Solution

WORK AND ENERGY

Class 09 - Science

Section A

1. **(a)** J/s
   Explanation:
   Power is measured in energy (joules) divided by time. The SI unit of power is the watt (W) or joule per second (J/s). Power is a scalar quantity, it has no direction.

2. **(c)** energy
   Explanation:
   Commercial unit of energy is kilowatt hour (kWh).

3. **(d)** 4.8 kW
   Explanation:
   Mass of water falling/second = 20 kg/s h = 30 m, g = 10 m/s^2, loss = 20% i.e., 80% is used.
   Power generated = 20 $\times$ 30 $\times$ 10 $\times$ 0.8 = 4800 W = 4.8 kW

4. **(c)** Electrical signal/energy
   Explanation:
   Microphones are loudspeakers in reverse, it converts sound (mechanical) energy to electrical energy.

5. **(a)** momentum is conserved
   Explanation:
   When a cracker bursts, its pieces move out in all directions. We explain it with the help of the law of conservation of momentum. In this case, initially, the momentum of the cracker is zero. Therefore, when it bursts, its pieces move out in different directions with some specific momentum. However, if we add up the momentum of these various pieces, the sum of the momenta will be zero.

6. **(c)** the body moves along the direction of the applied force
   Explanation:
   The work done is positive if the applied force is in the same direction as the direction of motion.

7. **(a)** 10 s
   Explanation:
   Due to conservation of energy,
   input energy = output energy
   Power $\times$ time = increase in kinetic energy
   $P \times t = \frac{1}{2}\left[mv^2 - mu^2\right]$
   (20000)(t) = $\frac{1}{2}\left[(800)(30)^2 - (800)(20)^2\right]$ or t = 10 s

8. **(a)** E = Pt
   Explanation:
   Energy = Power $\times$ time
   i.e. E = Watt $\times$ time
   When we say we have consumed 1 unit of electricity, that means we have consumed 1kWhr of electrical energy.
   1 Unit = kilo watt-hour.
   i.e. 1unit = 1kWhr

9.

(b) 3.6×10^6 joule

Explanation:

One kilowatt-hour is equal to 3600000 joules:

1kWh = 3600000J = 3.6×10^6J

10. **(a)** the momentum of the system is constant

Explanation:

The total momentum of the system just before the collision is the same as the total momentum just after the collision. So, the momentum of the system is constant.

11.

(b) Statement 1 is true but statement 2 is false

Explanation:

Potential energy (U)= $\frac{1}{2}kx^2$ i.e. $U \propto x^2$

This is the equation of parabola, so graph between U and x is a parabola, not straight line.

12.

(c) Fv

Explanation:

Power = Force $\times$ velocity = F $\times$ v

13.

(b) 20m s^{-1}

Explanation:

Change in gravitational potential energy of the skier, E_P = mgh = 50 $\times$ 10 $\times$ [60 - 20]= 20000 J = 2×10^4 J

Kinetic energy, E_K = 50% of $E_P = \frac{1}{2} \times 2 \times 10^4 \text{ J} = 1 \times 10^4 \text{ J}$

$E_K = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2\times1\times10^4}{50}} = 20 \text{ m s}^{-1}$

14.

(d) In moving from C to D, work done by the force on the body is positive

Explanation:

In moving from C to D, slope of graph is negative which means acceleration (force) is negative and displacement is also negative as the area under curve CD lies below the time axis. Hence, work done by the force on the body is positive.

15. **(a)** joule

Explanation:

The SI unit of work is joule and is denoted as ‘J’, which is named after an English physicist James Prescott Joule.

The 1 joule of work done is equal to 1N $\times$ 1 m. or, 1 joule = Nm.

16.

(d) half potential and half kinetic energy

Explanation:

As we know that when a body is at height h, it has

total energy = KE + PE

and at height ‘h’, velocity of body is zero

SO, KE = 0 and PE = mgh

Now, at height $\frac{h}{2}$

its PE = mg $\frac{h}{2}$ = $\frac{mgh}{2}$ .... (i)

and KE = $\frac{1}{2}$ mv^2

Where, velocity can be determined by equation of motion

$v^2 = u^2 + 2gh$

So, $v^2 = \frac{2gh}{2} \Rightarrow v = \sqrt{gh}$

So, KE = $\frac{1}{2}m(\sqrt{gh})^2$ .... (ii)

So, from equation (i) and (ii) body at ($\frac{h}{2}$) posses half potential energy and half kinetic energy.

17. **(a)** decreased by 3.5 times

Explanation:

$P1 = \frac{F_1}{A_1} = \frac{M_1 g}{A_1} = \frac{5\times 9.8}{0.30\times0.15} = 1.09 \times 10^3 N/m^2$

$P_2 = \frac{F_2}{A_2}$ = {tex}\;\frac{(M_1\;+\;M_2)g}{\mathrm{πr}^2}{/tex} $= \frac{(5+1)\times 9.8}{0.0154} = \frac{58.8}{0.0154} = 3.82 \times 10^3 N/m^2$

$\frac{P2}{P_1} = \frac{3.82\times10^3}{1.09\times10^3} = 3.5$

18.

(c) a person is lying on the ground

Explanation:

The potential energy of your body is least when you are lying down on the ground. An object can store energy as a result of its position. The stored energy of position is called potential energy.

19.

(c) mgd

Explanation:

Mass of the stone = m

Vertical distance, i.e. height h = d

Potential energy = mgh = mgd

20.

(d) Only (ii) is true.

Explanation:

The speed of the object is affected by the height from which it is released.

$mgh = \frac{1}{2}mv^2$ or $v = \sqrt{2gh}$ or $v \propto \sqrt{h}$

So, heavier object will not move with a greater speed at Y.

Speed of the object at M:

Loss in PE = KE

mg(25 - 20) = $\frac{1}{2}mv^2 \therefore v^2 = 100$ or $v = 10\ ms^{-1}$

21. **(a)** A, C and D

Explanation:

When an object starts to fall freely, the K.E. increase with decrease in potential energy and total mechanical energy remains constant. So, statement A, C, and D are incorrect and B is correct.

22.

(c) C and D

Explanation:

A. A bird sitting on a tree possesses potential energy only is a correct statement.
B. A stationary object may have energy is a correct statement.
C. A flying bird has kinetic energy only this is the incorrect statement because A flying bird has kinetic energy as well as positional energy also.
D. An aeroplane running on the run-way possesses kinetic energy only. So the given statement is incorrect.

23.

(c) C and D

Explanation:

(a) A bird sitting on tree possess potential energy only is correct statement.

(b) A stationary object may have energy is correct statement.

(c) A flying bird has kinetic energy only this is incorrect statement because A flying bird has kinetic energy as well as positional energy also.

(d) An aeroplane running on the run- way possess kinetic energy only. So given statement is incorrect.

24.

(d) A

Explanation:

When an object starts to fall freely, the K.E. increase with a decrease in potential energy, and total mechanical energy remains constant. So the given statement is incorrect.

25.

(d) (A), (C) and (D) are incorrect

Explanation:

When an object starts to fall freely, the K.E. increase with a decrease in potential energy, and total mechanical energy remains constant. So, statements A, C, and D are incorrect and B is correct.

26. When a body does not perform any work, it never implies that the body has no energy. The body may have energy bu still does not perform any work, e.g., a book placed on a table has potential energy but is not performing any work.
27. The speed is doubled.
28. Work is done against the force of gravity.
29. When we wind a watch, the configuration of its spring is changed. The energy stored in the spring is obviously potential in nature (elastic potential energy to be more accurate).
30. Yes, when a force acts at an angle of 90^o with the displacement.
31. 1J is that work which is done when a force of 1N is applied on an object and object moves a distance of 1m in the direction of force.
32. Work is said to be done if force acting on an object displaces it through a certain distance. It is measured as the product of force and displacement. Work done is negative if force and displacement are in the opposite direction.
33. The person does no work because, no displacement takes place in the direction of applied force as the force acts in the vertically upward direction.
34. The capacity of a body to do work is called energy possessed by the body. It is a scalar quantity and is measured in joule (J).
35. Changing its velocity.

Section B

36. Mass of substance m = 50 g

    Volume of substance V = 20 cm^3

    Therefore density of substance is

    $D = \frac{M}{V} = \frac{50}{20}$ = 2.5 g cm^{-3}

    The substance will sink in water, because its density is more than that of water.
37. Given : m = 1 kg, h = 1 m , g = 10 ms^{-2} PE = ?

    Using U = mgh = 1 × 10 × 1 = 10 J

    Since potential energy is converted completely into kinetic energy, therefore kinetic energy transferred to the nail is 10 J.
38. Given:

    i) Initial velocity (u) = 0,

    Final velocity (v) = ?

    Distance (s) = 50 cm = 0.5 m

    Acceleration (g) = 10 ms^{-2}

    Using the equation of motion,

    $v^2 - u^2 = 2gh$

    $\Rightarrow v^2 = u^2 + 2gh$

    we have

$V^2 = 0 + 2 \times 10 \times 0.5 = 10$

v = $\sqrt{10}$ = 3.16 ms^{-1}

ii) Kinetic energy of the body = $\frac{1}{2}mv^2 = \frac{1}{2} \times 10 \times 10$ = 50J

iii) Velocity of the body does not depend upon its mass, because the earth attracts all bodies with same acceleration due to gravity.

39. i. Energy consumed by five bulbs = $\frac{5\times100\times4}{1000}$ = 2 units

Energy consumed by 1 heater = $\frac{1500\times2}{1000}$ = 3 units

Energy consumed by electric iron = $\frac{1000\times5}{1000}$ = 5 units

Total energy consumed by them = (2 + 3 + 5) = 10 units

ii. 1 unit or kWh = 3.6×10^6 J

$\therefore$ 10 units = $3.6 \times 10^6 \times 10$ J = 3.6×10^7 J

40. Given : Power of bulb = 100 W = 100 Js^{-1}

Time = 2 hr = 7200 s

Therefore, Energy consumed = P × t = 100 ×7200 = 720,000 J

41. We know that, Power = $\frac{Work\ done\ or\ energy}{time} = \frac{mgh}{t}$ = m.g.($\frac{h}{t}$)

Since, speed =$\frac{Distance}{time} = \frac{h}{t}$

Therefore, mass, m=$\frac{Power}{g\times Speed}$

Hence, mass of a body that can be lifted = $\frac{Power}{g\times Speed} = \frac{100}{10\times1}$ = 10 kg

42. Given, Power of motor, P = 40 kW = 40×10^3 = 40,000 W

Here, Load to be lifted = Force applied (F) = 20,000 N

If v is the speed of load, then we know that, P = Fv

$\Rightarrow$ Speed, v = $\frac{P}{F} = \frac{40,000}{20,000}$ = 2 m/s

43. Force = 7 N

Displacement = 8 m

Work done = Force $\times$ Displacement

= 7×8 = 56 J

44. Given, mass of A (m_A) = 60 kg

mass of B (m_B) = 40 kg

mass of luggage (m_L) = 20 kg

Height of staircase (h) = 0.5×10 = 5 m

So, work done by boy A to climb staircase = mgh = (60 + 20) $\times$ 9.8 $\times$ 5 = 3920 J

So, power of A = $\frac{work}{time} = \frac{3920}{20} = 196\ W$

Similarly, power of Bf = $\frac{work}{time} = \frac{mgh}{t}$

$\frac{[(40+20)\times9.8\times5]}{10} = \frac{2940}{10} = 294\ W$

i. B possesses greater power than A.

ii. So, the ratio is given by $\frac{power\ of\ A}{power\ of\ B} = \frac{196}{294}$ = 2:3

So, power, P = $\frac{W}{t} = \frac{3000}{3}$ = 1000 W

45. We have given that,

Mass of the car, m =1500 kg, the initial velocity of the car, u = 30 km h^{-1}

u $= \frac{30\times1000m}{60\times60s}$

= $\frac{25}{3}$ ms^{-1}

Similarly, the final velocity of the car,

v = 60 km h^{-1} = $\frac{50}{3}$ ms^{-1}

Therefore, the initial kinetic energy of the car,

$E_{ki} = \frac{1}{2}mu^2$

$= \frac{1}{2} \times 1500\text{kg} \times \left(\frac{25}{3}\right)^2 \text{ms}^{-1}$

$= \frac{156250}{3}\text{J}$

The final kinetic energy of the car

$E_{kf} = \frac{1}{2} \times 1500\text{kg} \times \left(\frac{50}{3}\right)^2 \text{ms}^{-1}$
= $\frac{625000}{3}$ J.
Thus, the work done = Change in kinetic energy =E_{kf} - E_{ki} = 156250 J.

46. Mass of system,m = mass of girl + mass of trolley = 35+5 =40 kg.

    Initial velocity, u = $4ms^{-1}$, Final velocity, v = 0, Displacement,S = 16m

    Using v^2 - u^2 = 2aS,
    a = $\frac{v^2-u^2}{2S}$ = -$\frac{16}{2\times16}$ = -$\frac{1}{2}$ ms^{-2}
    Force = ma = 40 $\times$ (-$\frac{1}{2}$) = -20 N

    1. Work done on the trolley = Force$\times$ Displacement = 20 N $\times$ 16 m = 320 J.
    2. Since, A girl is sitting on a trolley, Therefore, Work done by the girl = 0 J.

47. Given mass, m = 500 kg
    The given unit of speed is km/h. It is to be converted into m/s.
    = 1 km/h
    = $\frac{1\times1000 \text{ metre}}{3600 \text{ second}}$
    = $\frac{5}{18}m/s$
    Initial speed, u = 36 km/h
    = $36 \times \frac{5}{18}m/s$
    = 10 m/s
    Final speed = v = 72 km/h
    = $72 \times \frac{5}{18}m/s$
    = 20 m/s
    Gain in KE = Final KE - Initial KE
    = $\frac{1}{2}mv^2 - \frac{1}{2}mu^2$
    = $\frac{1}{2}m \times (v^2 - u^2)$
    = $\frac{1}{2} \times 500 \times [(20)^2 - (10)^2]$
    = $\frac{1}{2} \times 500 \times [400 - 100]$
    = $\frac{1}{2} \times 500 \times 300$
    = 75000 joule
    = $7.5 \times 10^4 J$

48. Given, Mass, m = 200 kg, g = 10 m/s^2 and Distance, h = 6 m
    Work in lifting the mass is done against gravity.
    Therefore, the work done is W = Force $\times$Displacement = mg $\times$ h = mgh
    W = mgh= 200 $\times$ 10 $\times$ 6 = 12000 J.

49. Let, Potential energy of a person on Earth = mg_1h_1

    Potential energy of same person on planet 'A' = mg_2h_2

    Since, The potential energy of the person will remain the same on the Earth and on planet A.
    Therefore, mg_1h_1 = mg_2h_2

    Since mass remains same, So, if g_1 = g, then g_2 = $\frac{1}{2}$g

    Here, h_1 = 0.4 ; Now h_2 = $\frac{g_1h_1}{g_2}$ = $\frac{g\times0.4}{g_2}$

    or h_2 = 0.4 $\times$ 2 = 0.8 m.

    Therefore, he can jump on plant A= 0.8m

50. Energy consumed by a certain household = 250 kWh
    since 1 kWh $= 3.6 \times 10^6 J$
    therefore 250 kWh $= 250 \times 3.6 \times 10^6 = 9 \times 10^8 J$

51. Mass of car = 1500 kg
    Vel. of car = 60 kmh^{-1} = $\frac{60\times1000}{60\times 60}$= $16.67ms^{-1}$
    W.D. = Change in K.E. of the car = K_f - K_i

    K_i = $\frac{1}{2}mv^2$ = $\frac{1}{2}$×1500 × $(16.67)^2$

$=\frac{1}{2}\times 1500\times 277.89$
= 208416.68
Also K_f = 0
$\therefore$ W = 0 - 208416.68
= -208416.68 J

52. Here, Mass of Car =150 Kg.
Power developed by a car for one Kg = 500W
Total Power developed by a car for 150 Kg = 150 $\times$ 500 = 7.5 $\times 10^4$ W
We know that, Force = $\frac{Power}{Velocity}$ = $\frac{7.5\times 10^4}{20}$ = 3.75 $\times$ 10^3 N
Therefore, Force = 3750 N.

53. i) Weight of hot air = Volume × Density × g
= 50 × 0.4 × g
= 20 kgf
ii) Weight of hot air, balloon and equipment
= 20 +12 + P = (32 + P) kgf
iii) Upthrust = Weight of air displaced
= hdg
= 50 × 1.3 × g
= 65 kgf
By law of floatation we have,
32 + P = 65
P = 65 - 32 = 33 kgf

54. $K.E.=\frac{1}{2}\left(m\times v^2\right)$
Given initial kinetic energy = 25 J
given velocity
$v=5m/s$
$25=\frac{1}{2}\times m\times 25$
$m=2$
When velocity is doubled, new velocity,
$v=10m/s$
K.E.=$\frac{1}{2}\times\ \ 2\times\left(10^2\right)$
$K.E.=100J$
When velocity is made three times,
$v=15m/s$
K.E.=$\frac{1}{2}\times\ \ 2\times\left(15^2\right)$
$=225$

55. Electric heater’s power (p) = 1500 W = 1.5 kW
$Energy=power\times time\ =1.5kW\times 10h$ = 15 kWh

Section C

56. Power of Avinash P_A = F_A . v_A = 10 $\times$ 8 = 80 W
Power of Kapil P_K = F_K. v_K = 25 $\times$ 3 = 75 W
So, Avinash is more powerful than Kapil.

57. m_A = m_B = 1000 kg. v = 36 km/h= 10 m/s
Frictional force = 100 N
Since, the car A moves with a uniform speed, it means that the engine of car applies a force equal to the frictional force.
$\frac{\text{Force}\times\text{distance}}{\text{time}}$ Power =
= F.v
= 100 N $\times$ 10 m/s = 1000 W
after collision,
$m_A u_A + m_B u_E = m_A \upsilon_A + m_B$

$1000 \times 10 + 1000 \times 0 = 1000 \times 0 + 1000 \times \upsilon_B$

$v_B = 10\ ms^{-1}$.

58. Weight of water displaced = 50 gf
Weight of alcohol displaced = (50 -10) gf = 40 gf
As volume of water displaced = Volume of alcohol displaced
RD of alcohol = $\frac{weight\ of\ alcohol\ displaced}{weight\ of\ equal\ volume\ of\ water\ displaced} = \frac{40}{50}$

Section D

59. i. The commercial unit of energy is kilowatt-hour which is written as kWh. 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.
ii. 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.
iii. The electrical energy used during a month is expressed in terms of ‘units’. 1 ‘unit’ means 1 kilowatt hour. The electricity meter installed in our home records the electrical energy consumed by us in kilowatt-hours.
OR
1 kW h = 1 kW $\times$ 1 h
= 1000 W $\times$ 3600 s
= 3600000 J
1 kW h = 3.6 $\times$ 106 J.

60. i. **Potential Energy:** It is the energy possessed by a body by virtue of its position or shape.
ii. In a toy car, the wound spring possesses potential energy. When spring is released, its potential energy changes into kinetic energy due to which the toy car moves.
iii. Given, m = 50 kg, h_1 = 75 m, h_2 = 60 m
At point A, $PE_1 = mgh_1 = 50 \times 10 \times 75$
= 37500 J
At point B, $PE_2 = mgh_2 = 50 \times 10 \times 60$
= 30000 J
Change in PE = $PE_1 - PE_2$ = 37500 - 30000 = 7500 J
OR
The kinetic energy of an object of mass m moving with a velocity v is given by the expression $\frac{1}{2}mv^2$. To bring the object to rest, an equal amount of work i.e. $\frac{1}{2}mv^2$ is required to be done on the object.

61. i. The potential energy of the car remains the same since PE (= mgh) is independent of velocity.
ii. The kinetic energy of the car becomes four times, since $KE = (\frac{1}{2}mv^2)$ is proportional to square of velocity.
iii. The momentum of the car will also get doubled since momentum (p = mv) is proportional to velocity.
OR
The sum of the kinetic energy and potential energy of an object is called mechanical energy. The total amount of mechanical energy is merely the sum of the potential energy and the kinetic energy.

62. i. When a force of 1 Newton causes a displacement of 1 m in its own direction, the work done is said to be one joule.
ii. p = 5000 W, t = 2 h
iii. Energy consumed = pt = 5000 $\times$ 2 = 10000 Wh = 10 kW = 10 units.
When a carpet is beaten with a stick, the dust comes out of it because of the law of inertia. Initially, the dust particles are at rest along with the carpet. Beating the carpet with the stick makes the carpet move but the dust particles remain at rest due to inertia at rest, thus the dust gets detached from the carpet.
OR
Given W = 1000J, t = 10s, P = ?
We know, P = $\frac{W}{t} = \frac{1000}{10}$ = 100W

63. i. Work done on an object is defined as the magnitude of the force multiplied by the distance moved by the object in the direction of the applied force.
Work done = force $\times$ distance
W = F $\times$ s

ii. F = 250 kg $\times$ 10 ms^{-2} (g = 10 ms^{-2}) = 2500 Ns = 1 m

W = F.s = 2500 N $\times$ 1 m = 2500 Nm = 2500 J

iii. Zero, as the box does not move at all while holding it.

OR

In or do hold the box, men are applying a force that is opposite and equal to the gravitational force acting on the box. While applying the force, muscular effort is involved. So, they feel tired.

64. i. **Law of conservation of energy:** The energy in a system can neither be created nor destroyed. It may be transformed from one form to another, but the total energy of the system remains constant.

ii. The energy possessed by a body due to a displacement caused in it by the application of a force is called mechanical energy.

iii. Energy = Power $\times$ Time = 4 $\times$ 600 W $\times$ 5 h $= \frac{4\times600\ \times5}{1000} = \frac{12000}{1000} = 12$ KWh

Hence the energy in kWh consumed is 12 kWh.

OR

Yes, a body can have energy without possessing momentum. A body may have potential energy and still can be at rest. This means it would have zero momentum and still it could possess energy.

65. i. Power is defined as the rate of doing work.

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

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

ii. The SI unit of power is watt which is denoted by symbol W.

1 watt is the power of an appliance which does work at the rate of 1 joule per second.

iii. The power of an electrical appliance tells us the rate at which electrical energy is consumed by it.

OR

1 kilowatt = 1000 watts

1 kW = 1000 W

1 megawatt = 1000,000 watts

1MW = 10^6 W

66. i. Mass = m = 5 Kg

Height = h = 12 m.

g = Acceleration due to gravity = 9.8 m/s^2

P.E. = mgh

= 5 $\times$ 12 $\times$ 9.8

= 588 J

ii. Mass = m = 5 Kg

Height = h = 12 m.

g = Acceleration due to gravity = 9.8 m/s^2

Force = ?

Work Done = P. E. energy of the Body

Force $\times$ Distance Moved = 588

F $\times$ 12 = 588

F = 49 N

iii. The work done in lifting the body gets stored as potential energy.

OR

The work done by a force on a body depends on two factors:

a. Magnitude of force applied.
b. Displacement in the direction of force applied.

67. i. Given, mass of the object, m = 10 kg

Height, h = 50 cm = 0.5 m

As potential energy is given by PE = mgh

= 10 $\times$ 10 $\times$ 0.5

= 50 J

ii. Given, mass of the object, m = 10 kg

Height, h = 50 cm = 0.5 m

From the law of conservation of energy, the total energy of the ball just before dropping = total energy of the ball just on touching the ground

⇒ KE + PE of the ball just before dropping

⇒ KE = 50 J

iii. Given, mass of the object, m = 10 kg

Height, h = 50 cm = 0.5 m

As we know, KE = 50 J

So, $\frac{1}{2}mv^2 = 50 \Rightarrow v^2 = \frac{50\times2}{10} = 10$

So, the velocity with which it hits the ground,

v = $\sqrt{10}$ = 3.16 ms^{-1}

OR

Given, mass of the object, m = 10 kg

Height, h = 50 cm = 0.5 m

Yes, a body can have energy without possessing momentum. A body may have potential energy and still can be at rest. This means it would have zero momentum and still it could possess energy.

68. i. When it strikes ground, its PE is zero and after bouncing, its potential energy increases gradually.

ii. At the time it strikes the ground, it has maximum KE and after it bounces, its KE starts changing into potential energy.

iii. The ultimate or total energy remains constant at any point of time during the motion.

OR

It does not violate the law of conservation of energy, because sum of potential energy and kinetic energy remains always the same.

Section E

69. i. When a wet piece of cloth is shaken, small droplets of water fall down. This is because in the beginning, both water and the piece of cloth were at rest. When the piece of cloth is shaken, it is set into motion. The water tends to remain in the state of rest due to the inertia of rest. As a result, waterfalls down in the form of droplets.

ii. p = 100 W, t = 4 h

Thus energy consumed = p

t = 100 W $\times$ 4 h = 400 W h = 0.4 kWh

Now 1 kWh = 3.6 $\times$ 10^6 J

⇒ 0.4 kWh = 0.4 $\times$ 3.6 $\times$ 10^6

= 1.44 $\times$ 10^6 J

70. For the vertically upward motion of the ball

Initial velocity (u) = 20 ms^{-1}

Final velocity (v) = 0

Time (t) = ?

Distance covered upward (S) = ?

Acceleration due to gravity (g) = -10 ms^{-2}

For finding time taken by the ball to move upwards

Using v = u+ gt

⇒ 0 = 20 - 10 × t

⇒ 10 t = 20

⇒ t = 2s

As the ball takes 2 s to attain the maximum height, therefore, it will take another 2 s to just pass the thrower (since time of ascent is equal to the time of descent) thus, the time in which the ball passes the thrower.

= (2 + 2) s = 4 s

The total distance travelled by the ball in moving upwards and returning to the thrower can be obtained as follows

$V^2 - u^2 = 2as$

⇒ $0^2 - (20)^2 = 2 \times (-10) \times S$

⇒ S = $\frac{-400}{-20} = 20m$

For the downward motion of the ball from the top we have

Initial velocity u = 0 ms^{-1}

Distance of free fall (S) = 60 + 20 = 80 m

Time take t = ?

Using S = $ut + \frac{1}{2}at^2$ we have

80 = 0 × t + $\frac{1}{2}$× 10 × t^2

⇒ t^2 = 16

⇒ t = 4s

Therefore total time taken by the ball to reach the ground level = (2 + 4) = 6 s.

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

No, the kinetic energy of an object cannot be negative because both m and v^2 are always positive and KE = $\frac{1}{2}mv^2$

ii. Given, mass of car m = 1200 kg, Displacement covered, s = 40 m, time taken, t = 5 s, initial velocity, u = 0, W = ?

We know that, W = Fs = ma×s [∵ F = ma]

Now, s = ut + $\frac{1}{2}$ at^2

40 = 0 × t + $\frac{1}{2}$ × a × $(5)^2$

40 = $\frac{1}{2}$ × a × 25

a = $\frac{40\times2}{25}$ = 3.2 ms^{-2}

∴ W = Fs = ma × s

= 1200 × 3.2 × 40 = 153600 J

The work needed to be done by the car engine = 153600 J

72. i. If K is kinetic energy.

If initial kinetic energy is K_1

So, kinetic energy $K_1 = \frac{1}{2}mv^2$ ...(1)

As per given condition if mass increased four times (4m) and velocity is decreased two times $\frac{v}{2}$.

So, new kinetic energy

$K_2 = \frac{1}{2} \times 4m \times \left(\frac{v}{2}\right)^2$

$= 2m \times \frac{v^2}{4}$

$= \frac{1}{2}mv^2$ ...(2)

Thus from (i) and (ii)

K_1 :K_2 = 1: 1

Hence the ratio of the kinetic energies is 1 : 1.

ii. When a sparkle is lighted, then chemical energy is converted into heat and light energy.

73. Electric energy consumed per day by 4 bulbs = 4 × 40 × 5 = 800 Wh

Electric energy consumed per day by 4 lights = 4 × 60 × 5 = 1200 Wh

Electric energy consumed per day by TV = 100 × 6 = 600 Wh

Electric energy consumed per day by washing machine = 400 × 3 = 1200 Wh

∴ Total electric energy consumed by all electric appliances = (800 + 1200 + 600 + 1200) = 3800 Wh = 3.8 kWh

Total electric energy consumed by all electric appliances = 3.8 units

Total electric energy consumed in the month of April (30 days) = 3.8 × 30 = 114 units

Cost of one unit = Rs.1.80

Cost of 114 units = 114 × 1.80 = Rs.205.20

∴ Electricity bill amount = Rs.205.20

74. i. Work is said to be done only when the point of application of a force moves in the direction of the applied force.

Mathematically, work = Force × Displacement.

Two factors on which work depends :

a. The magnitude of applied force
b. Displacement in the direction of the force.

ii. Consider the masses of car and truck are 2m and 3 m.

Then Kinetic energy of the car = $\frac{1}{2}$ mv^2 = $\frac{1}{2}$ × 2m × $(30)^2$ = 900 m.

Kinetic energy of the truck = $\frac{1}{2}mv^2$ = $\frac{1}{2}$ × 3m × $(30)^2$ = 1350 m.

The ratio of their kinetic energies = 900 m : 1350 m = 2 : 3

75. i) Let V_1 = Total volume immersed (upto mid-point)

= Volume of the bulb + Volume of the immersed part of stem

= 12 + 0.32 × 10(Volume = Area of cross section × immersed length)

= 15.2 cm^3

For a floating body,

Weight of solid (mg) = Upthrust (Vdg)

22.8 × g = 15.2 × d_1 × g

or $d_1 = \frac{22.8}{15.2}$ = 1.5 g cm^{-3}

ii) V_2 = Total volume immersed = Volume of the bulb + total volume of stem

= 12 + 0.32 × 20 = 18.4 cm^{-3}

Since weight = upthrust, therefore

22.8 = 18.4 × d_2

or $d_2 = \frac{22.8}{18.4}$ = 1.24 gcm^{-3}