INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD ISSN: 2455-0620 Volume - 6, Issue - 5, May – 2020
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.497
Received Date: 04/05/2020 Acceptance Date: 15/05/2020 Publication Date: 31/05/2020

Study of Force and Effect of Force in Daily Life

Nirjar Vrind
M.Sc. Student, University department of physics
T.M.B.U.BHAGALPUR BIHAR-812007
Email- nirjarvrind9931@gmail.com

Abstract: *We will know here, what is force? How can we explain force theoretically and mathematically? How does force depend on momentum? How the force is vector quantity? We also know here the effect of force in daily life. We will know here about the different types of force. The whole above mentioned things is included in details in this article.*

Key Words: *Body, Force, Newton, Mass, Vector.*

1. INTRODUCTION:

Peoples have been studying about force for many moons ago. 'Archimedes'' and 'Aristotle' had some assumptions about force which has fallen down by 'Newton' in 17th century. 'Albert Einstein' a great German scientist gave the theory of relativity by which the world obtained the modern accreditation of force. In physics, force is a vector quantity (i.e, it has magnitude as well as a certain direction) by which any object can change their velocity.

Force can cause distortion or rotation of any 3-D body and can also responsible to change in pressure.

When the angular velocity changes with force then it is called torque or angular force.

In nature there are four fundamental force:-

- Gravitational force
- Electromagnetic force
- Strong nuclear force
- Weak nuclear force

Note- The unit of force is Newton given in the honor of Sir Isaac Newton.

2. MATHEMATICAL INTRODUCTION :

The mathematical definition of force has been obtained by "Newton's second law of motion". According to this law "the force acts on a body is directly proportional to the rate of change of momentum (i.e, time derivative) of that body. Now therefore,

Force $\propto$ rate of change of momentum

Force = constant× d(momentum)/d(t)

Since, momentum is defined as the product of mass and velocity then,

Force = constant× d(mass×velocity)/dt

Since, "mass of the body" is constant here then,

Force= constant.mass.d(velocity)/dt

Since, time derivative of velocity is called acceleration then,

Force= constant×mass×acceleration

In general the constant present here has the value 1 then,

Force= mass×acceleration

Hence, we can say that the force on a body is the product of mass of the body and velocity of that body.

3. Unit and Dimension of force

1. System International unit or S.I. unit

Force= mass × acceleration

= Kilogram × meter/s^2

= Kg-m/s^2

Since, 1 Newton= 1 kg-m/s^2

Therefore, the special name of S.I unit of force is Newton.

2. Centimeter Gram Second unit or C.G.S unit

Force= gram-cm/s^2

Since, 1 dyne= 1 gm-cm/s^2

Therefore, the special name of C.G.S unit of force is dyne.

Note- 1 Newton= 10^5 dyne

3. Foot Pound Second unit

The F.P.S unit of force is Force-Pound. Pound is defined as the weight and weight is force of gravity.

1 pound force= 4.45 Newton

Dimension-

[Force]= [mass] × [acceleration]

= MLT^{-2}

4. Vector representation of force: Force is a vector quantity i.e. it has magnitude as well as a certain direction.

Although, we can designate a force generally as a number of scalar quantity, it is useful to state it as a vector where we include the direction of force.

Example- In the lieu of saying that the force is 5N, we would say something like the force is 5N away from the floor.

Components of force

- Perpendicular vector components

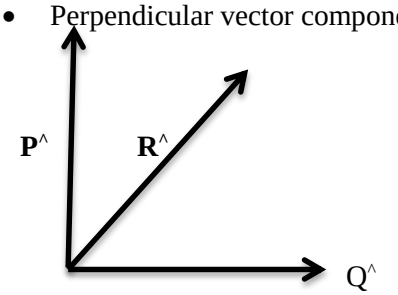

Figure 1: Perpendicular vector component

We can break a force vector into its components. We can understand this by using Pythagorean Theorem ($P^2+Q^2=R^2$) to determine the length of the components.

- Parallelogram vector components

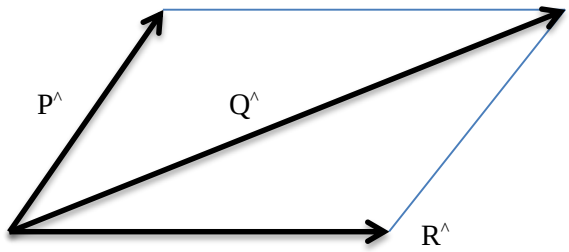

Figure 2: Parallelogram vector component

Force vector can also be broken into parallelogram vector components.

Force as a sum of vectors: We can add two or more force vectors that are the angles with respect to each-other to create a new force vector.

Example- If a ball is moving by applying some force in a given direction and another ball collides with a force on it at an angle the new motion will be as if a force was applied in that direction.

Note- A force vector is represented by an arrow in the direction of the force and with a length proportional to the magnitude of force.

Types of force:

- Centripetal force- When any object moves on a circular path then there is force acts on the center of this circle, this force is called centripetal force.

INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD ISSN: 2455-0620 Volume - 6, Issue - 5, May – 2020
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.497
Received Date: 04/05/2020 Acceptance Date: 15/05/2020 Publication Date: 31/05/2020

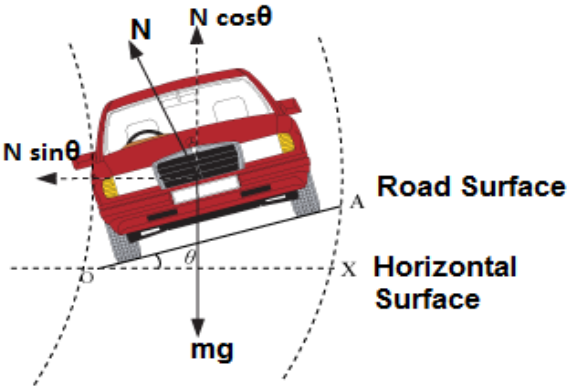

Figure 3: Car on the Curve Path

In the absence of this force a body can never move on the circular path.

The expression of centripetal force is,

$F = mv^2/r$.

- Frictional force- Friction is that force which opposes the relative contact motion between two surfaces. The magnitude of frictional force depends on the normal force between both surfaces.

  The expression of frictional force,

$F = \mu Mg$

Where, μ = coefficient of friction

g= acceleration due to gravity

M= mass of the block.

- Gravitational force- According to Newton's law of gravitation "the force of attraction between two point masses is directly proportional to the product of their masses and inversely proportional to the square of the distance between them".

  According to this law,

m ——————— M

r

$F:- mM/r^2$

$F= -GmM/r^2$

Where G= gravitational constant

$= 6.67\times10^{-11}\ Nm^2/kg^2$

Negative sign shows that the force is attractive.

Note- It is one of the weakest forces in nature. It is 10^{36} times smaller than electric force and 10^{38} times smaller than nuclear force.

- Electromagnetic force- Electromagnetic force includes electrostatic and magnetic force. Electrostatic forces are the force between two static charge and magnetic force are the force between two magnetic poles.

Coulomb's law of electrostatics- According to this law "the force of attraction or repulsion between two point charges is directly proportional to the product of their charges and inversely proportional to the square of the distance between them".

Mathematically,

q ——————— Q

r

$F:- qQ/r^2$

$F= KqQ/r^2$

Where K= constant

q= charge of 1st body

Q= charge of 2nd body
r= distance between these two charges.

Coulomb's law of magnetism- According to this law "the force of attraction or repulsion between two magnetic poles is directly proportional to the product of their strengths and inversely proportional to the square of the distance between them".

m r M

Thus, F:- mM/r^2
F= AmM/r^2
Where, A= constant= $\mu /4pi$
M=m= pole strength
μ = absolute permeability of the medium.

- Nuclear Force- The force acts between the protons and neutrons which is situated in the nucleus of atom is called nuclear force or nucleon-nucleon interaction or residual strong force. This force is generally attractive.

5. Force in daily life:

When catching a fast moving cricket ball- A player backs his hands. In this process the catching time increases and the force decreases. Therefore, the player has to apply a less average force. Thus, the ball will also apply a small reaction force. Hence in this process the player will not hurt his hands.

Shockers in the vehicles- when the vehicles move over a rough road, an impulsive force is exerted by the road. The work of shockers is to increase the impulsive time. This would reduce the jerking experienced by the rider or driver of the vehicle.

Difficulty appears to catch a cricket ball as compared to a tennis ball moving with the same velocity- Since cricket ball is heavier than a tennis ball. Therefore in the case of cricket ball the change in momentum is heavier than a tennis ball. Thus, more force is required for a cricket ball as compared to the tennis ball.

A man falling from a certain height gets more injuries when he falls on a marble floor than when he falls on a heap of sand- The concept works here is that the marble floor does not yield under the weight of the man. The man is stopped abruptly. A large change in momentum takes place in a very short time interval. Thus, a large amount of force is exerted by the floor on man. Now, when the man falls on a heap of sand, the sand yields under the weight of the man. This increases the interval of time and reducing the reaction force exerted by the floor on the man.

The Moon revolving around the Earth- Due to gravitational force the Moon revolves around the Earth. The Moon got necessary centripetal force by the attraction force present in both the Moon and the Earth.

Driving- When we take our van around a curve a centripetal force must be applied. In this process a combination of normal force and static friction acting at the tires contribute to keep the van in its circular path.

Standing still- We are in a constant circular motion since the Earth rotates.

The sunlight and other source of light consist of photons which are the electromagnetic force carriers.

6. CONCLUSION:

Force is a necessary and compulsory physical quantity in nature which effects not only the Earth rather also effects whole universe, it effects human life, living things and non-living things as well. Everything in the world is attached with the force; no work can be done without force. So we can say that force is like our part of body.

REFERENCES:

1. Singh D.P.(2007). *Physics* (pp.1/220,1/211) scientific book company.
2. Kurtus R.(2016). *Force vector*(pp79) Ron Kurtus's physics credentials.

AUTHOR'S BIOGRAPHY:

Mr. NIRJAR VRIND , M.Sc. University department of physics
(T.M.B.U.BHAGALPUR BIHAR-812007)

Mr. NIRJAR VRIND is M.Sc. in university department of physics (T.M.B.U.BHAGALPUR). He completed his master degree in science. He has three year experience of teaching undergraduate and intermediate students in the area of science (physics).