1. OBJECTIVE QUESTIONS

1. A body falling from a height of 10m rebounds from a hard floor. It loses 20% of energy in the impact. What is the height to which it would rise after the impact?
(a) 7m (b) 5m
(c) 8m (d) 6m

Ans : (c) 8m

$$80\% \text{ of } mgh = mgh'$$
$$\frac{80}{100} \times mgh = mgh'$$
$$h' = \frac{8}{10} \times 10 = 8m$$

2. If the angle between force and displacement is θ, then for what value of θ is work done zero?
(a) 60° (b) 45°
(c) 180° (d) 90°

Ans : (d) 90°
For $\theta = 90^\circ$, work done is zero.

3. Which of the following statements is correct regarding the relation between centripetal force and radius of the circular path?
(a) The work done by the centripetal force increases if the radius of the path is increased
(b) The work done by the centripetal force decreases by decreasing the radius
(c) The work done by the centripetal force increases by decreasing the radius
(d) The work done is always zero.

Ans : (d) The work done is always zero.
Force is perpendicular to displacement

$$W = F \times s\cos 90^\circ = 0$$

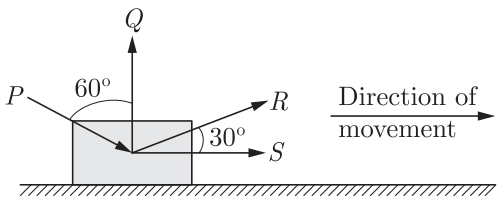
4. A man carrying a bucket of water and walking on a rough level road with a uniform velocity does no work while carrying the bucket. Which of the following statements gives the correct reason for this?
(a) The displacement of the bucket is zero.
(b) There is no force acting on the bucket.
(c) The displacement of the bucket is in the direction of force applied.
(d) There is no displacement in the direction of the force applied.

Ans : (d) There is no displacement in the direction of the force applied.
Man exerts a force in vertical upward direction (i.e., opposite to gravity) to hold the bucket and displace the bucket along the rough level road i.e., perpendicular to the direction of force applied. Also, the man is moving with uniform velocity, therefore, there is no force in the horizontal direction. Since, there is no displacement in the direction of force applied by man, hence he does no work.

5. When a force retards the motion of a body, the work done is
(a) positive (b) zero
(c) negative (d) undefined

Ans : (c) negative

6. Four forces of equal magnitude are acting on an object as shown in figure. Which of the following forces does the least work?



(a) P (b) Q
(c) R (d) S

Ans : (b) Q
There is no work done when the force and the displacement are perpendicular to each other.
The maximum work is done when the force applied is parallel to the direction of movement.

7. In an electric flashlight the chemical energy of the cell is
(a) converted into heat energy only
(b) converted into light energy only
(c) converted first into light and then heat energy
(d) converted first into heat and then light energy

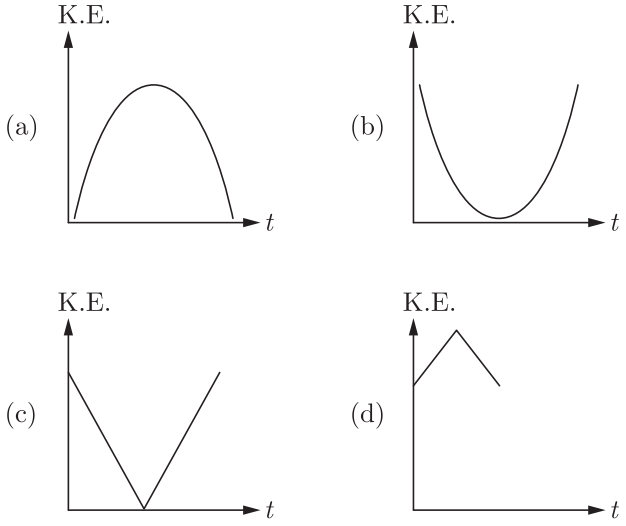
Ans : (d) converted first into heat and then light energy
It is heat energy which changes into light energy and not vice-versa.

8. Which of the following is not an example of potential energy?
(a) Water stored in a dam.
(b) A stretched bow and arrow system.
(c) A dog chasing a hare.

(d) A stone lying on the top of a roof.

Ans : (c) A dog chasing a hare.
When the dog chases a hare, it possesses K.E. on account of its motion.

9. A cricket ball is projected vertically upward such that it returns back to the thrower. The variation in kinetic energy with time is best represented by



Ans : (a)
When the ball rises up its K.E. decreases, till it becomes zero. On falling down its K.E. increases.

10. In which of the following cases is the potential energy of a spring minimum?
(a) When it is compressed
(b) When it is extended
(c) When it is at its natural length
(d) When it is at its natural length but is kept at a height h above the ground.

Ans : (c) When it is at its natural length

11. Potential energy of a person is maximum when
(a) person is sitting on a chair
(b) person is standing
(c) person is lying on the ground
(d) person is sitting on the ground

Ans : (b) person is standing
Greater the height of mass of the body above the ground, greater is the potential energy as P.E. $= mgh$.

12. The unit of work is joule. The other physical quantity that has same unit is
(a) power (b) velocity
(c) energy (d) force

Ans : (c) energy

13. A steam engine has an efficiency of 20%. It is given an energy of 1000 cal per min. What is the actual work done by it in calories and in joule?
(a) 100 cal, 800 J (b) 200 cal, 840 J
(c) 10 cal, 80 J (d) 100 cal, 100 J

Ans : (b) 200 cal, 840 J

$$\frac{20}{100} = \frac{W}{1000} = 200 \text{ cal}$$

or $200 \times 4.2 = 840 \text{ J}$

14. Watt second represents the unit of
(a) energy (b) power
(c) force (d) none of these

Ans : (a) energy

15. A man carries a suitcase in his hand climbs up the stairs. The work done by the man is
(a) positive (b) negative
(c) zero (d) none of the above

Ans : (a) positive
The displacement takes place in the direction of force.

16. If force and displacement of the particle (in direction of force) are doubled, work should be
(a) doubled (b) 4 times
(c) halved (d) 1/4 times

Ans : (b) 4 times

17. One kilowatt is approximately equal to
(a) 1.34 hp (b) 1.56 hp
(c) 2.50 hp (d) 1.83 hp

Ans : (a) 1.34 hp

$$1 \text{ hp} = 0.746 \text{ kW}$$

or $$1 \text{ kW} = \frac{1}{0.746} \text{ hp}$$

$$= 1.34 \text{ hp}$$

18. A body rolls down on inclined plane, it has
(a) only kinetic energy
(b) only potential energy
(c) both kinetic energy and potential energy
(d) neither kinetic energy nor potential energy

Ans : (c) both kinetic energy and potential energy

19. A ball is thrown upward from a point P, reaches the highest point Q.
(a) kinetic energy at P is equal to kinetic energy at Q
(b) potential energy at P is equal to kinetic energy at Q
(c) kinetic energy at P is equal to potential energy at Q
(d) potential energy at P is equal to potential energy at Q

Ans : (c) kinetic energy at P is equal to potential energy at Q
Initially the ball has K.E. which changes to P.E. at the height. As the energy is always conserved therefore, K.E. at p is equal to P.E. at Q.

20. Kinetic energy of a body depends
(a) on its mass only
(b) on its velocity only
(c) on its mass as well as on its velocity

(d) neither on its mass nor on its velocity

Ans : (c) on its mass as well as on its velocity
Kinetic energy of a body depends on its mass as well as on its velocity, i.e.,

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

21. A boy has four options to move a body through 3m as indicated below
(a) Push over an inclined plane
(b) lift vertically upwards
(c) Push over smooth rollers
(d) Push on a plane horizontal surface. In which case is maximum work done?

Ans : (b) lift vertically upwards

22. A rocket rises up vertically. What happens to its potential energy?
(a) It increases.
(b) It initially increases then decreases.
(c) It initially decreases then increases.
(d) It increases, till it becomes maximum.

Ans : (d) It increases, till it becomes maximum.
P.E. goes on increases till the rocket stops rising.

23. A rocket rises up in air due to the force generated by the fuel. The work done by the
(a) fuel is negative work and by force of gravity is positive work
(b) fuel is positive work and by force of gravity is negative work
(c) both fuel and force of gravity do positive work
(d) both fuel and force of gravity do negative work

Ans : (b) fuel is positive work and by force of gravity is negative work
As the rocket moves in the direction of force generated by fuel, therefore it is positive work. As the force of gravity acts in the direction opposite to the displacement, therefore, it is negative work.

24. Two boys A and B lift 100 bricks through the same height in 5 minutes and 6 minutes respectively. Then
(a) A has more power than B
(b) B has more power than A
(c) both have same power
(d) data insufficient

Ans : (a) A has more power than B
The rate of doing work of A is more than B because power is inversely proportional to time.

25. A stretched spring possesses
(a) kinetic energy
(b) elastic potential energy
(c) electrical energy
(d) magnetic energy

Ans : (b) elastic potential energy

26. Which of the following statements is true about work done?
1. Work done by a force is always positive.
2. SI unit of work is joule.
3. Work has both, magnitude and direction.
4. Work is said to be done if an object is displaced when a force acts on it.

(a) 1 and 2 (b) 2 and 3
(c) 2 and 4 (d) 1, 2, 3 and 4

Ans : (c) 2 and 4
Work done by a force can be negative, positive or zero, depending upon the direction of force applied.

Work is a scalar quantity. It has magnitude but no direction.

27. Which one of the following is not the measure of energy?
(a) kWh (b) erg
(c) Ws (d) Js

Ans : (d) Js
Js is not a unit of energy.

28. When the speed of a particle is doubled, the ratio of its kinetic energy to its momentum
(a) remains the same (b) gets doubled
(c) becomes half (d) becomes four times

Ans : (b) gets doubled

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

$$\Rightarrow \quad K.E._1 = \frac{1}{2}m \times (2v)^2$$

$$= 4 \times \frac{1}{2}mv^2 = 4E$$

$$p = mv$$

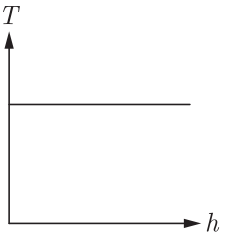
$$\Rightarrow \quad p_1 = m \times 2v$$

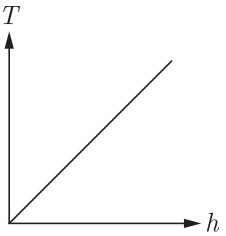
$$\Rightarrow \quad p_1 = 2mv = 2p$$

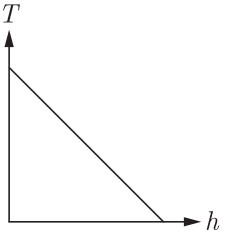
$$\frac{K.E._1}{p_1} = \frac{4E}{2p} = 2\left(\frac{K.E.}{p}\right)$$

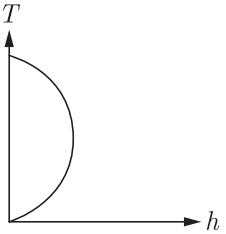
$\Rightarrow$ ratio of K.E. to momentum becomes doubled.

29. Which of the following graph best represents the total energy (T) of a freely falling body and its height (h) above the ground?

(a)


(b)


(c)


(d)


Ans : (a)

Total energy remains the same.

30. If a body is raised through height h on the surface of earth and the energy spent is E, then for the same amount of energy the body on the surface of moon will rise through the height of

(a) 2h (b) 6h

(c) 4h (d) 12h

Ans : (b) 6h

g on moon is 6 times less. Thus, for the same energy the body will rise up by 6h.

2. FILL IN THE BLANK

DIRECTION : Complete the following statements with an appropriate word/term to be filled in the blank space(s).

1. Energy is a _____ quantity.

Ans : Scalar

2. The work done in holding 15 kg suitcase while waiting for a bus for 15 minute is _____

Ans : zero

3. Work done by a force is maximum when angle between force and displacement is _____

Ans : 0°

4. Two bodies of masses m_1 and m_2 have equal moments. Their kinetic energies are in the ratio _____.

Ans : $\frac{m_2}{m_1}$

5. The energy possessed by the body due to its _____ is called kinetic energy.

Ans : motion

6. When angle between force and displacement is obtuse, work done by the force is _____

Ans : negative

7. The work done by the external force on a system equals the change in _____ energy.

Ans : Total

8. _____ energy can never be negative

Ans : kinetic

9. One horse power = _____ watt.

Ans : 746

10. An electric motor exerts a force of 40N on a cable and pulls it through a distance of 30m in one minute. the power supplied by the motor in watts is _____

Ans : 20

11. Watt second is a unit of _____

Ans : energy

12. A one kilogram mass has a kinetic energy of one joule when its speed is _____ meter/sec.

Ans : $\sqrt{2}$

13. Energy stored in an elongated rubber is _____

Ans : Potential energy

14. A truck and a car moving with the same kinetic energy are brought to rest by the application of brakes which provide equal retarding forces. The distance moved by the truck, in coming to rest, will then be _____ the distance moved by car.

Ans : the same

3. TRUE/FALSE

DIRECTION : Read the following statements and write your answer as true or false.

1. No work is done on a particle which remains at rest.

Ans : True

2. A body cannot have momentum when its energy is zero.

Ans : True

3. A man rowing a boat up stream is at rest with respect to the shore, is doing no work.

Ans : True

4. The total energy of a body in motion is equal to the work it can do in being brought to rest.

Ans : False

5. A man carrying a bucket of water, walking on a level road with a uniform velocity does no work.

Ans : True

6. Work is always done on a body when it experiences an increase in energy through a mechanical influence.

Ans : True

7. Work done by conservative forces is equal to increase in potential energy.

Ans : False

8. Work done by the resultant force is always equal to change in kinetic energy.

Ans : True

9. Gravitational force is non-conservative.

Ans : False

10. A light and a heavy body, having equal momenta, have equal kinetic energies.

Ans : False

11. Work done by conservative force in round trip is zero.
Ans : True

12. Work done in the motion of a body over a closed loop is zero for every force in nature.
Ans : False

13. Work done by friction can-never be positive.
Ans : False

14. More work is done in compressing a litre of air than a litre of water from a pressure of one atmosphere to three atmospheres.
Ans : True

15. Kinetic energy of a body depends upon the direction of motion.
Ans : False

4. MATCHING QUESTIONS

DIRECTION : In the section, each question has two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (a), (b), (c) and (d) out of which one is correct.

1.

List-I		List-II	
(P)	Kinetic energy	(1)	mgh
(Q)	Power	(2)	$\frac{1}{2}mv^2$
(R)	Potential energy	(3)	mv
(S)	Momentum	(4)	W/t

	P	Q	R	S
(a)	2	4	1	3
(b)	3	2	4	1
(c)	3	4	2	1
(d)	1	4	3	2

Ans : (a) P-2, Q-4, R-1, S-3

2.

List-I		List-II	
(P)	Potential energy to sound energy	(1)	A cracker bursts
(Q)	Chemical energy to heat, light and sound energy	(2)	A duster falling from a table.
(R)	Kinetic energy to sound energy	(3)	A container filled with marbles is shaken.
(S)	Kinetic energy to heat energy	(4)	Rubbing of hands

	P	Q	R	S
(a)	1	2	3	4
(b)	3	2	4	1
(c)	3	4	2	1
(d)	2	1	3	4

Ans : (d) P-2, Q-1, R-3, S-4

3.

List-I		List-II	
(P)	Joule	(1)	Power
(Q)	Watt	(2)	1hp
(R)	1 kWh	(3)	Energy
(S)	746W	(4)	3.6×10^6J

	P	Q	R	S
(a)	1	2	3	4
(b)	3	2	4	1
(c)	3	1	4	2
(d)	1	4	3	2

Ans : (c) P-3, Q-1, R-4, S-2

4.

List-I		List-II	
(P)	Mass of 1 kg, pulled through 1m horizontally, force applied 8N	(1)	Work done = 0
(Q)	Suitcase on head, person moves upstairs	(2)	Work done =mghJ
(R)	No component of force in the direction of motion	(3)	$Fs\cos\theta$
(S)	Work done	(4)	Work done =8 J

	P	Q	R	S
(a)	1	2	3	4
(b)	4	2	1	3
(c)	3	4	2	1
(d)	1	4	3	2

Ans : (b) P-4, Q-2, R-1, S-3

5.

List-I		List-II	
(P)	Force	(1)	kg m^2s^{-2}
(Q)	Work	(2)	kg m s^{-1}
(R)	Momentum	(3)	kg m^2s^{-3}
(S)	Power	(4)	kg m s^{-2}

	P	Q	R	S
(a)	4	1	2	3
(b)	3	2	4	1
(c)	3	4	2	1
(d)	1	4	3	2

Ans : (a) P-4, Q-1, R-2, S-3

5. ASSERTION AND REASON

DIRECTION : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

1. **Assertion :** A crane P lifts a car up to a certain height in 1 min. Another crane Q lifts the same car up to the same height in 2 min. Then crane P consumes two times more fuel than crane Q.
Reason : Crane P supplies two times more power than crane Q.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
Since power is inversely proportional to time, crane P supplies more power.

2. **Assertion :** Work done by or against gravitational force in moving a body from one point to another is independent of the actual path followed between the two points.
Reason : Gravitational forces are conservative forces.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
From, definition, work done in moving a body against a conservative force is independent of the path followed.

3. **Assertion :** The work done during a round trip is always zero.
Reason : No force is required to move a body in its round trip.

Ans : (d) Both Assertion and Reason are false.
The work done by a non-conservative force in a round trip is not zero. Since the body moves, there must be force acting on the body.

4. **Assertion :** Graph between potential energy of spring versus the extension or compression of the spring is a straight line.
Reason : Potential energy of a stretched or compressed spring, is directly proportional to square of extension or compression.

Ans : (d) Assertion is false but reason is true.

Potential energy $(u) = \frac{1}{2}kx^2$

i.e. $u \propto x^2$

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

5. **Assertion :** Watt hour has units of energy.
Reason : Kilowatt hour (kW h) is the unit of electric power.

Ans : (c) Assertion is true but reason is false.
Kilowatt (1000 watt) is the unit of power. Kilowatt hour is the power consumed in one hour = power × time = energy. One watt is equal to Joule per second. Hence, watt × time has units of energy.

6. **Assertion :** The work done during a round trip is always zero.
Reason : No force is required to move a body in its round trip.

Ans : (c) Assertion is true but reason is false.
This is typically true only in the special case of conservative force work but need not be true if F is not conservative.

7. **Assertion :** The kinetic energy, with any reference, must be positive.
Reason : In the expression for kinetic energy, the velocity appears with power 2 and mass is a scalar quantity.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.

8. **Assertion :** The change in kinetic energy of a particle is equal to the work done on it by the net force.
Reason : Change in kinetic energy of particle is equal to the work done only in case of a system of one particle.

Ans : (c) Assertion is true but reason is false.
Work done on the body in order to increase its velocity v_1 to v_2 is given by,

$$dW = \int_{v_1}^{v_2} F ds = \int_{v_1}^{v_2} m\frac{dv}{dt} ds$$

$$= \int_{v_1}^{v_2} m\left(\frac{ds}{dt}\right) dv = \int_{v_1}^{v_2} mv dv$$

$$= m\left[\frac{v^2}{2}\right]_{v_1}^{v_2} = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$$

Thus, work done by a force acting on a body is equal to change in kinetic energy of the body. This is true for a system containing any number of particles.

9. **Assertion :** A crane P lifts a car upto a certain height in 1 min. Another crane Q lifts the same car upto the same height in 2 min. Then crane P consumes two times more fuel than crane Q.
Reason : Crane P supplies two times more power than crane Q.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
Since, power is inversely proportional to time, crane P supplies more power.

10. **Assertion :** A light body and heavy body have same

momentum. Then they also have same kinetic energy.
Reason : Kinetic energy depends on mass of the body.

Ans : (d) Assertion is false but reason is true.
Kinetic energy of a body of mass m_1,

$$k_1 = \frac{1}{2}mv_1^2 = \frac{p_1^2}{2m_1}$$

Again, kinetic energy of a body of mass m_2,

$$k_2 = \frac{1}{2}m_2v_2^2 = \frac{p_2^2}{2m_2}$$

If $$p_1 = p_2, \frac{K_1}{K_2} = \frac{m_2}{m_1}$$

As given $m_2 > m_1$
Therefore, $K_1 > K_2$ i.e. the kinetic energy of light body will be more than the kinetic energy of heavy body when both have same momentum.

11. **Assertion :** A spring has potential energy, both when it is compressed or stretched.
Reason : In compressing or stretching, work is done on the spring against the restoring force.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
The work done on the spring against the restoring force is stored as potential energy in both cases, when it is compressed or stretched.

12. **Assertion :** A spring has potential energy, both when it is compressed or stretched.
Reason : In compressing or stretching, work is done on the spring against the restoring force.

Ans : (a) if both assertion and reason are true and reason is the correct explanation of assertion.
When spring is compressed or stretched, the work is done on the spring. Due to this work, the energy gets stored in it as elastic potential energy.

13. **Assertion :** Work done by the gravitational force through a certain distance is constant irrespective of the fact that the body has a uniform or accelerated motion.
Reason : Gravitational force is a conservative force.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
Work done by the gravitational force is mgh.

14. **Assertion :** When the force retards the motion of a body, the work done is negative.
Reason : Work done depends on angle between force and displacement.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
When the force retards the motion, the force and displacement are in opposite directions to each other. Hence, the work done by the force is negative.

15. **Assertion :** According to law of conservation of mechanical energy, change in potential energy is equal and opposite to the change in kinetic energy.
Reason : Mechanical energy is not a conserved quantity.

Ans : (c) Assertion is true but reason is false.
For conservative forces the sum of kinetic and potential energies at any point remains constant throughout the motion. It does not depend upon time. This is known as law of conservation of mechanical energy. According to this rule.
Kinetic energy + Potential energy = E = constant

16. **Assertion :** The kinetic energy, with any reference, must be positive.
Reason : It is because, in the expression for kinetic energy, the velocity appears with power 2 and mass is a scalar quantity.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.

17. **Assertion :** A winded toy car, when placed on floor, starts moving.
Reason : Toy car has kinetic energy stored in it which facilitates its motion.

Ans : (c) Assertion is true but reason is false.
When a toy car is winded, work done on it gets stored in the form of elastic potential energy and when it is placed on the ground, this elastic potential energy slowly converts into kinetic energy of the toy and facilitates its motion.

18. **Assertion :** Work done by or against gravitational force in moving a body from one point to another is independent of the actual path followed between the two points.
Reason : Gravitational forces are conservative forces.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
From, definition, work done in moving a body against a conservative force is independent of the path followed.

19. **Assertion :** When the force retards the motion of a body, the work done is zero.
Reason : Work done depends on angle between force and displacement.

Ans : (d) Assertion is false but reason is true.
Work done, $W = \vec{F}.\vec{s}$ For retarding, the force $\vec{F}$ should be inclined to $\vec{s}$ at angle θ such that $\frac{\pi}{2} < \theta < \pi$. For this angle $\cos\theta$ is negative, so work done is negative. Here negative work done implies that some external force is applied to change the state of a body.

20. **Assertion :** No work is done when a woman carrying a load on her head, walks on a level road with a uniform velocity.
Reason : No work is done if force is perpendicular to the direction of displacement.

Ans : (a) Both assertion and reason are true and reason is the correct explanation of assertion.
Work done $W = \vec{F} \cdot \vec{ds} = F\,ds\cos\theta = 0$ when $\theta = 90^\circ$. No work is done when force is normal to the displacement.