



Most Trusted Learning Platform



Generic drug vs

Branded drug

Patent over

Abc drug

10

Trial

Sell

2-7 yrs

Simple

Approval

Time

Cost

Research and dev

Trial

Approval

Marketing

(X) → company

Abc

→ animals

→ humans

India → Pharmacy of World

100

Exclusive Right

Patent

20 yrs

Production

Forces and Velocity

Force: In science, a push or a pull on an object is called a force. It can also be stated as an external agent which can cause change in the state or shape of any object.

Speed & velocity: Speed is the time rate at which an object is moving along a path, while velocity is the rate and direction of an object's movement. Put another way, speed is a scalar value, while velocity is a vector. For example, 50 km/hr (31 mph) describes the speed at which a car is traveling along a road, while 50 km/hr west describes the velocity at which it is traveling.

→ Forces

→ Frictional force

→ laws of motion

Speed

Velocity

acceleration

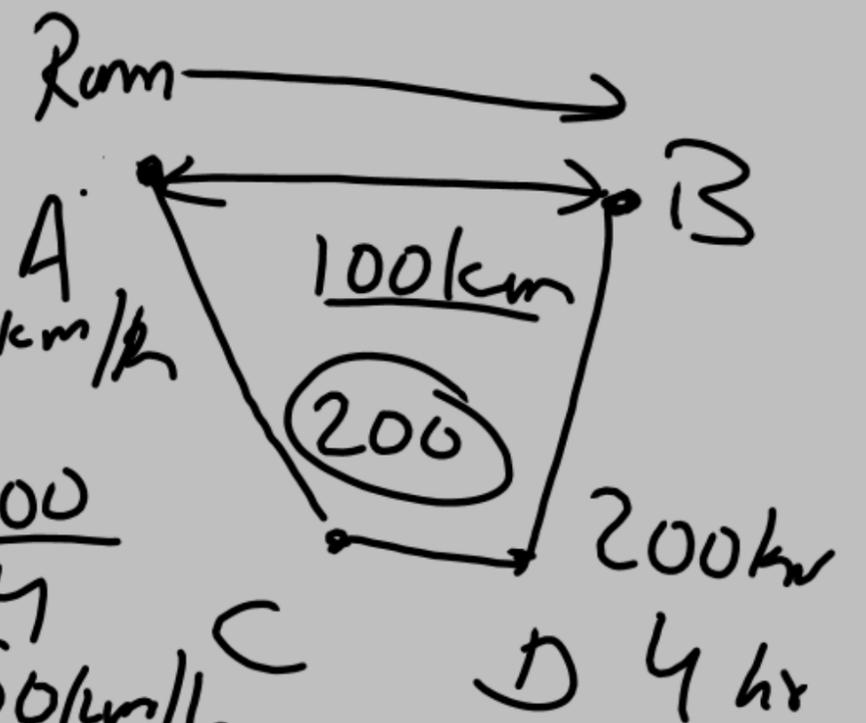
(Vs)

$$= \frac{100}{4} = 25 \text{ km/h}$$

$$\rightarrow \text{Ram} = 50 \text{ km/h}$$

$$\rightarrow \text{Shyam} = \frac{200}{4}$$

$$= 50 \text{ km/h}$$

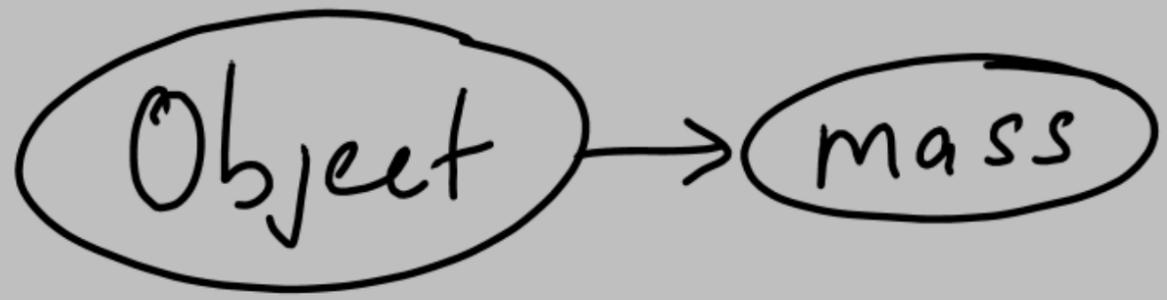


Forces

- Gravitational force
 - Strong nuclear force
 - Weak Nuclear force
 - Electromagnetic force
- weakest
-

Gravitational force → Tides

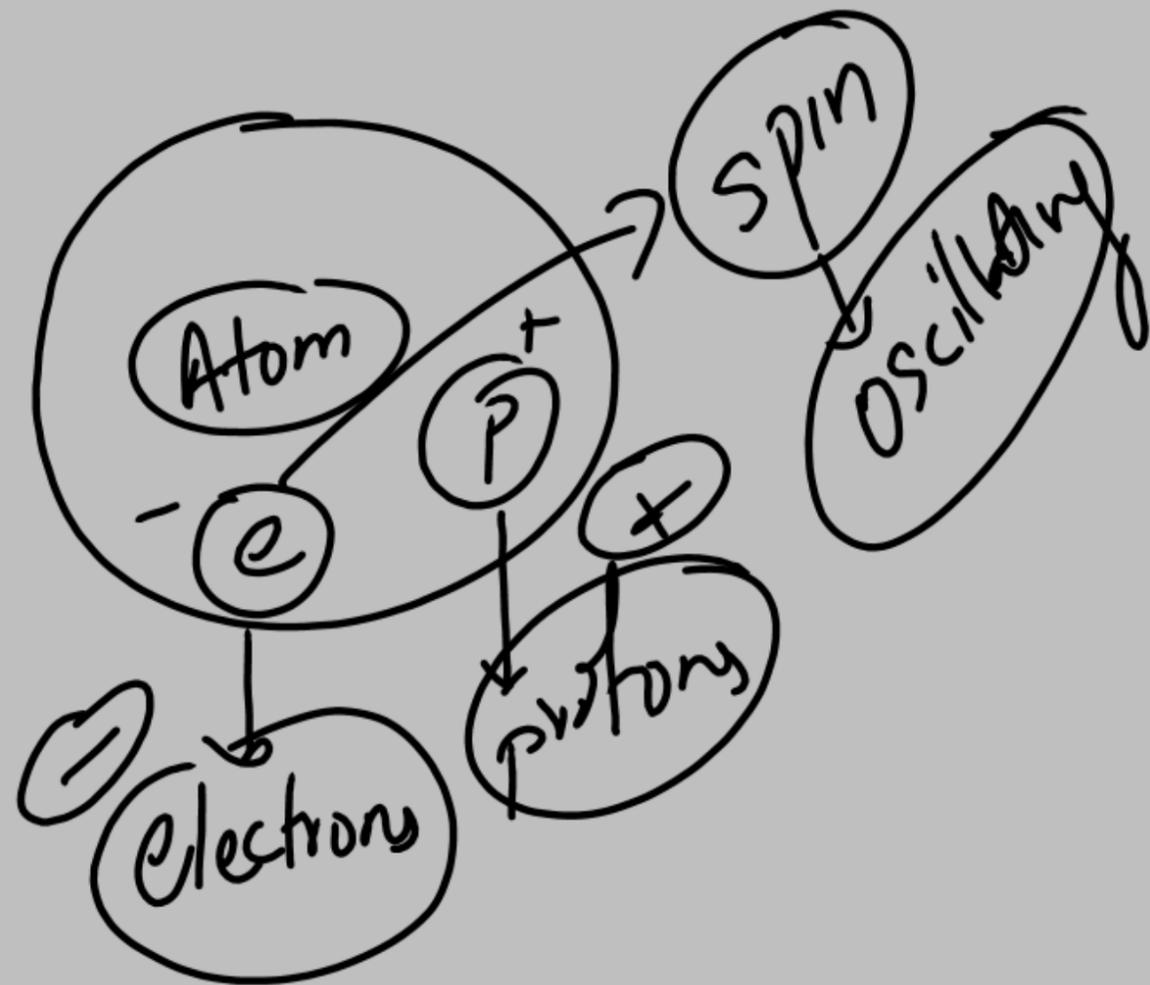
formation of galaxies, solar system, planets, stars, etc



force by virtue of mass

weakest force in nature

→ Existence of atmosphere on earth → force of attraction



Electromagnetic force

electric and magnetic forces exerted by charged particles

Responsible for stability of atoms.

uneven spins of electrons
Magnetic

Iron
Nickel

- quarks
- up ✓
- down
- Top
- bottom
- charm
- strange

Strong Nuclear force

force binding quarks together

Weak Nuclear force

Nuclear



proton

Proton
neutron



N



neutron

quarks

making of P & N

force changing the flavour of quarks

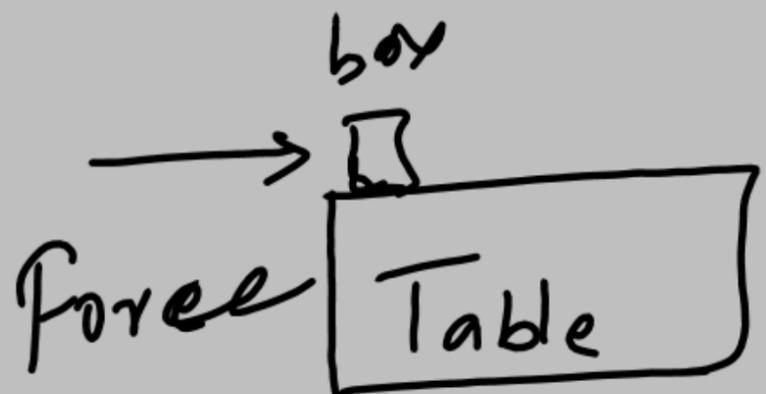


Proton

Fundamental forces of nature

- ① Strong NF → exist at nuclear level formation of matter
- ② Weak NF
- ③ Electromagnetic force → force b/w charged particles
large
- ④ Gravitational force → force of attraction b/w two objects due to mass.
large extent

Frictional force



Surface is not smooth



↳ opposes the movement of any object.
Acts only when particle is trying to move/moving

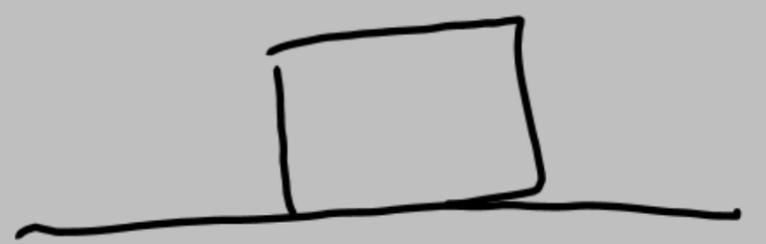


Walking → friction
→ writing → "
→ Breaks in
Vehicle

150mls
↓
0mls
100
50m
0

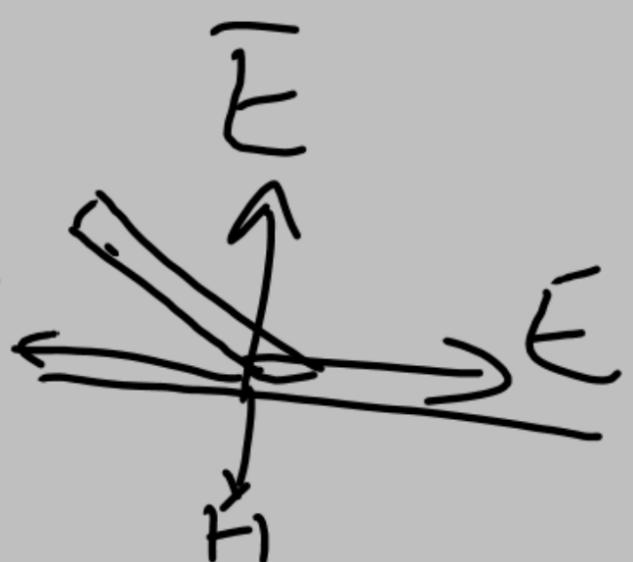
1st law

↳ state of Inertia

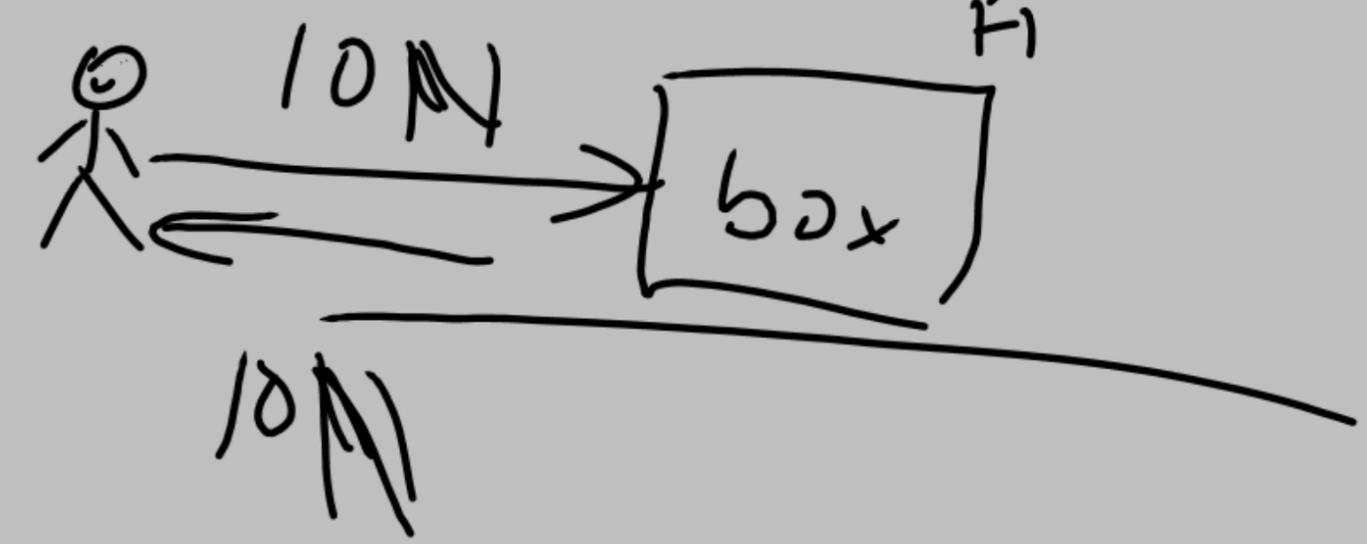


2nd law

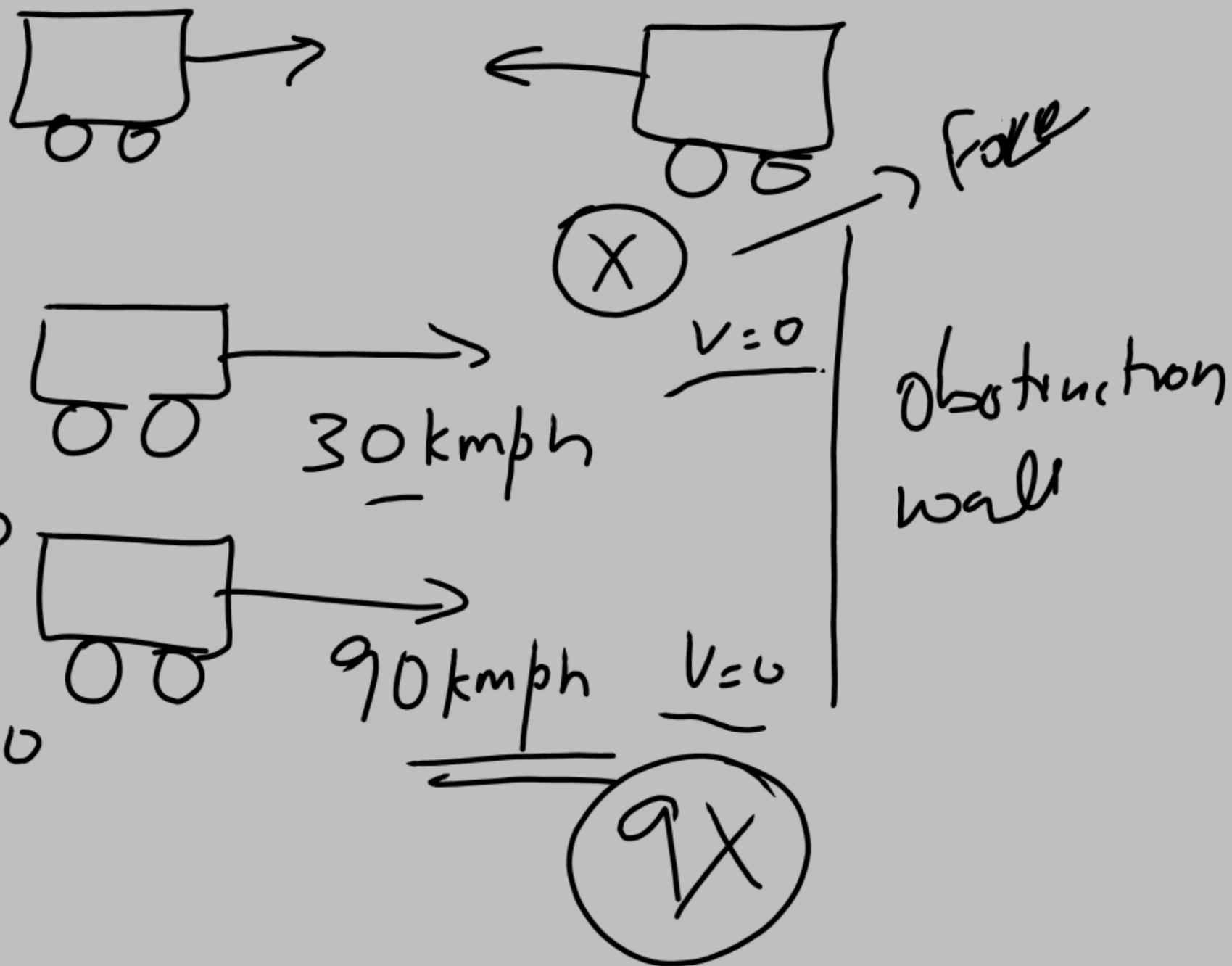
$\Rightarrow F \propto a_H$

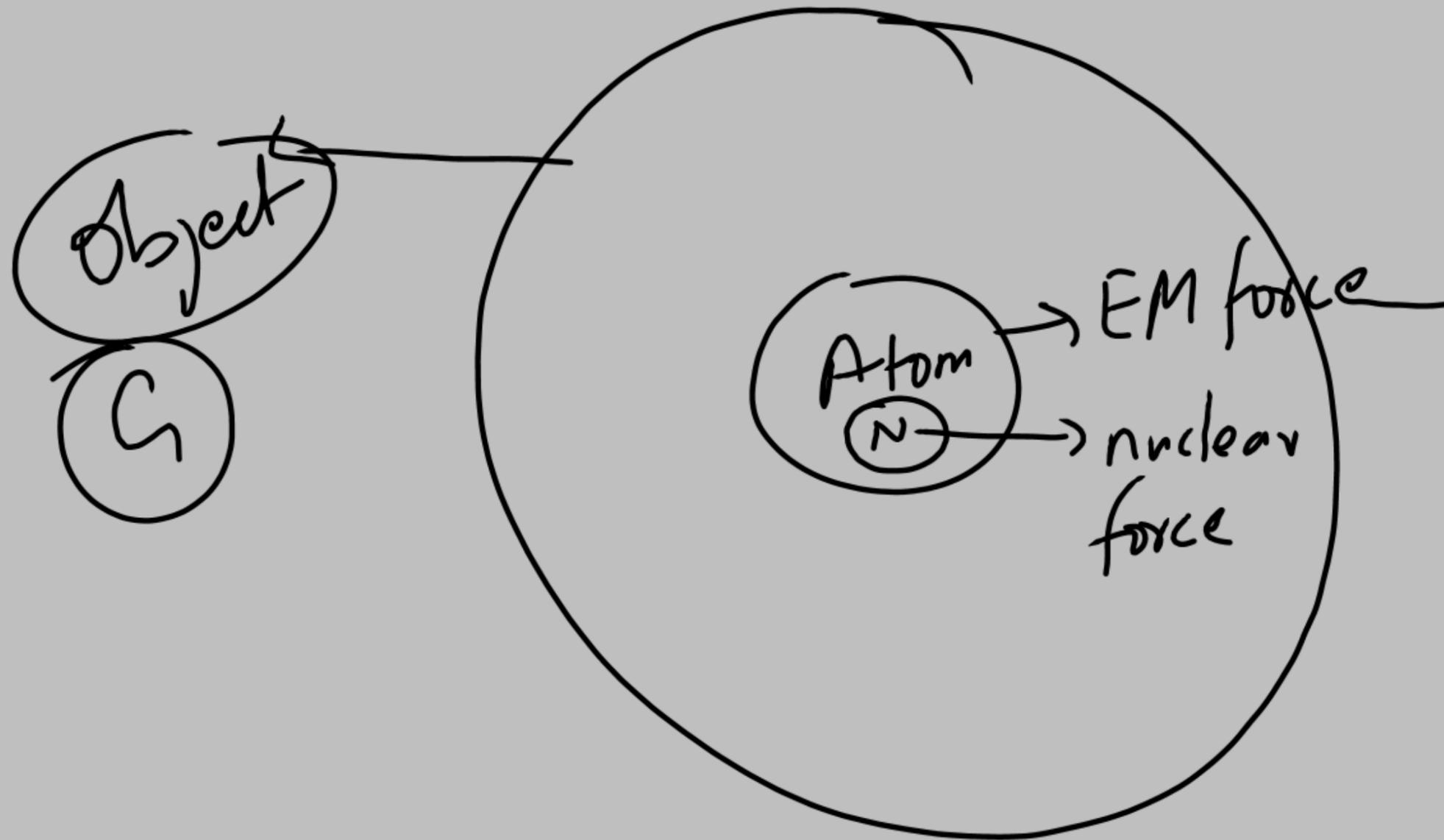


3rd law



$$\begin{aligned}
 \text{KE} &= \frac{1}{2} m v^2 \\
 &= v^2 \\
 &= 30^2 = 900 \\
 &= 90^2 = 8100
 \end{aligned}$$





Forces and Velocity

Acceleration: It is the rate at which velocity changes with time, in terms of both speed and direction. A point or an object moving in a straight line is accelerated if it speeds up or slows down. Motion on a circle is accelerated even if the speed is constant, because the direction is continually changing. For all other kinds of motion, both effects contribute to the acceleration. Because acceleration has both a magnitude and a direction, it is a vector quantity.

Forces and Velocity

Types of Forces:

The Four Fundamental Forces of Nature are

Gravitational force, Weak Nuclear force, Electromagnetic force and Strong Nuclear force.

The Four Fundamental Forces and their features

Gravitational Force – It is the weakest force in Nature but it has infinite range.

Weak Nuclear Force – It is the next weakest force but it has short range.

Electromagnetic Force – It is comparatively stronger force and at the same time it has infinite range.

Strong Nuclear Force – It is considered as the strongest force in nature but it has short range.

Forces and Velocity

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Forces and Velocity

Gravitational force: Gravity, also called gravitation, in mechanics, the universal force of attraction acting between all matter. It is by far the weakest known force in nature and thus plays no role in determining the internal properties of everyday matter.

On the other hand, through its long reach and universal action, it controls the trajectories of bodies in the solar system and elsewhere in the universe and the structures and evolution of stars, galaxies, and the whole cosmos.

On Earth all bodies have a weight, or downward force of gravity, proportional to their mass, which Earth's mass exerts on them. Gravity is measured by the acceleration that it gives to freely falling objects.

At Earth's surface the acceleration of gravity is about 9.8 metres (32 feet) per second per second. Thus, for every second an object is in free fall, its speed increases by about 9.8 metres per second.

Forces and Velocity

Examples of Gravitation:

- The force that holds the gases in the sun.
- The force that causes a ball you throw in the air to come down again.
- The force that keeps the Earth and all of the planets in line in the proper position in their orbits around the sun.
- The force that causes the moon to revolve around the Earth.
- The force from the moon that causes the tides of the ocean.
- The force that keeps you walking on Earth instead of floating away into space.

Forces and Velocity

Weak & Strong Nuclear Force:

The effects of the weak force were first discovered at the turn of the 20th century, in the place where it is most obviously at work: in radioactive beta decay.

In the most common form of this decay, beta-minus decay, a neutron decays into a proton, also spitting out a negatively charged electron in order to conserve electric charge; beta-plus decay does the reverse and turns protons into neutrons.

To understand what this, and the weak force, is all about, we first need to mention the strong nuclear force. The strong force binds the fundamental particles known as quarks together to form particles such as the protons and neutrons of the atomic nucleus.

Forces and Velocity

Weak & Strong Nuclear Force:

Protons and neutrons are both composites of three quarks of two types, or “flavours”, up and down. Protons have the configuration up-up-down, and neutrons up-down-down.

So if the strong force binds quarks together, it becomes apparent that the weak force allows them to change flavour: for example switching a down quark to an up quark or vice versa in beta decay

It sounds quirky, but it is far from irrelevant: only the action of the weak force changing protons into neutrons within a star like the sun allows nuclear fusion to get off the ground within its core at all. The burning of stars – and so the existence of life – depends on the weak force.

Forces and Velocity

Electromagnetic Force:

The term electromagnetism combines the electric and magnetic forces into a single word because both forces are due to the same underlying phenomenon. “Charged” particles generate electric fields, and positive and negative charges react to that field differently, which explains the force we observe. For electric interactions, positively charged particles (like protons) push away positively charged particles and attract negatively charged ones (like electrons), and vice versa. Electric field lines spread directly outward from positive electric charges, and this pushes particles in the direction of – or in the opposite direction to – the field lines.

Forces and Velocity

Magnetism comes from magnetic fields, which are generated by moving charges. Particles don't respond to magnetic fields in the same way as they do to electric fields. Magnetic field lines form circles, with no beginning or end. In response to them, particles move in a direction perpendicular to both their motion and the field line. As with electric forces, positively charged particles and negatively charged ones move in opposite directions.

The electromagnetic force is the second strongest force in nature. The strong nuclear force is the strongest, electromagnetic forces are 137 times less powerful, the weak nuclear force is a million times smaller, and gravity is much, much smaller than the rest (about 6×10^{-39} times weaker than the strong nuclear force).

Forces and Velocity

Laws of Motion:

1st Law of Motion

An object remains in a state of rest or of uniform motion in a straight line unless compelled to change that state by an applied force.

In other words, all objects resist a change in their state of motion. In a qualitative way, the tendency of undisturbed objects to stay at rest or to keep moving with the same velocity is called inertia. This is why, the first law of motion is also known as the law of inertia.

Forces and Velocity

Certain experiences that we come across while travelling in a motorcar can be explained on the basis of the law of inertia. We tend to remain at rest with respect to the seat until the driver applies a braking force to stop the motorcar. With the application of brakes, the car slows down but our body tends to continue in the same state of motion because of its inertia.

When a motorcar makes a sharp turn at a high speed, we tend to get thrown to one side. This can again be explained on the basis of the law of inertia. We tend to continue in our straight-line motion. When an unbalanced force is applied by the engine to change the direction of motion of the motorcar, we slip to one side of the seat due to the inertia of our body.

Forces and Velocity

2nd Law of Motion:

The second law states that the acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object. The acceleration of an object depends directly upon the net force acting upon the object, and inversely upon the mass of the object. As the force acting upon an object is increased, the acceleration of the object is increased. As the mass of an object is increased, the acceleration of the object is decreased.

Forces and Velocity

Examples:

While catching a fast moving cricket ball, a fielder in the ground gradually pulls his hands backwards with the moving ball? In doing so, the fielder increases the time during which the high velocity of the moving ball decreases to zero. Thus, the acceleration of the ball is decreased and therefore the impact of catching the fast moving ball is also reduced. If the ball is stopped suddenly then its high velocity decreases to zero in a very short interval of time. Thus, the rate of change of momentum of the ball will be large. Therefore, a large force would have to be applied for holding the catch that may hurt the palm of the fielder.

In a high jump athletic event, the athletes are made to fall either on a cushioned bed or on a sand bed. This is to increase the time of the athlete's fall to stop after making the jump. This decreases the rate of change of momentum and hence the force.

Forces and Velocity

3rd Law of Motion: The third law of motion states that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first. These two forces are always equal in magnitude but opposite in direction. These forces act on different objects and never on the same object.

In other words, to every action there is an equal and opposite reaction. However, it must be remembered that the action and reaction always act on two different objects, simultaneously.

Example: When we are walking, we push the road below us in backward direction and the road exerts an equal amount of force on us in the forward direction thus helping us to move.

Forces and Velocity

It is important to note that even though the action and reaction forces are always equal in magnitude, these forces may not produce accelerations of equal magnitudes. This is because each force acts on a different object that may have a different mass. When a gun is fired, it exerts a forward force on the bullet. The bullet exerts an equal and opposite force on the gun. This results in the recoil of the gun. Since the gun has a much greater mass than the bullet, the acceleration of the gun is much less than the acceleration of the bullet.

Another example: Launching a rocket relies on Newton's Third Law of Motion. A rocket engine produces thrust through action and reaction. The engine produces hot exhaust gases which flow out of the back of the engine. In reaction, a thrusting force is produced in the opposite reaction.

Forces and Velocity

Frictional Force: The force of friction always acts on all the moving objects and its direction is always opposite to the direction of motion.

Frictional force is the opposing force that is created between two surfaces that try to move in the same direction or that try to move in opposite directions. The main purpose of a frictional force is to create resistance to the motion of one surface over the other surface. The frictional force depends on the body surface textures.

Friction is caused by the irregularities on the two surfaces in contact. Even those surfaces which appear very smooth have a large number of minute irregularities on them. Irregularities on the two surfaces lock into one another. When we attempt to move any surface, we have to apply a force to overcome interlocking. On rough surfaces, there are a larger number of irregularities. So the force of friction is greater if a rough surface is involved

Forces and Velocity

When friction is highest? In moving body or static body?

The force required to overcome friction at the instant an object starts moving from rest is a measure of static friction. On the other hand, the force required to keep the object moving with the same speed is a measure of sliding friction. When the box starts sliding, the contact points on its surface, do not get enough time to lock into the contact points on the floor. So, the sliding friction is slightly smaller than the static friction.

Forces and Velocity

ABS Braking:

ABS or an Anti-Lock Braking System is a piece of safety equipment that prevents the wheels of a vehicle from locking up under emergency, panic, or harsh braking conditions.

In case of sudden braking, there is a possibility of an immediate loss of traction between the tyres and the road surface. This can cause tyres to skid. The situation becomes worse when all this happens uncontrollably. In such a case, the vehicle continues to be in motion, and the loss of grip may result in the driver or the rider losing control over the steering of the vehicle. This may, in turn, lead to an accident. That's where an ABS comes to the rescue!

Forces and Velocity

How does Anti-Lock Braking System work?

The working of an Anti-Lock Braking System or ABS includes the following processes:

In a vehicle, wheel speed sensors are located on the wheels that monitor the speed of each wheel. The electronic control unit (ECU) reads the signal from each sensor. After the speed sensors detect that the speed of any of the wheel(s) is reducing drastically compared to others, the ECU sends the signal to the valves of the respective wheel(s) to reduce the brake pressure, and the valves get closed.

After this, the wheels start to accelerate again, and the signal is sent to the ECU one more time, which in turn sends the signal to open the valve and increase the brake pressure, and hence, brakes are applied.

The cycle repeats itself until the application of brakes becomes normal.

UPSC



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THANKS FOR WATCHING

