4. Work and Energy

Very Short Answer Type Questions-Pg-145

1. Question

How much work is done when a body of mass m is raised to a height h above the ground?

Answer

Mass = m,

Height = h

Work done (w) = f s or we know that PE = W

E=mgh (in case of potential energy)

So,

W = mgh

2. Question

State the SI unit of work.

Answer

Work (W) = Force (F) x Distance (s)

SI unit of F is N (Newton) and s is m (meter)

Hence SI unit of work = N x m = Nm (Newton-meter)

Another name for 1Nm is joule.

Therefore, SI unit of work is joule.

3. Question

Is work a scalar or a vector quantity?

Answer

Work is a scalar quantity.

4. Question

Define 1 joule of work.

Answer

One joule of work is defined as the amount of energy exerted when a force of one Newton is applied over a displacement of one meter.

5. Question

What is the condition for a force to do work on a body?

Answer

First condition is that there must be some displacement in the body. If you apply force and body does not move, the work done will be zero.

Second condition is that direction of force should not be perpendicular to the direction of motion. You will learn more about this condition in higher grades.

In the above mentioned conditions, work done will be zero.

6. Question

Is energy a vector quantity?

Answer

Energy is a scalar. If it were a vector then conservation of energy would fail during uniform circular motion in a radial potential and many other situations.

7. Question

What are the units of (a) work, and (b) energy?

Answer

(a) The SI unit of work is Joule

(b) The SI unit of energy is Joule.

8. Question

What is the work done against gravity when a body is moved horizontally along a frictionless surface?

Answer

Force of gravity acts vertically downward, while the body is move horizontally. Thus, the force of gravity is not causing the motion. So, the work done by the force of gravity is zero.

9. Question

By how much will the kinetic energy of a body increase if its speed is doubled?

Answer

Kinetic energy of a body depends on its mass and its speed.

KE = (1/2) mv^2

Where, m = mass of the body

v = speed/velocity of the body

If the velocity has become twice of the previous value and since we can't change the mass of a body it's an inherited property of a body.

Since, Kinetic energy = (1/2) mv^2 so in case we see the result in respect of the Kinetic energy of the body which, for twice velocity we can easily conclude its KE must have increased by 300% and becomes four times the previous value.

10. Question

Write an expression for the kinetic energy of a body of mass m moving with the velocity v.

Answer

We know,

K.E. = 1/2 [mass of body × (velocity of body)^2]

Hence the Expression for kinetic energy will be,

K.E. = 1/2 (m v^2)

11. Question

If the speed of a body is halved, what will be the change in its kinetic energy?

Answer

Mass of the body, m = m

Velocity of the body, v = $\frac{1}{2\ (v)}$

Hence, the new kinetic energy,

= 1/2 (m × v^2/4)

= 1/8 mv^2

Hence, the Kinetic energy would be reduced to one fourth the actual one.

12. Question

On what factors does the kinetic energy of a body depend?

Answer

Kinetic energy of a body depends on the mass and velocity of that body.

13. Question

Which would have a greater effect on the kinetic energy of an object: doubling the mass or doubling the velocity?

Answer

If the mass of a body is doubled, its kinetic also gets doubled and if the mass of a body is halved, its kinetic energy also gets halved.

If the velocity of a body is doubled, its kinetic energy becomes four times and if the velocity of a body is halved, then its kinetic energy becomes one-fourth.

It is obvious that doubling the velocity has a greater effect on the kinetic energy of a body than doubling its mass.

14. Question

How fast should a man of 50 kg run so that his kinetic energy will be 625 J?

Answer

Given that , m(mass)= 50 kg and K.E.(kinetic energy) = 625 j

As we know that:-

$K.E.=1/2\times(m\times v^2)$

$1/2\times(50\times v^2) = 625$

$v^2 =(625 \times 2)/50=1250/50=25$

$v = \sqrt{25}= 5$ m/s Ans

15. Question

State whether the following objects possess kinetic energy, potential energy, or both:

(a) A man climbing a hill

(b) A flying airplane

(c) A bird running on the ground

(d) A ceiling fan in the off position

(e) A stretched spring lying on the ground.

Answer

(a) Potential energy and kinetic energy to (Since the person is gaining height along with velocity)

(b) Kinetic energy and potential energy (Since the airplane poses motion and height both)

(c) Only kinetic energy (Since the bird do not poses height but velocity)

(d) Only potential energy (Since the fan is at height and not moving)

(e) Only potential energy (Rather elastic potential energy). (As it do not poses motion)

16. Question

Two bodies A and B of equal masses are kept at heights of h and 2h respectively. What will be the ratio of their potential energies?

Answer

Potential energy= mgh

Potential energy for object at height, H = mgH (h = H)

Potential energy for object at height, 2H = mg2H (h = 2H)

Hence, mgH/ mg2H = 1/2

So, ratio is 1:2

17. Question

What is the kinetic energy of a body of mass 1 kg moving with a speed of 2 m/s?

Answer

Mass of the object, m = 1kg

Velocity of the object, v = 2m/s

Kinetic energy = $1/2(mv^2)$

= $1/2 \times 1 \times 2 = 2J$

18. Question

Is potential energy a vector or a scalar quantity?

Answer

Potential energy is a scalar quantity as it depends only on the magnitude and not on the direction.

19. Question

A load of 100 kg is pulled up by 5 m. Calculate the work done ($g = 9.8\ m/s^2$)

Answer

Mass of the object, m=100 kg

Given ($g = 9.8m/s^2$)

Height, h = 5m

Work done, W = mgh

= 100 × 9.8 × 5

=4900J

20. Question

State whether the following statement is true or false:

The potential energy of a body of mass 1 kg kept at a height of 1m is 1J.

Answer

False. Since, the potential energy = m * g * h

= 1 * 10 * 1 = 10J

21. Question

What happens to the potential energy of a body when its height is doubled?

Answer

Potential energy also gets doubled as potential energy is directly proportional to the height of the object.

22. Question

What kind of energy is possessed by the following?

(a) A stone kept on roof-top.

(b) A running car.

(c) Water stored in the reservoir of a dam.

(d) A compressed spring

(e) A stretched rubber band.

Answer

(a) Potential energy, since it only posses height and no motion.

(b) Kinetic Energy since the car only poses velocity and not the height

(c) Potential Energy, since the water is at a state of rest with a certain height.

(d) Potential Energy, since the spring do not contains any velocity but the shape is changed.

(e) Potential Energy, since there is no motion but change in shape.

23. Question

Fill in the following blanks with suitable words:

(a) Work is measured as a product of …… and ……..

(b) The work done on a body moving in a circular path is ……..

(c) 1 joule is the work done when a force of one ……..moves an object through a distance of one …… in the direction of ……..

(d) The ability of a body to do work is called ……. . The ability of a body to do work because of its motion is called …….

(e) The sum of the potential and kinetic energies of a body is called ……. energy.

Answer

(a) Work is measured as a product of force and distance

(b) The work done on a body moving in a circular path is zero

(c) 1 joule is the work done when a force of one Newton moves an object through a distance of one meter in the direction of force

(d) The ability of a body to do work is called energy. The ability of a body to do work because of its motion is called Kinetic Energy

(e) The sum of the potential and kinetic energies of a body is called mechanical energy.

Short Answer Type Questions-Pg-145

24. Question

What are the quantities on which the amount of work done depends? How are they related to work?

Answer

The amount of work done on a body depends on the following two factors:-

(i)Force (ii) Displacement.

Work = Force × displacement (in the direction of force)

If displacement is in a certain direction to the applied force then work done is calculated by force x displacement.

25. Question

Is it possible that a force is acting on a body but still work done is zero? Explain giving one example.

Answer

Yes, it the given condition is possible in certain conditions:-

(i) When Displacement is 0 or the initial point and final point are the same.

For e.g. When a car is moving on a road, there will be a frictional force applied by the road on the. Using Newton's third law we can say that, for every action, there is an equal and opposite reaction. Thus the force applied by the road on the car will be equal and opposite to the force applied by the car on the road. Since, there is no displacement of the road, there will be no work done on the road.

(ii) When the Displacement is in perpendicular direction to force applied

For e.g. No work is done by the porter in carrying the load. As the porter carries the load by lifting it upwards and the moving forward it is obvious the angle between the force applied by the porter and the displacement is 90^o (i.e., if Cos θ is zero or $\theta = \pi/2$).

26. Question

A boy thrown a rubber ball vertically upwards. What type of work positive or negative, is done :

(a) By the force applied by the boy?

(b) By the gravitational force of earth?

Answer

Work done by the two forces in the given condition is :

a) Work done by the force applied by the boy is positive due to reason that the displacement of the ball is in the direction of the force applied.

b) Work done by the gravitational force of earth is negative. This is because the displacement of the ball is opposite to the direction of the gravitational force.

27. Question

Write the formula for work done on a body when the body moves at an angle to the direction of force. Give the meaning of each symbol used.

Answer

The formula for work done on a body when the body moves at an angle to the direction of force is:

$W = F \times d \times \cos \theta$

Where F is force,

d is displacement,

θ is the angle between F and d.

28. Question

How does the kinetic energy of a moving body depend on its (i) speed and, (ii) mass?

Answer

The kinetic energy of a moving body depends on its speed and mass in the following ways:

(i) Speed = Kinetic energy of a moving body is directly proportional to the square of speed of the moving body. [$K.E \propto v^2$]

(ii) Mass = Kinetic energy of a moving body is directly proportional to the mass of the moving body. [$K.E \propto m$]

29. Question

Give one example each in which a force does:

(a) Positive work

(b) Negative work, and

(c) Zero work.

Answer

(a) Kicking a football. Here, the work done will be positive as the displacement of the football is in the direction of the applied force.

(b) When a object is being lifted in the upward direction. In this case, the force of gravity is acting in the downward direction and the displacement of the object is in the upward direction. As the angle between the force and displacement is 180°, the work done by the gravitational force on the object is negative. Work done by a force is negative if the applied force has a component in a direction opposite to the displacement.

(c)A boy pushing against a wall it does not move, d=0.Then work done is zero.

30. Question

A ball of mass 200 g falls from a height of 5 metres. What is its kinetic energy when it just reaches the ground? ($g = 9.8\ m/s^2$)

Answer

Mass of the ball, m = 200g = 0.2Kg

Height from which ball is dropped, h = 5m

Initial velocity of the ball, (u) = 0m/s

Acceleration due to gravity, (g) = $9.8m/s^2$

Therefore, final velocity (v) of the ball is:

$V^2 = u^2 + 2as$

By substituting the above given values, we get

$V^2 = 0 + 2(9.8)\ (5)$

$V^2 = 98$

As we know, kinetic energy,

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

K.E = 1/2 x 0.2 x 98

K.E = 9.8 J

Hence, the kinetic energy = 9.8 J

31. Question

Find the momentum of a body of mass 100 g having a kinetic energy of 20 J.

Answer

Kinetic energy, K.E. = 20 J (given);

Mass, m = 100 g = 0.1 kg (given)

And Momentum (p) =?

We know that, K.E. = $1/2\ mv^2$

20 = 1/2 x 0.1 x v^2

40 = 0.1 x v^2

400 = v^2

v = 20

Therefore, v=20m/s

p = 0.1 kg x 20 m/s

p = 2 kg m/s

Therefore, momentum = 2kgm/s

32. Question

Two objects having equal masses are moving with uniform velocities of 2 m/s and 6 m/s respectively. Calculate the ratio of their kinetic energies.

Answer

Let the velocity of the first body, v1 = 2m/s (given)

And the mass of the first body, m1= 'm' kg

Similarly, let the velocity of the second body, v2 = 6m/s (given)

And the mass of the second body, m2 = 'm' kg

Kinetic energy, K.E. = $1/2mv^2$

Therefore, K.E of the first body = 1/2 x m x $(2)^2$

K.E of the second body = 1/2 x m x $(6)^2$

Ratio of their kinetic energies = 1/2 x m x $(2)^2$/ 1/2 x m x $(6)^2$

= 4/36

= 1/9

Hence, the Ratio of the kinetic energy of body 1: Ratio of the kinetic energy of body 2 = 1:9

33. Question

A body of 2 kg falls from rest. What will be its kinetic energy during the fall at the end of 2 s? (Assume g = 10 m/s^2)

Answer

Given,

Mass of the body, m = 2kg

Initial velocity (u) = 0 m/s

Time (t) = 2s

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

We need to find, Final velocity (v) =?

We know,

$v = u + at$

$v = 0 + 10 \times 2$

$v = 20$ m/s

$K.E = 1/2 (mv^2)$

$K.E = 1/2 \times 2 \times (20)^2$

K.E = 400J

Hence, the Kinetic energy of the body during the fall at the end 2s = 400 J

34. Question

On a level road, a scooterist applies brakes to slow down from a speed of 10 m/s to 5 m/s. If the mass of the scooterist and the scooter be 150 kg, calculate the work done by the brakes. (Neglect air resistance and friction)

Answer

Mass of scooter rider and the scooter, m = 150 kg

Initial velocity (v1) = 10 m/s

Final velocity (v2) = 5 m/s

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

Initial kinetic energy = $1/2 mv1^2$

$= 1/2 \times 150 \times (10)^2$

= 7500J

Final kinetic energy = $1/2 mv2^2$

$= 1/2 \times 150 \times (5)^2$

= 1875 J

Work done by the brakes = change in kinetic energy

= (K.E) 2 - (K.E) 1

= 1875 - 7500

= - 5625J

(The negative sign indicates that the force applied by the breaks is opposite to the direction of motion of the body)

35. Question

A man drops a 10 kg rock from the top of a 5 m ladder. What is its speed jest before it hits the ground? What is its kinetic energy when it reaches the ground? ($g = 10\ m/s^2$)

Answer

Mass of the rock, m = 10kg

Height from which the rock is dropped, h = 5m

Initial velocity (u) = 0m/s

Let, the final velocity = v m/s

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

We know,

$v^2 - u^2 = 2as$

$V^2 = 2 \times 10 \times 5 = 100$

Hence, the velocity of the body when it reaches ground is 10 m/s

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

$=1/2 \times 10(10)^2$

=500 J

Therefore, kinetic energy of the rock = 500J

36. Question

Calculate the work done by the brakes of a car of mass 1000 kg when its speed is reduced from 20 m /s to 10 m /s?

Answer

Mass of the car, m = 1000kg

Initial velocity (v1) = 20m/s

Final velocity (v2) = 10m/s

Initial kinetic energy = $1/2\ mv1^2$

= 1/2 x 1000 x $(20)^2$

= 200,000J

Final kinetic energy=$1/2\ mv2^2$

= 1/2 x 1000 x $(10)^2$

= 50,000 J

Work done by the brakes = change in kinetic energy

= (K.E) 2 - (K.E) 1

= 50,000 - 200,000

= - 150000J

= - 150KJ

(The negative sign shows that the force applied by the breaks is in the opposite direction to the direction of motion of the body)

37. Question

A body of mass 100 kg is lifted up by 10 m, Find:

(i) The amount of work done.

(ii) Potential energy of the body at their height (value of g = 10 m/s^2)

Answer

Given,

Mass of the body, m = 100kg

Height, h = 10m

Acceleration due to gravity, g = 10m/s

(i) Work done, w = mgh

= 100 × 10 × 10

= 10,000 J.

(ii) Potential energy, PE = Work done (At any point above the surface of the ground, the work done in raising the body is numerically equal to the potential energy)

Potential energy = 10,000 J

Or, Potential energy = 10KJ

38. Question

A boy weighing 50 kg climbs up a vertical height of 100 m. Calculate the amount of work done by him. How much potential energy does he gain? (g = 9.8 m/s)

Answer

Given,

mass of the body, m = 50kg,

Acceleration due to gravity, g = 9.8 m/s^2, height, h = 100m

Potential energy = Work done = mgh

= 50 × 9.8 × 100

= 59000J

= 59KJ

(At any point above the surface of the ground, the work done in raising the body is numerically equal to the potential energy)

39. Question

When is the work done by a force on a body?

(a) Positive

(b) Negative, and

(c) Zero?

Answer

(a) Work done is positive, when a force acts in the direction of motion of the body.

For e.g. kicking a football

(b) Work done is negative, when a force acts opposite to the direction of motion of the body

For e.g. when a body is being lifted in the upward direction

(c) Work done is zero when a force acts at right angles to the direction of motion of the body

For e.g. No work is done by the porter in carrying the load.

40. Question

To what height should a box of mass 150 kg be lifted, so that its potential energy may become 7350 joules? (g = 9.8 m/s^2)

Answer

Given,

Mass, m = 150 kg,

Acceleration due to gravity, g = 9.8 m/s^2, Potential energy, P.E = 7350 J

Therefore,

h = P.E/mg

=7350/150 × 9.8

=7350/1470

= 5m.

Hence, the box should be lifted to a height of 5m.

41. Question

A body of mass 2 kg is thrown vertically upwards with an initial velocity of 20 m/s. What will be its potential energy at the end of 2 s? (Assume g = 10 m/s^2).

Answer

Given,

Mass of the body, m = 2kg,

Initial velocity, (u) = 20 m/s,

Time, (t) =2s,

Acceleration due to gravity, g = 10 m/s.

Let the height at the end of 2s = d

We know that,

$d = ut + 1/2at^2$

$d = 20 \times 2 + 1/2 \times (-10) \times (2)^2$

d = 40- 20

d = 20m

(g is taken as negative because it is acting in the direction opposite to the direction of motion)

Potential Energy, P.E = mgh

= 2 × 10 × 20

= 400 J.

42. Question

How much work is done when a force of 1 N moves a body through a distance of 1 m in its own direction?

Answer

We Know that,

Work done, w = F × d

Where, F = force applied

d = Displacement

Hence, substituting the values we get,

= 1 × 1

= 1 J

43. Question

A car is being driven by a force of 2.5 × 1010 N. Travelling at a constant speed of 5 m/s, it takes 2 minutes to reach a certain place. Calculate the work done.

Answer

Given, Force = 2.5×10^{1}N

Speed of the car (u) = 5m/s

Time taken (t) = 2 × 60s = 120s

Distance = Speed x time

= 5 x 120

Work done = Force × distance

= $2.5 \times 10^{10} \times 600$

Hence, Work done = 1.5×10^{13}J.

44. Question

Explain by an example that a body may possess energy even when it is not in motion.

Answer

The water in a tank on the roof of a building possesses potential energy due to its position (height) above the ground.

45 A. Question

On what factors does the gravitational potential energy of a body depend?

Answer

The gravitational potential energy depends on the following three factors:

(i) Mass of body,

(ii) Vertical distance or height, and

(iii) Acceleration due to gravity

45 B. Question

Give one example each of the body possessing: (i) kinetic energy, and (ii) potential energy.

Answer

A stationary stone lying at the top of a hill has only potential energy.

(Since, the stone only possess height and not the velocity)

When the stone reaches the bottom of the hill, it has only kinetic energy.

(Since, on reaching the bottom height would be reduced to zero But the stone would have gained Velocity)

46. Question

Give two examples where a body possesses both, kinetic energy as well as potential energy.

Answer

The two examples are given below:-

(i) A flying airplane has kinetic energy as well as potential energy.

(As it is on a certain height and moving)

(ii) A man climbing a hill has kinetic energy as well as potential energy.

(As it posses both height and velocity)

47. Question

How much is the mass of a man if he has to do 2500 joules of work is climbing a tree 5 m tall? ($g = 10\ m\ s^2$)

Answer

Given:

Work done in climbing, w = 2500J

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

Height above the ground = 5m

We know,

W = mgh

= 2500/10 × 5

=50Kg

Hence, Mass of the man = 50 kg

48. Question

If the work done by a force in moving an object through a distance of 20 cm is 24.2 J, what is the magnitude of the force?

Answer

Work done in moving a body, w = 24.2J

Distance travelled by the body, d = 20cm = 0.2m

Force, F = w/ d

= 24.2/ 0.2

= 121N.

Magnitude of the force = 121N

49. Question

A boy weighing 40 kg makes a high jump of 1.5 m.

(i) What is his kinetic energy at the highest point?

(ii) What is his potential energy at the highest point? (g = 10 m/s^2).

Answer

Given,

Mass of the boy, m = 40kg

Height gained by it, h = 1.5m

(i) K.E = 0 at highest point because velocity of the high jumper at the highest point will be 0

(ii) Potential Energy, P.E = mgh

= 40 × 10 × 1.5

= 600 J

50. Question

What type of energy is possessed?

(a) By the stretched rubber strings of a catapult?

(b) By the piece of stone which is thrown away on releasing the stretched rubber strings of catapult?

Answer

a) A stretched rubber string posses potential energy as there is no motion.

b) The stone posses kinetic energy as it posses motion.

51. Question

A weightlifter is lifting weights of mass 200 kg up to a height of 2 metres. If g = 9.8 m/s^2, calculate:

(a) Potential energy acquired by the weights.

(b) Work done by the weightlifter.

Answer

(a) Given,

Mass, m = 200kg

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

Height, h = 2m

(a) We know,

P.E = mgh

= 200 × 9.8 × 2

=3920 J.

(b) Work done = Potential energy gained = 3920 J.

(Since, at any point above the surface of the ground, the work done in raising the body is numerically equal to the potential energy)

Long Answer Type Questions-Pg-147

52 A. Question

Define the term 'work'. Write the formula for the work done on a body when a force acts on the body in the direction of its displacement. Give the meaning

of each symbol which occurs in the formula.

Answer

Work is done whenever a force acts on a body and the body moves in the direction of force.

When force is exerted on an object and object is displaced, work is said to be done.

Work = Force x Displacement

Or, W = F x s

Where, W is work

'F' is force and 's' is displacement

52 B. Question

A person of mass 50 kg climbs a tower of height 72 metres. Calculate the work done. ($g = 9.8\ m/s^2$)

Answer

Work done = mgh = 50 × 9.8 × 72

= 35280 J

53 A. Question

When do we say that work is done? Write the formula for the work done by a body in moving up against gravity. Give the meaning of each symbol which occurs in it.

Answer

Work is said to be done under the following conditions:

i) When a force acts on a body

ii) When there is displacement of the body that is caused by the applied force along the direction of the applied force .i.e., object is displaced

Formula for the work done by a body in moving up against gravity

Work done = mgh,

Where m is mass,

g is acceleration due to gravity and

h is height

53 B. Question

How much work is done when a force of 2 N moves a body through a distance of 10 cm in the direction of force?

Answer

Given, F=2N, distance travelled by the body= 10cm=0.1m

W = F × d

= 2N × 0.1m = 0.2J

Work done = 0.2J

54 A. Question

What happens to the work done when the displacement of a body is at right angles to the direction of force acting of it? Explain your answer.

Answer

Work done is zero in this case, since there is no displacement in the direction of force. Or in other words we can explain it as,

We know,

W = F s cos θ,

Where W = work done,

F = force,

s = displacement,

θ = angle between force and distance

When force is perpendicular to the direction of motion, Cos 90°=0,hence the work done is zero.

54 B. Question

A force of 50 N acts on a body and moves it a distance of 4 m on a horizontal surface. Calculate the work done if the direction of force is at an angle 60^o to the horizontal surface.

Answer

Given,

Force, F = 50 N,

Displacement, s = 4 mDirection of Force is at an angle of 60^o**Formula used:**

Work done $\overrightarrow{W} = \overrightarrow{F}.\overrightarrow{s} = |F| \times |S| \times \cos(\theta)$ Putting the values in above equation we get:-

$= 50 \times 4 \times \text{Cos } 60° = 50 \times 4 \times 1/2$

= 100 J [As Cos 60° = 1/2]

55 A. Question

Define the term 'energy' of a body. What is the SI unit of energy?

Answer

Energy is the capacity to do work. Hence, the energy possessed by an object is measured in terms of its capacity of doing work. The unit of energy is, therefore, the same as that of work, that is, joule (J). 1 J is the energy required to do 1 joule of work. Sometimes a larger unit of energy called kilo joule (kJ) is used. 1 kJ equals 1000 J.

55 B. Question

What are the various forms of energy?

Answer

Various forms of energy are kinetic energy, potential energy, chemical energy, heat energy, electrical energy, light energy, heat energy and nuclear energy

55 C. Question

Two bodies having equal masses are moving with uniform speeds of v and 2v respectively. Find the ratio of their kinetic energies.

Answer

Let the masses of the two bodies (m1) and (m2) be m kg

Let the velocity of the first body be v m/s

And the velocity of the second body be 2v m/s

Ratio of K.E = (KE) of body 1/ KE of body 2

$= (1/2\ mv^2)/ (1/2\ m\ (2v)^2)$

$= v^2/ (2v)^2 = (1)^2/ (2)^2$

$= 1:4\ (K.E \propto v^2)$

Hence, the ratio of their kinetic energies is 1:4

56 A. Question

What do you understand by the kinetic energy of a body?

Answer

The energy that is possessed by a body due to its motion is called its kinetic energy. Kinetic energy is directly proportional to the mass and square of the velocity of the moving body. It can be mathematically written as, K.E= $1/2mv^2$

56 B. Question

A body is thrown vertically upwards. Its velocity goes on decreasing. What happens to its kinetic energy as its velocity becomes zero?

Answer

When a body is thrown vertically upwards against the force of gravity, its Kinetic energy goes on decreasing as its velocity decreases due to the gravitational force acting downwards. At maximum height, the Kinetic energy becomes zero as the velocity becomes zero and all the energy of the body is converted into potential energy. Hence this states that as KE decreases PE increases

56 C. Question

A horse and a dog are running with the same speed. If the weight of the horse is ten times that of the dog, what is the ratio of their kinetic energies?

Answer

As we know,

K.E∝ mass,

Ratio of KE = K.E of horse/K.E of dog

= 10/1

=10

Hence, the ratio of their kinetic energies is 10:1

57 A. Question

Explain by an example what is meant by potential energy. Write down the expression for gravitational potential energy of a body of mass m placed at a height h above the surface of the earth.

Answer

Potential energy is defined as the energy possessed by a body due to its position.

For example; when a box is kept at a height, it possesses some energy because of its height. Because of this potential energy, object kept at a height falls over the ground.

Expression for Potential Energy is

P.E = mgh,

where m is mass ,

g is acceleration due to gravity and

h is the height .

57 B. Question

What is the difference between potential energy and kinetic energy?

Answer

Potential energy is the energy possessed by a body due to its position or its configuration Kinetic energy is the energy possessed by the body due to its motion.

Potential energy is independent of the speed of the body whereas Kinetic energy is directly proportional to the square of the velocity of the moving body.

E.g., a rock sitting at the edge of a cliff has potential energy

E.g., a rock falling from a cliff has kinetic energy

57 C. Question

A ball of mass 0.5 kg slows down from a speed of 5 m/s to that of 3 m/s. Calculate the change in kinetic energy of the ball. State your answer giving proper units.

Answer

Mass, m = 0.5 kg

Initial velocity (v1) = 5m/s

Final velocity (v2) = 3m/s

Initial K.E = $1/2m\ (v1)^2$

$=1/2 \times 0.5 \times (5)^2$

Final K.E = $1/2\ (mv2)^2$

$=1/2 \times 0.5 \times (3)^2$

Work done = Change in K.E

= 2.25 - 6.25

= - 4 J

58 A. Question

What is the difference between gravitational potential energy and elastic potential energy? Give one example of a body having gravitational potential energy and another having elastic potential energy.

Answer

Energy of a body due to its position above the ground is called the gravitational potential energy whereas energy of a body due to a change in its shape and size is called elastic potential energy.

Elastic property of the body is responsible for this energy. Elastic potential energy is associated with the state of compression or extension of an object.

For example, a wound –up circular spring possess elastic potential energy which drives a wound-up toy.

58 B. Question

If 784 J of work was done in lifting a 20 kg mass, calculate the height through which it was lifted. ($g = 9.8\ m/s^2$)

Answer

Mass of a body = 20kg

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

Work done = 784 J

As we know,

W = m x g x h

h = W/m x g

h = 784/ 20 x 9.8

h = 784/196

h = 4m

Therefore, the height through which the body was lifted is 4m

Multiple Choice Questions (MCQs)-Pg-148

59. Question

A car is accelerated on a leveled road and acquires a velocity 4 times of its initial velocity. During this process, the potential energy of the car:

A. Does not change

B. Becomes twice that of initial potential energy

C. Becomes 4 times that of initial potential energy

D. Becomes 16 times that of initial potential energy.

Answer

The potential energy does not depend on the velocity of thee object.

60. Question

A car is accelerated on a leveled road and attains a speed of 4 times its initial speed. In this process, the kinetic energy of the car:

A. Does not change

B. Becomes 4 times that of initial kinetic energy

C. Becomes 8 times that of initial kinetic energy

D. Becomes 16 times that of initial kinetic energy

Answer

In the kinetic energy of the object is proportional to the square of its velocity.

61. Question

In case of negative work, the angle between the force and displacement is:

A. 0^o B. 45^o

C. 90^o D. 180^o

Answer

Since, in order to have the negative work the direction of force applied and the direction of the displacement must be in opposite direction.

62. Question

An iron sphere of mass 10 kg has the same diameter as an aluminium sphere of mass 3.5 kg. Both the spheres are dropped simultaneously from a tower. When they are 10 m above the ground, they have the same:

A. Acceleration

B. Momentum

C. Potential energy

D. Kinetic energy

Answer

Since, the acceleration due to gravity remains constant unaffected by the masses of the object.

63. Question

A girl is carrying a school bag of 3 kg mass on her back and moves 200 m on a leveled road. If the value of g be 10 m/s^2, the work done by the girl against the gravitational force will be:

A. 6000 J B. 0.6 J

C. 0 J D. 6 J

Answer

Since, the force applied and the displacement is in perpendicular direction.

64. Question

The work done on an object does not depend on the:

A. Displacement

B. Angle between force and displacement

C. Force applied

D. Initial velocity of the object

Answer

Since, Work done = Force * Displacement and none of them depends on the velocity of an object.

65. Question

Water stored in a dam possesses:

A. No energy

B. Electrical energy

C. Kinetic energy

D. Potential energy

Answer

Since, the stored water is at a height and did not posses any kind of motion.

66. Question

The momentum of a bullet of mass 20 g fired from a gun is 10 kg m/s. The kinetic energy of this bullet in kJ will be:

A. 5 B. 1.5

C. 2.5 D. 25

Answer

Since, Momentum, p = Mass (m) * Velocity (v)

10 = 20v, v = 0.5

We know, K.E. = $\frac{1}{2}mv^2$

= $\frac{1}{2}$ * 10 * $(0.5)^2$ = 2.5 J

67. Question

Each of the following statement describes a force - acting. Which force is causing work to be done?

A. The weight of a book at rest on a table

B. The pull of a moving railway engine on its coaches

C. The tension in an elastic band wrapped around a parcel

D. The push of a person's feet when standing on the floor

Answer

Since, the force applied and the displacement is in same direction.

68. Question

A girl weighing 400 N climbs a vertical ladder. If the value of g be 10 m s^{-2}, the work done by her after climbing 2 m will be:

A. 200 J B. 800 J

C. 8000 J D. 2000 J

Answer

Since, Force = Mass * Acceleration

400 = 10m

m = 40

Work done = Mass * Acceleration * Height

= 40 * 10 * 2 = 800 J

69. Question

Which of the following does not possess the ability to do work not because of motion?

A. A sparrow flying in the sky

B. A sparrow moving slowly on the ground

C. A sparrow in the nest on a tree

D. A squirrel going up a tree

Answer

Since, the displacement of the sparrow is zero in this case.

70. Question

A stone is thrown upwards as shown in the diagram. When it reaches P, which of the following has the greatest value for the stone?

A. Its acceleration

B. Its kinetic energy

C. Its potential energy

D. Its weight

Answer

Since, as shown in the picture the object at point P will have the maximum height so the kinetic energy will be zero and stone would have the maximum potential energy.

Questions Based on High Order Thinking Skills (HOTS)-Pg-148

71. Question

A boy tries to push a truck parked on the roadside. The truck does not move at all. Another boy pushes a bicycle. The bicycle moves through a certain distance. In which case was the work done more: on the truck or on the bicycle? Give a reason to support your answer.

Answer

The boy pushing the truck does no work as the displacement is zero (no motion of the truck). But, when the boy pushes the bicycle, work done is more as the force applied by him causes displacement (motion of the bicycle).

72. Question

The work done by a force acting obliquely is given by the formula: $W = F \cos \theta \times s$. What will happen to the work done if angle between the direction of force and motion of the body is increased gradually? Will it increase, decrease or remain constant?

Answer

On increasing the value of angle between force and distance, the value of Cos θ decreases to zero when θ=90∘.Therefore, work done decrease as angle increase, work done is 0 when θ = 90∘ and work done is negative when angle further increases.

Cos θ reduces further to –1.

Therefore, work done decrease as angle increase, work done is 0 when θ=90∘ and work done is negative when angle further increases.

73. Question

What should be the angle between the direction of force and the direction of motion of a body so that the work done is zero?

Answer

When the force is perpendicular to the direction of motion, work done will be zero. Or in other words we can say that the angle should be 90∘ between force and displacement, for the work to be zero.

74. Question

In which of the following case the work done by a force will be maximum: when the angle between the direction of force and direction of motion is 0^o or 90^o?

Answer

When angle is 0, because Cos 0° has the maximum value i.e. 1

75. Question

How much work is done by the gravitational force of earth acting on a satellite moving around it in a circular path? Give reason for your answer.

Answer

Work done is zero, as force and displacement are at 90∘ to each other. And we know that Cos 90° is 0.

76. Question

A man is instructed to carry a package from the base camp at B to submit A of a hill at a height of 1200 metres. The man weighs 800 N and the package weighs 200 N. If g = 10 m/s^2,

(i) How much work does man do against gravity?

(ii) What is the potential energy of the package at A if it is assumed to be zero at B?

Answer

(i) Weight of the man = 800N

Weight of the package = 200N

Total weight = 800 + 200 = 1000N

Height of the hill = 1200m

g = $10m/s^2$

Work done = mass × height × g

= 10 × 1200 × 1000

= 12, 00, 000 J

= 12×10^5 J

(ii) Given, Weight of the package (mg) = 200N, h = 1200m

P.E = m x g x h

= 200 × 1200 × 10

= 24×10^5 J

77. Question

When a ball is thrown vertically upwards, its velocity goes on decreasing. What happens to its potential energy as its velocity becomes zero?

Answer

The potential energy keeps on increasing as velocity keeps on decreasing. It is maximum when the velocity becomes zero.

78. Question

A man X goes to the top of a building by a vertical spiral staircase. Another man Y of the same mass goes to the top of the same building by a slanting ladder. Which of the two does more work against gravity and why?

Answer

Work done against gravity depends on the vertical distance through which the body is lifted and is independent of the path travelled to achieve the height. Therefore, we can say that both men did the same work as the vertical distance travelled by them is the same.

79. Question

When a ball is thrown inside a mocking bus, does its kinetic energy depend on the speed of the bus? Explain.

Answer

Yes, the kinetic energy of the ball thrown inside a moving bus depends on the speed of the moving bus. This is because the speed of the bus adds up to the speed with which the ball is thrown inside the moving bus.

For instance, If the bus is moving at a speed of 24 km/hr and a person inside the bus throws a ball with a speed of 26 km/hr in the same direction as that of the motion of the bus. Then, for a person inside the bus, the K.E= 1/2 x m x $(24)^2$. But, for a person who is static and is outside the bus, the K.E of the ball=1/2 x m x $(24+26)^2$. Hence, the motion of the bus affects the K.E of the ball.

80. Question

A bullet of mass 15 g has a speed of 400 m/s. What is its kinetic energy? If the bullet strikes a thick target and is brought to rest in 2 cm, calculate the average net force acting on the bullet. What happens to the kinetic energy originally in the bullet?

Answer

Given,

Mass = 15g = 0.015kg,

Initial velocity = 400m/s,

Distance, s = 2cm = 0.02m

K.E. (initial) = $1/2mv^2$

= 1/2 x 0.015 x $(400)^2$

K.E. (initial) = 1200J

As final velocity = 0.

Therefore, K.E. (final) = 0 (Where F is the average force)

F = 1200/2 × 10−2

= - 6 × 104 N

Negative sign shows that force is acting opposite to the direction of motion of the bullet. And the kinetic energy originally in the bullet is eventually transformed into heat energy by friction.

Very Short Answer Type Questions-Pg-162

1. Question

Name the commercial unit of measurement of energy.

Answer

Kilowatt-hour is the commercial unit for the measurement of energy. Its symbol is (kWh).

2. Question

Define kilowatt-hour.

Answer

1 Kilowatt hour is the energy consumed when 1000 Watt is consumed for 60 minutes.

3. Question

Name two units of power bigger than watt.

Answer

Kilowatt (kW) and megawatt (mW) are the two units used for measuring power that are larger than watt.

4. Question

Define the term 'watt'.

Answer

One Watt is defined as the power when one Joule of work is done in 1 s.

5. Question

How many watts equal one horse power?

Answer

One horse power is equal to 746 watt.

A horse power is a unit that is used to measure the power of engines and motors.

6. Question

Name the physical quantity whose unit is watt.

Answer

Power is the physical quantity whose SI unit is watt. Power is the rate of doing work. It is the amount of energy consumed.

7. Question

What is the power of a body which is doing work at the rate of one joule per second?

Answer

The SI unit of power is the watt (W), which is doing work at the rate of one joule per second.

8. Question

A body does 1200 joules of work in 2 minutes. Calculate its power.

Answer

Work = 1200 J,

Time = 2 min = 2 x 60 sec = 120 sec

Power = work done/time taken

= 1200/120

= 10 W

9. Question

How many joules are there in one kilowatt-hour?

Answer

1 KWh = 1 KW × 1h

$=10^3$ W × (3.6×10^3) s

$=3.6 \times 10^6$ Ws

$= 3.6 \times 10^6$J

10. Question

Name the quantity whose unit is:

(a) Kilowatt

(b) Kilowatt – hour

Answer

(a) Kilowatt is the unit of power. Power is the rate of doing work. It is the amount of energy consumed .The SI unit of power is the watt (W), which is equal to one joule per second.

(b) Kilowatt-hour is the unit of energy. Energy is measured by the amount of work done, usually in joules or watts.

11. Question

What is the common name of '1 kWh of electrical energy'?

Answer

The common name of '1 kWh' of electrical energy is the Unit of electricity.

12. Question

A cell converts one form of energy into another form. Name the two forms.

Answer

.A cell converts Chemical energy into Electrical energy. A cell is a power supply that uses chemical energy to make electricity.

13. Question

Name the device which converts electrical energy into mechanical energy.

Answer

Electric Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy.

14. Question

Name the devices or machines which convert:

(a) Mechanical energy into electrical energy.

(b) Chemical energy into electrical energy.

(c) Electrical energy into heat energy.

(d) Electrical energy into light energy.

Answer

(a) Electric generator: A device for converting mechanical energy to electrical energy.

(b) Battery: A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights.

(c) Electric iron: It is a device that converts electrical energy into heat energy and is used for ironing cloths.

(d) Solar cell: A solar cell or photovoltaic cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical phenomenon.

(e) Electric bulb: An electric bulb is a device that produces light from electricity.

15. Question

Name the devices or machines which convert:

(i) Electrical energy into sound energy.

(ii) Hear energy into kinetic energy (or mechanical energy).

(iii) Chemical energy into kinetic energy (or mechanical energy).

(iv) Chemical energy into heat energy.

(v) Light energy into heat energy.

Answer

(i) Speaker in radio and television converts electrical energy into sound energy.

(ii) Steam engine converts heat energy into kinetic energy.

(iii) Car engine converts chemical energy into kinetic energy

(iv)Gas stove chemical energy into heat energy

(v) Solar water heater converts light energy into heat energy

16. Question

Fill in the following blanks with suitable words:

(a) Power is the rate of doing …….

(b) 1 watt is a rate of working of one ……. per ……..

(c) The electricity meter installed in our home measures electric energy in the units of ……..

(d) The principle of ……. Of energy says that energy can be ……. From one form to another, but it cannot be ……. or ….

(e) When a ball is thrown upwards, ……..energy is transformed into ……. energy.

Answer

(a) Power is the rate of doing work

(b) 1 watt is a rate of working of one joule per second

(c) The electricity meter installed in our home measures electric energy in the units of kWh

(d) The principle of conservation of energy says that energy can be transformed from one form to another, but it cannot be created or destroyed

(e) When a ball is thrown up wards kinetic energy is transformed into potential energy.

Short Answer Type Questions-Pg-163

17. Question

A trolley is pushed along a road with a force of 400 N through a distance of 60 m in 1 minute. Calculate the power developed.

Answer

Force= 400N,

Distance travelled = 60m,

Time, t = 1 min = 60 s

Work done = Force x distance

Work done = 400 x 60

Work done = 24000 J

Power = Work done/Time

Power = 24000/60

= 400 W

18. Question

What kind of energy transformations takes place at a hydroelectric power station?

Answer

The principle behind hydroelectric power is law of conservation of energy. That is energy can neither be created nor be destroyed. i.e., One form of energy is converted to another form.

In hydroelectric power, the fast moving water strikes the turbines and they start moving and this energy is used to run electric generators.

The transference of energy takes place from Kinetic energy to mechanical energy.

19. Question

What kind of energy transformations takes place at a coal-based thermal power station?

Answer

In a thermal power station, we basically require energy to rotate the turbine, which would convert the mechanical energy into the electrical energy. Large amount of fossil fuels are burnt every day in power stations to heat up water to produce steam which further runs the turbine to generate electricity. Thus the heat energy released by burning the fuel is converted into electric energy.

20. Question

A man weighing 500 N carried a load of 100 N up a fighter of stairs 4 m high in 5 seconds. What is the power?

Answer

Given, weight of the man = 500N

Weight of the load = 100N

Total weight = 500 + 100 = 600N

Height (vertical distance) = 4m

Work done = total weight x vertical distance

Work done = 600 x 4

Work done = 2400 J

Power = Work done/time

= 2400/ 5

= 480W

21. Question

The power output of an engine is 3 kW. How much work does the engine do in 20 s?

Answer

Given,

Power = 3KW = 3000W;

Time, t = 20s

Work done = power × time

= 3000 × 20

= 60000 J

= 60 KJ

Work done = 60KJ

22. Question

An electric heater uses 600 kJ of electrical energy in 5 minutes. Calculate its power rating.

Answer

Energy = 600KJ = 600000J;

Time = 5 min = 5 x 60 = 300s

Power = Energy/ Time

= 600000/300

Power = 2000W

Therefore, Power of electric heater = 2000W

23. Question

How much electrical energy in joules does a 100 watt lamp consumes:

(a) In 1 second?

(b) In 1 minute?

Answer

(a) Given,

Power (P) = 100 watt

Time, t = 1 s

Energy = P × T

= 100 × 1

= 100 J

(b) t = 1min = 60 sec

Energy = P × t

= 100 × 60

= 6000 J

24. Question

Five electric fans of 120 watts each are used for 4 hours. Calculate the electrical energy consumed in kilowatt hours.

Answer

Given,

Power = 120 watts = 0.12 kW;

Time, t = 4 hr

Hence, the energy consumed by one fan = P × t

= 0.12 × 4

= 0.48 KWh

Hence, the energy consumed by 5 fans,

= 0.48 x 5

=2.4 kWh

25. Question

Describe the energy changes which take place in a radio.

Answer

Radio converts electrical energy into kinetic energy and finally into sound energy.

It can be shown as-

Electrical Energy → Kinetic Energy → Sound Energy

26. Question

Write the energy transformations which take place in an electric bulb (or electric lamp).

Answer

In an electric bulb, electrical energy is transformed into light energy and heat energy. It can be represented as-

Electrical Energy → Heat Energy → Light Energy

27. Question

Name five appliances or machines which use an electric motor.

Answer

The appliances or machines which use an electric motor are as follows:

Grinder, Electrical fans, refrigerator, washing machine, and electric iron.

28. Question

A bulb lights up when connected to a battery. State the energy change which takes place:

(i) In the battery.

(ii) In the bulb.

Answer

(i) Chemical energy → Electrical energy.

(Here, the chemical energy gets converted into Electrical energy)

(ii) Electrical Energy → Heat Energy → Light Energy

(In an electric bulb, electrical energy is transformed into light energy and heat energy)

29. Question

The hanging bob of a simple pendulum is displaced to one extreme position B and then released. It swings towards centre position A and then to the other position C. In which position does the bob have: (i) Maximum potential energy?

(ii) Maximum kinetic energy?

Give reasons for your answer.

Answer

(i) Maximum Potential energy will be at the extreme position B and C because at these positions, the bob is at maximum height from the ground. K.E at these points will be zero.

(ii) Maximum Kinetic energy will be at A because at these positions, the bob has maximum velocity. Potential energy at this point will be zero due to no height.

30. Question

A car weight 20000 N climbs up a hill at a steady speed of 8 m/s, gaining a height of 120 m in 100 s. Calculate:

(a) Work done by the car.

(b) Power of engine of car.

Answer

(a) Weight of the car (W) = 20000 N

Height = 120 m

Time taken (t) = 100 s

Work done by car = Force × displacement

= 20,000 × 120

= 2400000 KJ or 2.4 x 10^6J

(b) Power = work done/ time

= 2400000/100

= 24 KW

Long Answer Type Questions-Pg-163

31 A. Question

What do you understand by the term "transformation of energy"? Explain with an example.

Answer

The conversion of energy from one form to another is called transformation of energy.

The application of inter-conversion of potential energy and kinetic energy can be described using a bow or an arrow.

When the archer pull the string with the arrow a small part of the muscular energy of the archer is transferred to the bow and is stored as the potential energy (here it is the elastic potential energy) of the bow. When the string is released the potential energy in the bow is transferred to the arrow as the kinetic energy of the arrow. The arrow shoots out with a certain velocity.

31 B. Question

Explain the transformation of energy in the following cases:

(i) A ball thrown upwards.

(ii) A stone dropped from the roof of a building.

Answer

(i) When a ball thrown up all of its kinetic energy is converted into potential energy at the top point.

(ii) When a stone is drop from certain height all of its potential energy at that height is converted into kinetic energy just above the ground.

32 A. Question

State and explain the law of conservation of energy with an example.

Answer

Law of conservation of energy states that the energy can neither be created nor destroyed but can be transformed from one form to another or in other words we can say that the total energy of a system remains unchanged before and after transformation.

For example- A rock on a cliff. The rock has potential energy, when it's pushed off from a height, the potential energy is changed into kinetic energy.

The sum of potential energy and kinetic energy remains constant at every point of the falling of object.

$mgh + 1/2\ mv^2$= constant at every point

The sum of potential energy and kinetic energy is the total mechanical energy of the rock falling from a height (cliff).

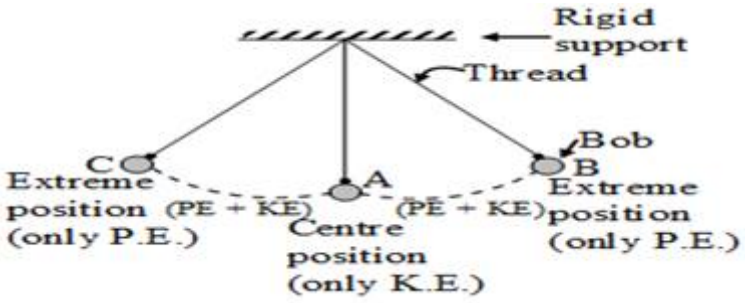
32 B. Question

Explain how, the total energy a swinging pendulum at any instant of time remains conserved. Illustrate your answer with the help of a labeled diagram.

Answer

A swinging pendulum is a perfect example to show the conservation of energy. It shows the transformation of potential energy into kinetic energy and kinetic energy back into potential energy without any energy loss. In a pendulum, the law establishes that, when the ball is at its highest point, all the energy is potential energy and there is zero kinetic energy. At the ball's lowest point, all the energy in the ball is kinetic and there is zero potential energy. The total energy of the ball is the sum of the potential energy and kinetic energy.

Initially, the bob of the pendulum is at the mean position (B). When we draw the pendulum bob to one side (Extreme position A), we raise the bob to a little height end give it potential energy. This is the energy transferred by work done by hand. As at the extreme position, the bob has only PE, it tends to move down. The P.E decreases and K.E increases. At the lowest (mean) position, the bob has got K.E. Due to this it moves to the other side. Now, its K.E decreases and P.E increases. At the extreme positions A and C, all energy is in the form of potential energy and therefore it tends to move down. Thus the bob oscillates. At all other intermediate positions, energy of the pendulum is partly potential and partly kinetic. But, the total energy of the pendulum remains conserved.



33 A. Question

What is the meaning of the symbol kWh? What quantity does it represent?

Answer

KWh means Kilowatt hour. It is the commercial unit of measurement of electrical energy.

1 kWh = $3.6 * 10^6$ J

It can be defined as the amount of electrical energy consumed when an electrical appliance of 1KW power runs for one hour.

33 B. Question

How much electric energy in kWh is consumed by an electrical appliance of 1000 watts when it is switched on for 60 minutes?

Answer

Power = 1000 watt (1KW);

Time = 60 min = 1 hr

Energy = P × t = 1000 × 1h = 1000 Wh = 1 KWh

34 A. Question

Derive the relation between commercial unit of energy (kWh) and SI unit of energy (joule).

Answer

The relation between commercial unit of energy (kWh) and SI unit of energy (joule) is-

1kWh = 1000 W × 1h.

1 watt = 1 joule/1 sec

= 1000 × 60 × 60

= 3.6×10^6J

34 B. Question

A certain household consumes 650 units of electricity in a month. How much is this electricity in joules?

Answer

Energy equal to one kwh is termed as one unit.

So 650 units equal to 650 kwh.

Now 1 kwh = 3.6×10^6

So,

650kwh = $650 \times 3.6 \times 10^6$

= 2340×10^6

35 A. Question

Define power. Give the SI unit of power.

Answer

Power is the rate of doing work. It is equivalent to an amount of energy consumed per unit time. In the SI system, the unit of power is the joule per second (J/s), known as the watt in honor of James Watt, the eighteenth-century developer of the steam engine.

1 Watt is the power of an object which does work at the rate of 1 Joule per second.

35 B. Question

A boy weighing 40 kg carriers a box weighing 20 kg to the top of a building 15 m high in 25 seconds. Calculate the power. (g = 10 m/s^2)

Answer

Given,

Mass of boy = 40Kg

Mass of box = 20 kg

Total mass = 40 + 20 = 60kg

g = $10m/s^2$

h = 15m

t = 25 sec

Power = mgh/t

=$60 \times 10 \times 15/ 25$

= 360 W

Power = 360 W

Multiple Choice Questions (MCQs)-Pg-164

36. Question

When an object falls freely towards the earth, then its total energy:

A. Increases B. Decreases

C. Remains constant

D. First increases and then decreases

Answer

Since, According to Law of Conservation of energy, Energy can neither be created nor be destroyed but can be only transformed from one form to another.

37. Question

Which one of the following is not the unit of energy?

A. Joule B. Newton-metre

C. Kilowatt D. Kilowatt-hour

Answer

Since, Kilowatt is the unit of Power.

38. Question

Which of the following energy change involves frictional force?

A. Chemical energy to heat energy

B. Kinetic energy to heat energy

C. Potential energy to sound energy

D. Chemical energy to kinetic energy

Answer

Heat Energy is the manifestation of the energy in the form of heat and the kinetic energy that it posses due to its motion.

39. Question

Which one of the following statements about power stations is not true?

A. Hydroelectric power stations use water to drive turbines

B. In a power station, turbines drive generators

C. Electricity from thermal power stations differs from that produced in hydroelectric power stations

D. In hydroelectric power stations and thermal power stations, alternators produce electricity.

Answer

Since, we produce electricity is same in both the cases.

40. Question

An electric motor raises a load of 0.2 kg, at a constant speed, through a vertical distance of 3.0 m in 2 s. If the acceleration power stations and thermal power stations, alternators produce electricity

A. 0.3 B. 1.2

C. 3.0 D. 6.0

Answer

Since, Power = $\frac{Work\ done}{time} = \frac{mgh}{t}$

$= \frac{(0.2*10*3)}{2} = 3.0$

41. Question

An object is falling freely from a height x. After it has fallen a height, it will possess :

A. Only potential energy

B. Only kinetic energy

C. Half potential and half kinetic energy

D. Less potential and more kinetic energy

Answer

According to Law of Conservation of Energy. When the object will reach to half height it would have Potential Energy equal to that of Kinetic Energy.

42. Question

The commercial unit of energy is:

A. Watt B. Watt-hour

C. Kilowatt-hour D. Kilowatt

Answer

SI unit of energy is Joule.

Commercial unit of energy is KWh

1 KWh = 1 kW * 1 h

= 1000 W * 3600 s

1 watt – second = 1 Joule

1 kWh = 3600000 J

43. Question

How much energy does a 100 W electric bulb transfer in 1 minute?

A. 100 J B. 600 J

C. 3600 J D. 6000 J

Answer

Since, Energy = Power * Time

= 100 * 60 = 6000 J

44. Question

The device which converts mechanical energy into energy which runs our microwave oven is:

A. Electric motor

B. Alternator

C. Turbine

D. Electric heater

Answer

Since, Alternator is a device which converts mechanical energy into electrical energy.

45. Question

A microphone converts:

A. Electrical energy into sound energy in ordinary telephone

B. Microwave energy into sound energy in a mobile phone

C. Sound energy into mechanical energy in a stereo system

D. Sound energy into electrical energy in public address system

Answer

Since, it catches our sound and sends it converting into the electrical form to the device connected.

Questions Based on High Order Thinking Skills (HOTS)-Pg-164

46. Question

The following data was obtained for a body of mass 1 kg dropped from a height of 5 metres:

Distance above ground Velocity

5 m/s 0 m/s

3.2 m 6 m/s

0 m 10 m/s

Show by calculations that the above data verifies the law of conservation of energy (Neglect air resistance). ($g = 10\ m/s^2$)

Answer

Given: $g = 10 m/s^2$

Mass, m = 1 kg

h = 5m, v = 0 m/s

Case 1: Kinetic Energy, K.E. $= \frac{1}{2} mv^2 = \frac{1}{2} * 1 * 0 = 0$

Potential Energy, P.E. = m * g * h = 1 * 10 * 5 = 50J

Total Energy = P.E. + K.E. = 50 + 0 = 50J

Case 2: h = 3.2

v = 6 m/s

K.E. $= \frac{1}{2} mv^2 = \frac{1}{2} * 1 * (6)^2 = 18J$

P.E. = m * g * h = 1 * 10 * 3.2 = 32J

Total Energy = P.E. + K.E. = 32 + 18 = 50J

Case 3: h = 0

v = 10 m/s

K.E. $= \frac{1}{2} mv^2 = \frac{1}{2} * 1 * (10)^2 = 50J$

P.E. = m * g * h = 1 * 10 * 0 = 0J

Total Energy = P.E. + K. E. = 50 + 0 = 50J

Since, the total energy is equal in all the three cases.

Hence, the above data verifies the Law of Conservation of Energy.

47. Question

A ball falls to the ground as show2n below:

A potential energy = 80 J

Kinetic energy = 0

B Kinetic energy = 48 J

C = potential energy = 0

(a) What is the kinetic energy of ball when it hits the ground?

(b) What is the potential energy of ball at B?

(c) Which law you have made use of in answering this question?

Answer

a) The kinetic energy of ball when it hits the ground will be equal to the potential energy of the ball when it was about to be made to fall. Hence, the kinetic energy will be 80J.

b) The potential energy of ball at position B will be,

PE= 80 - 48

= 32J

c) With the help of law of conservation of energy which states that energy can neither be created not be destroyed but can only be changed from one form to another, the above answers can be found. Since, the total energy will remain constant in all the three given stages.

48. Question

In an experiment to measure his power, a student records the time taken by him in running in a flight of steps on a staircase. Use the following data to calculate the power of the student:

Number of steps = 28

Height of each step = 20 cm

Time taken = 5.4 s

Mass of student = 55 kg

Acceleration = 9.8 m s^{-2}

Due to gravity

Answer

Number of steps = 28

Height of each step = 20 cm

Total height of student = 28 * 20 = 560 cm

= 5.6 m

Time, t = 5.4 sec

Mass of student, m = 55kg

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

Power = $\frac{Work\ done}{Time} = \frac{mgh}{t}$

= $\frac{55*9.8*5.6}{5.4}$ = 559W (approx)

49. Question

In loading a truck, a man lifts boxes of 100 N each through a height of 1.5 m.

(a) How much work does he do in lifting one box?

(b) How much energy is transferred when one box is lifted?

(c) If the man lifts 4 boxes per minute, at what is he working? (g = 10 m s^{-2})

Answer

(a) Mass, m = 100N = 10 kg

Height, h = 1.5 m

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

Work done = mgh

= 10 * 1.5 * 10 = 150J

(b) Potential energy = mgh = 10 * 1.5 * 10 = 150J

(c) Rate at which he is working = $\frac{4*Work\ done\ for\ 1\ box}{Time\ (s)} = \frac{4*150}{60}$

= 10W

50. Question

Name the energy transfers which occur when:

(a) An electric bell rings

(b) Someone speaks into a microphone

(c) There is a picture on a television screen

(d) A torch is on

Answer

(a) Electrical energy is converted into Sound energy when an electric bell rings

(b) Sound energy is converted into Electrical energy

(c) Electrical energy is converted into light energy (and Heat energy)

(d) Chemical energy is converted into electrical energy to light energy (and Heat energy)