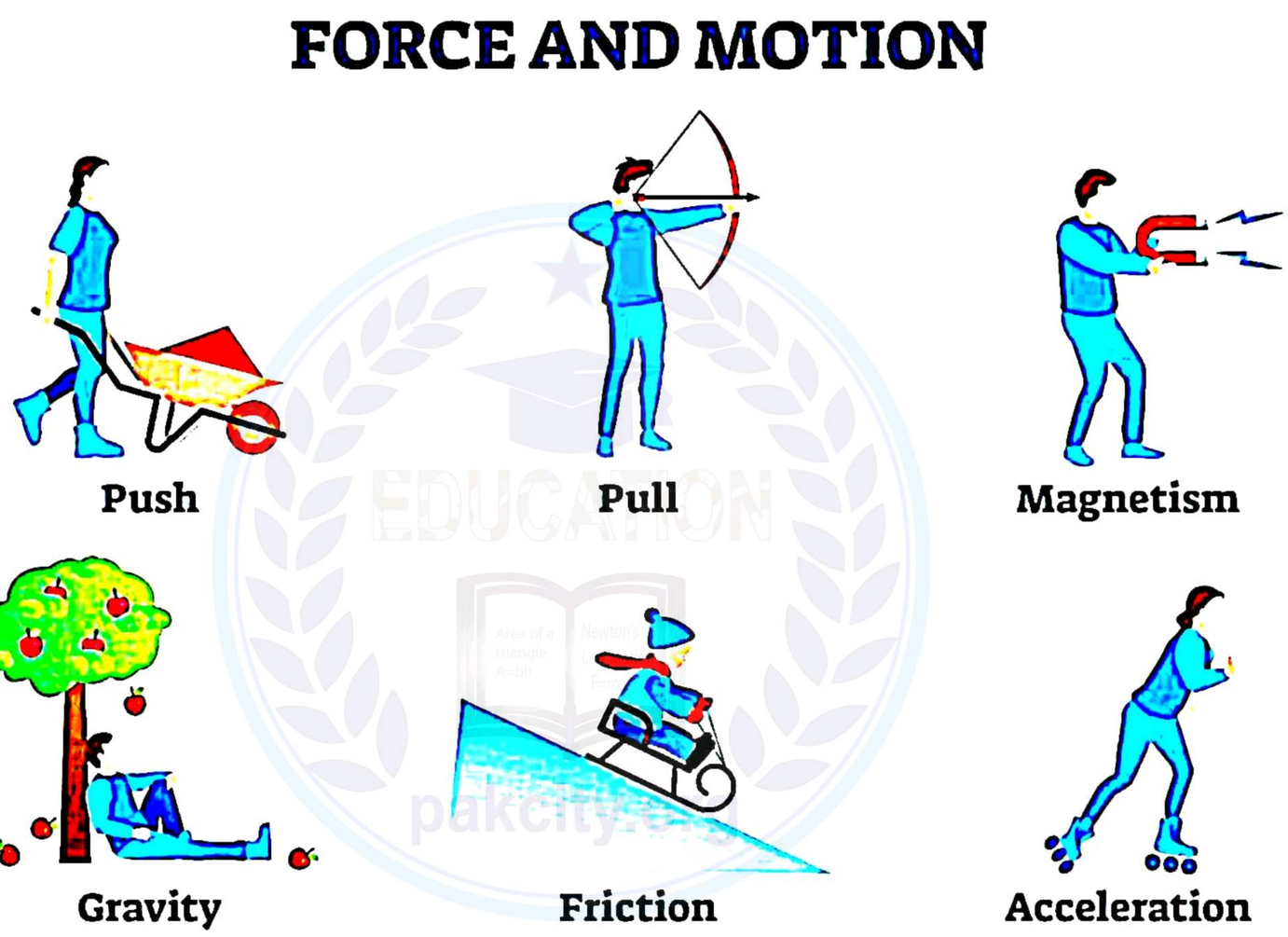
Chapter =03

Dynamics

Q1)Define force. Give its formula and unit

Force

Force is an agent which produce or trend to produce motion in an object. Force can also change the shape of an object.



Formula

F=ma

Unit

It is a vector quantity and S.I unit is $N(kgm/s^2)$

Q2)Define momentum with SI unit.

Momentum

The momentum of an object is equal to the mass multiplied by the velocity of the object

Smaller Mass
smaller momentum

larger Mass
larger momentum

Two bodies moving with Velocity V

Formula

P=mV

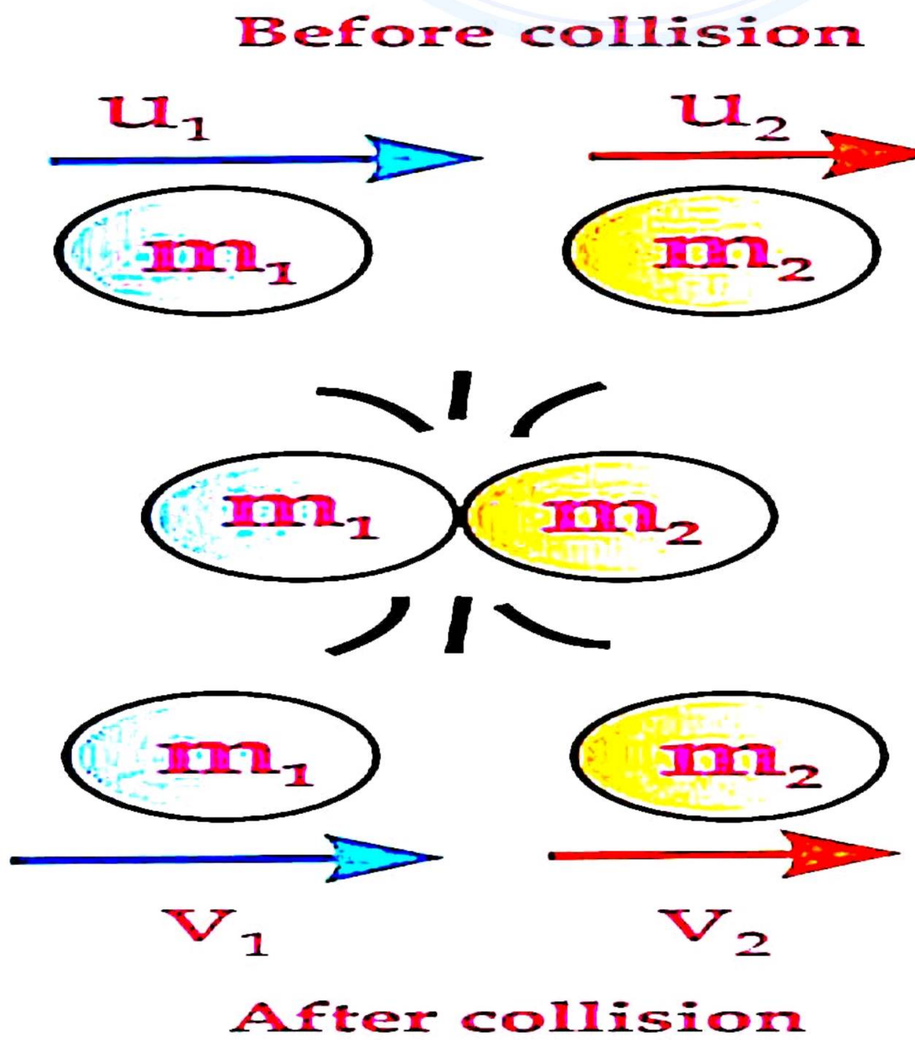
Unit

It is a vector quantity and S.I unit is N.s(kgm/s)

Q3)State and explain Law of Conservation of Momentum.

STATEMENT

Law of conservation of momentum states that when two bodies collides the total momentum is conserved i.e the total momentum after collision and total momentum before collision is same.



MATHEMATICAL EXPRESSION

Suppose, two bodies of mass m_1 and m_2 moves with initial velocity u_1 and u_2 after some time t the collide and then they again began to move with final velocity v_1 an v_2.

Momentum before collision = $m_1u_1 + m_2u_2$

Momentum after collision = $m_1v_1 + m_2v_2$

therefore,

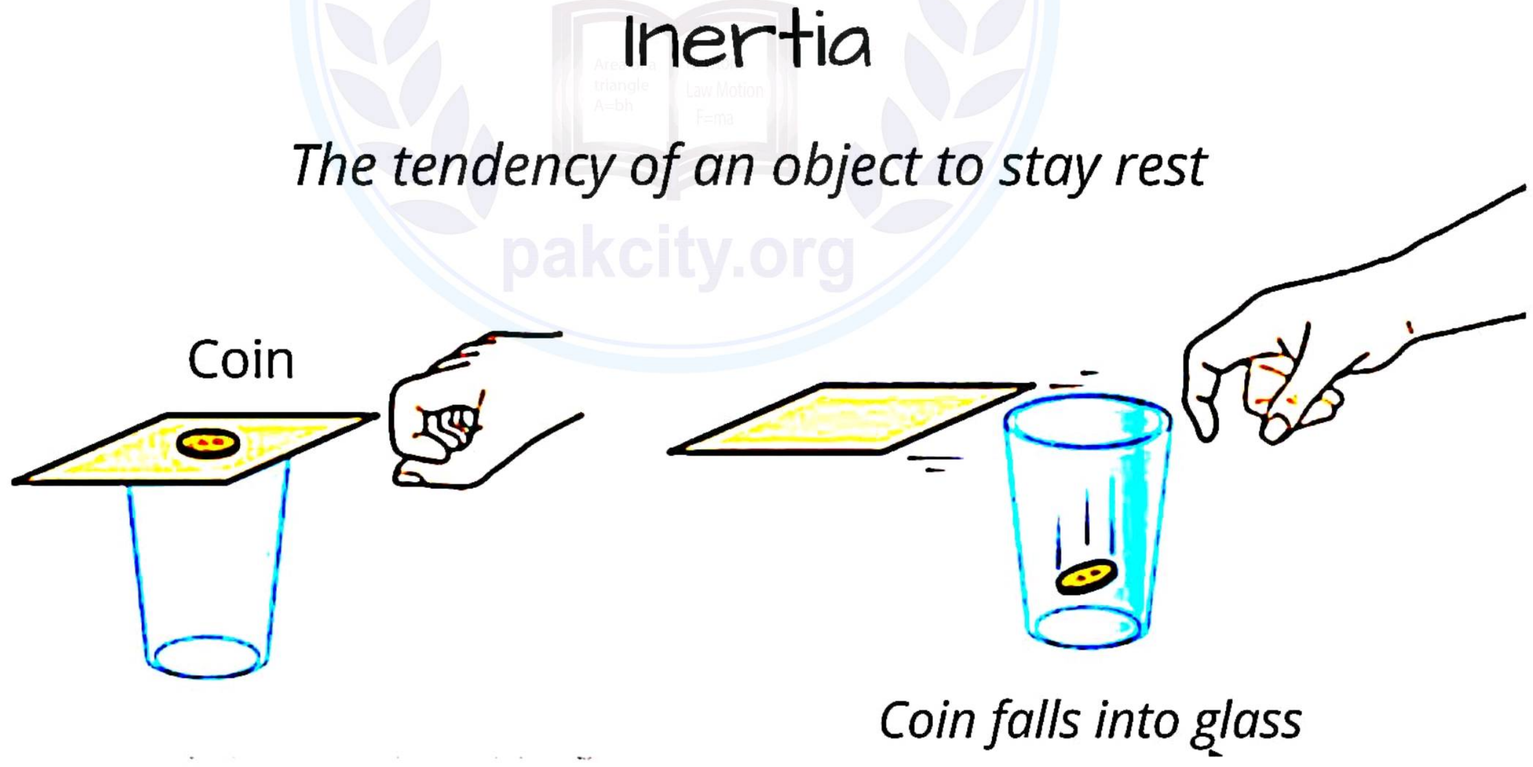
momentum before collision = momentum after collision

$$m_1u_1 + m_2u_{2=} m_1v_1 + m_2v_2$$

Q4)What is inertia? State Newton 1st and 3rd law of motion

Inertia

Inertia is the property of an object due to which it tends to continue its state of rest or motion. Inertia is resistance to change the state.

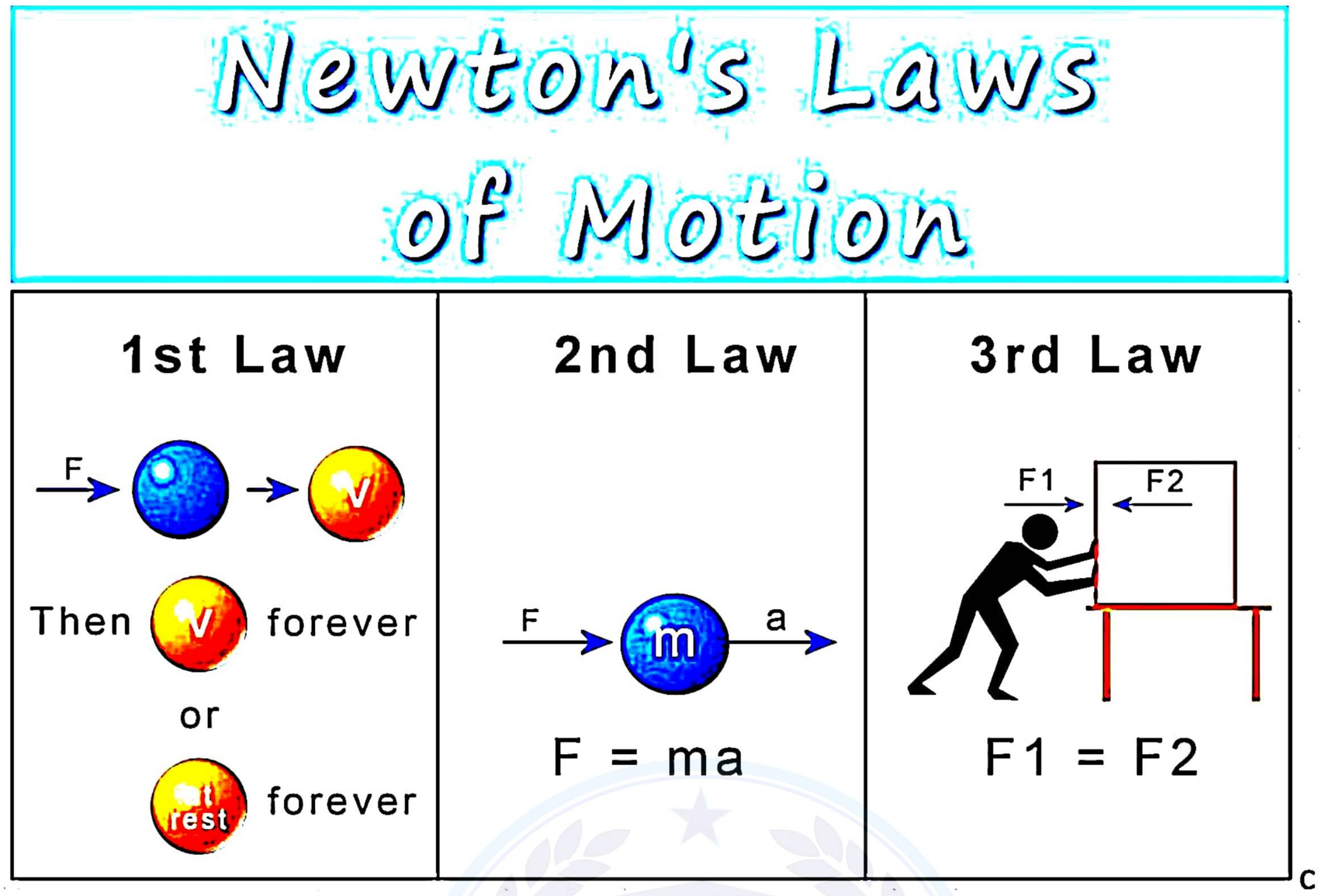


Newton's first law of motion

A body continues its state of rest or of uniform motion in a straight line unless an external force acts on it.

Newton's third law of motion

To every action, there is an equal and opposite reaction



Q5)State Newton 2nd law of motion. Show the relationship between applied force and the acceleration produced in the body.

Newton 2nd law of motion

When a net force acts on a body it produces acceleration in the direction of force. The acceleration is directly proportional to force and inversely proportional to mass of body

Therefore,

$$a \propto F$$

$$a \propto \frac{1}{m}$$

$$a \propto \frac{F}{m}$$

putting the proportionality constant k,

$$a = k\frac{F}{m}$$

$$Fk = ma$$

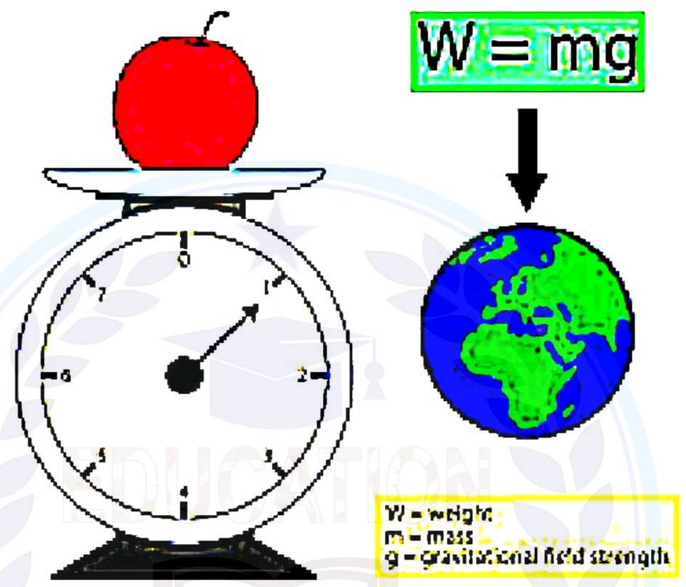
taking value of constant k =1,

$$F = ma$$

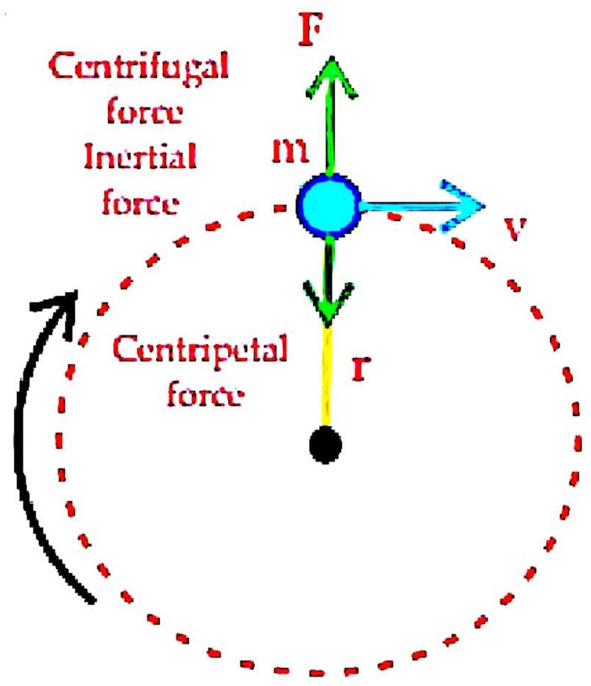
Q6)Enumerate at least three clear differences between mass and weight.

Mass	Weight

Mass is the quantity of matter in a body regardless of its volume or of any forces acting on it.	Weight is a measurement of the gravitational force acting on an object.
It is scalar quantity	It is vector quantity
Its S.I unit is Kg	Its S.I unit is N
Mass is measured using a pan balance, lever balance or electronic balance	Weight is measured using a spring balance.

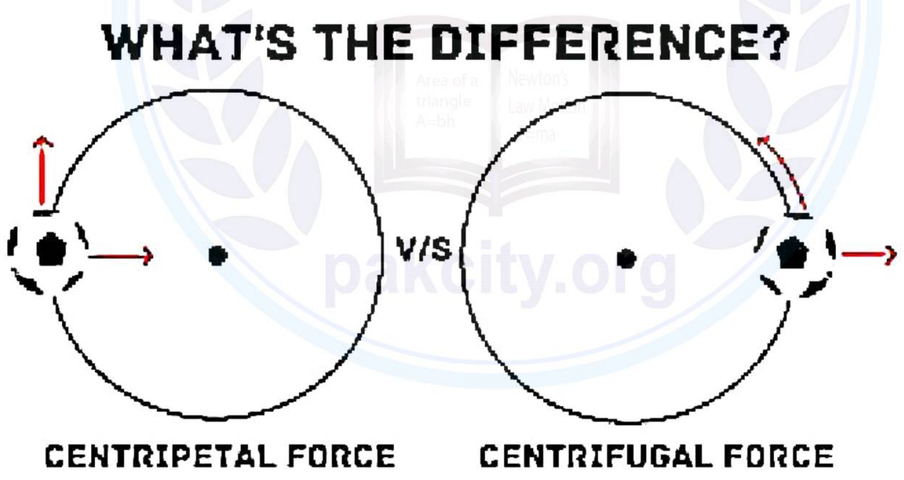


Q7)Draw a figure showing the direction of centripetal force, centrifugal force and velocity of an object along a circular path.



Q8)Differentiate between Centripetal force and Centrifugal force.

Centripetal force	**Centrifugal force**
The force required to move a body along a circular path is called Centripetal force.	A force that acts outward on a body which moves along a curved path is called centrifugal force.
It is always directed toward the center of curvature.	It is always directed away from center of curvature.
The velocity of the object is constant and perpendicular to a line running from the object to the center of the circle	The magnitude of centrifugal force is equal but opposite in direction to centripetal force.



Q9)List down some purposeful uses of centrifuge that humans are benefitting everyday

Uses of centrifuge

Centrifuge appliances are used to separate heavier particles from lighter particles in liquids

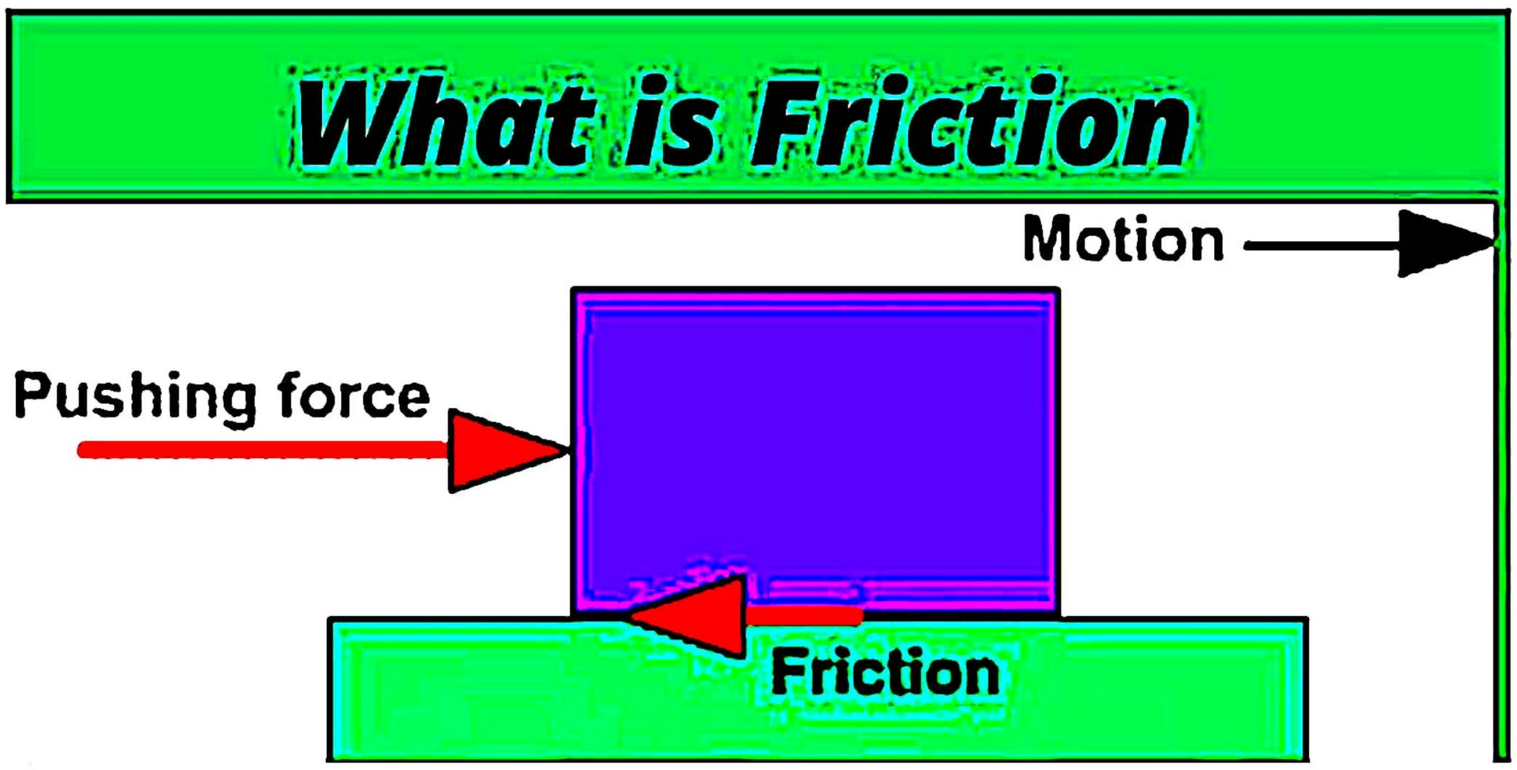
Example

- Sugar crystals are separated from molasses.
- Blood analysis is carried out through a centrifuge process in laboratory.
- Cream separator is used to separate the cream from skimmed milk.
- An ultracentrifuge is used for separating small particle from large molecules.
- Gas centrifuge is used for separation of isotopes.

Q10) What is friction? What is force of friction? Explain with two examples from daily life.

Friction

The force that resists relative motion between two surfaces is called friction.



Force the Friction

The force which opposes the motion of the body is known as frictional force

Examples

Friction Enable us to walk on ground.

Due to friction, we can stop a moving object.

Because of friction in our hand, we can hold objects.

Q11) Discus the types of friction.

Static friction

It is force acting on an object at rest that resists its ability to start moving. The maximum static friction is known as “limiting friction”

Kinetic friction

It is the force that resists the motion of a moving object. It is interesting to know that in almost all situations, static friction is greater than kinetic friction.

Sliding friction

When one body slides over the other body the friction between two surfaces is said to be sliding friction.

Rolling friction

When a body moves on wheels the friction is said to be rolling friction. Rolling friction is much lesser than the sliding friction

Q12) Give some advantages of friction

Advantages of friction

1. Friction enables us to walk on ground.
2. Friction protects from sliding, as sand is thrown to maintain friction on inclined railway tracks during rain.
3. The car brakes slow down the car to stop safely.
4. Threads and grooves are designed on tires to increase the friction and improve grip between road and wheel.

Q13) Give some disadvantages of friction.

Disadvantages of friction

1. A large amount of energy is wasted in the machines due to friction.
2. Friction leads to wear and tear of parts hence increases the service cost.
3. Failure of oil pump in car engine results contact between dry metals which yields high temperature hence the car engine is seized.

Q14) What are some ways reducing friction?

Reducing friction

1. Wheels, pullies, ball bearings, lubricants and graphite are used to overcome the friction
2. Lubricating the motor axel, sewing machine and bicycle chain reduces friction and prevents wear and tear
3. The shape of vehicle is also designed to reduce air resistance.

Numerical problems

Numerical # 1

Find the momentum of body of mass 6 kg moving with a velocity of 25 ms^{-1}. What will be the velocity if the momentum becomes 200Ns?

Data

m = 6kg

$v = 25\ ms^{-1}$

P = ?

If, P = 200 N.s

V = ?

Solution

P = mv

P = 6 x 25

P = 150 N.s

P = mV

200 = 6 x V

V = 200/6

$V = 33.33\ ms^{-1}$

Practice of Numerical # 1

Find the momentum of body of mass 8 kg moving with a velocity of 30 ms^{-1}. What will be the velocity if the momentum becomes 300Ns?

Numerical # 2

A body of mass 10 kg is moving with velocity of 10 ms^{-1}. A force acts for 5 seconds to reduce its velocity to 2 ms^{-1}. Find the momentum of body before and after application of the force on it.

Data

m = 10kg

$Vi = 10\ ms^{-1}$

t = 5 sec

$Vf = 2\ ms^{-1}$

Pi = ?

Pf = ?

Solution

P = mVi

P = 10 x 10

P = 100 N.s

P = mVi

P = 10 x 2

P = 20 N.s

Practice of Numerical # 2

A body of mass 8 kg is moving with velocity of 12 ms^{-1}. A force acts for 6 seconds to reduce its velocity to 3 ms^{-1}. Find the momentum of body before and after application of the force on it.

Numerical # 3

A force of 3400 N is applied on a body of mass is 850 kg, find the acceleration produced by the force? How much force should be applied on a body of mass 425kg to produce acceleration same as calculated.

Data

F = 3400N

m = 850 kg

a = ?

IF, m = 425

F = ?

Solution

F = ma

3400 = 850 x a

$$a = \frac{3400}{850}$$

$$a = 4\ ms^{-2}$$

$$F = ma$$

$$F = 425 \times 4$$

$$F = 1700\ N$$

Practice of Numerical # 3

A force of 1400 N is applied on a body of mass is 950 kg, find the acceleration produced by the force? How much force should be applied on a body of mass 325 kg to produce acceleration same as calculated.

Numerical # 4

Find the mass of a body which is accelerated by applying a force of 200 N, that speeds up it to 36 ms^{-2}. What should be the acceleration of the same body if the applied force changes to 280N.

Data

$$F = 200\ N$$

$$a = 36\ ms^{-2}$$

$$m = ?$$

If, $F = 280\ N$

$$a = ?$$

$$F = ma$$

$$200 = m \times 36$$

$$m = \frac{200}{36}$$

$$m = 5.55\ kg$$

$$F = ma$$

$$280 = 5.55 \times a$$

$$a = \frac{280}{5.55}$$

$a = 50.45\ ms^{-2}$

Practice of Numerical # 5

Find the mass of a body which is accelerated by applying a force of 300 N, that speeds up it to 40 ms^{-1}. What should be the acceleration of the same body if the applied force changes to 320N.

Numerical # 6

An empty car has 1200 kg mass. Its engine can produce acceleration of 4 ms^{-2}. If 300 kg load is added to mass by passengers and luggage. What acceleration the same engine will produce?

Data

m_1(empty) = 1200 kg

$a = 4\ ms^{-2}$

m_2(load) = 300 kg

a = ? (with load)

Solution

m = 1200 + 300 = 1500 kg

F = ma

F = 1500 x 4

F = 6000 N

Practice of Numerical # 6

An empty car has 1400 kg mass. Its engine can produce acceleration of 5 ms^{-2}. If 250 kg load is added to mass by passengers and luggage. What acceleration the same engine will produce?

Numerical # 7

The mass of an object is 60 kg, find its weight on (i) Earth (ii) Moon (iii) Mars assume the acceleration due to gravity on Earth = 9.8 ms^{-2} on Moon=1.6 ms^{-2} and on Mars= 3.7 ms^{-2}

Data

m = 60kg

$g_{earth} = 9.8\ ms^{-2}$

$g_{moon} = 1.6\ ms^{-2}$

$g_{mars} = 3.7\ ms^{-2}$

W_{earth} = ?

W_{moon} = ?

W_{mars} = ?

Solution

$W_{earth} = mg_{earth}$

$W_{earth} = 60 \times 9.8$

$W_{earth} = 588\ N$

$W_{moon} = mg_{moon}$

$W_{moon} = 60 \times 1.6$

$W_{moon} = 96\ N$

$W_{mars} = mg_{mars}$

$W_{mars} = 60 \times 3.7$

$W_{mars} = 222\ N$

Practice of Numerical # 7

The mass of an object is 70 kg, find its weight on (i) Earth (ii) Moon (iii) Mars assume the acceleration due to gravity on Earth = 9.8 ms^{-2} on Moon=1.6 ms^{-2} and on Mars= 3.7 ms^{-2}

Numerical # 8

A car is running on a circular part of highway having about 1000m radius. The mass of car is 600kg and its velocity is 72 kmh^{-1}. Find (i) Centripetal force exerted by the car. (ii) Centripetal acceleration of car.

r = 1000m

m = 600kg

V = 72kmh^{-1} = 72 x 1000 ÷ 3600 = 20 ms^{-1}

Fc = ?

ac = ?

Solution

$$Fc = \frac{mv^2}{r}$$

$$Fc = \frac{600 \times 20^2}{1000}$$

$$Fc = \frac{600 \times 400}{1000}$$

$$Fc = \frac{240000}{1000}$$

Fc = 240 N

$$ac = \frac{v^2}{r}$$

$$ac = \frac{20^2}{1000}$$

$$ac = \frac{400}{1000}$$

ac = 0.4 ms^{-2}

Practice of Numerical # 8

A car is running on a circular part of highway having about 800m radius. The mass of car is 600kg and its velocity is 72 kmh^{-1}. Find (i) Centripetal force exerted by the car. (ii) Centripetal acceleration of car.

Numerical # 9

A block is placed on a wet slippery floor. The mass of block is 15 kg. When it is pulled through a string and spring balance, it shows force equal to 3 N. Find the coefficient of friction. ($F_s = \mu mg$)

Data

m = 15kg

F = 3N

g = $10ms^{-2}$

μ = ?

Solution

F = μR

R = W = mg

R = 15 x 10

R = 150 N

F = μR

3 = μ 150

μ = 3/150

μ = 0.02

Practice of Numerical # 9

A block is placed on a wet slippery floor. The mass of block is 18 kg. When it is pulled through a string and spring balance, it shows force equal to 4 N. Find the coefficient of friction. ($F_s = \mu mg$)