



Class: 9th

Subject: Physics

Chapter 3: Dynamics

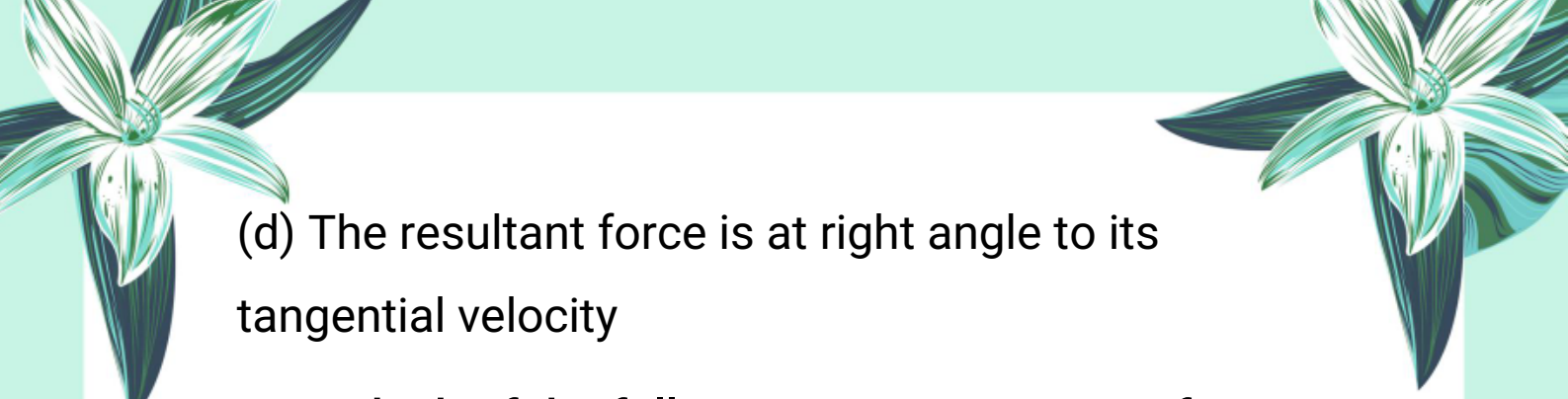
A Exercise MCQs

3.1. When we kick a stone, we get hurt. This is due to:

- (a) Inertia
- (b) Velocity
- (c) Momentum
- (d) Reaction


3.2. An object will continue its motion with constant acceleration until:

- (a) The resultant force on it begins to decrease
- (b) The resultant force on it is zero
- (c) The resultant force on it begins to increase




(d) The resultant force is at right angle to its tangential velocity

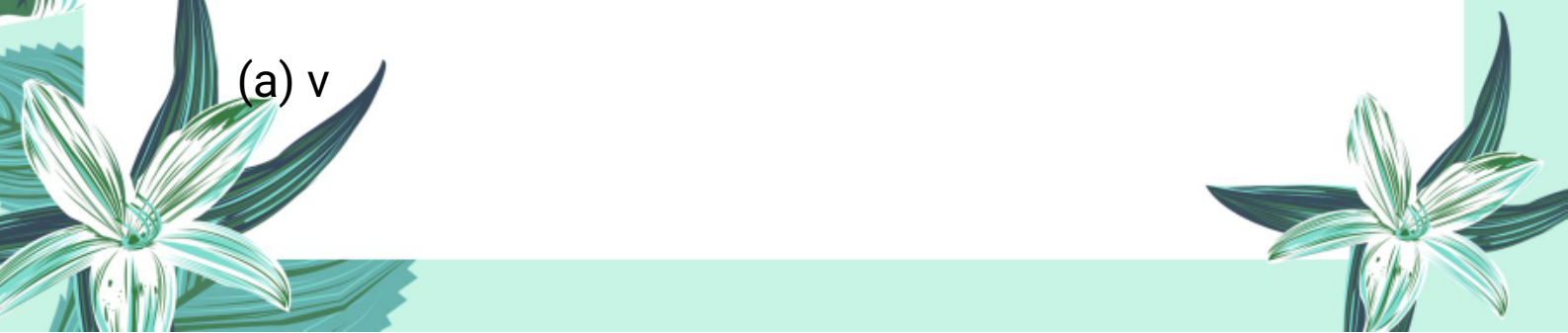
3.3. Which of the following is a non-contact force?

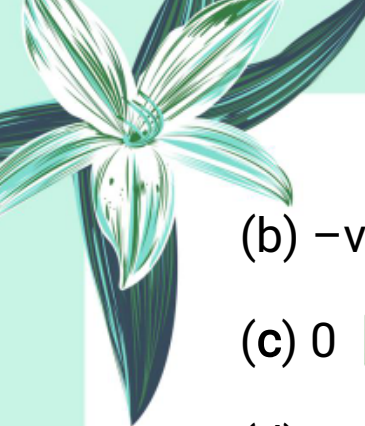
- 
- (a) Friction
 - (b) Air resistance
 - (c) Electrostatic force
 - (d) Tension in the string

3.4. A ball with initial momentum p hits a solid wall and bounces back with the same velocity. Its momentum after collision will be:

- 
- (a) p
 - (b) $-p$
 - (c) $2p$
 - (d) $-2p$

3.5. A particle of mass m moving with a velocity v collides with another particle of the same mass at rest. The velocity of the first particle after collision is:

- 
- (a) v



(b) $-v$

(c) 0

(d) $-1/2$

3.6. Conservation of linear momentum is equivalent to:



(a) Newton's first law of motion

(b) Newton's second law of motion

(c) Newton's third law of motion

(d) None of these


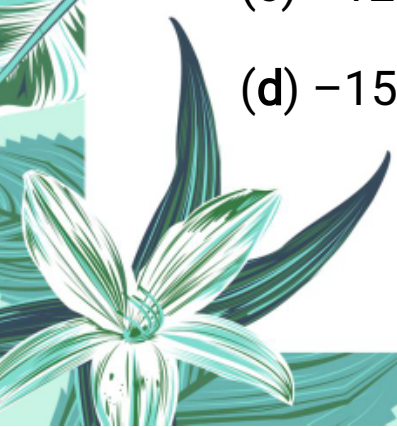
3.7. An object with a mass of 5 kg moves at constant velocity of 10 m/s. A constant force then acts for 5 seconds and gives it a velocity of 2 m/s in the opposite direction. The force acting on the object is:

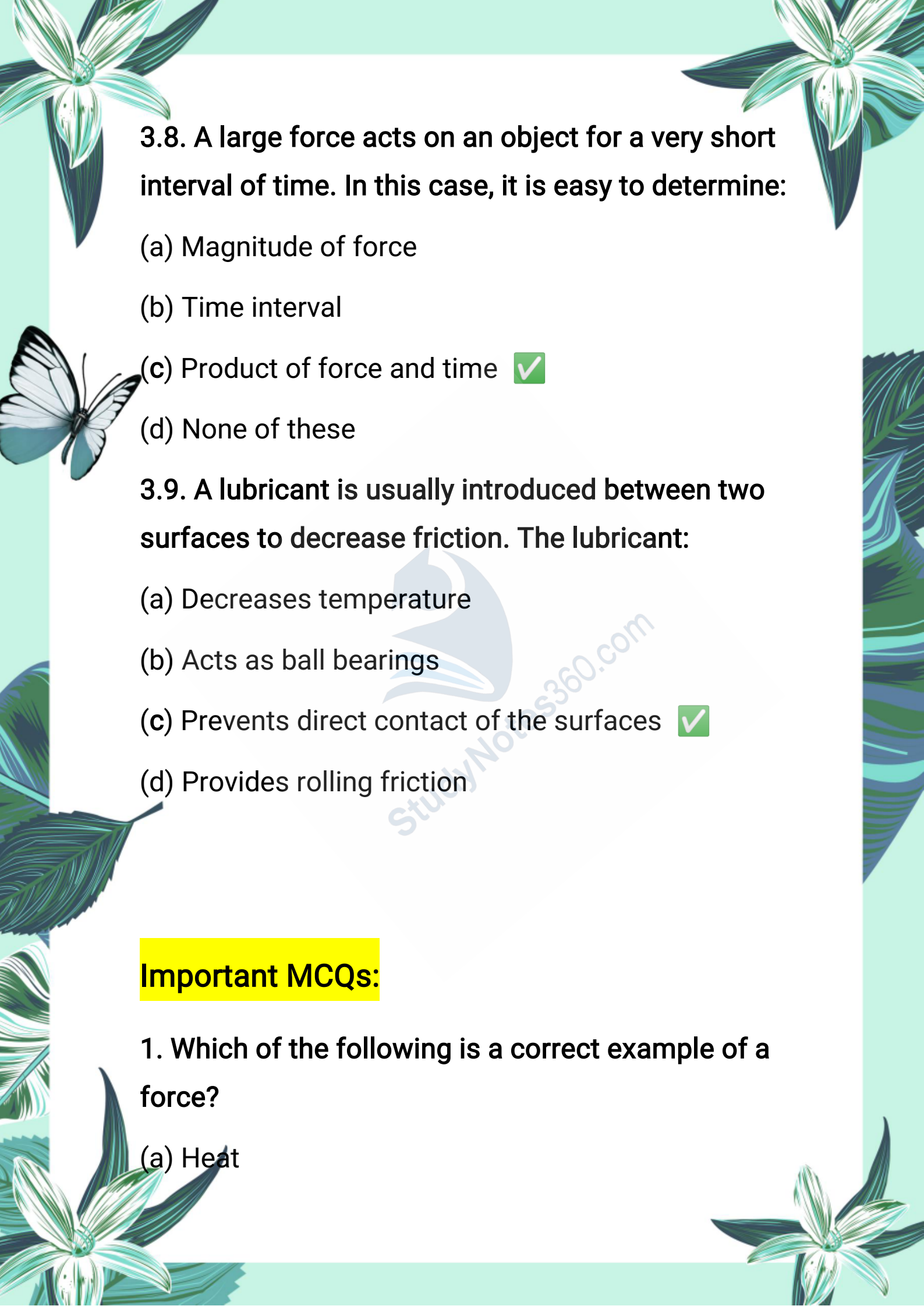
(a) 5 N

(b) -10 N

(c) -12 N

(d) -15 N





3.8. A large force acts on an object for a very short interval of time. In this case, it is easy to determine:

- (a) Magnitude of force
- (b) Time interval
- (c) Product of force and time
- (d) None of these

3.9. A lubricant is usually introduced between two surfaces to decrease friction. The lubricant:

- (a) Decreases temperature
- (b) Acts as ball bearings
- (c) Prevents direct contact of the surfaces
- (d) Provides rolling friction

Important MCQs:

1. Which of the following is a correct example of a force?

- (a) Heat



(b) Sound

(c) Push or Pull

(d) Light

2. A force that resists motion when two surfaces come in contact is called:



(a) Thrust

(b) Tension

(c) Friction

(d) Normal Force

3. Which force helps us to walk on the ground?

(a) Gravity

(b) Friction

(c) Thrust

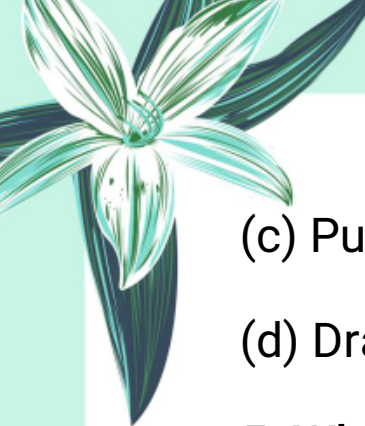
(d) Air Resistance

4. A type of force that works without physical contact is called:

(a) Contact force

(b) Magnetic force





(c) Push force

(d) Drag

5. Which of the following is a contact force?

(a) Electrostatic force



(b) Magnetic force

(c) Friction

(d) Gravitational force

6. What type of force does a man apply to move a wheelbarrow?

(a) Magnetic force

(b) Push force

(c) Electrostatic force

(d) Gravitational force

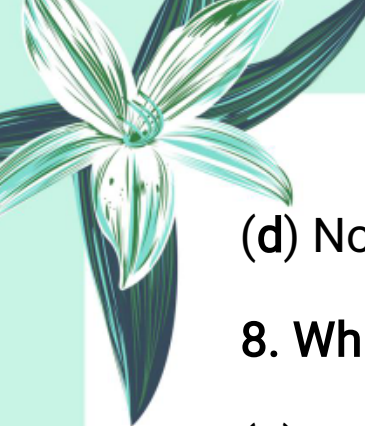
7. The force of reaction exerted by a surface on an object is called:

(a) Elastic force

(b) Tension force

(c) Thrust






(d) Normal force

8. Which force allows a ship to float in the sea?

(a) Drag

(b) Gravity



(c) Thrust

(d) Tension

9. Which of the following is a non-contact force?

(a) Tension

(b) Normal force

(c) Gravitational force

(d) Drag

10. What happens when like electric charges come near each other?

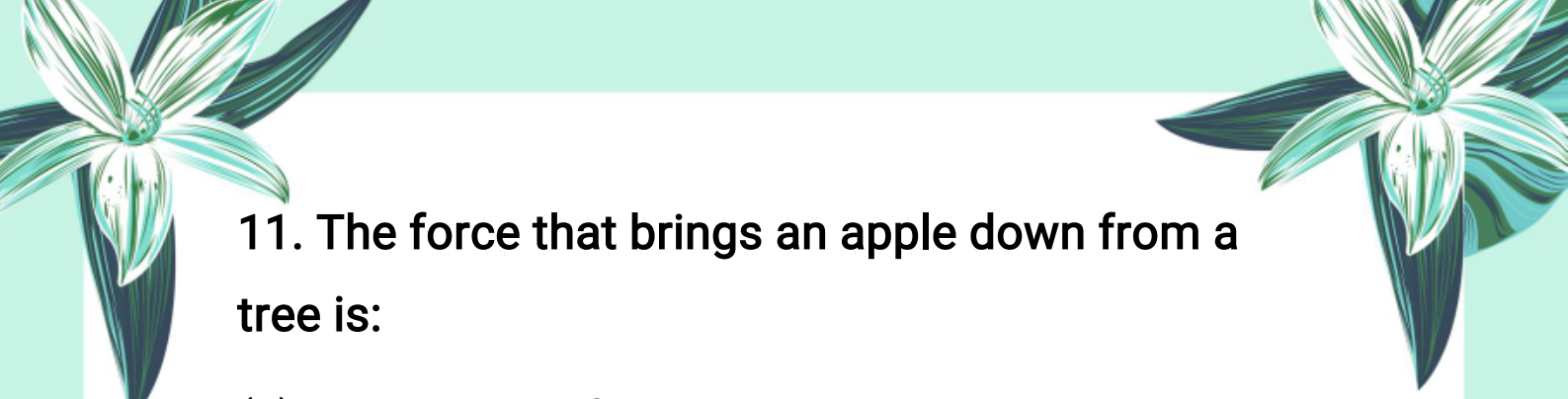
(a) They attract

(b) They repel

(c) They cancel


(d) No effect





11. The force that brings an apple down from a tree is:

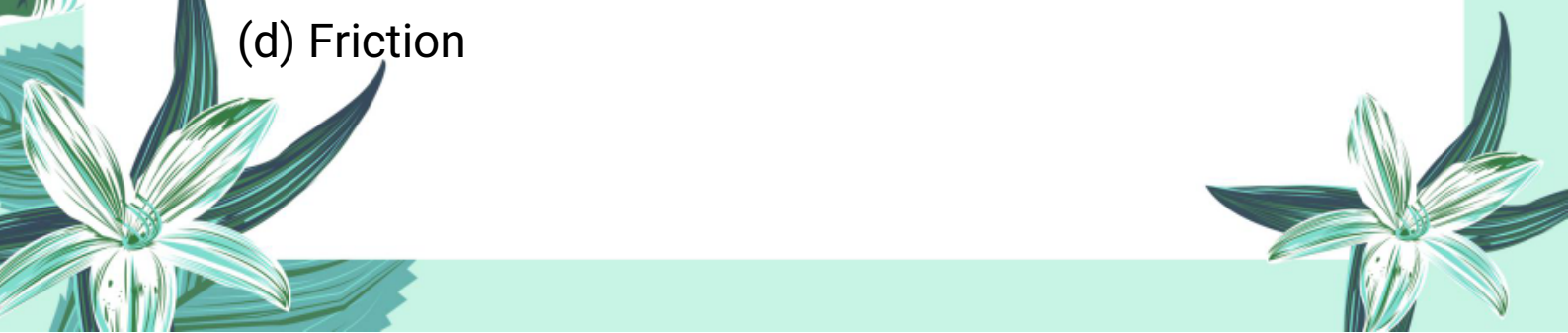
- (a) Electrostatic force
- (b) Magnetic force
- (c) Gravitational force
- (d) Friction



12. The force experienced by a stretched rubber band is called:

- (a) Tension force
- (b) Elastic force
- (c) Drag
- (d) Magnetic force

13. The resistance offered by air to a falling object is known as:

- (a) Thrust
 - (b) Air resistance
 - (c) Tension
 - (d) Friction
- 



14. Which force is responsible for keeping planets in orbit around the Sun?

- (a) Electrostatic force
- (b) Gravitational force
- (c) Magnetic force
- (d) Thrust



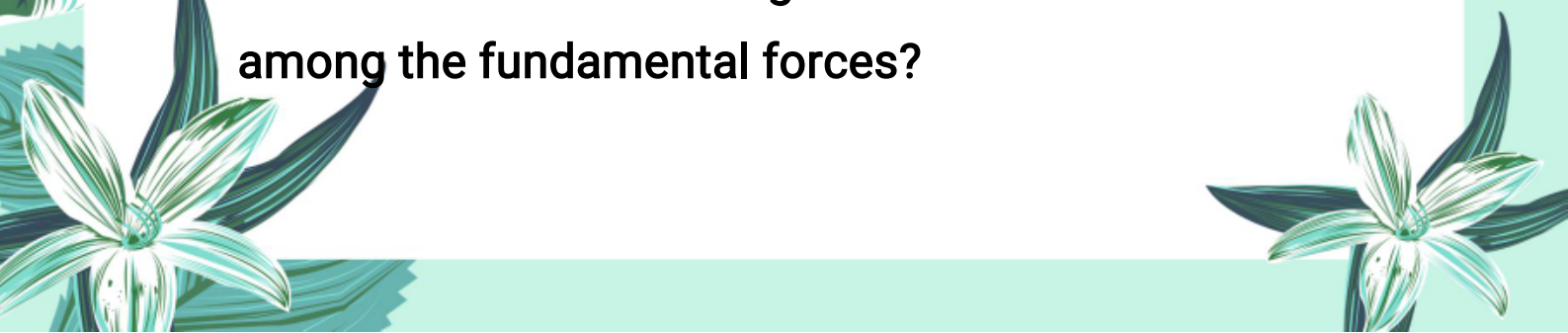
15. The electrostatic force acts between:

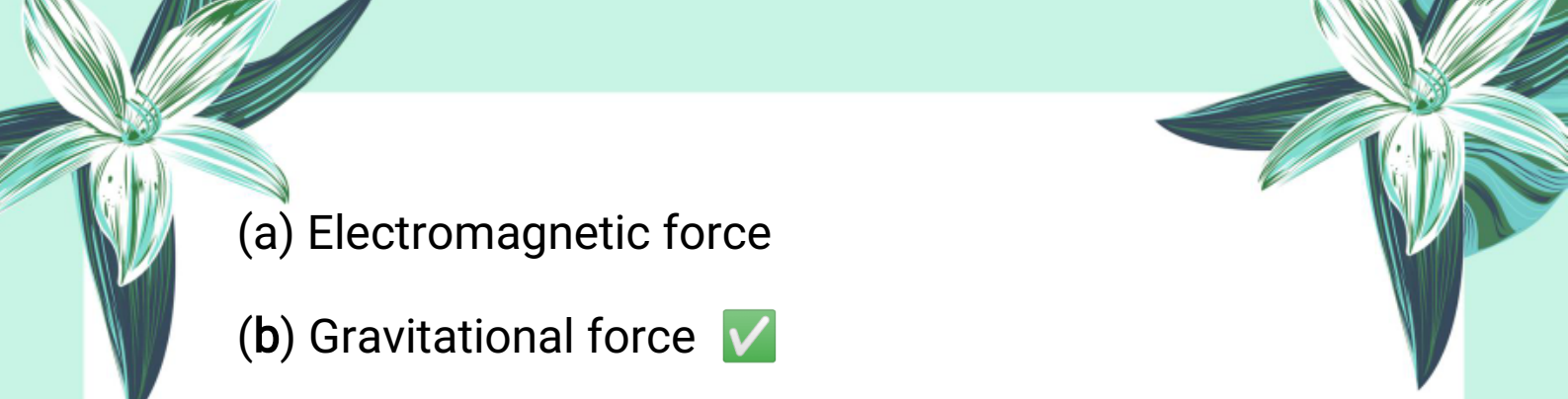
- (a) Magnets
- (b) Masses
- (c) Charged particles
- (d) Planets

16. How many fundamental forces exist in nature?

- (a) 2
- (b) 3
- (c) 4
- (d) 5

17. Which of the following is the weakest force among the fundamental forces?



- 
- (a) Electromagnetic force
 - (b) Gravitational force
 - (c) Strong nuclear force
 - (d) Weak nuclear force



18. Which force is responsible for the attraction between masses?

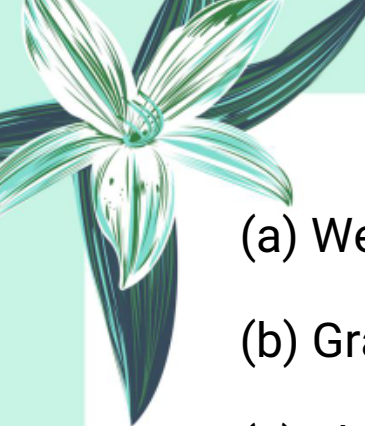

- (a) Strong nuclear force
- (b) Gravitational force
- (c) Weak nuclear force
- (d) Magnetic force

19. Which fundamental force acts between electrically charged particles?

- (a) Gravitational force
- (b) Strong nuclear force
- (c) Electromagnetic force
- (d) Weak nuclear force

20. Which force holds the nucleus of an atom together?



- 
- 
- (a) Weak nuclear force
 - (b) Gravitational force
 - (c) Electromagnetic force
 - (d) Strong nuclear force



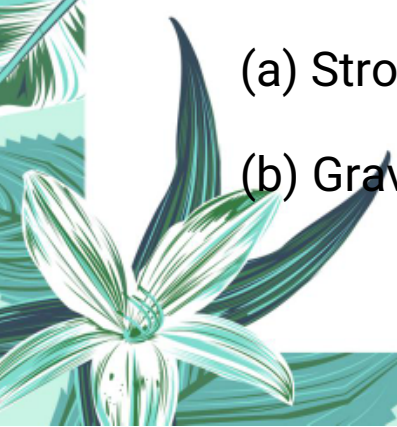

21. What is the range of the strong nuclear force?

- (a) Infinite
- (b) 10^{14} m
- (c) 10^{-14} m
- (d) 10^{-8} m

22. Which force is responsible for beta decay in a nucleus?

- (a) Electromagnetic force
- (b) Weak nuclear force
- (c) Strong nuclear force
- (d) Gravitational force

23. The force that causes radioactive decay is:

- (a) Strong nuclear force
 - (b) Gravitational force
- 
- 



(c) Weak nuclear force

(d) Magnetic force

24. Which force causes friction between two surfaces in relative motion?



(a) Weak nuclear force

(b) Electromagnetic force

(c) Gravitational force

(d) Strong nuclear force

25. Who among the following was awarded the Nobel Prize in 1979 for unifying weak and electromagnetic forces?

(a) Einstein

(b) Isaac Newton

(c) Dr. Abdus Salam

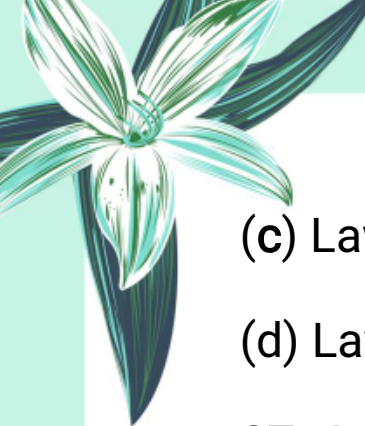
(d) Nikola Tesla

26. Newton's First Law of Motion is also known as:

(a) Law of force

(b) Law of gravity





(c) Law of inertia

(d) Law of energy

27. According to Newton's First Law, a body remains at rest or in uniform motion unless:



(a) It is heavy

(b) Gravity acts on it

(c) An external force acts on it

(d) Its direction changes

28. The property of a body to resist any change in its state of motion is called:

(a) Velocity

(b) Force

(c) Inertia

(d) Energy

29. Greater the mass of an object, the greater is its:

(a) Speed

(b) Acceleration

(c) Inertia





(d) Momentum

30. Newton's Second Law of Motion is mathematically written as:

(a) $F = m/v$

(b) $F = v/a$

(c) $F = ma$ ✓

(d) $F = a/m$

31. SI unit of force is:

(a) Joule

(b) Kilogram

(c) Newton ✓

(d) Pascal

32. One newton is the force that produces an acceleration of:

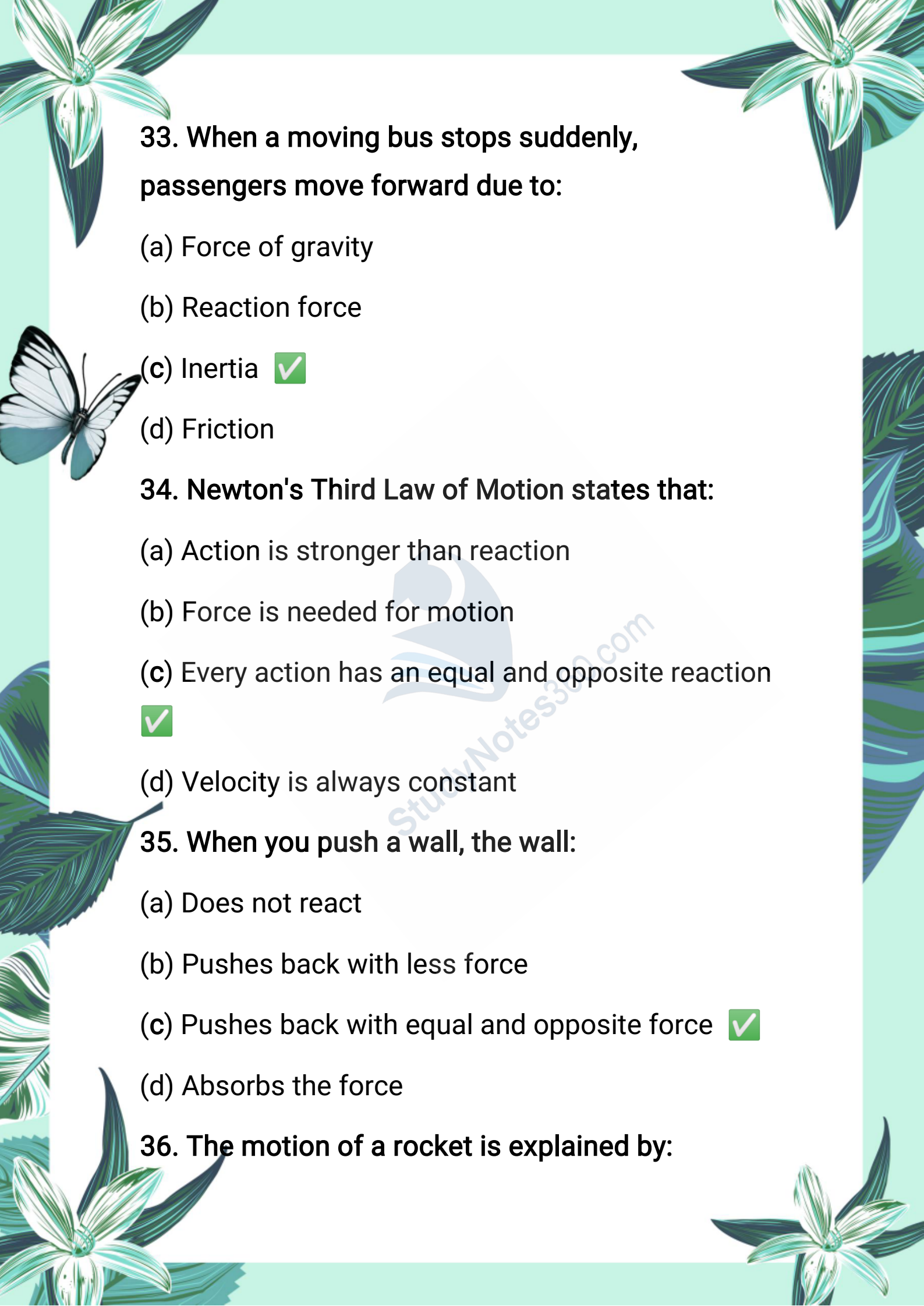
(a) 1 m/s in 1 kg

(b) 1 m/s^2 in 1 kg ✓

(c) 1 m/s^2 in 10 kg

(d) 10 m/s^2 in 1 g





33. When a moving bus stops suddenly, passengers move forward due to:

- (a) Force of gravity
- (b) Reaction force
- (c) Inertia
- (d) Friction

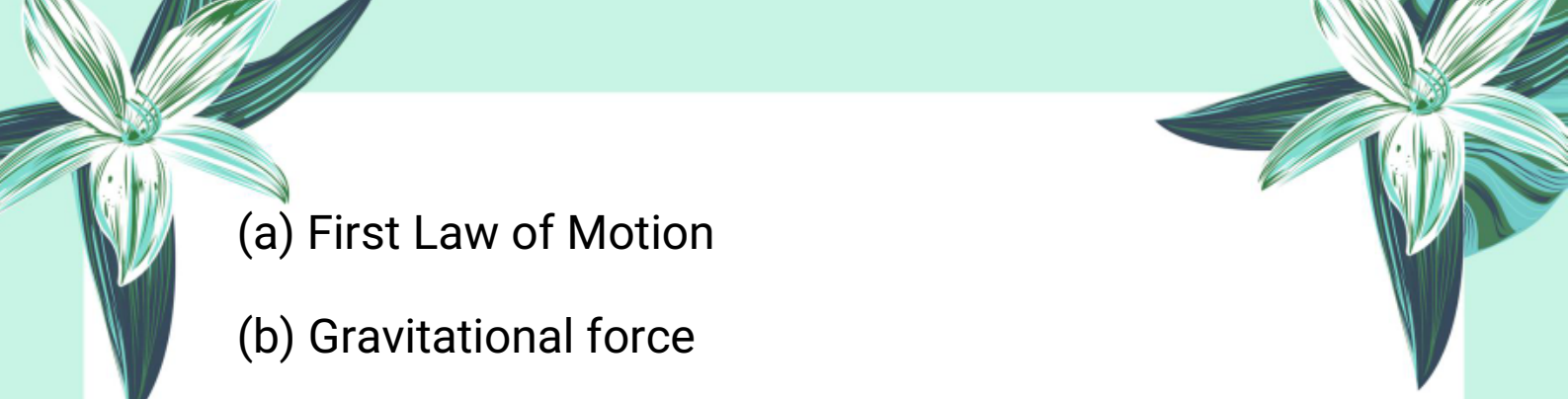
34. Newton's Third Law of Motion states that:


- (a) Action is stronger than reaction
- (b) Force is needed for motion
- (c) Every action has an equal and opposite reaction
- (d) Velocity is always constant

35. When you push a wall, the wall:

- (a) Does not react
- (b) Pushes back with less force
- (c) Pushes back with equal and opposite force
- (d) Absorbs the force

36. The motion of a rocket is explained by:

- 
- (a) First Law of Motion
 - (b) Gravitational force
 - (c) Newton's Third Law
 - (d) Inertia



37. What changes when a net external force acts on a body?

- (a) Mass
- (b) Inertia
- (c) Shape
- (d) Velocity

38. The unit 1 N is equal to:

- (a) 1 kg m/s^2
- (b) 1 kg/s^2
- (c) 1 m/kg
- (d) 1 J/s

39. If the same force is applied to a bicycle and a truck, the bicycle accelerates more because:

- (a) It has more weight
- 



(b) It has more inertia

(c) It has less mass**

(d) It has more speed

40. Which of the following explains why a bus at rest pushes passengers backward when it suddenly starts?



(a) Friction

(b) Gravity

(c) Action-Reaction

(d) Inertia

41. Newton's laws of motion are not applicable when:

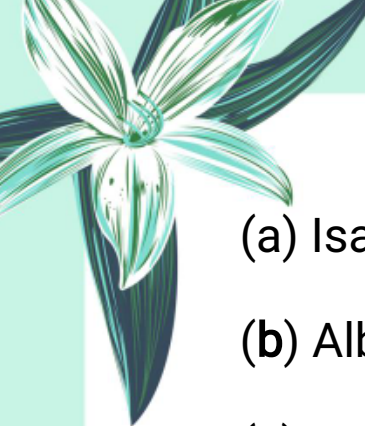

(a) The object is at rest

(b) The object moves slowly

(c) The object is large

(d) The object moves close to the speed of light

42. Which scientist developed relativistic mechanics?

- 
- 
- (a) Isaac Newton
 - (b) Albert Einstein
 - (c) Galileo
 - (d) Archimedes



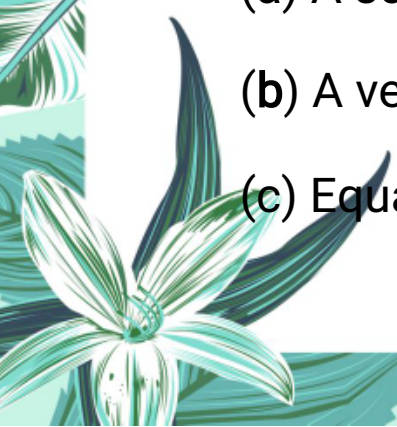

43. Mass is a measure of:

- (a) Force
- (b) Energy
- (c) Weight
- (d) Quantity of matter

44. The SI unit of mass is:

- (a) Newton
- (b) Gram
- (c) Pound
- (d) Kilogram (kg)

45. Weight is:

- (a) A scalar quantity
 - (b) A vector quantity
 - (c) Equal to mass
- 
- 




(d) Always constant

46. The correct formula to calculate weight is:

(a) $w = m/v$

(b) $w = mg$ ✓



(c) $w = m + g$

(d) $w = m \times a^2$

47. As gravitational field strength (g) changes from place to place, weight:

(a) Remains constant

(b) Disappears

(c) Changes accordingly ✓

(d) Equals mass

48. Which device is used to measure weight directly?

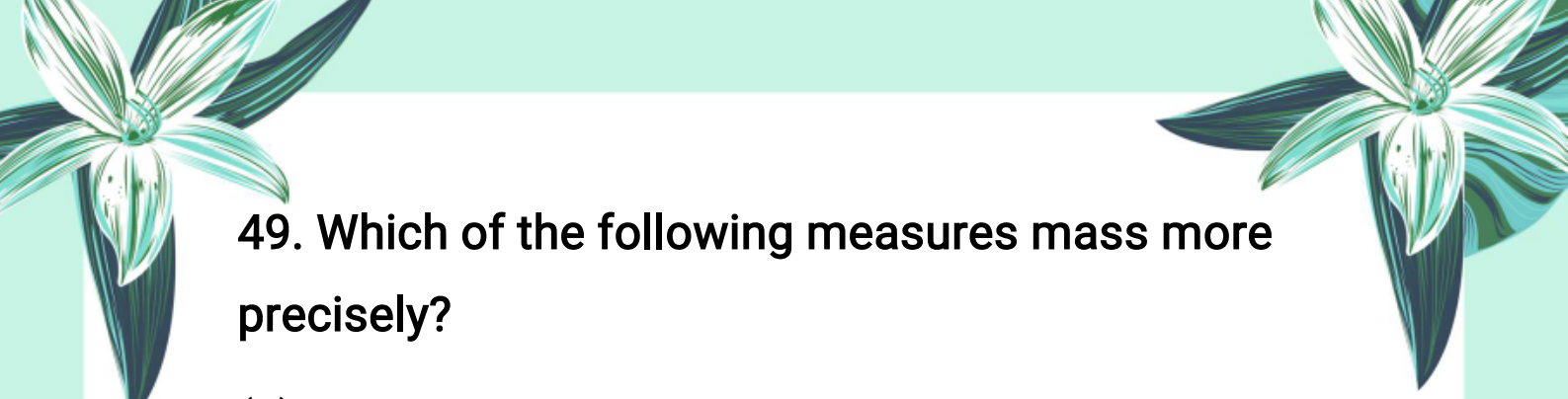
(a) Mechanical balance

(b) Electronic balance

(c) Beam balance

(d) Force meter ✓





49. Which of the following measures mass more precisely?

- (a) Force meter
- (b) Mechanical balance
- (c) Platform balance
- (d) Electronic balance

50. In a force meter, the force is measured in:

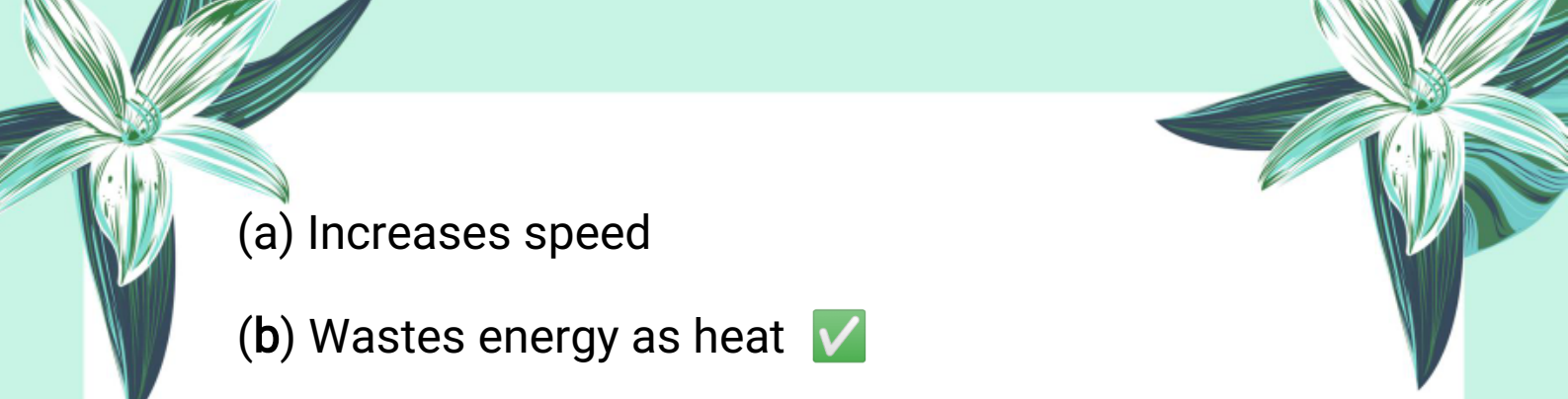
- (a) Kilograms
- (b) Meters per second
- (c) Newtons
- (d) Pounds


51. What causes a moving cricket ball on the ground to eventually stop?

- (a) Gravity
- (b) Friction
- (c) Magnetic force
- (d) Air pressure

52. Friction is called a dissipative force because it:



- 
- (a) Increases speed
 - (b) Wastes energy as heat
 - (c) Creates motion
 - (d) Saves energy



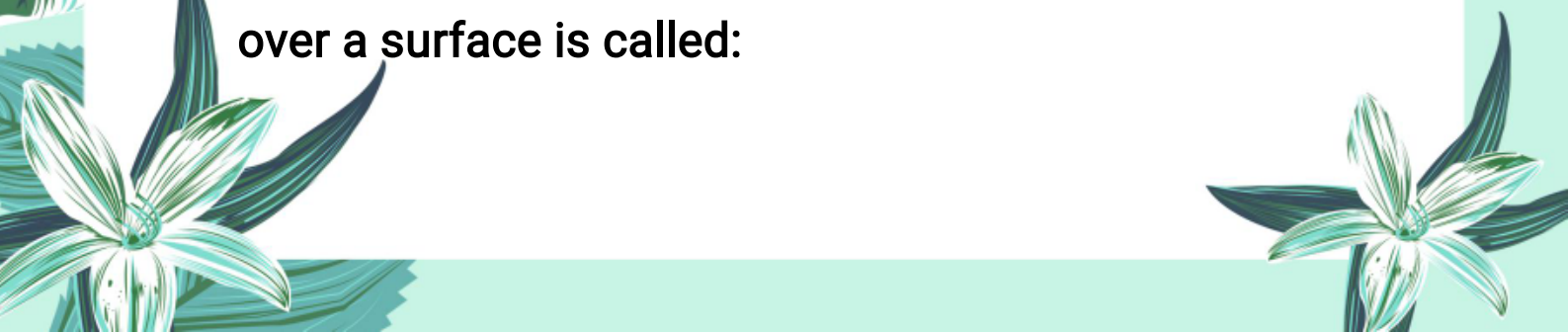
53. Which type of friction acts between two solid surfaces that are not moving relative to each other?

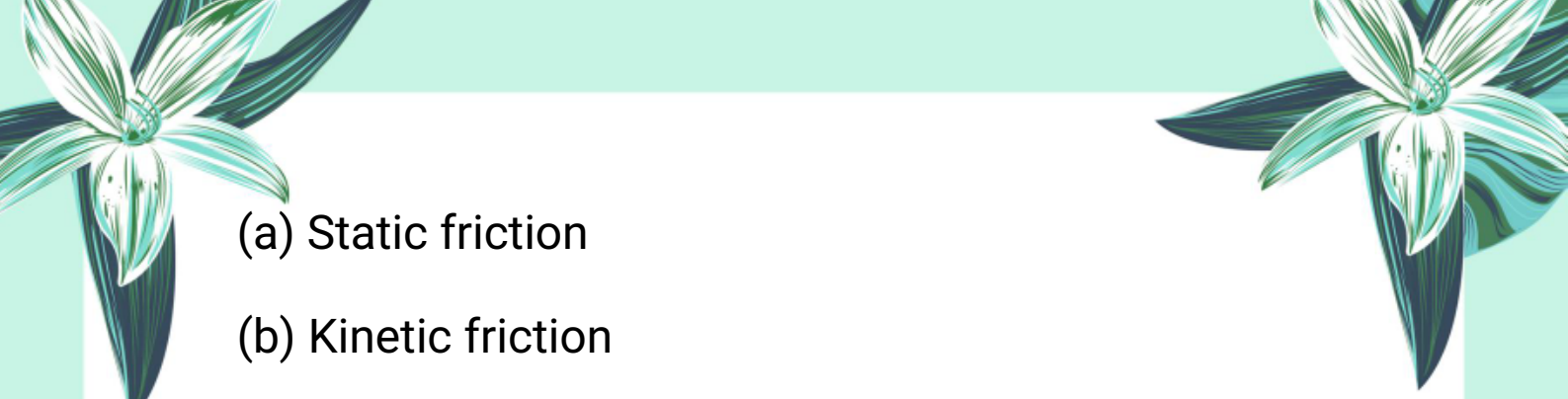
- (a) Kinetic friction
- (b) Static friction
- (c) Rolling friction
- (d) Fluid friction

54. When a block just starts sliding on a surface, the friction acting on it is called:

- (a) Kinetic friction
- (b) Static friction
- (c) Rolling friction
- (d) Air resistance

55. The friction that occurs when an object rolls over a surface is called:



- 
- (a) Static friction
 - (b) Kinetic friction
 - (c) Rolling friction
 - (d) Fluid friction



56. Why is rolling friction less than sliding friction?

- (a) Because the object moves slower
- (b) Because there is no relative sliding motion between wheel and surface
- (c) Because rolling surfaces are rougher
- (d) Because rolling friction does not exist

57. Which of the following methods helps reduce friction in machines?

- (a) Using rough surfaces
- (b) Applying oil or grease
- (c) Increasing surface area
- (d) Using heavy weights

58. What is the role of ball bearings in machines?

- (a) Increase friction
- 



(b) Convert sliding friction into rolling friction

(c) Stop the machine

(d) Increase heat

59. Terminal velocity is attained when:



(a) Gravity is zero

(b) Air resistance balances gravitational force

(c) Object stops moving

(d) Object falls faster

60. Vehicles and airplanes are streamlined to:

(a) Increase air resistance

(b) Reduce friction with air

(c) Increase weight

(d) Reduce speed

61. Momentum of a moving body depends on:

(a) Mass only

(b) Velocity only

(c) Mass and velocity both

(d) Force applied





62. The formula for momentum (p) is:

- (a) $p = \text{mass} / \text{velocity}$
- (b) $p = \text{mass} \times \text{velocity}$ ✓
- (c) $p = \text{force} \times \text{time}$
- (d) $p = \text{velocity} / \text{mass}$



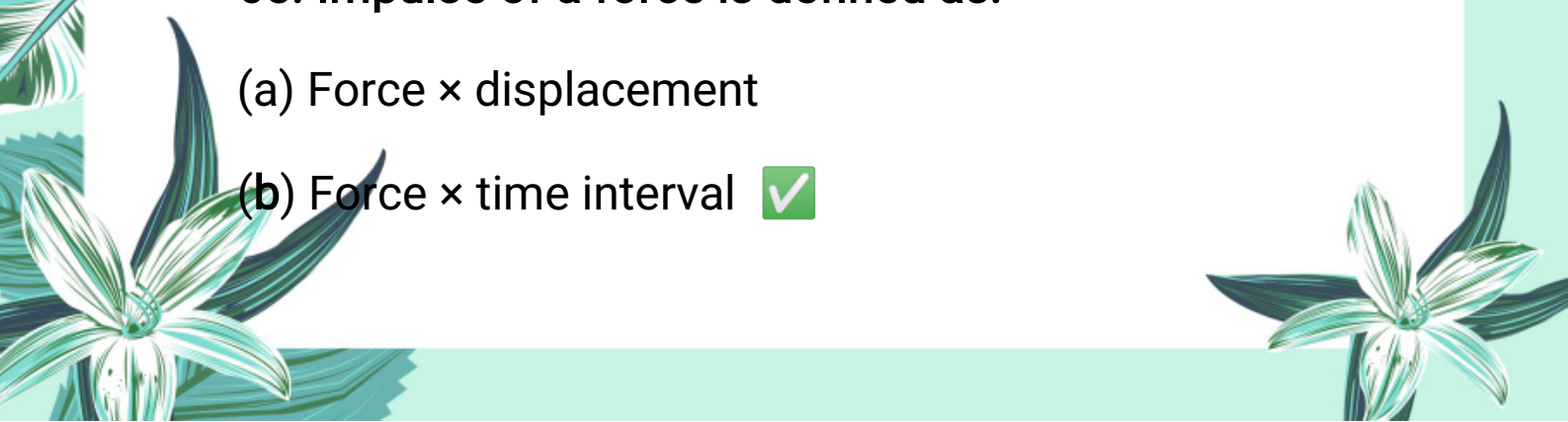
63. Momentum is a:

- (a) Scalar quantity
- (b) Vector quantity ✓
- (c) Constant quantity
- (d) None of these

64. The SI unit of momentum is:

- (a) kg m/s^2
- (b) kg m/s ✓
- (c) N s
- (d) m/s

65. Impulse of a force is defined as:

- (a) $\text{Force} \times \text{displacement}$
 - (b) $\text{Force} \times \text{time interval}$ ✓
- 



(c) Mass \times velocity

(d) Velocity / time

66. According to Newton's second law in terms of momentum, force acting on an object is equal to:



(a) Change in velocity per unit time

(b) Change in momentum per unit time

(c) Momentum \times time

(d) Velocity \times time

67. The principle of conservation of momentum states that total momentum of an isolated system:

(a) Increases after collision

(b) Remains constant before and after collision


(c) Decreases after collision

(d) Becomes zero

68. When two identical balls collide, the momentum:

(a) Is destroyed

(b) Is transferred from one ball to another





(c) Increases

(d) Decreases

69. Why do seatbelts help passengers during sudden stops?



(a) They increase momentum

(b) They reduce the forward motion by applying force

(c) They increase velocity

(d) They stop the car

70. Before firing a bullet, the total momentum of the bullet and gun system is:

(a) Equal to the velocity of the bullet

(b) Zero

(c) Equal to the velocity of the gun

(d) Infinite






B Exercise Short Questions

3.1. What kind of changes in motion may be produced by a force?

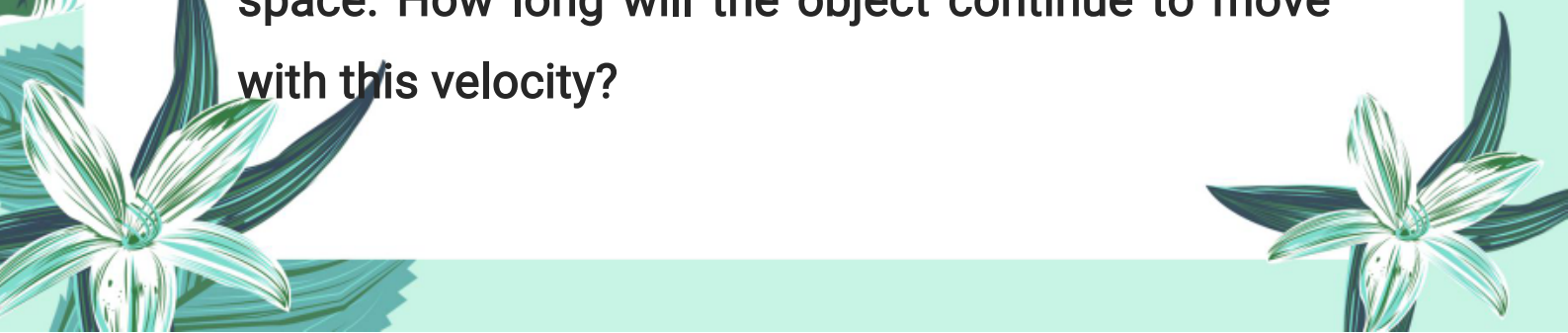
A force can:

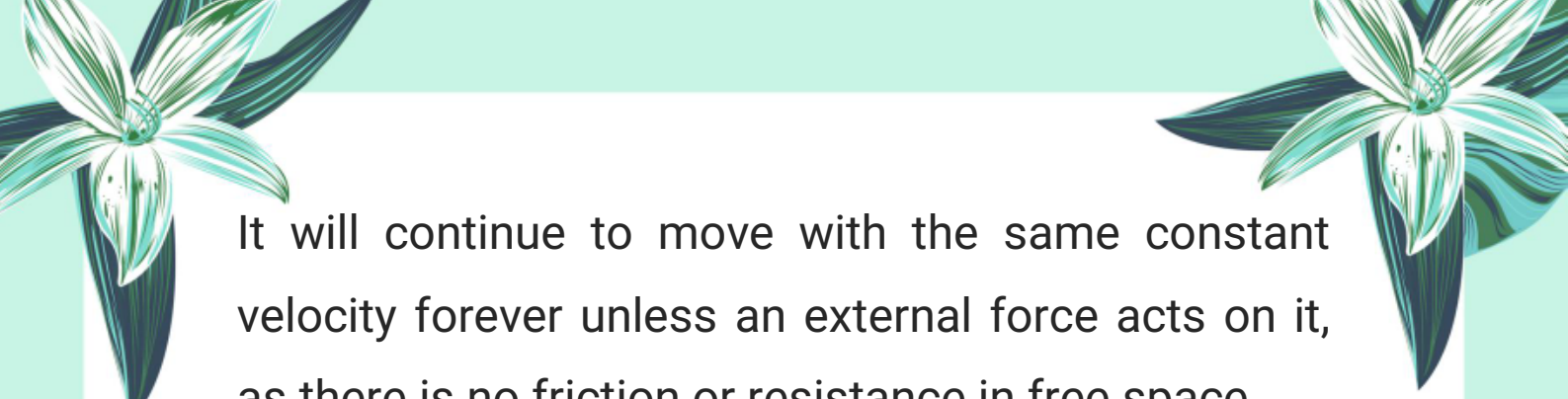
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- Start a stationary object
 - Stop a moving object
 - Change the speed of an object
 - Change the direction of motion
 - Change the shape of an object

3.2. Give 5 examples of contact forces.

1. Frictional force
2. Tension in a rope
3. Normal reaction force
4. Air resistance
5. Applied force by hand or machine


3.3. An object moves with constant velocity in free space. How long will the object continue to move with this velocity?





It will continue to move with the same constant velocity forever unless an external force acts on it, as there is no friction or resistance in free space.

3.4. Define impulse of force.

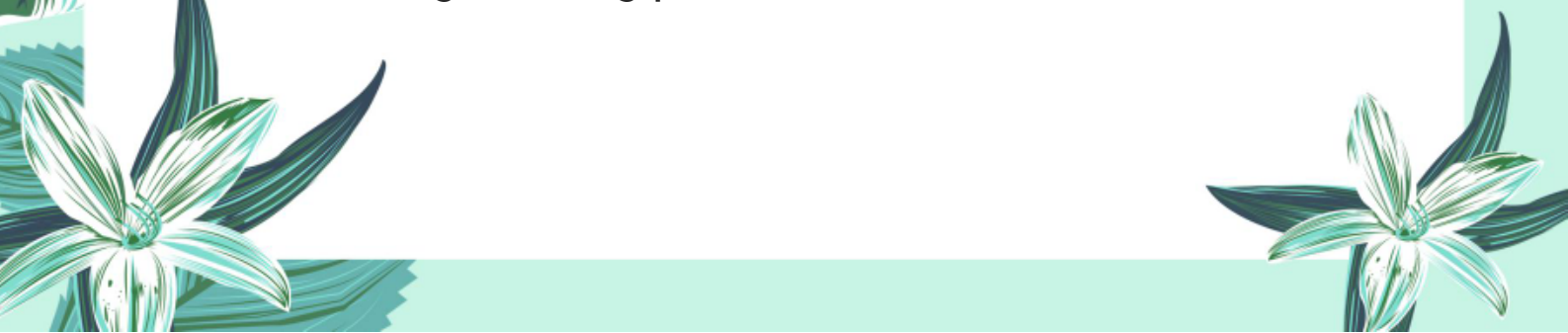
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- Impulse is the product of force and the time for which it acts on a body.
 - Formula: Impulse = Force \times Time = Change in momentum

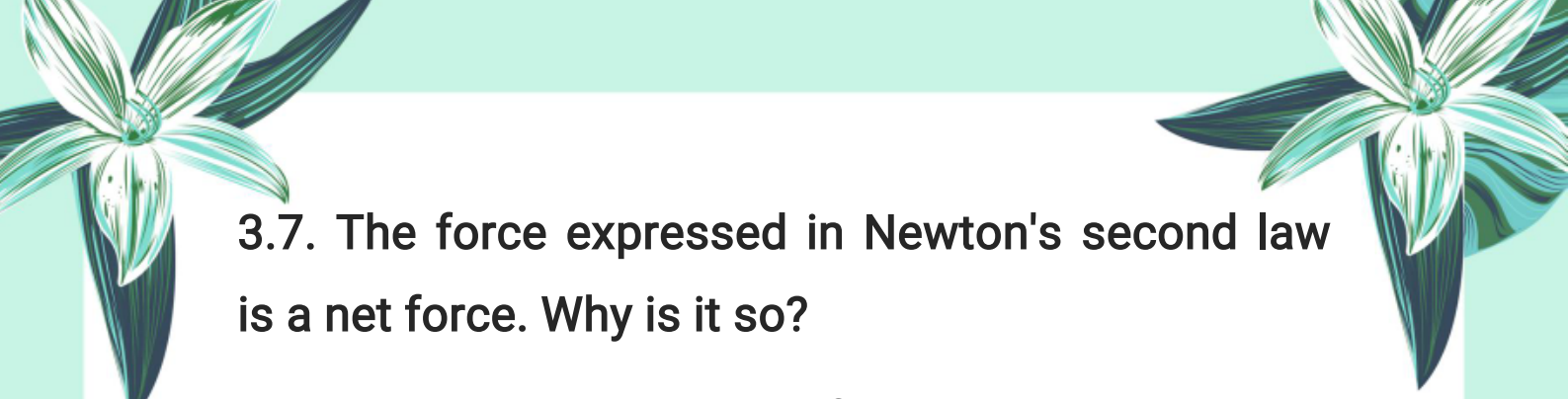
3.5. Why has not Newton's first law been proved on the Earth?

On Earth, friction and air resistance always act on objects. These external forces make it difficult to observe Newton's first law directly.

3.6. When sitting in a car which suddenly accelerates from rest, you are pushed back into the seat, why?


Due to inertia, your body tends to remain at rest when the car suddenly moves forward. This gives the feeling of being pushed backward.





3.7. The force expressed in Newton's second law is a net force. Why is it so?

Because it considers all the forces acting on a body. The acceleration is produced by the resultant or net force acting on it.



3.8. How can you show that rolling friction is lesser than the sliding friction?

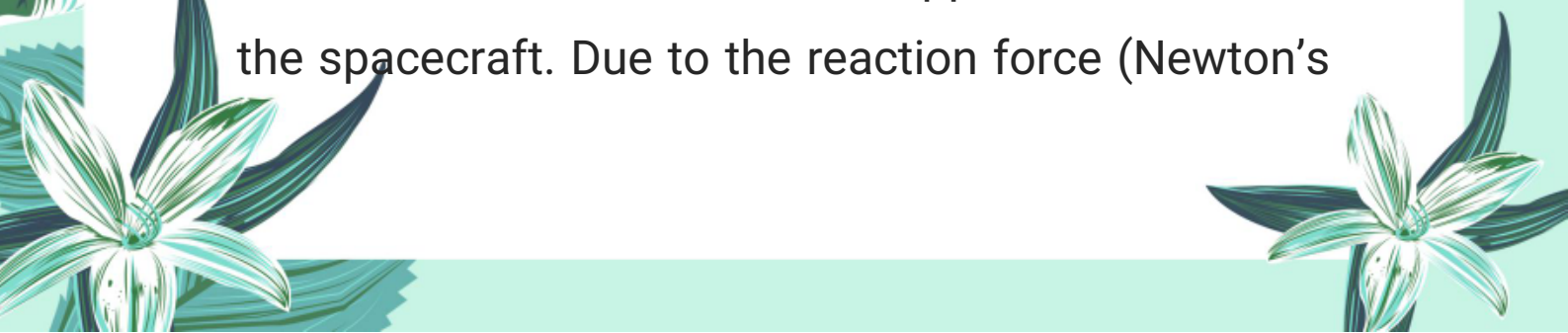
By pulling the same object first by sliding and then by using wheels (rolling), less force is required for rolling. This shows rolling friction is smaller.

3.9. Define terminal velocity of an object.

Terminal velocity is the maximum constant velocity attained by a freely falling object when the force of air resistance becomes equal to the weight of the object.

3.10. An astronaut walking in space wants to return to spacecraft by firing a hand rocket. In what direction does he fire the rocket?

He should fire the rocket in the opposite direction of the spacecraft. Due to the reaction force (Newton's



third law), he will move towards the spacecraft.

Important Short Questions:

1. What is meant by force?

Answer:

A force is a push or pull that can start, stop or change the motion of a body. It can also change the shape of an object.

2. How does force change the state of motion of a body?

Answer:

Force can change the speed, direction or both of a moving object. It can also bring a moving object to rest or set a stationary object into motion.

3. What is meant by contact force? Give two examples.

Answer:


Contact force is the force that acts only when two objects are in physical contact.



Examples: Friction, Tension in a string.

4. Define friction and mention its effect.

Answer:

- 
- Friction is a contact force that opposes the motion between two surfaces in contact.
 - **Effect:** It slows down or stops the motion of objects.

5. What is drag force?

Answer:

Drag is a resistive force that acts opposite to the direction of motion of an object moving through a fluid (like air or water).

6. Define thrust with one example.

Answer:

Thrust is an upward force exerted by a fluid on an object immersed in it.

Example: A ship floats because the upward thrust balances its weight.


7. What is normal reaction force?





Answer:

Normal reaction force is the support force exerted by a surface on an object resting on it. It acts perpendicular to the surface.



8. Define non-contact force and write any one example.

Answer:

A non-contact force acts between objects that are not in physical contact.

Example: Gravitational force.

9. What is electrostatic force?

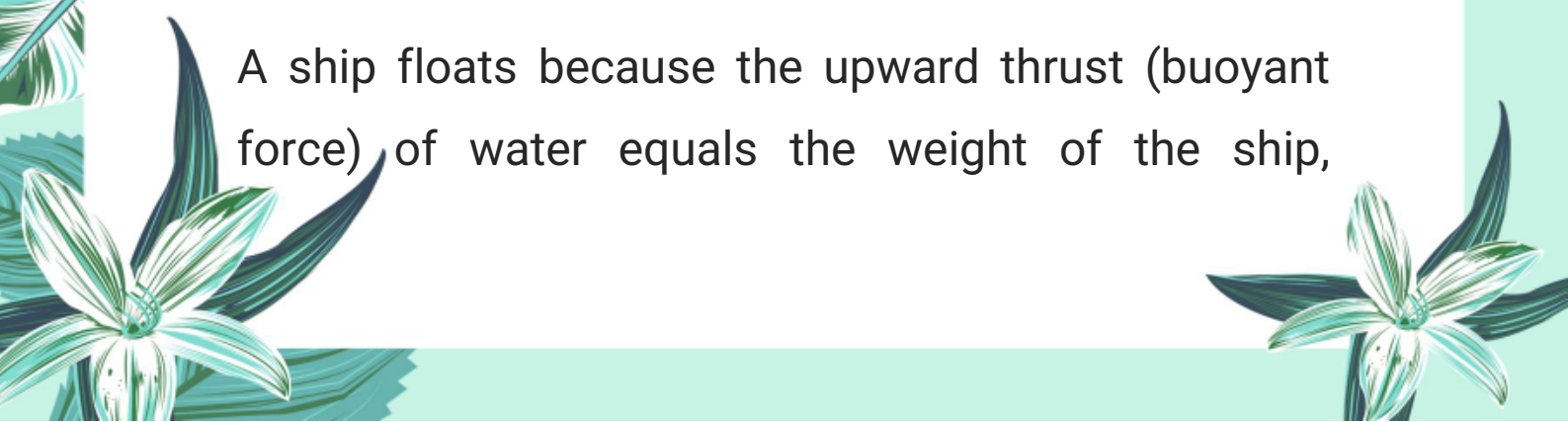
Answer:

Electrostatic force is the force between two charged objects. Like charges repel, and unlike charges attract each other.

10. Why does a ship float on water?

Answer:

A ship floats because the upward thrust (buoyant force) of water equals the weight of the ship,






allowing it to stay afloat.

11. What are the four fundamental forces of nature?

Answer:

The four fundamental forces of nature are:

- 
1. Gravitational force
 2. Electromagnetic force
 3. Strong nuclear force
 4. Weak nuclear force

12. Why is the gravitational force called a long-range force?

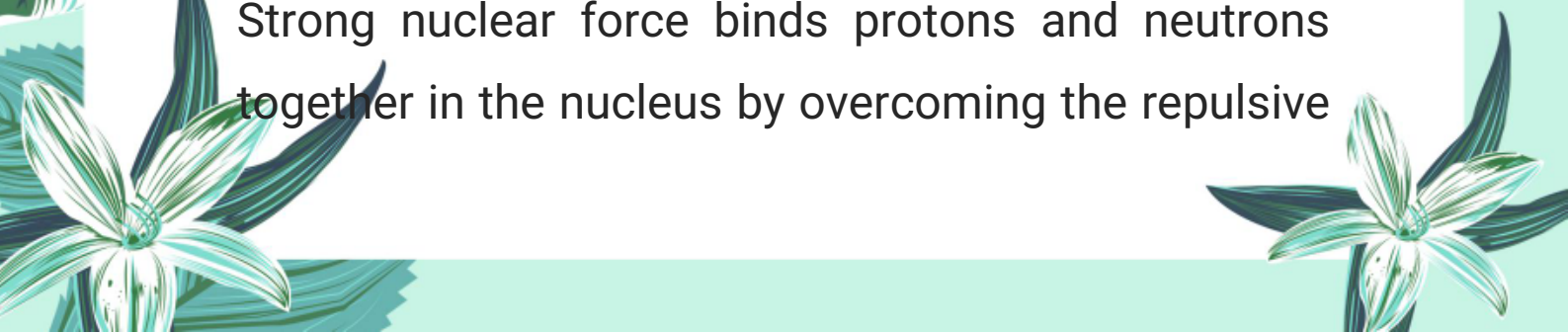
Answer:

Gravitational force acts over an infinite distance, although it becomes weaker with increasing distance. Therefore, it is called a long-range force.

13. What is the role of strong nuclear force in the nucleus?

Answer:

Strong nuclear force binds protons and neutrons together in the nucleus by overcoming the repulsive






force between positively charged protons.

14. What is beta decay and which force is responsible for it?


Answer:



Beta decay is a process in which a neutron changes into a proton, emitting an electron and an antineutrino. It is caused by the weak nuclear force.

15. What was the contribution of Dr. Abdus Salam in unification of forces?


Answer:




Dr. Abdus Salam, along with two other scientists, unified the weak nuclear force and electromagnetic force into a single theory called the electroweak force. They received the Nobel Prize in Physics in 1979.

16. State Newton's First Law of Motion.

Answer:



Newton's First Law of Motion states that a body continues in its state of rest or uniform motion in a straight line unless acted upon by some external






force.

17. What is meant by inertia? Give one example.

Answer:




Inertia is the property of a body to maintain its state of rest or uniform motion unless acted upon by an external force.

Example: A book remains at rest on a table until a force moves it.

18. How is mass related to inertia?

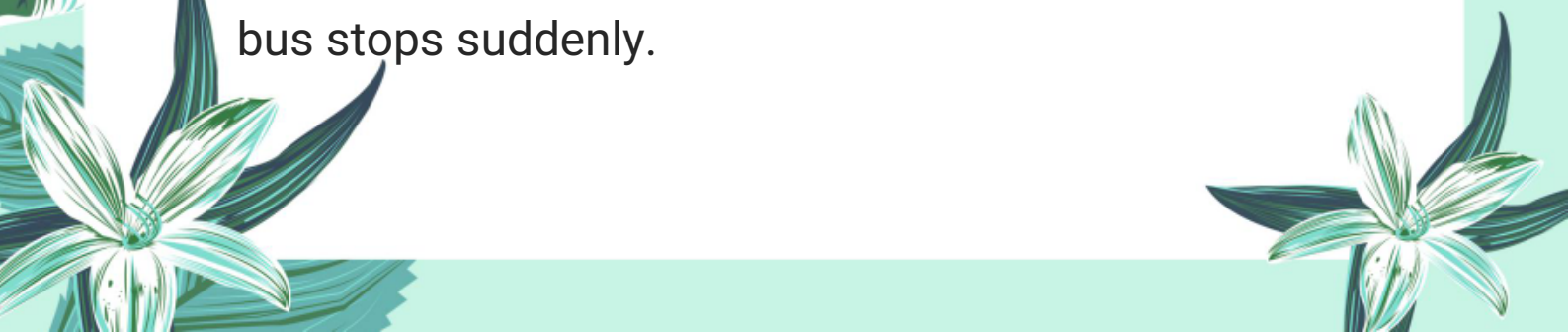
Answer:



Mass is a measure of inertia. The greater the mass of an object, the greater its inertia, meaning it resists changes in its motion more.

19. Why do passengers fall forward when a moving bus suddenly stops?

Answer:



Passengers fall forward because their bodies tend to continue moving forward due to inertia, while the bus stops suddenly.



20. Define force using Newton's First Law.

Answer:

Force is an agency that changes or tends to change the state of rest or uniform motion of a body.



21. State Newton's Second Law of Motion.

Answer:

Newton's Second Law states that when a net external force acts on a body, it produces an acceleration in the direction of the force. The acceleration is directly proportional to the force and inversely proportional to the mass of the body.

22. Write the mathematical form of Newton's Second Law and define each term.

Answer:

The mathematical form is:

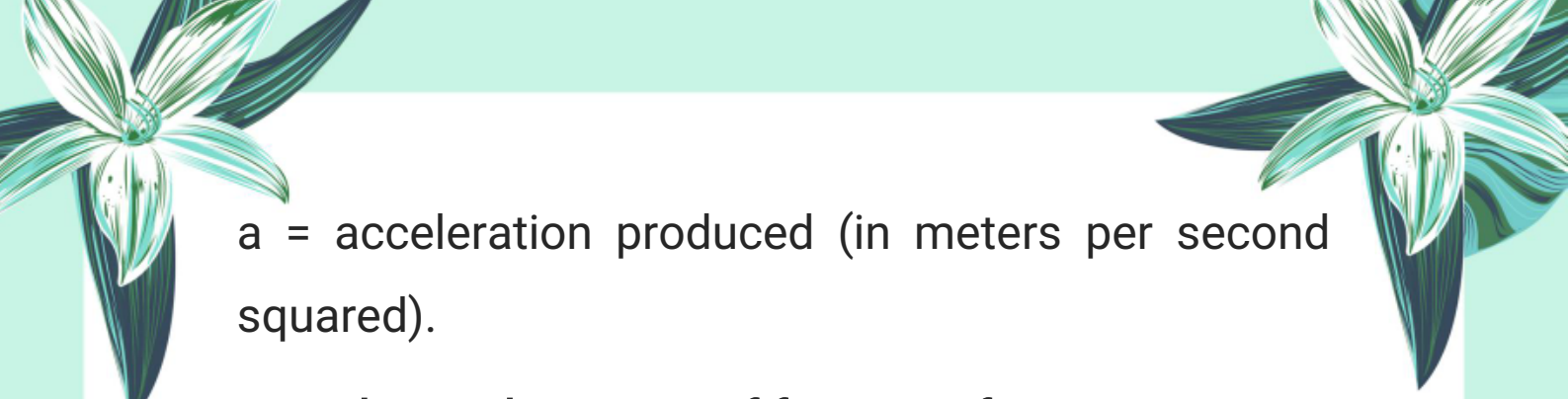
$$F = ma$$

where,

F = net force applied on the body (in newtons),

m = mass of the body (in kilograms),





a = acceleration produced (in meters per second squared).

23. What is the SI unit of force? Define it.

Answer:



The SI unit of force is the newton (N).

One newton is the force which produces an acceleration of 1 m/s^2 in a body of mass 1 kg.

24. State Newton's Third Law of Motion.

Answer:

Newton's Third Law of Motion states: For every action, there is an equal and opposite reaction.

25. Why does a gun recoil when a bullet is fired?

Answer:

When a bullet is fired forward (action), the gun experiences an equal and opposite force backward (reaction), causing it to recoil.

26. What are the limitations of Newton's Laws of Motion?





Answer:

Newton's Laws do not apply accurately to very small particles moving near the speed of light. For such cases, relativistic mechanics developed by Einstein is used.



27. Define mass scientifically.

Answer:

Mass is the characteristic of a body that determines the magnitude of acceleration produced when a force acts on it. It is a measure of the quantity of matter in the body.

28. How is mass different from weight?

Answer:

Mass is a scalar quantity and remains the same everywhere; weight is the gravitational force on the body, a vector quantity directed towards Earth's center, and varies with location.

29. What is the SI unit of mass?

Answer:






The SI unit of mass is the kilogram (kg).

30. Define weight and give its formula.

Answer:




Weight is the gravitational force acting on a body. It is given by the formula:

Weight (W) = mass (m) × gravitational field strength (g)

31. Why does the weight of an object vary from place to place?

Answer:



Because the gravitational field strength (g) varies with location and altitude, so weight varies accordingly.

32. How is mass measured practically?

Answer:

Mass is measured using an ordinary balance, which compares an object's mass with standard masses.

33. Describe the working principle of a mechanical balance.





Answer:

A mechanical balance uses a horizontal beam balanced on a central knife edge with two pans. The object is placed on one pan and standard weights on the other until equilibrium is reached.



34. What are electronic balances?

Answer:

Electronic balances measure mass without standard weights, showing the mass digitally on a screen. They are more precise than mechanical balances.

35. What is a force meter and how does it work?

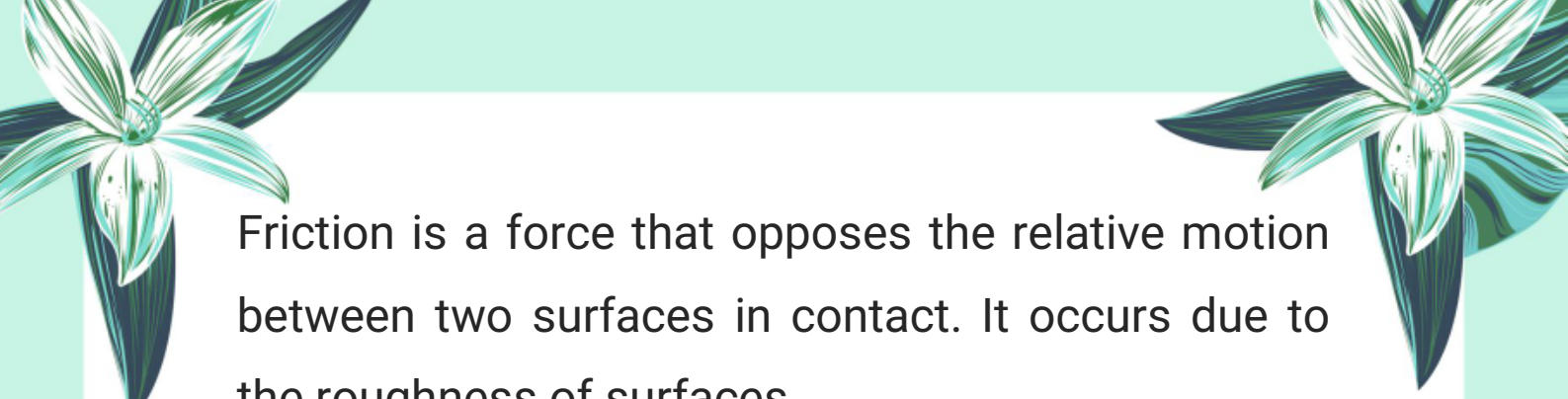
Answer:

A force meter (spring balance) measures force (weight) directly in newtons. It has a spring that compresses or stretches when an object is hung, moving a pointer over a scale calibrated in newtons.

36. What is friction and why does it occur?

Answer:





Friction is a force that opposes the relative motion between two surfaces in contact. It occurs due to the roughness of surfaces.

37. What is meant by the dissipative effect of friction?



Answer:

The dissipative effect of friction refers to the loss of mechanical energy as heat when work is done to overcome friction.

38. Define static friction with an example.

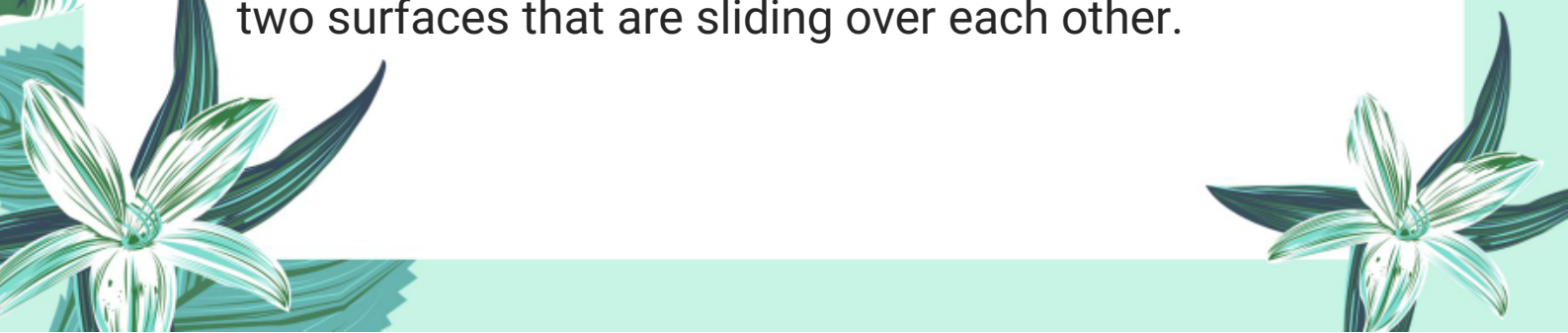
Answer:

Static friction is the frictional force that prevents a stationary object from moving when a force is applied. Example: A block on a table that does not move until a certain force is applied.

39. What is kinetic friction?

Answer:


Kinetic friction is the frictional force acting between two surfaces that are sliding over each other.





40. Explain rolling friction and its significance.

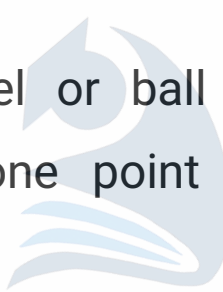
Answer:



Rolling friction occurs when an object rolls over a surface. It is much smaller than sliding friction, making it easier to move objects with wheels or ball bearings.

41. Why is rolling friction less than sliding friction?


Answer:



Because the wheel or ball bearing touches the surface at only one point and does not slide, reducing friction.

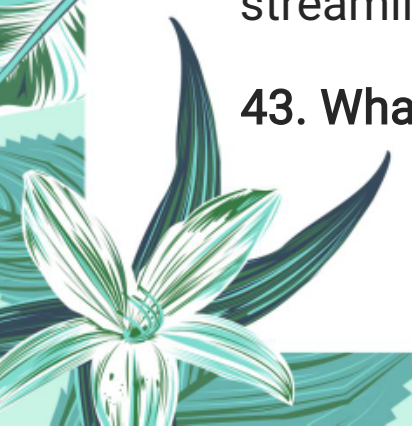
42. What are some methods used to reduce friction?

Answer:



Methods include polishing surfaces, using lubricants like oil or grease, using ball bearings to convert sliding friction into rolling friction, and streamlining vehicles.


43. What is terminal velocity?





Answer:

Terminal velocity is the constant velocity reached by a falling object when the upward air resistance equals the downward gravitational force, stopping further acceleration.



44. How does air resistance affect the motion of falling objects?

Answer:

Air resistance opposes the motion, reducing acceleration. Objects with larger surface area face more air resistance and fall slower.

45. Give an example where friction causes energy dissipation in daily life.



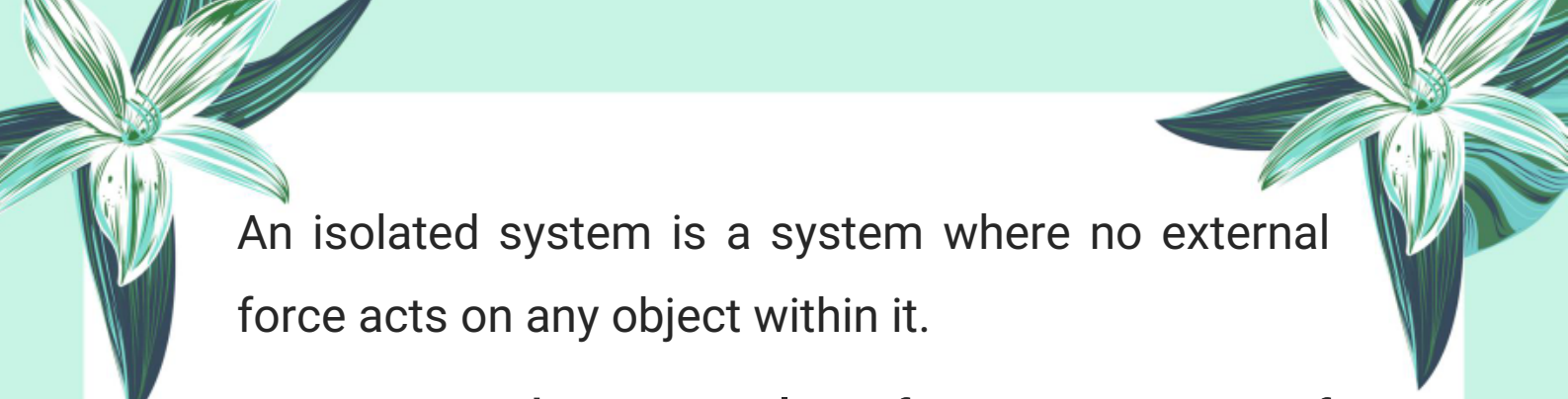
Answer:

Rubbing hands together produces heat due to friction, warming the hands.

46. What is an isolated system in terms of momentum?

Answer:






An isolated system is a system where no external force acts on any object within it.

47. State the principle of conservation of momentum.

Answer:



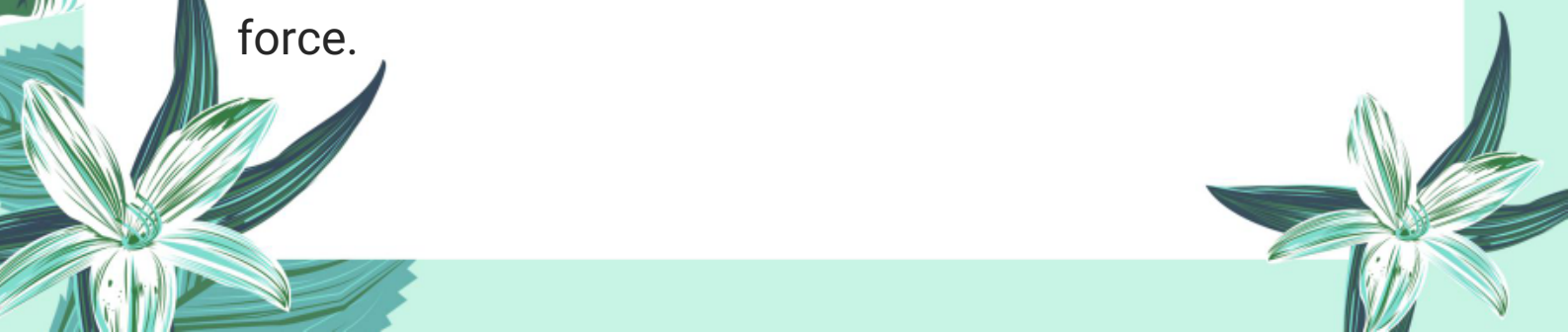
If no external force acts on an isolated system, the total momentum before and after a collision remains the same.

Important Long Questions:

Q1: What is force? Explain the types of force with suitable examples.

Answer:

Force is a push or a pull that can start, stop, or change the speed or direction of an object. It is responsible for changing the state of motion of a body. For example, when you push a door to open it or pull a rope during a tug of war, you are applying force.


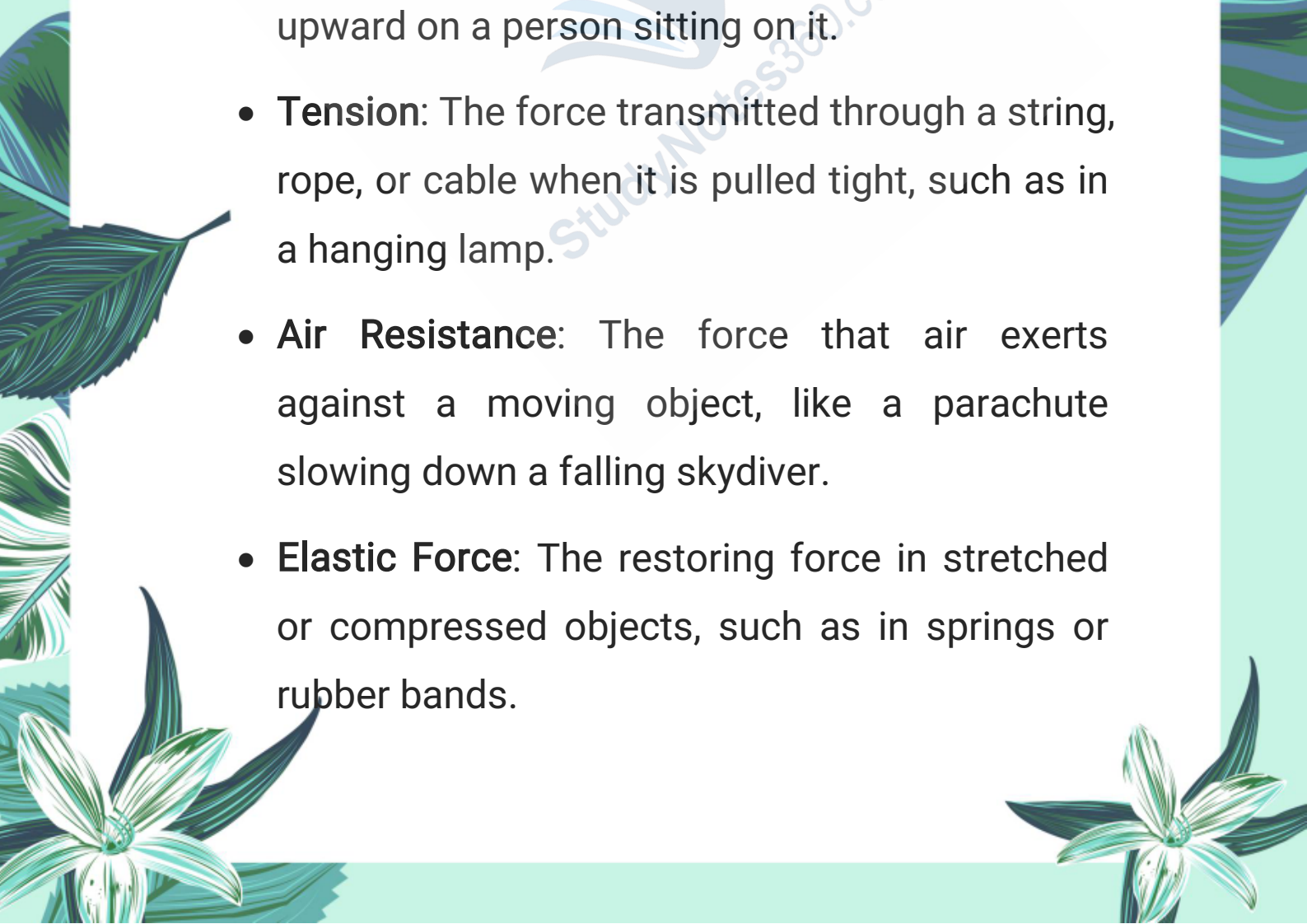




There are two main types of forces:

1. Contact Forces:

These forces act when two objects physically touch each other. **Examples include:**


- 
- **Friction:** The force that opposes motion when two surfaces rub against each other, like the friction between a moving car's tires and the road.
 - **Normal Force:** The support force exerted by a surface, like the force of a chair pushing upward on a person sitting on it.
 - **Tension:** The force transmitted through a string, rope, or cable when it is pulled tight, such as in a hanging lamp.
 - **Air Resistance:** The force that air exerts against a moving object, like a parachute slowing down a falling skydiver.
 - **Elastic Force:** The restoring force in stretched or compressed objects, such as in springs or rubber bands.
- 



2. Non-contact Forces:

These forces act even when objects are not physically touching; they act at a distance.

Examples include:

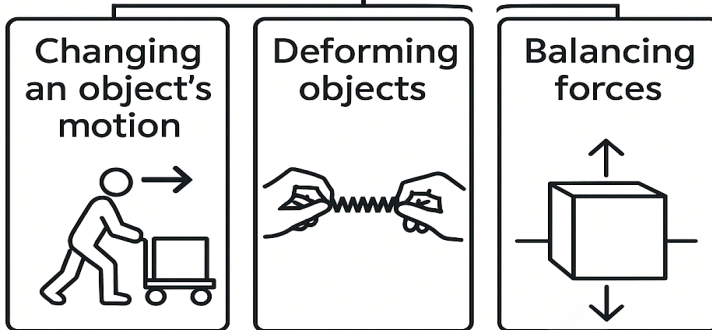
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- **Gravitational Force:** The attractive force between masses, such as the Earth pulling objects towards its surface, which causes objects to fall.
 - **Electrostatic Force:** The force between charged objects; opposite charges attract and like charges repel each other. For example, the attraction between a balloon rubbed on hair and small pieces of paper.
 - **Magnetic Force:** The force exerted by magnets on magnetic materials or other magnets, like the attraction or repulsion between the poles of two magnets.

Q2: Define force and explain its effects with two examples from everyday life.

Definition of Force:



Effects of force



Force is a push or a pull that can start, stop, or change the motion of an object. It can change the speed or direction of an object's movement or even change its shape.

Effects of Force:

- A force can start a stationary object to move.
- It can stop a moving object by opposing its motion.
- It can change the speed of a moving object, either speeding it up or slowing it down.
- It can change the direction of the moving object.
- Sometimes, force can also change the shape of an object, such as bending or stretching it.

Examples from everyday life:

- Pushing a door: When you push a door, you apply a force that causes the door to open or close. Without this force, the door would remain still.
- Sitting in a car: When a car moves around a corner, you feel a push against the seat. This force acts on your body to change its direction along with the car.

Q3: What is friction? Why is it called a contact force? Explain its role in our daily activities with examples.

What is Friction?



Friction is a force that resists the motion of one surface moving over another. It always acts opposite to the direction of motion or attempted motion.

Why is it called a contact force?

- Friction is called a contact force because it occurs only when two surfaces are physically touching each other. The force arises from the microscopic roughness and interaction between the surfaces at their point of contact.
- **Role of Friction in daily life with examples:**
- **Walking:** When we walk, friction between our shoes and the ground prevents us from slipping and helps us move forward safely.
- **Writing with a pencil:** Friction between the pencil tip and paper allows the pencil to leave marks and write.
- **Stopping a vehicle:** The brakes of a vehicle use friction to slow down and stop the wheels.
- **Holding objects:** Friction between our hands and objects prevents them from slipping out of our grasp.

Without friction, many daily activities would become difficult or impossible, such as walking, driving, or



holding things.

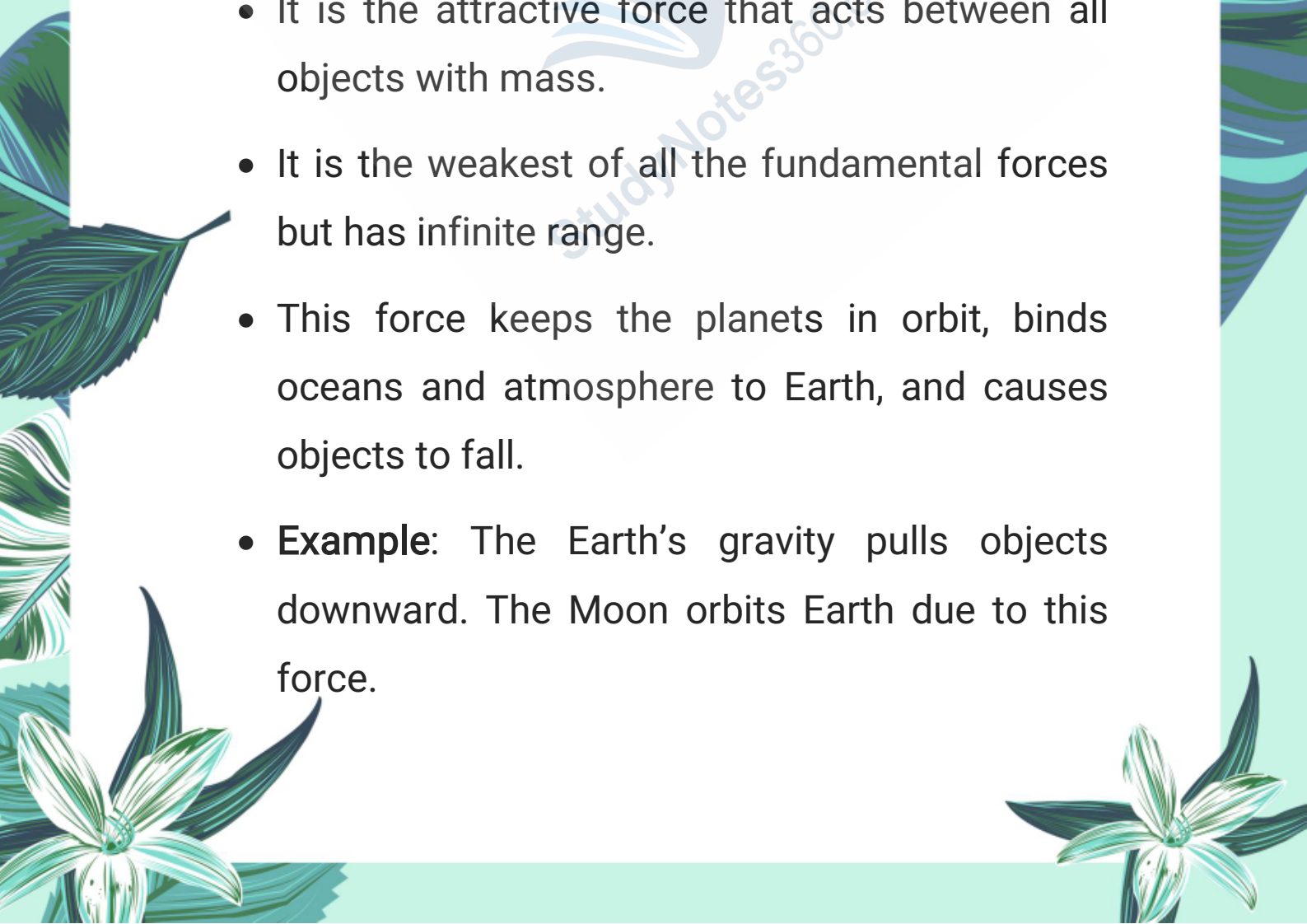
Q4: What are the four fundamental forces of nature? Describe each force in detail with examples.



Answer:

The universe is governed by four fundamental forces which are responsible for all physical interactions. These forces are:

(i) Gravitational Force:

- It is the attractive force that acts between all objects with mass.
 - It is the weakest of all the fundamental forces but has infinite range.
 - This force keeps the planets in orbit, binds oceans and atmosphere to Earth, and causes objects to fall.
 - **Example:** The Earth's gravity pulls objects downward. The Moon orbits Earth due to this force.
- 



(ii) Electromagnetic Force:

- This force acts between electrically charged particles.
- It includes both electric and magnetic forces.
- It is much stronger than gravitational force and also has an infinite range.
- This force is responsible for chemical bonding, electricity, magnetism, and friction.
- **Example:** When a balloon is rubbed on hair, it attracts paper due to static electricity. Magnets attract iron due to magnetic force.


(iii) Strong Nuclear Force:

- It is the strongest of all four forces but has a very short range (around 10^{-15} meters).
- It binds protons and neutrons together inside the atomic nucleus.
- It overcomes the repulsive electromagnetic force between positively charged protons.
- **Example:** The nucleus of a helium atom



remains stable due to the strong nuclear force.

(iv) Weak Nuclear Force:



- 
- It is responsible for radioactive decay, especially beta decay of neutrons.
 - It is weaker than electromagnetic and stronger than gravitational force.
 - Its range is very short (around meters).
 - **Example:** In beta decay, a neutron changes into a proton, emitting an electron and an antineutrino due to weak nuclear force.

Q5: Differentiate between strong nuclear force and weak nuclear force. Explain their role in atomic structure.

1. Strong Nuclear Force:

Definition:

It is the strongest force in nature that acts between nucleons (protons and neutrons) inside the nucleus.





- **Range:**

Very short range (about 1 femtometre 1×10^{-15} m).



Strength:

Strongest among the four fundamental forces in nature.

Nature:

It is always attractive in nature.

Function/Role in Atom:

It holds protons and neutrons tightly together in the nucleus despite the electrostatic repulsion between positively charged protons.

2. Weak Nuclear Force:

Definition:

A force responsible for certain types of nuclear decay, such as beta decay.

Range:

Even shorter than strong nuclear force.





Even shorter than strong nuclear force.

Strength:

Weaker than strong nuclear force and electromagnetic force, but stronger than gravitational force.

Nature:

Can be both attractive and repulsive.

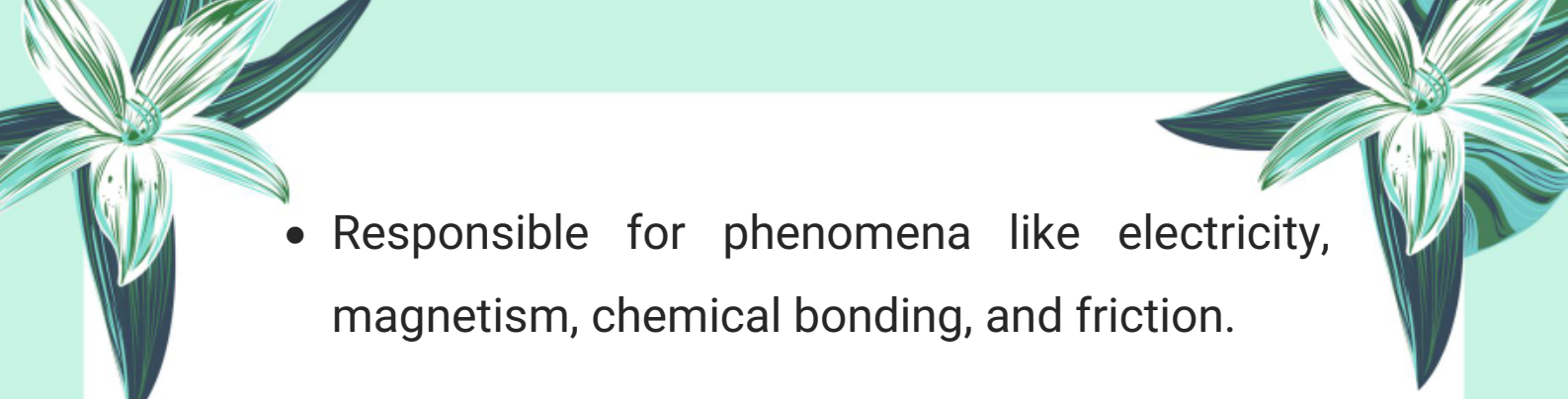
Function/Role in Atom:

It plays a key role in radioactive decay and nuclear fusion processes in the sun and stars. It changes one type of subatomic particle into another (like neutron into proton).


Q6: What is electromagnetic force? How does it differ from gravitational force? Discuss with examples.

Answer:

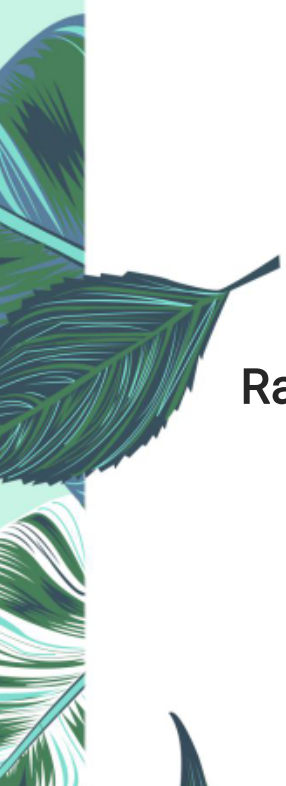
- Electromagnetic Force:
- Acts between electrically charged particles.
- Includes both electric and magnetic forces.

- 
- Responsible for phenomena like electricity, magnetism, chemical bonding, and friction.
 - It can be attractive or repulsive.

Range: Infinite.

- 
- **Strength:** Much stronger than gravitational force.
 - **Example:** When you rub a plastic pen on your clothes and it attracts bits of paper.

Gravitational Force:

- 
- Acts between masses, regardless of charge.
 - It is always attractive.
 - Responsible for free fall, orbits of planets, and weight.

Range: Infinite.

- **Strength:** Weakest of all forces.
- **Example:** Apple falling from a tree due to Earth's gravity.

Comparison:



2. Difference Between Electromagnetic Force and Gravitational Force

Property	Electromagnetic Force	Gravitational Force
Acts on	Charged particles	Masses only
Nature	Attractive or repulsive	Only attractive
Strength	Much stronger	Weakest
Range	Infinite	Infinite
Examples	Friction, electricity, magnetism	Falling objects, orbits

Q7: What is Newton's First Law of Motion? Explain with examples. Also define inertia.

Definition: Newton's First Law of Motion states:

> "A body continues in its state of rest or of uniform motion in a straight line unless acted upon by an external force."


This law is also known as the Law of Inertia.

Explanation: This means that an object will not change its motion by itself. If it is at rest, it will stay at rest. If it is moving, it will continue to move in the same direction and speed unless some external force (like friction or push) changes its state.



Examples:

1. **Passenger in a bus:** When a moving bus stops suddenly, passengers tend to move forward. This is because their bodies were in motion and wanted to remain in motion even though the bus stopped.



2. **Ball rolling on the ground:** A ball rolling on a smooth floor eventually stops due to friction. If there were no friction, it would keep moving forever.

Definition of Inertia:

> “Inertia is the property of a body to resist a change in its state of rest or of uniform motion.”

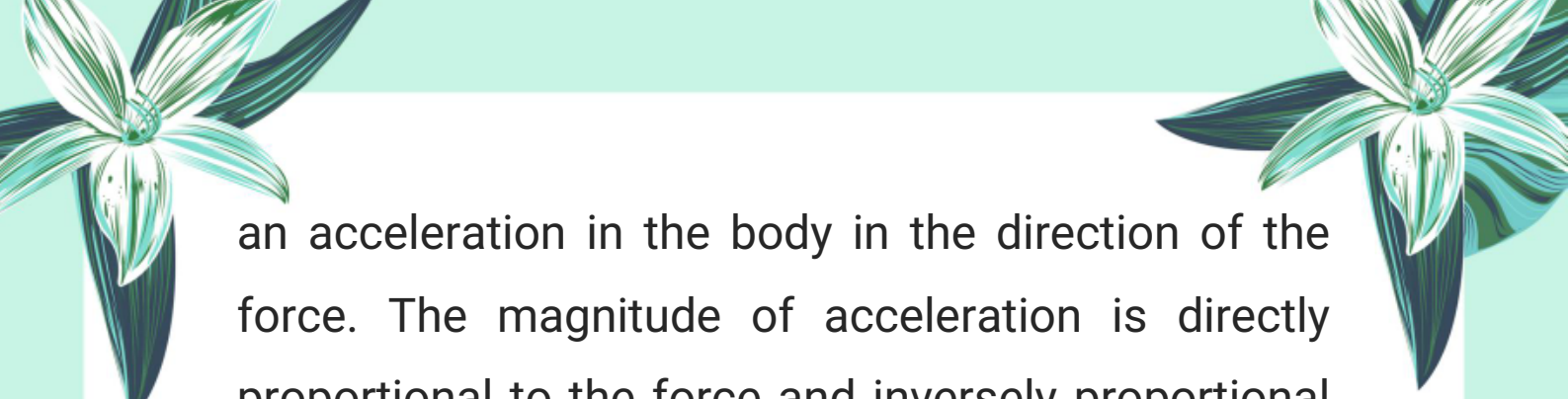
The greater the mass of an object, the greater its inertia. That’s why a truck resists motion more than a bicycle.

Q8: State and explain Newton’s Second Law of Motion. Derive the relation $F = ma$ and define one newton.


Law Statement:

> “If a net external force acts on a body, it produces





an acceleration in the body in the direction of the force. The magnitude of acceleration is directly proportional to the force and inversely proportional to the mass of the body.”



Explanation: This law explains how force affects the motion of a body. A greater force produces greater acceleration. A heavier object (more mass) needs more force to accelerate.

Mathematical Derivation: According to the law:

$$a \propto F \quad \text{and} \quad a \propto \frac{1}{m}$$

Combining both:

$$a = \frac{F}{m} \Rightarrow F = ma$$

This equation shows that the force applied is equal to the product of mass and acceleration.

Definition of One Newton:

> “One newton is the force which produces an acceleration of 1 m/s^2 in a body of mass 1 kg .”

$$1\text{N} = 1 \text{ kg} \times 1 \text{ m/s}^2 = 1 \text{ kg} \cdot \text{m/s}^2$$

SI Unit of Force: Newton (N)



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Q9: How does Newton's Second Law explain the effect of force on the velocity of a body?

Explanation: Newton's Second Law shows that force causes acceleration, which is the rate of change of velocity. Hence, applying a force can change the velocity of an object.

1. If a force increases the speed, the object accelerates (positive acceleration).
2. If a force decreases the speed, the object decelerates (negative acceleration).
3. If a force changes the direction, the velocity changes even if speed stays constant (because velocity is a vector).

So, force changes the magnitude, direction, or both of the velocity of a body. **For example:**


- A football kicked in a new direction changes its velocity.
- A car slowing down at a red light experiences deceleration.



**Q10: What is Newton's Third Law of Motion?
Explain it with two daily life examples.**

Law Statement:

> "For every action, there is an equal and opposite reaction."

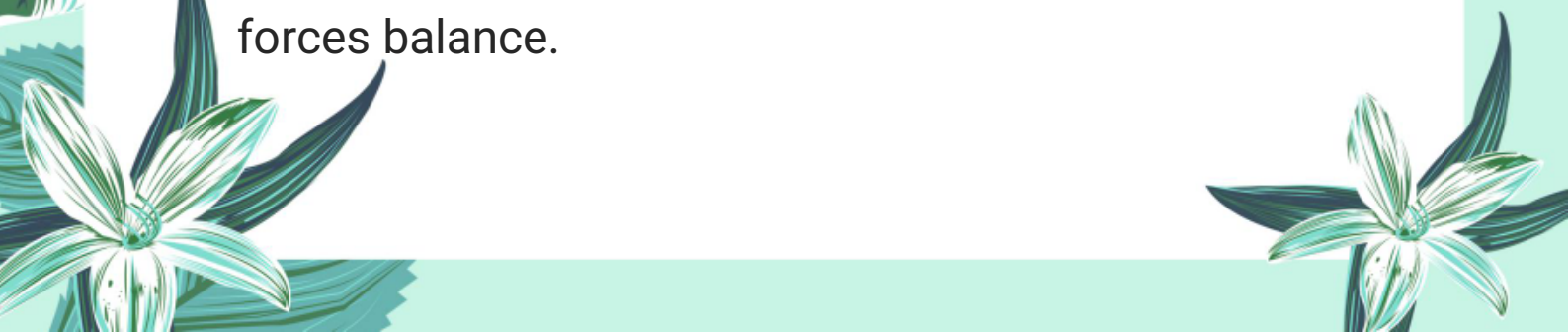


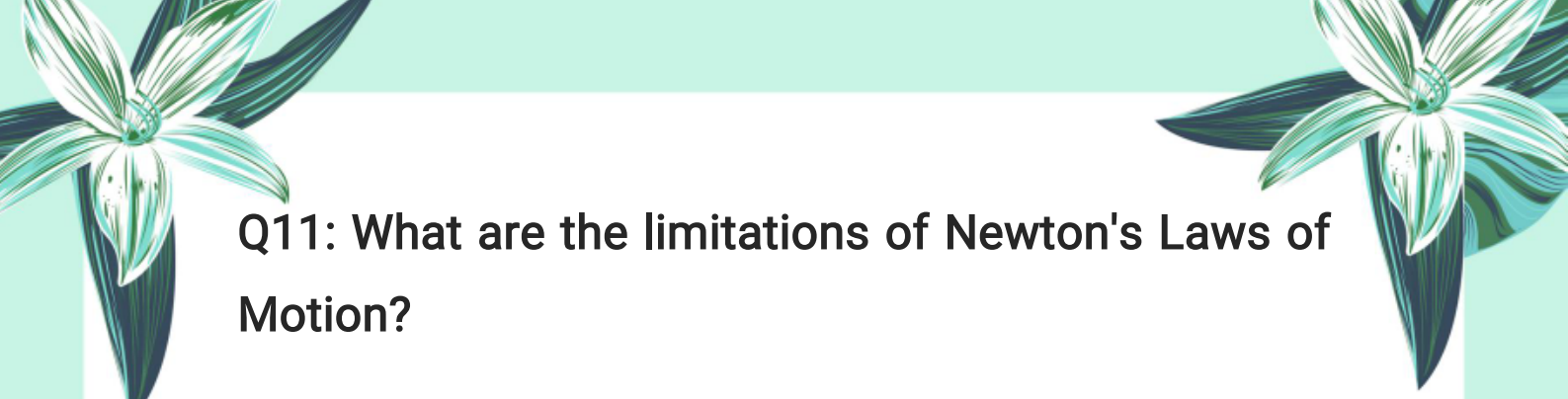
Explanation: This law means that forces always act in pairs. When one object exerts a force on another, the second object exerts a force of the same magnitude but in the opposite direction on the first object.

Examples:

1. Gun and bullet: When a bullet is fired forward (action), the gun recoils backward (reaction). Both forces are equal in magnitude and opposite in direction.


2. Book on table: A book placed on a table exerts a downward force equal to its weight (action). The table exerts an equal upward force on the book (reaction). The book stays at rest because the forces balance.





Q11: What are the limitations of Newton's Laws of Motion?

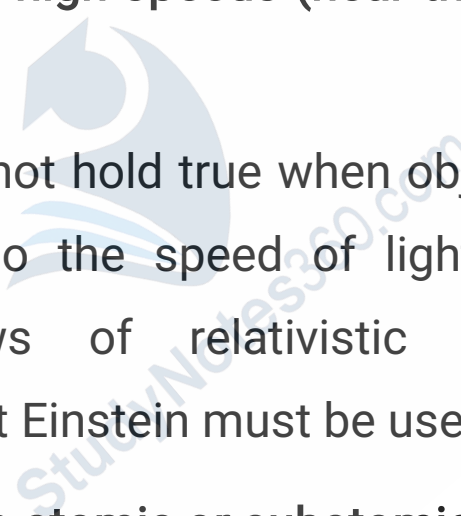
Answer:



Newton's Laws of Motion are very accurate and applicable to most everyday situations. However, they are not universal and have certain limitations.

Limitations:

1. Not valid at very high speeds (near the speed of light):



Newton's laws do not hold true when objects move at speeds close to the speed of light. At such speeds, the laws of relativistic mechanics developed by Albert Einstein must be used instead.

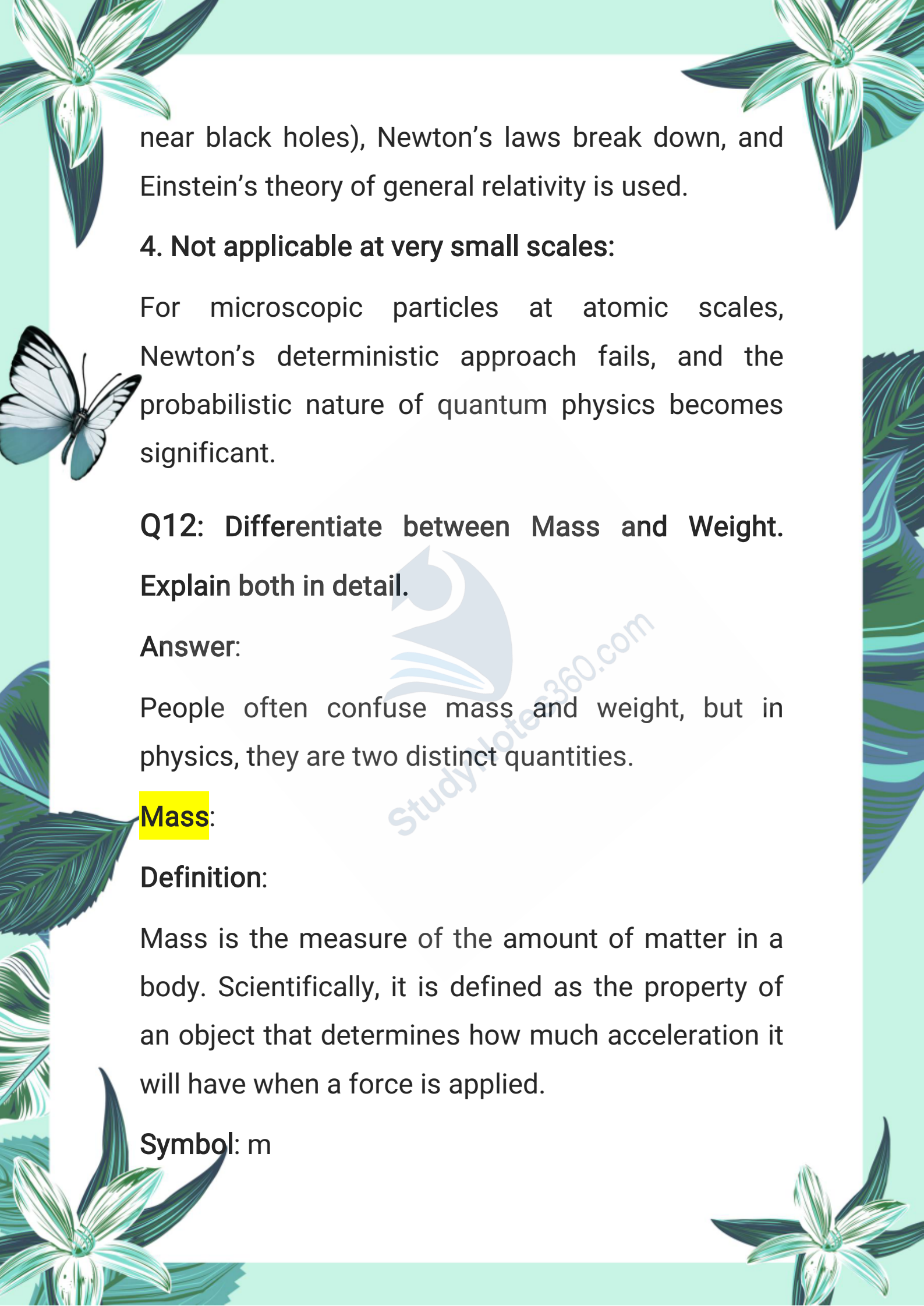
2. Not applicable to atomic or subatomic particles:

When dealing with elementary particles like electrons or protons, Newton's laws fail to describe their motion correctly. Instead, quantum mechanics is required.

3. Not suitable for very strong gravitational fields:

In extremely strong gravitational fields (such as



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near black holes), Newton's laws break down, and Einstein's theory of general relativity is used.

4. Not applicable at very small scales:

For microscopic particles at atomic scales, Newton's deterministic approach fails, and the probabilistic nature of quantum physics becomes significant.

Q12: Differentiate between Mass and Weight.

Explain both in detail.

Answer:

People often confuse mass and weight, but in physics, they are two distinct quantities.

Mass:

Definition:

Mass is the measure of the amount of matter in a body. Scientifically, it is defined as the property of an object that determines how much acceleration it will have when a force is applied.

Symbol: m



SI Unit: kilogram (kg)

Nature: Scalar quantity (has magnitude only, no direction)

Constant: Mass remains the same everywhere in the universe.



Measurement Tool: Ordinary balance

Weight:

Definition:

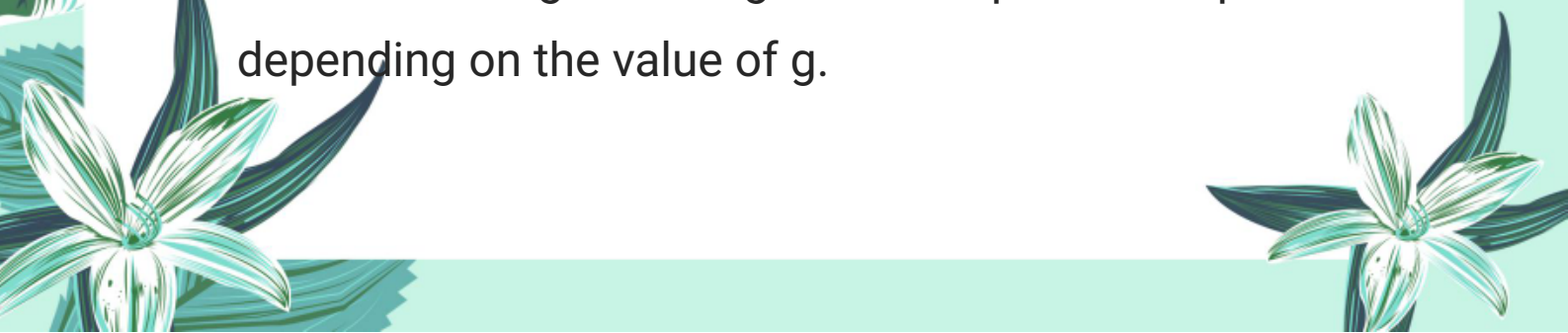
Weight is the gravitational force with which the Earth attracts a body towards its center. It depends on both the mass of the object and the gravitational field strength.

Formula:

- Weight (W) = $m \times g$
- **SI Unit:** Newton (N)

Nature: Vector quantity (has both magnitude and direction)

Variable: Weight changes from place to place depending on the value of g.



Measurement Tool: Spring balance

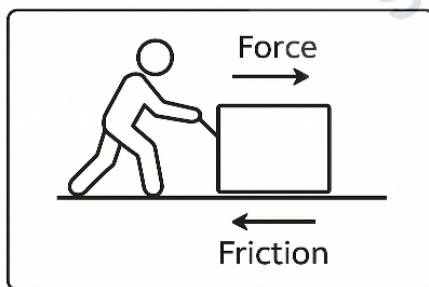
Gravitational Field:

- The space around a mass where another mass experiences a gravitational force is called the gravitational field.
- The strength of the field is defined as the force acting on unit mass and is denoted by g .

On Earth, $g \approx 10 \text{ N/kg}$.

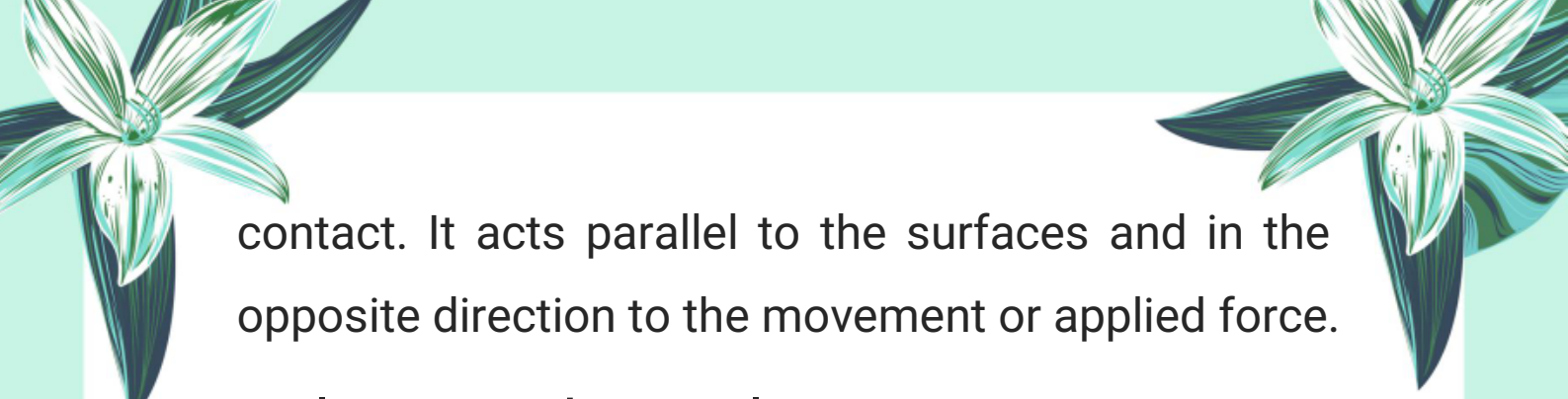
Q13: Define friction. Explain with an example how friction acts as a force opposing motion.

Friction acts as a force opposing motion as shown below.




Definition of Friction:

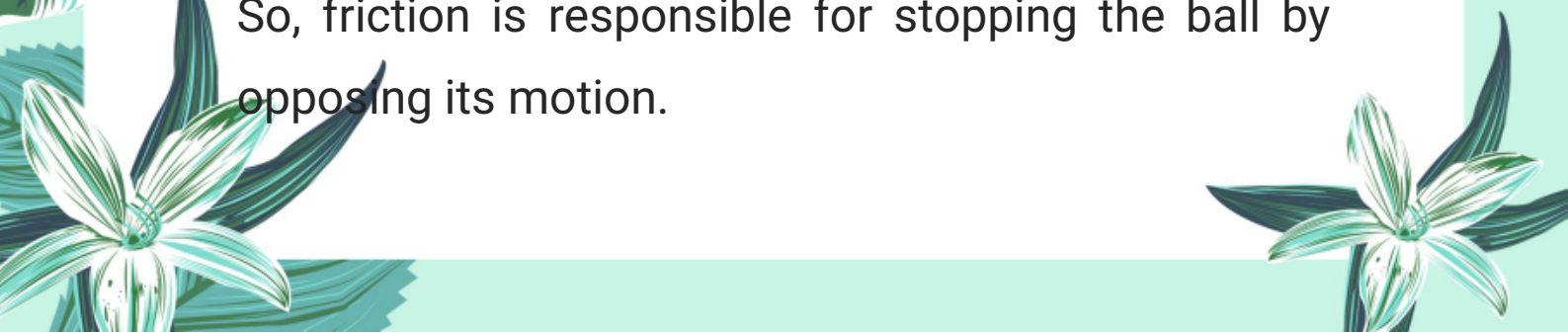
Friction is a force that opposes the relative motion or tendency of motion between two surfaces in



contact. It acts parallel to the surfaces and in the opposite direction to the movement or applied force.

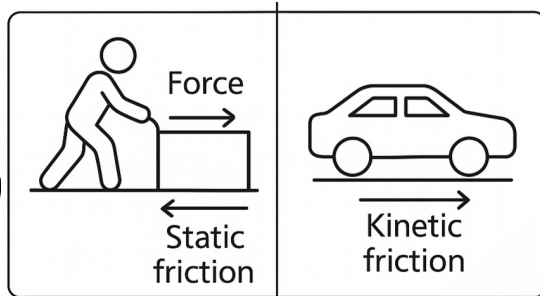
Explanation with Example:

- 
- When a cricket ball is hit by a bat, it moves forward on the ground with a certain velocity. According to **Newton's first law** of motion, the ball should continue moving indefinitely with the same speed and in the same direction unless acted upon by an external force.
 - **However, in reality, the cricket ball** gradually slows down and eventually stops after covering some distance. This happens because of the force of friction between the ball and the ground. Friction acts opposite to the direction of motion of the ball, opposing its movement. This force slows down the ball by converting its kinetic energy into heat energy, causing it to stop.



So, friction is responsible for stopping the ball by opposing its motion.

Q14: Differentiate between static friction and kinetic friction with the help of a diagram and suitable examples.

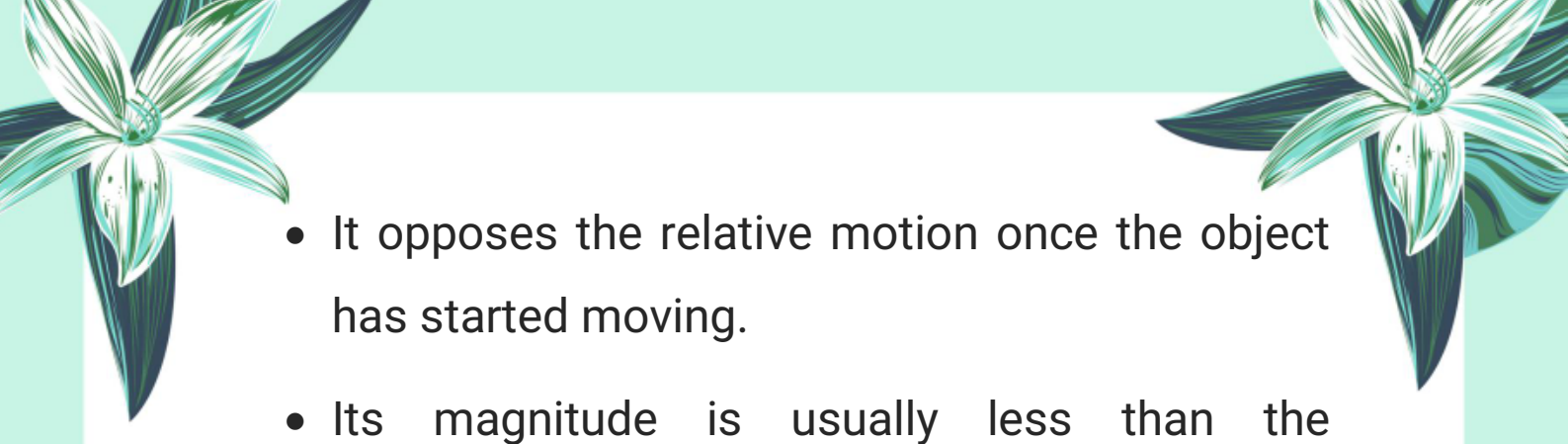


Static Friction:

- Static friction acts between two surfaces that are in contact but not moving relative to each other.
- It prevents the initiation of motion.
- It adjusts its magnitude to match the applied force up to a certain maximum limit.
- **Example:** A block resting on a table remains stationary because static friction acts to resist any force trying to move it.

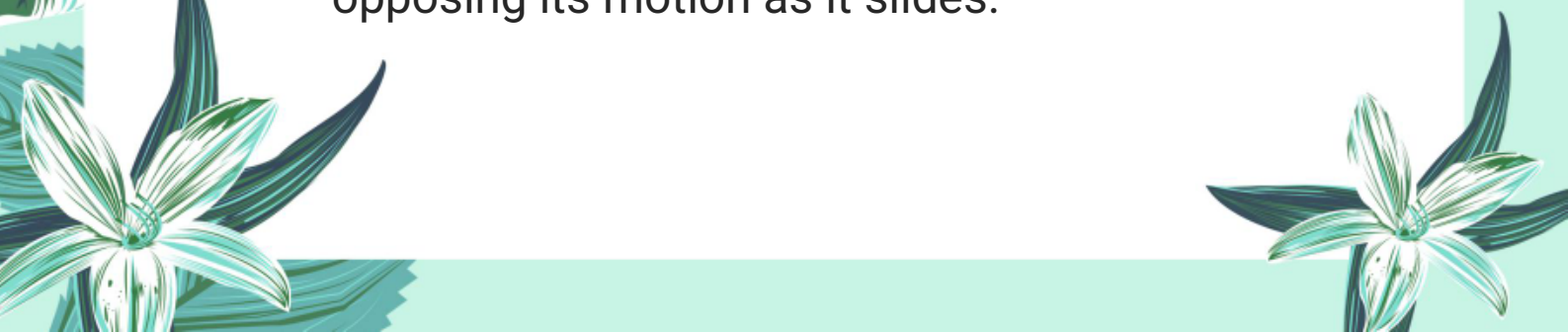
Kinetic Friction (or Sliding Friction):

- Kinetic friction acts between two surfaces sliding past each other.

- 
- It opposes the relative motion once the object has started moving.
 - Its magnitude is usually less than the maximum static friction.
 - Example: Once the block starts sliding on the table, kinetic friction acts to oppose its motion.



Example with a Block on a Table:

- Imagine a block placed on a horizontal table connected to a string over a pulley with weights hanging on the other side.
 - Initially, when small weights are added, the block does not move because static friction opposes the pulling force exactly.
 - As more weights are added gradually, the pulling force increases.
 - When the force exceeds the maximum static friction, the block starts sliding.
 - Now, kinetic friction acts on the block, opposing its motion as it slides.
- 

C Constructed Response Questions

3.1 Ice Skaters and Newton's Third Law:

Given:

Mass of Skater A = 60 kg, Velocity = 4 m/s

Mass of Skater B = 80 kg, Velocity = ?

Explanation: According to Newton's Third Law of Motion,

> "For every action, there is an equal and opposite reaction."

When the skaters push off against each other, both apply equal and opposite forces. As a result, both move in opposite directions with velocities inversely proportional to their masses (Law of Conservation of Momentum).


Using momentum conservation: Initial momentum = 0

Final momentum = $(60 \text{ kg} \times 4 \text{ m/s}) + (80 \text{ kg} \times V_2) = 0$


$$\Rightarrow 240 + 80V_2 = 0$$

$$\Rightarrow V_2 = -3 \text{ m/s}$$

Conclusion:



The 80 kg skater moves with 3 m/s in the opposite direction, confirming Newton's Third Law. The law applies perfectly – action and reaction forces are equal and opposite.


3.2 Airbags and Momentum:

Explanation: When a car crashes, the momentum of passengers needs to be reduced to zero.

Seatbelt alone:

- Brings the body to a sudden stop
- Force acts over a short time
- Higher chance of injury due to large force

Airbags:

- Increase the time over which the momentum reduces to zero
 - Reduce the force acting on the body
 - Protect head, chest, and neck by cushioning
- 

the impact

3.3 Horse and Cart Paradox:

Horse's Argument:

"Force I apply on cart = force cart applies on me \Rightarrow
Net force = 0 \Rightarrow No movement"

Why this is wrong:

- The action-reaction forces act on different objects, not on the same body.
- For the horse to move, it pushes the ground backward with its hooves.
- Ground reacts by pushing the horse forward (Newton's 3rd Law), allowing it to move and pull the cart.

3.4 Catching a Cricket Ball – Why Draw Hands Backward?

Explanation:

When the fielder catches the ball:

- Ball has high momentum
- Stopping it suddenly = large force

- Pulling hands backward increases the stopping time

According to the impulse-momentum relation:

- Force \times Time = Change in Momentum
- \Rightarrow If time increases, force decreases

3.5 Jumping from a Boat – Why Do People Fall?

Explanation:

- Jumping forward from the boat applies a force backward on the boat
- Boat reacts by moving backward
- If the person doesn't jump with proper speed or balance, the boat slips away

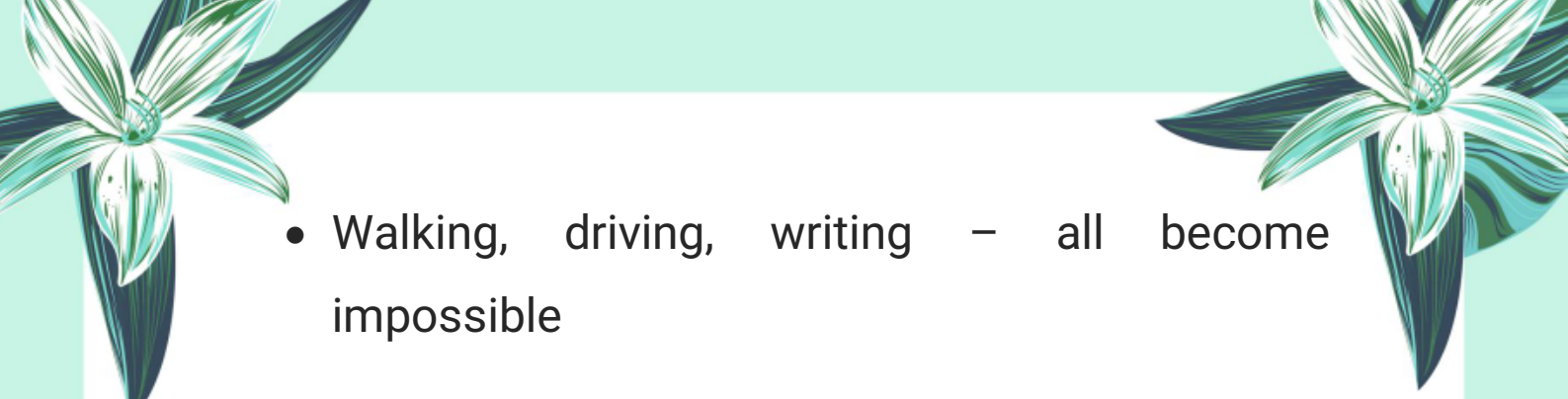
Result:

Person may miss the river bank and fall into the water.

3.6 What If Friction Suddenly Disappears?

Explanation: Friction plays a critical role in daily life.

- If friction vanishes

- 
- Walking, driving, writing – all become impossible
 - Vehicles can't stop or turn
 - Nails and screws won't hold
 - Machines will slip and fail
 - Heating from rubbing (like hands or brakes) won't occur
 - No grip in shoes, tools, tires

D Comprehensive Questions

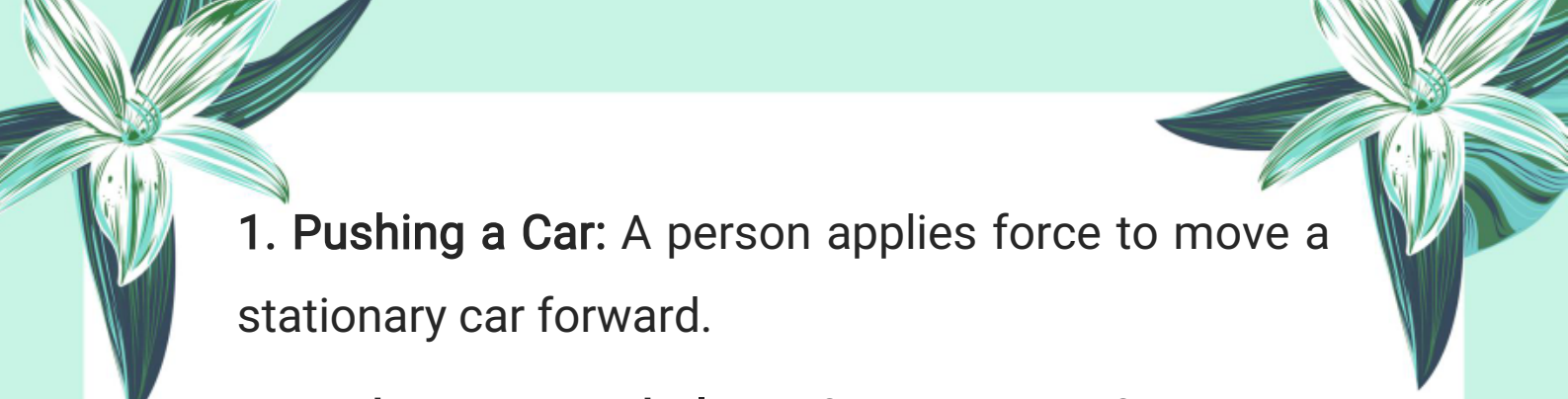
Q3.1: Explain the concept of force by practical examples.

Definition:

- Force is a push or pull that changes the state of rest or motion of a body.
- It can also change the shape or direction of an object.


Practical Examples:





1. **Pushing a Car:** A person applies force to move a stationary car forward.

2. **Kicking a Football:** A foot applies force that changes the motion and direction of the ball.



3. **Opening a Drawer:** A pull force is used to slide the drawer open.

4. **Pressing a Sponge:** Changes its shape due to applied force.

Q3.2: Describe Newton's laws of motion.

Answer:

1. Newton's First Law (Law of Inertia):

An object remains at rest or in uniform motion unless acted upon by an external force.

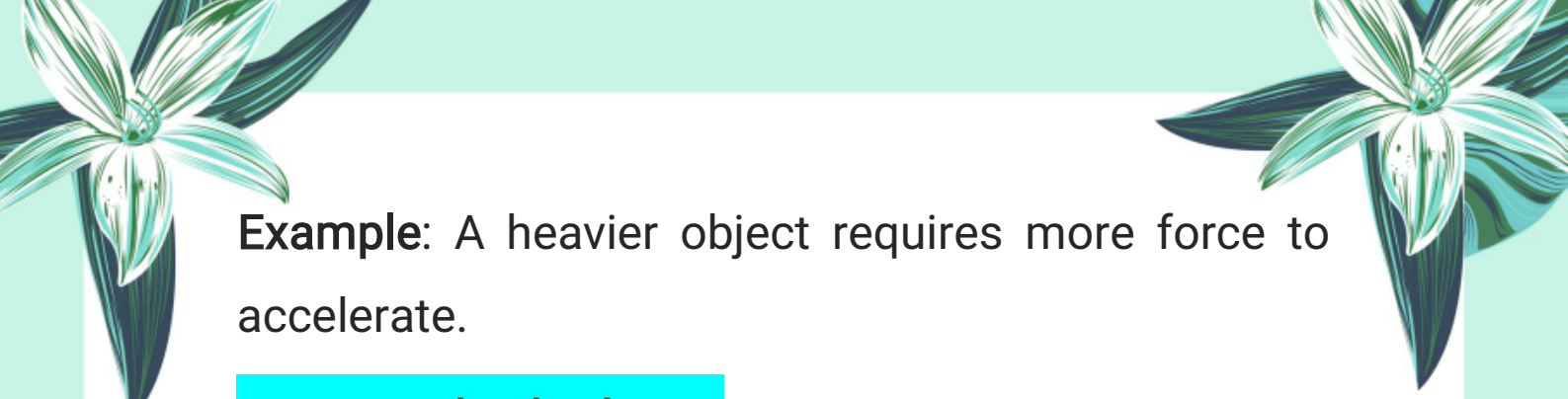
Example: A ball remains still on the ground until someone kicks it.

2. Newton's Second Law:

Force is directly proportional to the rate of change of momentum (or acceleration).

Formula: $F = ma$






Example: A heavier object requires more force to accelerate.

3. Newton's Third Law:

For every action, there is an equal and opposite reaction.



Example: When you jump off a boat, it moves backward.

Q3.3: Define momentum and express Newton's 2nd law in terms of change in momentum.

Definition of Momentum:

Momentum is the product of mass and velocity of a body.

Formula:

$$p = m \times v$$

Newton's Second Law in Momentum Form:

Force is equal to the rate of change of momentum.

$$F = \Delta p / \Delta t = (mv - mu) / t$$

Where:

m = mass






u = initial velocity

v = final velocity

t = time

Δp = change in momentum



Q3.4: State and explain the principle of conservation of momentum.

Answer:

Statement:

In a closed system with no external force, the total momentum before and after an event remains constant.

Formula:


$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

Explanation:

When two objects interact, like colliding or pushing apart, their combined momentum stays the same.

Example:

Two ice skaters push each other and move in opposite directions. Their total momentum before






and after pushing remains zero.

Q3.5: Describe the motion of a block on a table with friction. Define static and kinetic friction.

Answer:

Description:

- 
- A block on a table resists motion due to friction.
 - As we increase the pulling force:
 - At first, the block does not move \Rightarrow static friction is acting.
 - After a certain force, the block starts moving 'n static friction reaches its maximum.
 - Once the block moves, kinetic friction takes over and opposes motion.

Types of Friction:

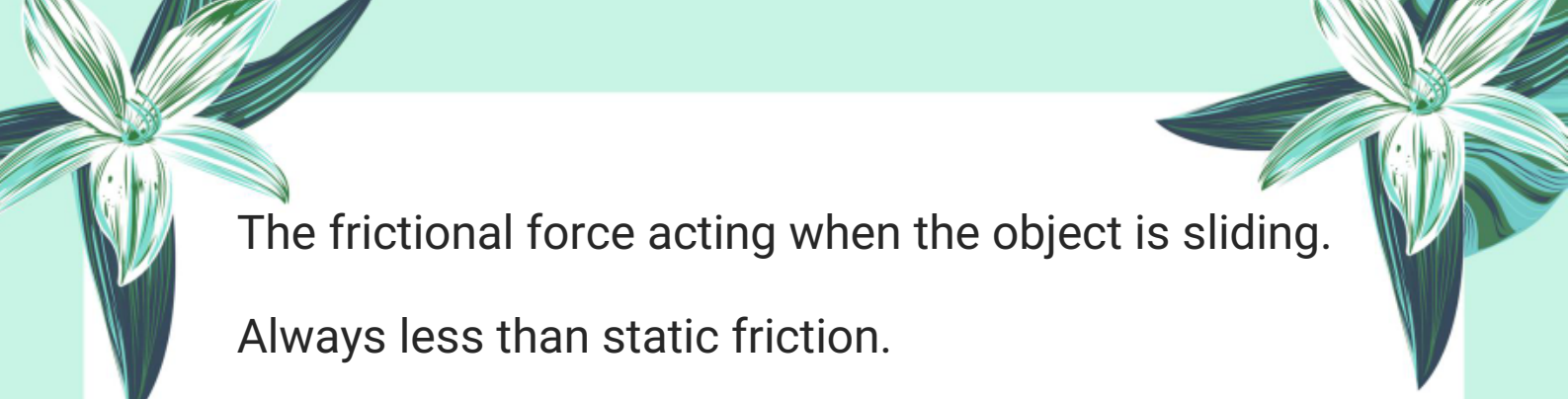
1. Static Friction:

The frictional force that prevents the start of motion.

Acts when object is at rest.

2. Kinetic Friction:





The frictional force acting when the object is sliding.
Always less than static friction.

Q3.6: Explain the effect of friction on the motion of vehicles in context of tyre surface and braking force.



Answer:

1. Tyre Surface:

- Friction between tyre and road provides grip for motion and turning.
- Worn-out tyres reduce friction, leading to skidding and accidents.

2. Braking Force:

- When brakes are applied, friction helps stop the wheels.
- Stronger the friction, quicker the stop.
- On wet or icy roads, less friction \Rightarrow braking becomes ineffective.

3. Summary:

- Proper tyre tread and road contact are crucial
- 





for vehicle control.

- Controlled braking depends on the frictional force between tyre and road.

Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

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Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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