body by virtue of its motion is called kinetic energy.

$$\text{Work done} = \text{Force} \times \text{Displacement} \quad \text{or} \quad W = Fs$$

$$\text{By second law of motion, } F = ma$$

$$\text{By third law of motion, } s = \frac{v^2 - u^2}{2a}$$

(ii) For  $u = 0$ ,  $s = v^2/2a$

$$\therefore W = Fs = ma \times v^2/2a$$

$$\text{or} \quad \text{K.E.} = W = 1/2 mv^2$$

Its SI unit is joule.

$$\text{Given: } m = 400 \text{ g} = 0.4 \text{ kg, } v = 25 \text{ ms}^{-1}.$$

(b) Energy =  $\frac{1}{2}mv^2 = \frac{1}{2} \times 0.4 \times 25 \times 25 = 125 \text{ J}$

39 (a) State the law of conservation of mechanical energy. 5

(b) Explain the conservation of energy in case of a freely falling object.

(c) Find the velocity of a body of mass 2 kg having kinetic energy of 100 J.

**Ans :**

(a) Energy can neither be created nor destroyed. The total mechanical energy of a system remains constant.

(b) Refer to Ans. 112

(c) Given: Mass,  $m = 2 \text{ kg}$ ; Energy,  $E_k = 100 \text{ J}$

$$\text{If velocity} = v, \text{ then } E_k = \frac{1}{2} mv^2$$

$$\text{or } v = \sqrt{2E_k/m} = \sqrt{\frac{2 \times 100}{2}} = 10 \text{ m/s}$$

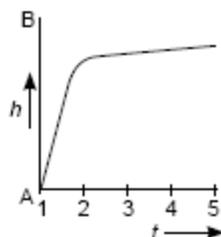
40 Read the graph depicting change in height of an object with time. 5

(a) Explain the changes in components of total mechanical energy with reasons.

(b) Find the velocity with which the object is projected.

(c) Find the maximum height achieved by the stone if it takes 4 s to reach that height.

(d) Find out the maximum P.E. of the stone if its mass is 200 g.



**Ans :**

(a) Mechanical energy remains constant. Kinetic energy constantly reduces but potential energy increases.

Loss in kinetic energy = Gain in potential energy

(b) From graph,  $t = 4$  s,  $v = 0$ ,  $g = -10 \text{ ms}^{-2}$

$$u = v - gt = 0 - (-10)4 = 40 \text{ ms}^{-1}$$

$$(c) h = \frac{v^2 - u^2}{2g} = \frac{0 - (40)^2}{2 \times (-10)} = 80 \text{ m}$$

(d) Given:  $m = 200 \text{ g} = 0.2 \text{ kg}$

$$\therefore \text{P.E.} = mgh$$

$$\text{P.E.} = 0.2 \times 10 \times 80 = 160 \text{ J}$$

41(a) Define 1 kWh.

5

(b) A crane is lifting a body to a height  $h$  in time  $t$ . Find the relation between the power of crane to the speed at which it is lifting the object.

(c) If an electric iron of 1600 W is used for 45 minutes everyday, find the electric energy consumed in the month of March.

**Ans :**

(a) Energy consumed by a device is 1 kWh if a device of power 1 kW is operated for 1 h.

(b)  $\text{Power} = \frac{\text{Work done}}{\text{Time taken}}$

If mass =  $m$ , height =  $h$ , work done =  $mgh$

$$\therefore P = \frac{mgh}{t} = mg \left( \frac{h}{t} \right)$$

If speed at which body is lifted,  $v = \frac{h}{t}$

$$\text{Force} = F = mg$$

Then  $\text{power} = (mg) \left( \frac{h}{t} \right) = mg v = F v$

i.e.  $P = mg v = F v$

(c)  $P = 1600 \text{ W} = 1.6 \text{ kW}$ ,  $t = 45 = \frac{45}{60} \text{ h}$

Time of consumption in March, i.e. 31 days =  $T = \left( \frac{45}{60} \times 31 \right) \text{ h}$

$$\text{Energy consumed} = PT = 1.6 \times \frac{45}{60} \times 31 = 37.2 \text{ units}$$

(i.e.  $\frac{\text{Distance}}{\text{Time}}$ )