Introduction

When a boatman rows the boat in the river, he has to apply force to push the boat in the forward direction. Or, if a person pulls a box from one place to another he is applying force. A women cutting grass in the field and binding it with the rope; here also she is applying the force. For any type of work , force has to be applied. In thischapter, we will discuss the various kinds of force and its applications. The force can be defined as the push or pull of an object. It is also the influence, which can change the state of an object.

Commonly Asked QUESTIONS

In a tug of war, when two teams pull the rope, a stage comes when the rope does not move to either side at all. What can you say about the magnitude of force being applied to the rope by the two teams at that stage?

(a) Equal (b) Greater on first side
(c) Greater on second side (d) All of these
(e) None of these

Answer: (a)

Explanation

If there is no movement on either side, the force applied form both side is equal in magnitude.

It the two forces of equal magnitude are acting on an object in opposite directions, the net force acting on the object is equivalent to the _____.

(a) Unity (b) Zero
(c) Infinity (d) All of these
(e) None of these

Answer: (a)

Explanation

If the two forces of equal magnitude are acting on the object then the net force on the object is zero.

Types of Forces

There are different types of forces:

(i) Applied force (ii) Gravitational force
(iii) Normal force (iv) Frictional force
(v) Tension force (vi) Muscular force
(vii) Electrostatic force (viii) Magnetic force

Applied force

It is the force, which is applied to an object by a person or by another object. If a person is pushing a bed across the room, there is a applied force acting on the bed.

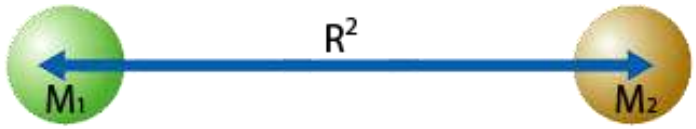
Gravitational Force

The force, which exists between any two planets, or any two objects in this universe, is called gravitational force. This force always attracts the object towards each other. All object on the surface of earth experience a force of gravity towards the centre of earth, which is equivalent to the weight of the object. Numerically it is given by,

$F = m \times g$

Here, m is the mass of the object and g is the acceleration due to the gravity.

The numerical value of g is 9.8 m/sec^2.



$$Force(\mathrm{f}) = \frac{G \times M_1 \times M_2}{R^2}$$

Two objects of mass 10 kg and 35 kg are 50 m apart from each other. The force acting between two objects at any instant of time is _____.

(a) 2x 10^{-11} N
(b) 1.2x 10^{-11} N
(c) 2.2x 10^{-11} N
(d) 0.934 x 10^{-11} N
(e) None of these

Answer: (d)

Explanation

The net force between any two objects can be calculated by using the relation, $F = \frac{G \times M \times m}{R^2}$. On calculation it was founded that its value is 0.934 x 10^{-11}N.

According to the universal law of gravitation, the value of gravitational constant remains same at all places in this universe. But, the acceleration due to the gravity changes from one place to another on the surface of the planet. The reason for this change in the value of acceleration due to gravity on the planet is_____.

(a) Volume
(b) Density
(c) Mass
(d) Surface area
(e) None of these

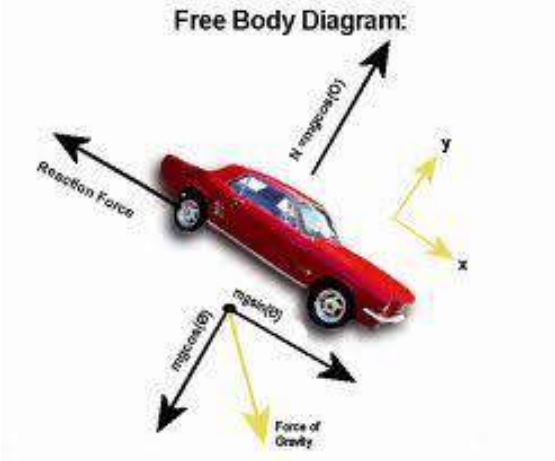
Answer: (c)

Explanation

The acceleration due to the gravity depends on the mass of the planet.

Normal Force

The normal force is the force, which is exerted upon an object in contact with another stable object. For example, if a plate is resting on the table, the surface of the table exerts an upward force on the plate in order to support the weight of the plate. A normal force acts horizontally between two objects, that are in direct contact with each other. For instance, if a person leans against a wall, the wall will apply a horizontal force on the person.



Commonly Asked QUESTIONS

A car moving on a slope is balanced by different types of forces. The force acting vertically downward is given by _____.

(a) Mg
(b) Mgcosθ
(c) Mgsinθ
(d) Zero
(e) None of these

Answer: (b)
Explanation
The force acting in vertically downward direction is given by Mgcosθ.

An object is moving in the vertically upward direction, which is normal to the plane. The net work done by the object when it reaches a height of 35 m is_____.

(a) 0 J
(b) 35 J
(c) 20 J
(d) 15 J
(e) None of these

Answer: (a)
Explanation
When the object moves in vertically upward direction, normal to the plane, the net work done is 0 J.

Frictional Force

It is the force exerted by a surface when an object moves across the surface. It can also be defined as the force, which opposes the motion of an object. It is also known as the constant force. There are two types of frictional forces:

(i) Kinetic friction (ii) Static friction

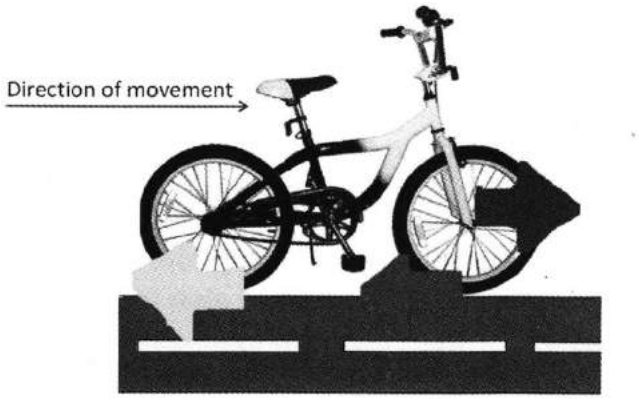
Kinetic Friction

The frictional force between any two moving surface is called the kinetic friction. There are different types of kinetic friction, such as, sliding friction, rolling friction. For example, if a boy is sliding on a slider in the garden, the force exerted by the slider on the boy is a sliding friction. On the other hand, if a wheel is rolling down the slope, the friction between the wheel and slope is called the rolling friction. The frictional force also depends on the nature of the surface and degree to which they are pressed together. The maximum amount of frictional force is calculated by using the relation:

Force = Coefficient of friction x Normal force

Static Friction

It is the friction that acts between the surfaces of two motionless objects. It always acts in the direction opposite to the force, which tends to produce the motion in one of the two objects. It increases with the external force until motion is initiated in the object.



← Force acting on the road by the bicycle

→ Reaction force acting on the bicycle by the road, it is called friction too

← Friction acting on the bicycle to oppose its motion

Commonly Asked QUESTIONS

A car of mass 1200 kg is moving on the road at the speed of 60 km/h. If the coefficient of friction is 38 and the normal force is 50 N, the frictional force acting on the car is given by _____.

(a) 300 N (b) 3000 N

(c) 2500 N (d) 30 N

(e) None of these

Answer: (b)

Explanation

The frictional force acting on the object is given by,

Force = Coefficient of friction x Normal force.

On calculation, it was found that the frictional force acting on the object is 3000 N.

A train at rest tends to move from the platform and it attains a velocity of 100 km/h within a few second. While trying to come in motion it has to overcome the frictional force; that frictional force is_____.

(a) Static friction (b) Rolling friction

(c) Sliding friction (d) Kinetic friction

(e) None of these

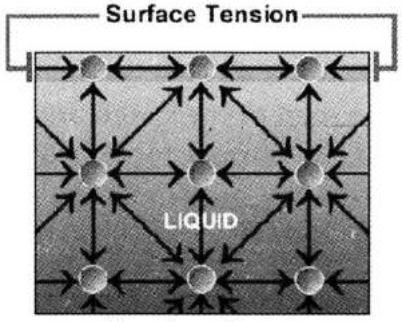
Answer: (a)

Explanation

When an object tends to come in motion from the rest, the frictional force acting on the object is called static friction.

Tension Force

When an object is hanged with the help of a rope, a force is transmitted through the rope, called tension force. It always acts along the length of the rope, and is pulled equally on the objects in the opposite direction. Let us consider the surface of water. If you observe the upper surface of water carefully, you will find that, it behaves like an elastic surface. This is because of the fact, that there is intermolecular force of attraction between the molecules of water, which holds the molecules together. This force is called surface tension.



Tension Force

Commonly Asked QUESTIONS

Thomas gently places a coin on the surface of water in the bucket, and finds that it does not sink in the water. It shows that the surface is behaving like a elastic surface. The reason for this behavior of the surface is _____.

(a) Nuclear force (b) Electrostatic force

(c) Intermolecularforce (d) Gravitational force

(e) None of these

Answer: (c)

Explanation

The surface of water behaves like an elastic surface, because there is intermolecular force between the molecules of water.

David mixes a drop of water in the cup containing mustard oil. He observes that it changes into the shape of a spherical ball. What could be the possible reason for this?

(a) Surface tension (b) Viscosity

(c) Density (d) Surface area

(e) None of these

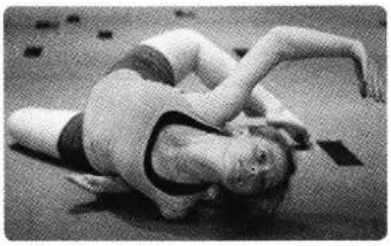
Answer: (a)

Explanation

When the oil is mixed in water, it becomes spherical. It is because of the surface tension between the molecules of the oil drop.

Muscular Force

To lift a table from the ground to a certain height, we need to apply a force; or if you want to throw a cricket ball, also you have to apply a force. These forces are exerted by the muscles of our arm or body. The force applied by the muscles of our body is known as the muscular force. The muscular force depends upon the strength of the body or the mass of the object. Human use the muscular force of the animals to do various work. For example, ploughing of the field by an ox, or carrying of loads from one place to another by camels or donkey.



Muscular Forces

Commonly Asked Questions

A weight lifter lifts the weight with the help of his hand, and has to apply large force to do this. The force, which the weight lifter has to apply to lift the weight is called _____.

(a) Cellular force (b) Nuclear force

(c) Muscular force (d) Magnetic force

(e) None of these

Answer: (c)

Explanation

The force applied by our body to do any type of work, is a muscular force.

A boy is pulling the cart on the road, in the process he is using his muscular energy. The muscles get its energy form the body in the form of glucose. From where does, the body derives it energy_____.

(a) Sunlight (b) Tissues

(c) Cell (d) Food

(e) None of these

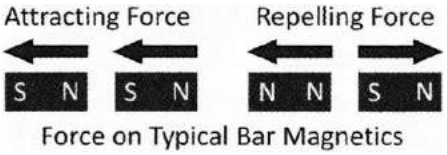
Answer: (d)

Explanation

The body derives its energy from the food we eats.

Magnetic Force

A magnet is a material that attracts certain other types of the material towards itself. Such materials are called the magnetic material. For example, the materials like iron, nickel etc are attracted by the magnet. The force that attracts the magnetic material is called magnetic force. The magnet has two poles, north pole and south pole. Like poles repel each other and unlike poles attract each other. If we break a bar magnet into several pieces, each piece will behave like an independent magnet. We cannot separate the poles of the magnet.



Force on Typical Bar Magnetics

Commonly Asked QUESTIONS

Rojer takes a rod and connects its one end with the electric current. He finds the rod behaves like a magnetic and exerts attractive force on magnetic material, such as, iron and nickel. The force which is being exerted by the rod is known as_____.

(a) Magnetic force (b) Electrostatic force

(c) Electromagnetic force (d) Nuclear force

(e) None of these

Answer: (c)

Explanation

The magnetic force that generates due to the electric current is called the electromagnetic force.

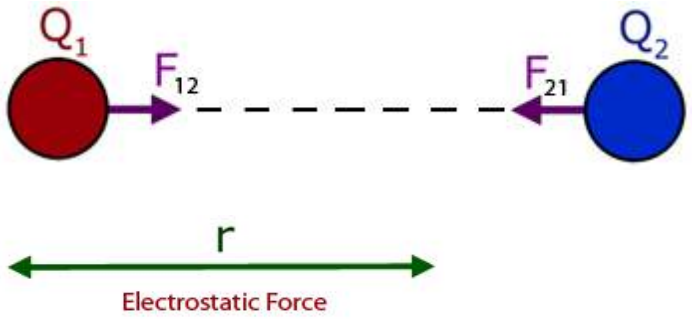
Our earth behaves like a huge bar magnetic. All the object falling from a certain height is attracted towards the centre of the earth. The magnetic behavior of the earth is solely due to the certain elements present in the core of the earth. The elements due to which earth behave like a huge bar magnetic is ___?

(a) (Ni, Fe) (b) (Ni, Co)

(c) (Fe, Co) (d) (Zn, Fe)
(e) None of these
Answer: (a)
Explanation
The element, which is present in the core of the earth and due to which it behaves like a magnet, is Ni and Fe.

Electrostatic Force

An electrically charged object exerts force on an uncharged object. Such force is called the electrostatic force. For example, if you rub a plastic comb with your hair and bring the comb near the tiny piece of the paper, the piece of paper will either stick to the comb, or will start moving due the electrostatic force. Similarly, an ebonite rod when rubbed with the woolen cloth, it acquires the negative charge and attracts the tiny piece of paper.



When a plastic comb is rubbed with hair, it acquires some charges due to which it attracts tiny pieces of paper. The types of charge, which the comb acquires form the hair is ____.
(a) Positive (b) Negative
(c) α charge (d) β charge
(e) None of these
Answer: (b)

Alford is wearing a woolen shirt at home. After some time, he starts feeling hot and takes off his shirt. While doing so he finds that, the hair on his skin got erected and are attracted towards the woolen shirt. Why is this happening with the wool?
(a) It lost charge (b) It gained charge
(c) Just a coincidence (d) All of these
(e) None of these
Answer: (a)
Explanation
The above phenomenon is happening as the wool has gained charge from the hair of the skin.

Effects of Forces

A force cannot be seen, only it can be felt. Its effect it produced when it acts on an object. The various effects of the force are:

(i) It can move the stationary objects

(ii) It can stop the moving objects

(iii) It can change the magnitude and direction of the object

(iv) It can change the shape and size of the object

Units of Force

The force is always measured in Newton and is denoted by N. 1 Newton force is equivalent to the force required to accelerate one kilogram of mass, at the rate of one meter per second squared or Kgms-2.

Numerically, it is given by, F = m x a

Where, 'm' is the mass and 'a' is the acceleration.

Some Other Units of Force

1 dyne = 10^{-5} N

1 kilogram - force (kgf) or kilopound (kp) = 9.80665 N = 1 metric slug

1 lbf = 32.174 poundals = 1 slug

1 kgf=2.2046 lbf

The value of 1 dyne of force in Newton is _____.

(a) 10^{-4} (b) 10^{-5}

(c) 10^{-6} (d) 10^{-7}

(e) None of these

Answer: (b)

Explanation

The value of one dyne of force is equivalent to the 10^{-5}.

The value of 1 metric slug in Newton is ____.

(a) 9.90666 (b) 9.80665

(c) 9.90556 (d) 9.80556

(e) None of these

Answer: (b)

Explanation

The value of one metric slug in Newton is given by 9.80665.

You Must KNOW

- A person weighing 100 kg on earth will weight 38 kg on the surface of moon.
- The force of gravity 100 km above the surface of earth will decrease by 3%.
- Some roller coasters have gravitational force of 4 to 6 g.
- Due to friction the velocity of the body gets reduced, which leads to production of acceleration.
- During the race the tyres lose weight, and each tyre loses its weight by 0.5 kg due to wearing.

SUMMARY

- Force is the push or pull of the object.
- According to the Newton's first law, an object in motion or an object at rest will remain in motion or at rest until and unless it is compelled by an external unbalance force.
- Inertia is the property of the object due to which it opposes the state of an object.
- The force, which opposes the motion of an object is called the frictional force.
- According to the Newton's second law, the rate of change of momentum is directly proportional to the force acting on the object.
- According to the Newton's third law, to each and every action there is equal and opposite reaction.
- Momentum is the product of mass and velocity.
- Law of conservation of momentum states that, total momentum before collision is equal to the total momentum after collision.
- The total momentum of an isolated system always remains conserved.
- A force of one Newton is defined as the force, which produces an acceleration of 1 m/s^2 on an object of mass 1 kg.

Self Evaluation TEST

Duration
10 Minutes

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1. **Thomas and Mary are playing carom board. They arrange the seeds in the vertical order. Thomas strikes on the seeds with the striker, with a great speed. He finds that, the stakes do not fall down. On the other hand, when he strikes the seeds with less speed, all the seeds of the stakes fell down. Which property of force this shows?**

(a) Newton's third law
(b) Motion
(c) Inertia
(d) Reaction of force
(e) None of these

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2. **Steven was driving a car, whose mass is 1500 kg. Due to sudden traffic, he had to change his velocity from 72 km/h to 36 km/h. Find the change in momentum of his car.**

(a) 150 kg m/s
(b) 1500 kg m/s
(c) 15,000 kg m/g
(d) 15km/g
(e) None of these

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3. **While playing cricket Thomas hurt his palm on trying to catch the ball coming in his direction. On the other hand his friend jack while catching the ball pulls his hand backward, and is not hurt. The reason for this is:**

(a) Change of momentum
(b) Change in acceleration
(c) Change in velocity
(d) Change in force
(e) None of these

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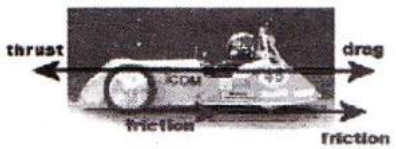
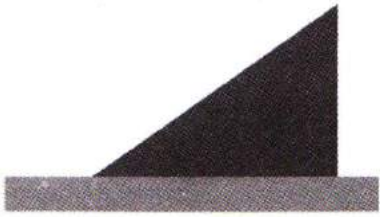
4. **Which one of the figure represents the sliding friction?**

(a)



(b)



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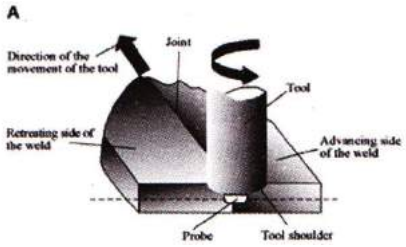

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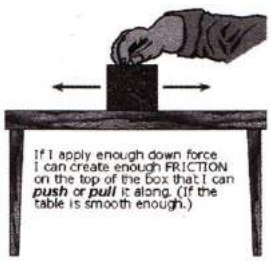
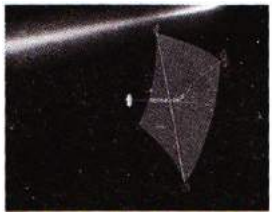


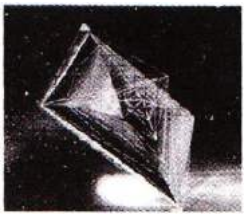
(e) None of these

5. Which one of the following is an example of Newton's third law of motion?

(a) 

(b) 

(c) 

(d) 

(e) None of these

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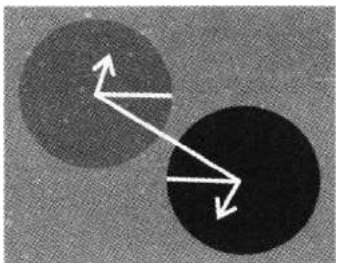
6. Two boys X and Y throw balls of equal mass and size towards each other. On the way the balls collide with each other and get stick together, come to rest. The collision is called:



(a) Elastic collision
(b) Inelastic collision
(c) Head on collision
(d) All of these
(e) None of these

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7. David was riding his bicycle. After some time, he got tired and stopped paddling the cycle. The cycle stopped after traveling some distance. Which laws of motion helps us to explain this phenomenon?

(a) First law of motion
(b) 2nd laws of motion
(c) 3rd laws of motion
(d) Law of conservation of energy
(e) None of these

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8. Two cars, X of mass 1500 kg and velocity 25 m/s and car Y of mass 1000 kg and velocity 15 m/s are moving towards each other head on. After collision, the velocity of the car X becomes 20 m/s. Find the velocity of car Y after the collision.

(a) 20 m/s
(b) 21.5 m/s
(c) 22.5 m/s
(d) 25 m/s
(e) None of these

9. **James combs his hair and brings the comb near some tiny pieces of paper. He finds the comb is attracting paper pieces. The force of attraction by the comb on the tiny piece of paper is due to which one of the following force?**

(a) Magnetic force
(b) Gravitational force
(c) Nuclear force
(d) Electrostatic force
(e) None of these

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10. **Match the following column:**

Sr. No.	Objects		Nature of force
1.	Force on falling ball	**A.**	Frictional force
2.	Force on moving charge	**B.**	Muscular force
3.	Force on lifting objects	**C.**	Electrostatic force
4.	Force on sliding ball	**D.**	Gravitational force

(a) 1-D, 2-C, 3-B, 4-A
(b) 1-A, 2-D, 3-B, 4-C
(c) 1-B, 2-C, 3-D, 4-A
(d) 1-C, 2-D, 3-A, 4-D
(e) None of these

Answers – Self Evaluation Test																			
1.	C	**2.**	C	**3.**	A	**4.**	B	**5.**	A	**6.**	A	**7.**	A	**8.**	C	**9.**	D	**10.**	A