

Force and Laws of Motion

1. OBJECTIVE QUESTIONS

1. Identify the correct statement(s).

- To accelerate the motion of an object, a balanced force is required.
 - Balanced forces do not change the state of rest or of motion of an object.
 - Balanced forces do not produce any acceleration, they can change the shape or size of the body.
- (a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) None of these

Ans : (b) 2 and 3

To accelerate the motion of an object, an unbalanced force is required.

2. A cannon after firing recoils due to

- (a) conservation of energy
(b) backward thrust of gases produced
(c) Newton's third law of motion
(d) Newton's first law of motion

Ans : (c) Newton's third law of motion

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3. A number of forces acting on a body changes velocity of the body. The forces cannot be

- (a) paralleled (b) unbalanced
(c) balanced (d) inclined

Ans : (c) balanced

When a number of forces acting on a body change velocity of body, they produce a non zero acceleration, the forces are unbalanced, parallel and inclined.

4. If a body is moving alone a constant speed, it may be assumed that

- (a) a net force is pushing it forward
(b) the sum of only vertical forces is zero
(c) the buoyant force is greater than gravity
(d) the sum of all forces is zero

Ans : (d) the sum of all forces is zero

5. Galileo's law of inertia is another name for Newton's law of motion.

- (a) first (b) third
(c) second (d) none of these

Ans : (a) first

6. A rider on horse falls back when horse starts running, all of a sudden because

- (a) rider is taken back

(b) rider is suddenly afraid of falling

(c) inertia of rest keeps the upper part of body at rest while lower part of the body moves forward with the horse

(d) none of the above

Ans : (c) inertia of rest keeps the upper part of body at rest while lower part of the body moves forward with the horse

7. If A and B are two objects with masses 6 kg and 34 kg respectively, then

- (a) A has more inertia than B
(b) B has more inertia than A
(c) A and B have same inertia
(d) none of the two has inertia.

Ans : (b) B has more inertia than A
Mass is a measure of inertia.

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8. Swimming is possible on account of

- (a) First law of motion
(b) Second law of motion
(c) Third law of motion
(d) Newton's law of gravitation

Ans : (c) Third law of motion

9. The inertia of a moving object depends on

- (a) momentum of the object
(b) speed of the object
(c) mass of the object
(d) shape of the object

Ans : (c) mass of the object

10. Newton's third law is equivalent to the

- (a) law of conservation of linear momentum
(b) law of conservation of angular momentum
(c) law of conservation of energy

(d) law of conservation of energy and mass

Ans : (a) law of conservation of linear momentum

11. The momentum of a body of given mass is proportional to its

- (a) velocity (b) size
(c) shape (d) all of these

Ans : (a) velocity

As $p = mv$, for given mass $p \propto v$

12. A man is at rest in the middle of a pond on perfectly smooth ice. He can get himself to the shore by making use of Newton's

- (a) first law (b) second law
(c) third law (d) all the laws

Ans : (c) third law

13. Newton's second law of motion gives us a measure of

- (a) force (b) inertia
(c) mass (d) acceleration

Ans : (a) force

Newton's second law of motion gives us a measure of force.

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14. A body, whose momentum is constant, must have constant

- (a) force (b) velocity
(c) acceleration (d) all of these

Ans : (b) velocity

For a given mass, $p \propto v$. If the momentum is constant then its velocity must be constant.

15. The momentum of an object at a given instant is independent of its

- (a) inertia (b) mass
(c) velocity (d) acceleration

Ans : (d) acceleration

The momentum of a body is the product of its mass and its velocity at that instant. The momentum of an object at a given instant is independent of its acceleration.

16. Read the given statements and select the correct option.

Statement 1 : The forces of action and reaction always appear due to actual physical contact of two bodies.

Statement 2 : A particle can move only under the action of a force.

- (a) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
(b) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
(c) Statement 1 is true but statement 2 is false.
(d) Both statements 1 and 2 are false.

Ans : (d) Both statements 1 and 2 are false.

There is no need of actual physical contact of two bodies for the forces of action and reaction to appear. Suppose if two bodies are separated by some distance and the first body is attracting the second body by a

gravitational force F_1 then the second body will also attract the first body with the same gravitational force.

If a particle is moving with constant speed it will continue to move with that speed until an external force is applied.

17. A body is accelerating in a straight line. The unbalanced force acts

- (a) in the direction of motion of the body.
(b) in a direction opposite to the direction of motion.
(c) in a direction perpendicular to the direction of motion of the body.
(d) none of these

Ans : (a) in the direction of motion of the body.

When a body is accelerating in a straight line, the unbalanced force acts in the direction of motion of the body.

18. A man getting down a running bus, falls forward because

- (a) due to inertia of rest, road is left behind and man reaches forward
(b) due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road
(c) he leans forward as a matter of habit.
(d) of the combined effect of all the three factors stated in (a), (b) and (c)

Ans : (b) due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road

19. A man is standing on a boat in still water. If he walks towards the shore the boat will

- (a) move away from the shore
(b) remain stationary
(c) move towards the shore
(d) sink

Ans : (a) move away from the shore

According to Newton's third law, the boat will move away from the shore.

20. Choose the correct statement(s).

- (a) Action and reaction forces act on same object.
(b) Action and reaction forces act on different objects.
(c) Both a and b are possible.
(d) Neither a nor b is correct.

Ans : (b) Action and reaction forces act on different objects.

Action and reaction forces act on different objects.

21. A cannon after firing recoils due to

- (a) conservation of energy
(b) Newton's third law of motion
(c) Newton's first law of motion
(d) none of these

Ans : (b) Newton's third law of motion

A cannon after firing recoils due to Newton's third law of motion.

22. A body at rest explodes into two equal parts. Then
- they move with different speeds in different directions
 - they move with different speeds in same direction
 - they move with same speed in same direction
 - they move with same speed in opposite directions

Ans : (d) they move with same speed in opposite directions

Due to conservation of linear momentum,

$$m_1 v_1 + m_2 v_2 = 0$$

$$v_1 = -v_2$$

(as $m_1 = m_2$)

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23. When a body is stationary
- There is no force acting on it
 - The force acting on it not in contact with it
 - The combination of forces acting on it balances each other
 - The body is in vacuum

Ans : (c) The combination of forces acting on it balances each other

24. Two bodies of equal masses (m) moving with equal speed (V) in opposite directions collide and stick to each other. The resultant velocity of the combination is
- V
 - $2V$
 - $-V$
 - zero

Ans : (d) zero
Applying principle of conservation of momentum,

$$(m + m) V = mv + m(-v) = 0$$

or $V = 0$

25. The speed of a falling body increases continuously, this is because
- no force acts on it
 - It is very light
 - the air exert the frictional force
 - the earth attract it

Ans : (d) the earth attract it

26. If an object is in a state of equilibrium
- It is at rest
 - It is in motion at constant velocity
 - It is in free fall
 - may be more than one of the above

Ans : (d) may be more than one of the above

27. An unbalanced force acts on a body. The body
- must remain in same state
 - must move with uniform velocity
 - must be accelerated
 - must remain at rest

(d) must remain at rest

Ans : (c) must be accelerated

When unbalanced force acts on a body, the body will be accelerated.

28. A hockey player pushes the ball on the ground. It comes to rest after travelling certain distance because
- the player stops pushing the ball.
 - balanced force acts on the ball.
 - the opposing force acts on the ball.
 - none of these

Ans : (c) the opposing force acts on the ball.
The opposing force of friction acts on the ball.

29. The Newton's laws of motion are valid in
- inertial frames
 - non-inertial frames
 - rotating frames
 - accelerated frames

Ans : (a) inertial frames

30. Which of the following has the largest inertia?
- Pin
 - An ink pot
 - Pen
 - Our body

Ans : (d) Our body
Out of the four choices, our body is the heaviest. Hence, it has the largest inertia.

31. How much force acts on a body whose momentum (P) is constant with time (t)?
- Zero
 - $p/2t$
 - $2p/t$
 - None of these

Ans : (a) Zero
Force is the rate of change of momentum. So, momentum is constant when force is zero.

32. When we jump out a boat standing in water it moves
- forward
 - backward
 - side ways
 - none of the above

Ans : (b) backward

33. A football has lesser inertia than a stone of the same size because
- football has more air inside than the stone
 - football has less air inside than the stone
 - football has less mass than the stone
 - football has more mass than the stone

Ans : (c) football has less mass than the stone
Massive object has more inertia. Hence, inertia of stone is more than that of a football of same size.

34. A parrot is sitting on the floor of a closed glass cage which is in a boy's hand. If the parrot starts flying with a constant speed, the boy will feel the weight of the cage as
- unchanged
 - reduced
 - increased
 - nothing can be said

Ans : (a) unchanged

2. FILL IN THE BLANK

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

1. is equal to change in momentum.
Ans : impulse
 2. When a running car stops suddenly, the passengers are jerked
Ans : forward
 3. If there are several forces on an object, its acceleration depends on its mass and the force.
Ans : net unbalanced.
 4. is a measure of the inertia of a body.
Ans : mass
 5. The change in the velocity of an object is proportional to the applied to it.
Ans : impulse
 6. To every action, there is an and reaction.
Ans : equal, opposite
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7. In any interaction between two or more isolated objects, the total does not change.
Ans : momentum
 8. Application of a force changes the of an object.
Ans : velocity
 9. If a force of 200 newtons is required to move a wagon up a frictionless hill at constant speed the force needed to left the wagon roll downhill at constant speed is
Ans : 200 Newtons
 10. An object moving at constant speed is in a state of
Ans : equilibrium
 11. The SI unit of force is the
Ans : Newton
 12. Impulse is the product of force and
Ans : Time
 13. The change in the momentum of an object is equal to the applied to it.
Ans : impulse

3. TRUE/FALSE

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

1. Action and reaction act on the same body.
Ans : False
2. When we push our foot against the ground backwards (action), the ground exerts an equal and opposite force (reaction) on our foot which causes us to move forward.
Ans : True
3. It is easier to start motion in a lighter body than a heavier body.
Ans : True
4. The product of the mass of a body and its velocity is called inertia.
Ans : False
5. Action and reaction force acts on the same object.
Ans : False
6. Momentum is never created nor destroyed.
Ans : momentum
7. Particle is at rest, if force is zero.
Ans : False
8. A body can be in equilibrium under the action of three coplaner forces.
Ans : True
9. Particle moves in the direction of force.
Ans : False
10. If particle is initially at rest then it moves in direction of net force.
Ans : True
11. No net force acts on a rain drop falling vertically with a constant speed.
Ans : True

4. MATCHING QUESTIONS

DIRECTION : Each question contains statements given in two columns which have to be matched. Statements (A,B,C,D,E) in Column I have to be matched with statements (p,q,r,s,t) in Column II.

1.

	Column I		Column II
(A)	To every action there is equal and opposite.	(p)	Momentum
(B)	During collision, there is conservation of	(q)	Force

	Column I		Column II
(C)	Rate of change of velocity is	(r)	Reactions
(D)	Rate of change of momentum is	(s)	Acceleration
(E)	Force that opposes motion	(t)	Force of Friction

Ans : (A) (r), (B) (p), (C) (s), (D) (t), E (q)

2.

	Column I		Column II
(A)	Force	(p)	kg ms ⁻¹
(B)	Momentum	(q)	newton
(C)	Impulse	(r)	kg
(D)	Mass	(s)	ms ⁻²
(E)	Acceleration	(t)	Force × time

Ans : (A) (q), (B) p, (C) t, (D), r, (E) s

5. ASSERTION AND REASON

DIRECTION : In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, given below, mark the correct answer 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) Both Assertion and Reason are false.

1. **Assertion :** If the net external force on the body is zero, then its acceleration is zero.

Reason : Acceleration does not depend on force.

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

According to Newton's second law,

$$\text{acceleration} = \frac{\text{force}}{\text{mass}} \text{ i.e.,}$$

if net external force on the body is zero ($F = 0$), then, the acceleration of a body is also zero.

2. **Assertion :** A rocket works on the principle of conservation of linear momentum.

Reason : For two bodies system when there is a change in momentum of one body, the same change occurs in the momentum of the second body but in the opposite direction.

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

As the fuel in rocket undergoes combustion, the gases so produced leave the body of the rocket with large velocity and give upthrust to the rocket. If we assume that the fuel is burnt at a constant rate, then the rate of change of momentum of the rocket will be constant. As more and more fuel gets burnt, the mass of the rocket goes on decreasing and it leads to increase of

the velocity of rocket more and more rapidly.

3. **Assertion :** A quick collision between two bodies is more violent than a slow collision, even when the initial and the final velocities are identical.

Reason : Because the rate of change of momentum which determines the force is greater in the first case.

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

4. According to law of inertia (Newton's first law), when cloth is pulled from a table, the cloth come in state of motion but dishes remains stationary due to inertia.

Assertion : When a firefly hits a bus, each of them exerts the same force.

Reason : Firefly has more mass as compared to the windshield.

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

5. **Assertion :** Linear momentum is conserved in both elastic and inelastic collisions.

Reason : Total energy is conserved in all collisions.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

Both linear momentum and kinetic energy are conserved in elastic collisions. Linear momentum is conserved in inelastic collisions but kinetic energy is not conserved. The total energy is conserved in all collisions.

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6. **Assertion :** Force required to accelerate a mass in two perpendicular directions is never same.

Reason : The presence of g will not influence the acceleration.

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

7. **Assertion :** A quick collision between two bodies is more violent than a slow collision, even when the initial and the final velocities are identical.

Reason : The rate of change of momentum determines the force.

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

In quick collision, time of impact is small which increases the impact of force.

8. **Assertion :** While walking on ice, one should take small steps to avoid slipping.

Reason : This is because smaller steps ensure smaller friction.

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

9. **Assertion :** From Newton's second law of motion, impulse is equal to change in momentum.

Reason : Impulse and momentum have different SI units.

Ans : (d) Both Assertion and Reason are false.

As impulse is equal to change in momentum. Therefore, impulse and momentum have same SI units.

10. Assertion : Newton's third law applies to all types of forces. e.g. gravitational, electric or magnetic forces etc.

Reason : Newton's third law of motion is applicable only when bodies are in motion.

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

According to third law of motion it is impossible to have a single force out of mutual interaction between two bodies, whether they are moving or at rest. While, Newton's third law is applicable for all types of forces.

11. Assertion : A body is momentarily at rest when it reverses the direction.

Reason : A body cannot have acceleration if its velocity is zero at a given instant of time.

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

12. Assertion : When a bullet is fired from a gun, there is a forward force on the bullet and recoil of gun.

Reason : Every action has an equal and opposite reaction.

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

13. Assertion : When astronauts throw something in space, that object would continue moving in the same direction and with the same speed.

Reason : The acceleration of an object produced by a net applied force is directly related to the magnitude of the force, and inversely related to the mass of the object.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

14. Assertion : A large number of concurrent forces acting at the same point of the object, then the object will be in equilibrium, if sum of all the forces is equal to zero.

Reason : Equilibrium of a particle in mechanics refers to the situation when the net external force on the particle is non-zero.

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

15. Assertion : When we sit on a chair, our body exerts a force downward and that chair needs to exert an equal force upward or the chair will collapse.

Reason : The third law says that for every action there is an equal and opposite reaction.

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

16. Assertion : A table cloth cannot be pulled from a table without dislodging the dishes.

Reason : Newton's second law of motion gives definition of inertia.

Ans : (d) Both Assertion and Reason are false.

17. Assertion : Force exerted by the ground on the man moves him forward.

Reason : It is a reactional force.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

18. Assertion : Mass is a measure of inertia of the body

in linear motion.

Reason : Greater the mass, greater is the force required to change its state of rest or motion.

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

According to Newton's second law of motion, $a = \frac{F}{m}$ i.e., magnitude of the acceleration produced by a given force is inversely proportional to the mass of the body. Higher is the mass of the body, lesser will be the acceleration produced i.e., mass of the body is a measure of the opposition offered by the body to change a state, when the force is applied i.e., mass of a body is the measure of its inertia.

19. Assertion : Change in momentum is impulse.

Reason : Impulse is the area between (F-t) graph and time axis.

Ans : (b) Both assertion and reason are true but reason is not the correct explanation of assertion.

20. Assertion : A boy facing forward in a moving bus throws a ball straight up. At the same instant the bus begins to accelerate. The ball goes up and falls in front of the boy.

Reason : As the ball rises, velocity remains constant.

Ans : (d) Both Assertion and Reason are false.

Only the horizontal component of velocity of the ball remains unchanged. When the ball rises the vertical component of velocity keeps on decreasing. During this time the bus accelerates out under the ball. To the boy the ball appears to go over his head. The ball, therefore, falls behind him.

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