FORCE AND MOTION

Force: This push or pull acting on an object is known as a force.

BALANCED AND UNBALANCED FORCE

Inertia:

Inertia is the tendency of objects to stay at rest or to keep moving with the same velocity.

Inertia ∝ Mass of the object

If The Mass increases, then the Inertia increase and vise versa.
Thus all objects do not resist a change in their state of rest or motion equally.
Massive objects resist more than lighter ones. We can say that mass is a measure of inertia.

Eg for Inertia :
1. Passengers falling in the backward direction when the bus starts suddenly.
2. Passengers falling forward as the moving bus stops suddenly

Newton's First Law of Motion:

Every body continues in its state of rest or of uniform motion in a straight line until unless it is compelled by some unbalanced force to change that state.

Newton's first **law of motion tells us that all bodies resist a change in their state of motion.**
We know that this property of bodies is called inertia.
That is why, Newton's first law of motion is also known as **the law of inertia.**

Eg for First law :
1. Passengers falling in the backward direction when the bus starts suddenly.
    When the bus starts suddenly, the feet start moving with the bus. But the upper part of the passengers tries to remain at rest due to inertia and tends to fall in the backward direction.
2. Passengers falling forward as the moving bus stops suddenly.
             When the bus stop suddenly, the feet also stop with the bus. But the upper part of the passengers tries to remain in motion due to inertia and tends to fall in the forward direction.

Momentum(p): is a measurement of mass in motion: how much mass is in how much motion.
It is usually given the symbol 'p 'momentum, p of a moving body is defined as the product of its mass, **m** and velocity,

That is **p = mv**

it refers to the quantity of motion that an object has. **Or the impact of a moving object.**

Newton's second law of motion:

"Rate of change of momentum of a body is directly proportional to the **force acting** on it and takes place in the same direction as the force. "
F = ma
Suppose the velocity of an object of mass **m** changes from **u** to **v** in time **t** by the application of a constant force **F.**

Initial momentum of the object will be p1 = mu
Final momentum of the object will be p2 = mv

change in momentum in time t = p2 – p1.
F∝ (p2 – p1)/t
F ∝(mv – mu)/t   (v-u)/t=ace-a
F ∝m(v-u)/ t
F ∝ma
F =K*ma

We choose the unit of force in such a manner that the value of k becomes one.
For this define one unit of force as that amount which produces an acceleration of 1 m/s2 in an object of 1kg mass.
So that: 1 unit of force = k (1 kg) × (1 ms-2)

Thus, the value of constant k becomes 1.

F = ma

Example of Second Law of Motion

1. While catching a fast-moving cricket ball, why does a fielder move his hands backward?

By doing so the fielder increases the time duration in which the momentum of the ball becomes zero .
As the rate of change of momentum decreases, a small force is required for holding the catch.
 So the hands of the fielder do not get hurt.

2. Why does a person get hurt when he falls on a cemented floor?

Just before touching the floor, the person has some initial velocity, say **u,** which becomes **zero** when he comes to re
Thus the momentum of the person becomes zero within a very short time.
 As the rate of change of momentum is very high, so very large force is exerted on the person, thereby hurting him.

3. How does a karate player break a pile of tiles or a slab of ice with a single blow?

In doing so the entire momentum of the hand is reduced to zero in a very short time. As a result, the force delivered on the tiles or slab of ice is large enough to break it.

20	State Newton's second law of motion. Using this law derive the unit of force. A person pushes a box of mass 50 kg with a force of 80 N. Calculate the acceleration of the box due to this force. न्यूटन का गति का द्वितीय नियम बताइए। इस नियम का उपयोग करके बल के मात्रक की व्युत्पत्ति कीजिए। एक व्यक्ति 50 kg द्रव्यमान के एक सन्दूक को 80 N के बल से धकेलता है। इस बल के कारण सन्दूक का त्वरण परिकलित कीजिए।	4

$F=ma$
  $=Kg\ m/S2$ or N.
$1N= 1Kg$ with acceleration of $1m/s2$
$F=80N$
$M=50Kg$
$F=m*a$
$80=50*a$
$a=80/50=1.6m/s2$

12 Naseem was enjoying a 'Karate' show. He wonders, how does the karate player break a pile of tiles with a single blow ? Help him to understand the scientific principle behind this act.   2

नसीम कराटे का प्रदर्शन देख रहा था । वह यह देख कर चकित था कि कराटे का खिलाड़ी एक ही प्रहार से टाइल्स के स्तम्भ को कैसे तोड़ देता है । आप किस प्रकार उसे इससे संबंधित वैज्ञानिक सिद्धान्त को समझने में सहायता करेंगे ?

The karate player hits the pile of tiles or a slab of ice as fast as possible with her hand. In doing so the entire momentum of the hand is reduced to zero in a very short time. As a result, the force delivered on the tiles or slab of ice is large enough to break it.

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

Example of Third Law of Motion

1. A swimmer pushes the water backwards with hands to move in forward direction.
2. rockets and jet-planes also work on the principle of action and reaction.

Conservation of Momentum:

If two or more objects collide with each other, their total momentum remains conserved before and after the collision provided there is no external force acting on them.

M1 V1 M2 V2 $M1*V1=M2*V2$

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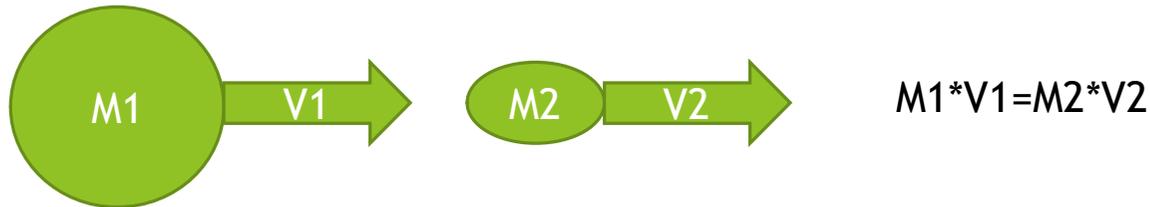
15. State Newton's third law of motion and write its three significant features.   **2**

न्यूटन का गति का तीसरा नियम बताइए और इसके तीन महत्वपूर्ण लक्षण लिखिए।

24 State Newton's third law of motion. Mention its three significant features. **4**
Najma and Surekha are standing on roller-skates 2 m apart facing each other.
Najma throws a packet of 2 kg towards Surekha who catches it. How will this
activity affect the position of the two ? Explain your answer.

न्यूटन का गति का तृतीय नियम बताइए । इसके तीन महत्वपूर्ण लक्षण लिखिए । नजमा और
सुरेखा रोलर-स्केटों पर एक दूसरे के सामने 2 m दूरी पर खड़ी हैं । नजमा 2 kg का एक
पैकेट सुरेखा की ओर फेंकती है जिसे वह लपक लेती है । इस क्रियाकलाप द्वारा इन दोनों
की स्थितियों पर क्या प्रभाव पड़ेगा ? अपने उत्तर की व्याख्या कीजिए ।

21. What is meant by the term momentum ? Give its SI unit. Is it a scalar or a vector **4**
quantity.
A force of 68 N acts on a body and produces an acceleration of 1.7 ms^{-2}. Find the
mass of the body.
संवेग का क्या अभिप्राय है ? इसका SI मात्रक बताइए। क्या यह अदिश अथवा सदिश राशि है?
68 N बल किसी वस्तु पर कार्य करता है और उसमें 1.7 ms^{-2} का त्वरण उत्पन्न करता है। वस्तु का द्रव्यमान
ज्ञात कीजिए।

F= 68 N
A=1.7

F=ma
m= F/a
    =68/1.7

FRICTION:

Friction is the resistance of motion when one object rubs against another.
Anytime two objects rub against each other, they cause **friction.**
Friction works against the motion and acts in the opposite direction.

- Friction exists between the surfaces of all materials which are in contact with each other.
  The direction of the frictional force is **always in a direction opposite to the motion**.

- The resistive force, before the body starts moving on a surface is called **static friction**.
- Once a body starts moving on a surface the friction between them is called **sliding or kinetic friction**.
- You should remember that the **sliding friction is slightly less than the static friction.**
- By using the ball bearing the sliding friction is replaced by **rolling friction.**
  As the rolling friction is less than the sliding friction, therefore,
  the friction between the moving parts is reduced.

Factors affecting friction:

1. **smoothness** of the surfaces is one of the factor on which friction depends.
2. friction also depends upon the **normal reaction**(reaction of the surface on the box against the action of its weig
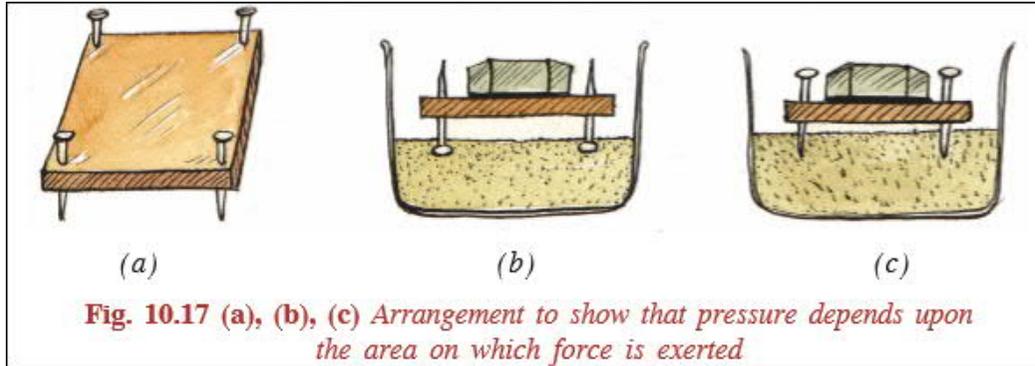
14. Differentiate between static and kinetic friction. State two factors on which the force of friction depends. 2

स्थैतिक तथा गतिज घर्षण के बीच अन्तर बताइए । दो कारकों के नाम बताइए जिन पर घर्षण बल निर्भर करता है ।

Advantages of friction	Disadvantages of friction
The force of friction developed between the soles of your shoes and the ground helps us to move.	energy is wasted in the form of heat that causes wear and tear of the moving parts of a machine
You can write with a pen on page or with a chalk on the blackboard due to friction.	reduces efficiency of the machines as considerable amount of energy is wasted in overcoming friction
you could not fix a nail on the wall.	
friction between tires and surface of the road.	

THRUST AND PRESSURE :
The **force** acting upon the surface of a body **perpendicular** to it is called **thrust.**

Fig. 10.17 (a), (b), (c) *Arrangement to show that pressure depends upon the area on which force is exerted*

The thrust on unit area is called **pressure.**
Pressure =thrust/ area

SI unit of pressure is **Nm-2**
This unit has also been given a specific name **pascal (Pa)**