UNIT 3 Dynamics

Section A Multiple Choice Questions (M.C.Qs)

Tick mark (✓) the correct answer:

01. *Newton's First law of motion is also known as the law of:*
(a) speed (b) rest (c) inertia (d) force

02. *Quantity of matter contained in body is called_____.*
(a) mass (b) volume (c) area (d) weight

03. *Quantity of motion contained in a body is called:*
(a) force (b) inertia (c) momentum (d) gravity

04. *Law of conservation of momentum defines that the total momentum of a system of two bodies before and after collision_____.*
(a) remains constant (b) retains more momentum
(c) losses some momentum (d) None of the above is true

05. *Weigh of a body can be measured using a spring balance, it differs from place to place because of variation in _____.*
(a) acceleration (b) gravitational pull (c) velocity (d) size of spring balance

06. *It is easier to push an empty shopping cart than a full one because the filled cart has more mass than the empty one. This can be expressed by:*
(a) $F > m$ (b) $F < m$ (c) $F > 1/m$ (d) $F \propto m$

07. *Centrifugal force is always directed:*
(a) towards centre (b) away from centre
(c) along the circular path (d) all sides

08. *Friction opposes motion between two bodies in contact because of:*
(a) charges on bodies (b) weight of bodies
(c) roughness of surfaces (d) None of above

09. *Which statement is true for limiting frictional force?*
(a) It is greater than rolling friction. (b) It is greater than sliding friction.
(c) It is greater than kinetic friction. (d) All are true

10. *A man pulls a crate of mass 25 kg across the levelled ground with a horizontal force of 60 N.A constant force of friction of 20N acts on the sledge. What is the acceleration of the sledge?*
(a) $0.63 ms^{-2}$ (b) $1.6 ms^{-2}$ (c) $2.4 ms^{-2}$ (d) $3.2 ms^{-2}$

11. *The S.I unit of force is:*
(a) kilogram (b) Newton (c) Ampere (d) Candela

12. *The magnitude of a force can be measured using a:*
(a) Vernier caliper (b) screw gauge (c) light gate (d) spring balance

13. *The momentum depends upon the:*
(a) quantity of mass and velocity of the object
(b) quantity of mass and applied force
(c) the velocity of the object and applied force
(d) applied force and acceleration produced

14. *Which equation represents the momentum?*
(a) ma (b) m + a (c) m + v (d) mv

15. *The S.I unit of momentum is:*
(a) N (b) Ns (c) Ns^{-1} (d) Ns^{-2}

16. *Momentum is equal to the:*
(a) ma (b) Fa (c) Ft (d) mt

17. *It is very useful quantity when it comes to calculate what happens in collision or explosion.*
(a) Force (b) Velocity (c) Momentum (d) Torque

18. *The property of an object due to which it tends to continue its state of rest or motion is called:*
(a) force (b) inertia (c) torque (d) momentum

19. *It is resistance to change the state of a body.*
(a) Inertia (b) momentum (c) torque (d) acceleration

20. *When a bus starts moving the passengers feel a:*
(a) sideway jerk (b) forward jerk (c) backward jerk (d) no jerk

21. *The acceleration is directly proportional to:*
(a) momentum (b) torque (c) velocity (d) force

22. *It is inversely proportional to mass of body.*
(a) Acceleration (b) Velocity (c) Momentum (d) Torque

23. *The force required to move a body along a circular path is called:*
(a) gravitational force (b) centripetal force (c) centrifugal force (d) torque

24. *The centripetal force is equal to:*
(a) mvt (b) $\frac{mv}{t}$ (c) mv^2t (d) $\frac{mv^2}{t}$

25. *It is the tendency of an object to leave the circular path and fly off in a straight line.*
(a) gravitational force (b) centripetal force (c) centrifugal force (d) torque

26. *These are always parallel to the plane of contact between two surfaces and opposite to the direction of the applied force.*
(a) gravitational forces (b) centripetal forces
(c) centrifugal forces (d) frictional forces

27. *It is a self-adjusting force.*
(a) Friction (b) Torque (c) Centripetal force (d) Centrifugal force

28. *It is a force acting on an object at rest that resists its ability to start moving.*
(a) Kinetic friction (b) Sliding friction (c) Static friction (d) Rolling friction

29. *The maximum static friction is known as:*
(a) Kinetic friction (b) Sliding friction (c) Static friction (d) Limiting friction

30. *Static friction is greater than:*
(a) Kinetic friction (b) Sliding friction (c) Rolling friction (d) Limiting friction

Answers

1.	(c)	2.	(a)	3.	(c)	4.	(a)	5.	(b)	6.	(d)	7.	(b)
8.	(c)	9.	(d)	10.	(b)	11.	(b)	12.	(d)	13.	(a)	14.	(d)
15.	(b)	16.	(c)	17.	(c)	18.	(b)	19.	(a)	20.	(c)	21.	(d)
22.	(a)	23.	(b)	24.	(d)	25.	(c)	26.	(d)	27.	(a)	28.	(c)
29.	(d)	30.	(a)										

Section B & C Short & Detailed Answer Questions

Introduction

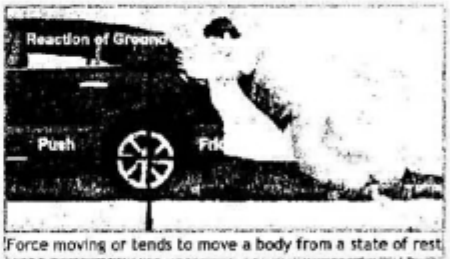
What causes a body to change its speed? What causes the cricket ball to change its direction from wicket to boundary line? When we stop paddling our bicycle it does not stop at once. Why? After learning this unit we will be able to answer these and some other similar questions.

Q.1 ***Describe force and its unit.***

Ans: ***Force:*** Force is the agent that changes the state of rest or uniform motion of a body. Its S.I unit is Newton (N). One Newton (1 N) is the amount of force that can produce $1 ms^{-2}$ acceleration in 1 kg mass.

An object at rest needs a force to get moving; a moving object needs a force to come in rest change its velocity or direction. The magnitude of a force can be measured using a spring balance.

In short, force is required to change the position, state or shape of an object. It can act as a pull or push agent. Force produces acceleration and can produce distortion. It is a vector quantity.

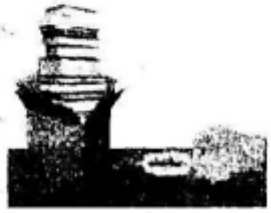


Force moving or tends to move a body from a state of rest

Activity

Take a cardboard box. Connect it to a spring balance through a string. Pull the string and note down the reading of the spring balance. How much force is required to make it move? Put a few books on the box. Now pull the string until the box starts moving. Note down the reading on a spring balance.

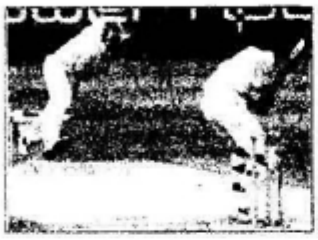
Again put many books on the box and pull it. Fill in your observations in the following and discuss with your colleagues.

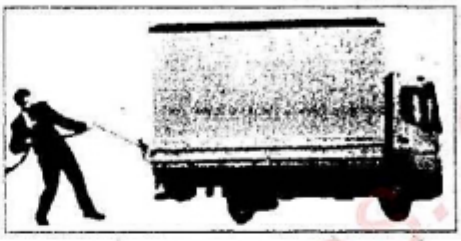


Case	Force required	Discussion
Empty box		
Few books on box		
Many books on box		

Q.2 What is momentum?

Ans: ***Momentum:*** If a cricket ball and a car are moving at the same speed, we cannot stop the car with hands but we can stop the ball.





On the other hand, it is not possible for a person to stop even a slow-moving truck by pulling from the backside. The momentum depends upon the quantity of mass and velocity of the object. The greater the mass greater will be momentum. Similarly faster the speed greater will be momentum.

Definition: Momentum is defined as the quantity of motion contained in a body. Momentum is the product of the mass and velocity of a moving object.

In terms of an equation, the momentum of an object is equal to the mass multiplied by the velocity of the object.

$$\text{Momentum} = \text{mass} \times \text{velocity}$$

Symbolically, the momentum is represented by p. Thus, the above equation can be written as:

$$p = mv$$

where m is the mass and v is the velocity. The momentum is a vector quantity.

S.I Unit of Momentum: A mass unit is multiplied by a velocity unit to provide a momentum unit. This is consistent with the equation for momentum. The S.I unit of momentum is describe below,

$$\text{Momentum} = \text{mass} \times \text{velocity}$$
$$= kg \times ms^{-1} = kgms^{-1} = kgms^{-2} \times s$$
$$\text{or} = Ns \text{ (Newton second)}$$

More Information:

The pull of gravity on:	
A fly	= 0.001 N
An apple	= 1 N
The frictional force slowing a rolling football	= 2N
The force required to squash an egg	= 50 N
The tension in a rope towing a car	= 1000N (1kN)
The fractional force exerted by the brakes of a car	= 5000N (5kN)
The push from the engines of a space rocket	= 1000000N (1MN)

Q.3 *Describe momentum in terms of force.*
OR Derive the equation of momentum in terms of force.

Ans: ***Momentum in terms of force:*** We can also say that the change in momentum is equal to the force multiplied by the time interval for which it was applied. Consider a body of mass m, moving with initial velocity v_i. A force F acts on the body to produce acceleration a, therefore the final velocity after time t will become v_f. Note that if p = mv and m is constant, and then the change in velocity changes the momentum of the body.

$$p_i = mv_i$$
$$p_f = mv_f$$

and $p_f - p_i = mv_f - mv_i$ change in momentum

$$p_f - p_i = m(v_f - v_i)$$

Dividing both sides by t:

$$\frac{p_f - p_i}{t} = m\,\frac{v_f - v_i}{t}$$

Since the rate of change of velocity is acceleration:

$$\frac{v_f - v_i}{t} = a, \quad \text{therefore} \quad \frac{p_f - p_i}{t} = ma$$

According to Newton's second law of motion, $F = ma$

Therefore, $$\frac{p_f - p_i}{t} = F$$

So, $$p_f - p_i = Ft$$
$$\Delta p = Ft$$

Q.4 *Write a note on safety devices.*

Ans: ***Safety Devices:*** The equation $\Delta p = Ft$ is important when it comes to considering a number of safety features in our lives. If we are moving, we have momentum. To stop moving, a force must be applied. According to the equation $\Delta p = Ft$ if we take a longer time to stop, a smaller force will be used to slow us down.

Observe a car to identify the safety measures taken to reduce the risk of injuries in case of a road accident. The car bumpers and grills are designed to provide extra time to reduce speed before any collision.

We can find some crumple zones or bumpers on the front and backside. Seat belts are provided to hold the passengers from moving suddenly. There are extra cushions and airbags as well. These measures provide extra time to change the momentum of the passenger inside it. This means that force acting on the passenger is less to prevent the risk of fatal injuries.

Styrofoam packing to reduce the effect of sudden shock.

The helmets protect from a direct strike on the head and provide extra time to reduce speed before something strikes it. Different safety helmets are used by workers, riders and sportsmen.

Q.5 *Explain the law of conservation of momentum.*

Ans: ***Law of Conservation of Momentum:*** The concept of momentum is important particularly in situations when two or more bodies are interacting with each other. It is a very useful quantity when it comes to calculate what happens in a collision or explosion. It always conserves when the colliding bodies are in an isolated system. This means that when bodies collide no external forces act on the bodies.

Thus the law of conservation of momentum state that:

"The total momentum of an isolated system always remains constant".

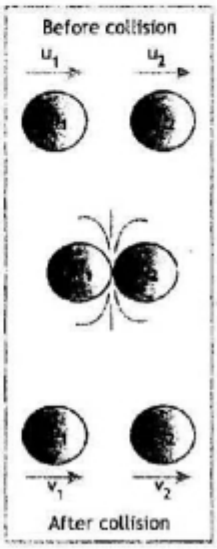
For simplicity, we consider a system of two billiard balls of mass m_1 and m_2 moving in a straight line with velocities u_1 and u_2 respectively where u_1 is greater than u_2.

Total momentum of the system before collision $= m_1u_1 + m_2u_2$

According to the law of conservation of momentum:

Total momentum of the system before collision = *Total momentum of the system after collision*

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$



Q.6 State and explain Newton's first law of motion.

Ans: ***First Law of Motion:*** We have often observed the table placed in our classroom. It always remains at the same place until we apply some force to move it. Like a book placed on the table remains at its place unless someone picks it back. Similarly, a satellite in space continuously moves with constant speed because there is no air or force of friction in space.

Contrary to the above examples, a ball rolling on the ground however stops after some time because the friction of the ground and air resistance exert force on it and change its state of motion or direction of motion. We can define Newton's first law of motion as:

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

Q.7 Define inertia. Which law of motion is also called the law of inertia?

Ans: ***Inertia:*** Newton's first law is also called the law of inertia.

We have observed that when we put our bag on the seat next to us and the bus stops suddenly, the bag slides forward off the seat.

The bag was initially moving forward because it was on moving bus. When the bus stopped, the bag continued moving forward, which was its initial state of motion, and therefore it slid forward off the seat.

Definition: 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.

When a bus starts moving the passengers feel a backward jerk because the lower part of the body moves along the motion of the bus the upper part of the body tends to stay at its initial position rest. On the other hand, when we stop padding our bicycle it does not stop at once. The bicycle continues moving. However, the road's friction and air resistance act against its motion and bring it to rest after some time.

More Information:

Newton's Laws of motion were published in the Latin language in 1687. The first law of motion was written as "Lex I: Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impresis cogitur statum illum mutare".

Isaac Newton
1642-1727

Activity

Coin and card activity is very common to observe the property of inertia of a body.
We need a glass, a card and a coin.
Place the card on the glass.
Place the coin at the center of the card (Fig. a)
Now flick the card with a jerk of the finger
What did we observe?
The card moves away from the glass (Fig. b)
Did the coin move away?
Why did the coin fell into the glass?
The coin tends to stay at rest.
The coin resisted change in its state of rest.

Q.8 State the second law of motion and derive its expression.

Ans: ***Second Law of Motion:*** Newton's second law of motion describes the relationship between force and acceleration. Newton's second law of motion states that:

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

Therefore,

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

Weblinks:

Teacher should encourage learners to visit following website to observe supportive information

- http://www.quia.com/jq/19675.html
- http://csep10.phys.utk.edu/astr161/lect/history/newton3laws.html
- http://www.istp.gsfc.nasa.gov/stargaze/Snewton.htm
- http://www.walter.fendt.de/ph11e/n2law.htm

Combining the above equations, we get:

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

Putting the proportionality constant k, we get:

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

$$Fk = ma$$

Taking the value of constant k=1, therefore

$$\boxed{F = ma}$$

Q.9 *Define mass and weight.*

Ans: ***Mass:*** Mass is the amount of matter present in a body. Mass is the actual amount of material contained in a body and is measured in kg. It is independent of everything. It is an intrinsic property of the body and remains the same wherever the body might be.

Weight: Weight is the force exerted by the gravity on that object (w = mg). Weight is a force, (Force = mass x acceleration). The weight of an object is the mass times the acceleration due to gravity. It is a measure of how strongly gravity pulls on that matter. It is different on the earth, moon, and other places due to the difference in gravitational pull.

For example, objects weigh lesser on the moon where gravity is lower as compared to that on the Earth.

Q.10 *State and explain Newton's Third law of motion.*

Ans: ***Newton's Third Law of Motion:*** This law describes what happens when a body exerts a force on another body.

Definition: Newton's third law of motion can be defined as:

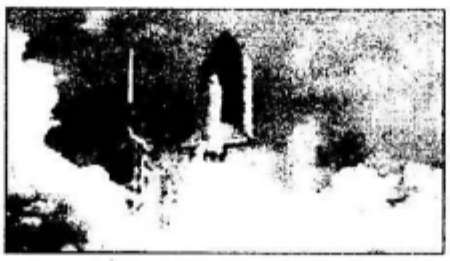
To every action, there is an equal and opposite reaction.

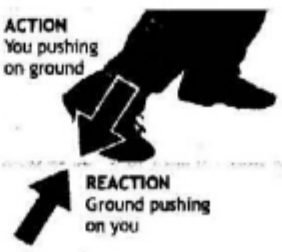
Examples:

(1) Many times we throw a ball towards a wall and it bounces back. If it is thrown with greater force the ball is returned with greater push. It is because the wall reacts against the action of the ball.

(2) While walking on the ground we push the ground with feet the ground pushes us back thus we move.

Action and Reaction Forces: Action and reaction forces always occur in pairs, so when one body pushes against another, the second body pushes back just as hard. For example, when we put a book on a table the book pushes the table downward, the table pushes back the book upward. The action and reaction are forces that occur together as a pair. They are always equal in quantity but opposite in direction. While standing on the ground the gravity pulls you down against the ground, the ground pushes up against your feet. When a rocket ignites its fuel behind it, the expanding exhaust gas pushed on the rocket causing it to accelerate.





PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

Q.11 What is the role of force according to Newton's second law of motion?

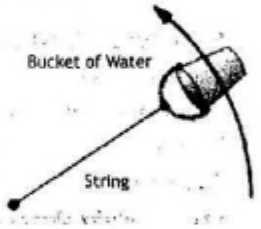
Ans: According to Newton's second law of motion, a force is a vector that causes an object with mass to accelerate. Newton's second law states that the acceleration of an object depends upon two variables - the net force acting on the object and the mass of the object. The acceleration of the body is directly proportional to the net force acting on the body and inversely proportional to the mass of the body. This means that as the force acting upon an object is increased, the acceleration of the object is increased. Likewise, as the mass of an object is increased, the acceleration of the object is decreased.

Q.12 What happens according to Newton's third law, while you pull a catapult?

Ans: "An object at rest stays at rest until a force is applied, and an object in motion stays in motion, at the same speed, until a force acts upon it".
An object at rest stays at rest- this means that the projectile will always sit in the cap if we don't apply a force to it. Until a force is applied- the force we applied was the arm of the catapult. When we pull back the arm it stores up a lot of energy, but when we let go of the arm it changed the form of energy and applied a force to the projectile. This change in the energy created a force that launched the projectile forward.

Q.13 Describe uniform circular motion.

Ans: ***Uniform Circular Motion:*** We take a smaller bucket; tie a piece of string to its handle. We hold the other end of the string and rotate the bucket in a vertical circle.
We may feel some pull on your arm. Now we put few coins in the bucket again rotate it. It is amazing the coins do not fall even the bucket goes bottom up. More interesting will be experimenting with some water. We pour about a cup of water into the bucket. Now we try rotating the bucket around and up. The water stuck to the bottom of the bucket. The force that keeps it stuck is known as centrifugal force and the force we apply against the pull on our arm is known as centripetal force.



Q.14 Define centripetal force.

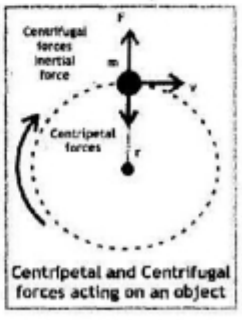
Ans: ***Centripetal Force:*** The force required to move a body along a circular path is called Centripetal force.
It is denoted by F_c. The centripetal force is always directed towards the center of the circular path. It depends on three factors:

(i) the velocity of the object "v"
(ii) the object's distance from the center "r" and
(iii) the mass of the object "m".

It is given by the relation:

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

where m = mass of the body moving in circle
v = velocity of body
r = radius of the circle



Centripetal and Centrifugal forces acting on an object

The velocity of the object is constant and perpendicular to a line running from the object to the center of the circle.

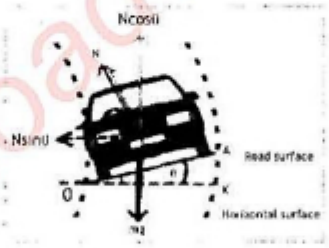
Q.15 ***Define centrifugal force.***

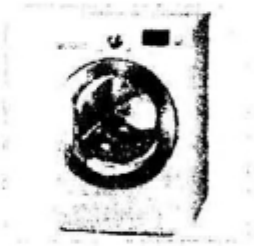
Ans: ***Centrifugal Force:*** Centrifugal force is the tendency of an object to leave the circular path and fly off in a straight line. Thus it is defined as:
A force that acts outward on a body that moves along a curved path is called centrifugal force.

- It is always directed away from the center of curvature.
- The magnitude of centrifugal force is equal but opposite in direction to centripetal force.

Q.16 ***Write few applications of the centrifuge.***

Ans: ***Application of Centrifuge:*** Centrifuge appliances are used to separate heavier particles from lighter particles in liquids e.g. sugar crystals are separated from molasses. Blood analysis is carried out through a centrifuge process in a laboratory. A cream separator is used to separate the cream from skimmed milk. An ultracentrifuge is used for separating small particles from large molecules. A gas centrifuge is used for the separation of isotopes.
Road Banking: The outer edge or bank of the road is raised to a certain height at the curved part of roads. This provides the centripetal force against the types of the vehicle hence prevents from skidding.
Cream Separator: The milk plants in the country are using high-speed spinners to separate cream from milk. The skimmed milk is heavier whereas the cream is lighter. When the milk is spun at high speed the heavy particles are pushed towards the walls of the spinner. These particles push the lighter particles of cream to the center wherefrom it is collected through a tube.
Dryer: Nowadays built-in dryer is available in most washing machines. It spins the wet clothes hence the water droplets are thrown away from the perforated walls of the dryer and clothes get dry instantly.



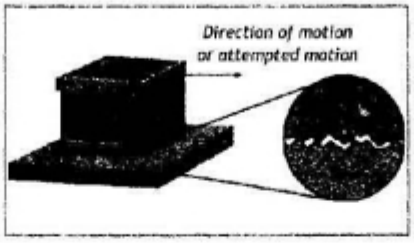


Q.17 ***Which force prevents a passenger from falling down a roller coaster while it turns the riders into an upside - down position?***

Ans: Inertia is what keeps us from falling out. Inertia is a resistance against a change in direction. It keeps us pressed against the bottom of the car with a force stronger than gravity.

Q.18 ***Define friction. Write down its expression and on what factors it depends?***

Ans: ***Introduction of Friction:*** When we throw a ball, it comes to rest after covering some distance. When we kick a ball and a box with the same force, the ball covers more distance than a box. We know that friction helps us walk easily, it prevents us from sliding but sometimes it has disadvantages as well.
Definition of Friction: The force that resists relative motion between two surfaces is called friction.
It is a contact force caused by the roughness or deformation of the materials in contact. The frictional force between a wooden block and cemented floor caused by the roughness of both the surfaces is projected in the given figure. Frictional forces are always parallel to the plane of contact between two surfaces and opposite to the direction of the applied force.



Expression of Friction: Friction is self-adjusting force. It can increase to a certain value known as limiting force (F_s).

It is proportional to normal force R.

$$F_s \propto R$$

The ratio between limiting force and normal reaction R is constant that is represented by the coefficient of friction μ.

Thus, $F_s = \mu R$

or $$\mu = \frac{F_s}{R}$$

When a body is placed on a surface its weight w acts downward then according to Newton's third law of motion R = W, here w = mg by putting the value R = mg in eq., $F_s = \mu R$, we get

$$F_s = \mu mg$$

The coefficient of friction has different values for different surfaces as shown in the given table.

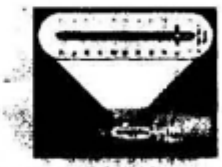
More Information:

Value of Coefficient of Friction for different Surfaces

Tyre and Road	1.0
Iron and iron	1.0
Glass and glass	0.9
Wood and cemented floor	0.6
Wood and marble	0.4
Wood and leather	0.4

Activity

Let us experience the difference in friction on different surfaces.
We need a wooden block, a spring balance connecting strings and few weight slots.
Put a 1kg slot on the block.
Pull it across the wooden table, note down the reading from a spring balance.
Now put 3 kg weight on the block, again pull it and note the reading.
Similarly, put the 5 kg weight on the block and noted own the reading in the observation table.
Now repeat the experiment with different surfaces.
Note down the reading for glass surface, cemented floor and carpeted floor. Now put a few pieces of pipes under the wooden block and repeat the activity.
Observe how rolling friction is lesser than sliding friction.
Fill the table below with observations then discuss the difference of force of friction in each case. Also, discuss the use of ball bearing in vehicles.



Surface	Reading for Load on Wooden Block		
	1kg	3kg	5kg
Cemented floor			
Carpeted floor			
Glass surface			
Wooden Table			
Rolling on pieces of pipes			

Q.19 *Write down the different types of friction.*

Ans: ***Types of Friction***

(i) ***Static Friction:*** It is a force acting on an object at rest that resists its ability to start

moving. The maximum static friction is known as "limiting friction".

(ii) ***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.

(iii) ***Sliding Friction:*** When one body slides over the other body the friction between two surfaces is said to be sliding friction.

Weblinks:

Supportive information Weblink about friction:
http://www.phy.ntnu.edu.tw/java/friction/friction.html

(iv) ***Rolling Friction:*** When a body moves on wheels the friction is said to be rolling friction. Rolling friction is much lesser than sliding friction.

More Information:

Safety ramps are constructed along the roadside where the failure of brakes is feared due to the sharp inclination of the road.

Q.20 *Write down few advantages of friction.*

Ans: ***Advantages of Friction:***

(i) Friction enables one to walk on the ground.

(ii) Friction protects from sliding, as sand is thrown to maintain friction on inclined railway tracks during rain.

(iii) The car brakes slow down the car to stop safely.

(iv) Threads and grooves are designed on tyres to increase the friction and improve grip between road and wheel.

Tyre Grooves Improve grip on road

(v) Now vehicles are equipped with Anti-lock Braking System (ABS). ABS is designed to maintain steering stability, improve vehicle control, avoid skidding and decrease stopping distances on dry and slippery surfaces. The ABS maintains the static friction as the wheel starts slipping it releases the brake automatically for a fraction of a second then holds the wheel again to create static friction between road and tyres.

Q.21 *What are the few disadvantages of friction?*

Ans: ***Disadvantages of Friction:***

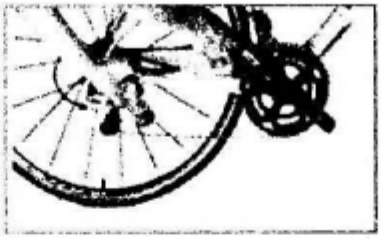
(i) A large amount of energy is wasted in the machines due to friction.

(ii) Friction leads to wear and tear of parts hence increases the service cost.

(iii) Failure of oil pump in car engine results in contact between dry metals which yields high temperature hence the car engine is seized.

Q.22 *Describe some ways to reduce friction.*

Ans: ***Ways to reduce Friction:*** Wheels, pulleys, ball bearings, lubricants and graphite are used to overcome the friction. Lubricating the motor axel, sewing machine and bicycle chain reduce friction and prevents wear and tear. The shape of the vehicle is also designed to reduced air resistance.



Q.23 ***When a free–falling object moves towards earth due to the pull of the earth on it, does earth also move towards that object due to reaction? Explain.***

Ans: This can be easily explained by the equation of Newton's second law of motion F = ma. Earth and any other body pull each other towards each other. The force applied on both of them remaining the same, but the changes in the position of an object are determined by its velocity and acceleration. Assume the mass of earth to be M and that of the arbitrary body to be m. Now the force on both of these objects is GMm/r^2. r is the separation between these objects. Now acceleration of these bodies are

Earth: Gm/r^2 Body B: GM/r^2

If we try putting in values(as G is very small), the earth's acceleration remains a very minute, ignorable quantity until the mass of b becomes significantly large, comparable to planetary masses. On the other hand acceleration of B is considerably high and hence we can observe if its position changes w.r.t. time. If B was something as heavy as the sun we would have been able to see the change in earth's position as we experience earth revolving.

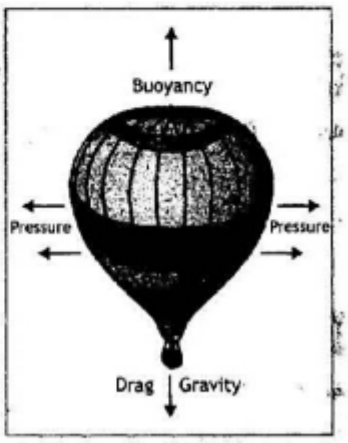
Q.24 ***Enlist any four uses of rolling friction in everyday life.***

Ans: Any ball or wheel has rolling friction when rolled on a surface. Some uses of rolling friction include:

(i) truck, car and skateboard tires (ii) Rolling of Ball bearings
(iii) bike wheels (iv) rolling pin (v) roller skate wheels

Q.25 ***Explore the following phenomenon relation with dynamics:***
(a) When an air–filled balloon is released.

Ans: To help understand the forces acting on a balloon, use a free–body diagram. A free-body diagram is a drawing that shows the forces and directions acting on an object. Below is a free-bodydiagram of a hot air balloon. Buoyancy or lift is created when the temperature in the balloon is increased, causing the density of the air to decrease. The less-dense (lighter) air inside the balloon tends to float on the more dense (heavier) air on the outside of the balloon. That is why hot-air balloons are referred to as lighter than air vehicles. If the amount of lift is greater than the force of gravity acting on the mass of the balloon, then the balloon will rise.

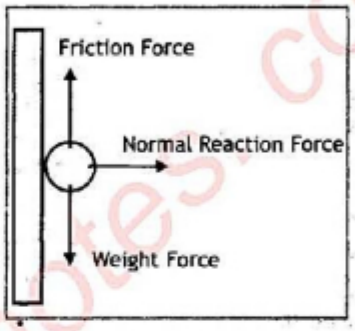


Warmer air inside the balloon will also cause the pressure inside the balloon to increase. The pressure inside the balloon will be greater than that on the outside of the balloon. For the balloon to maintain its shape, this force has to be greater than the forces acting in the opposite directions (pushing inward on the balloon).
In hot-air balloons, drag is the friction that occurs as the balloon rises and moves through the surrounding air. Friction occurs between the moving balloon and the molecules of air. It hits as it rises. Both drag and the force of gravity pulling on the mass of the balloon act in a downward force

in opposition to the lift. If the lift is greater than the drag and force of gravity, then the balloon rises. If the lift is less than the drag and the force of gravity, then the balloon descends. If the lifting force is equal to the force of drag and gravity, then the balloon will neither rise nor fall. For the purpose of illustration, there is no wind shown in the figure. However, wind can also act as a force on the balloon. The wind can come from nearly any direction and will tend to move the balloon in the direction it is blowing.

(b) The biker riding in the death well.

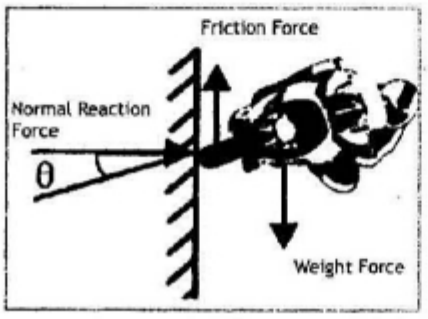
Ans: When a bike moves on the walls, there are a number of forces in play. These include the gravitational force, which acts downward from the bike to the walls, the frictional force that the walls exert against the tires of the bike, and the normal reaction force, a perpendicular push back by the wall surface when it receives a force. There is also centripetal force, which is directed towards the center of the circular path that the bike traces. For a bike moving in a horizontal circle on a vertical wall, the normal reaction (N) is the factor that supplies enough force to sustain motion in a circle. Also, the fact that the bike does not slide down the wall signifies that the forces of friction and gravitation balance each other out (as shown in the figure above).

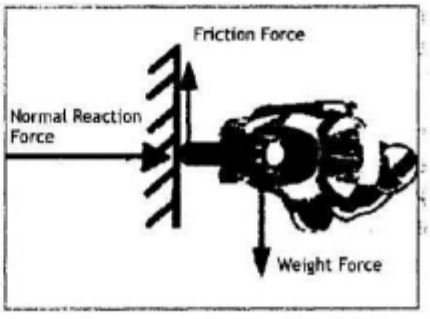


In short, the two forces, the gravitational force and the force of friction act in opposite directions opposite directions and compensate each other, while the normal reaction from the wall is what keeps the bike moving. However, it's not that simple. The frictional force exerted on the tires of the bike depends on the speed of the bike as it moves along the circle. This means that there has to be a minimum velocity of the bike that produces the maximum frictional force, effectively balancing out the gravitational force. This is crucial because if the gravitational force is greater, then the bike will slide down and the rider will fall off. The friction becomes stronger as the speed increases, but with increasing speed, it becomes more and more difficult for the rider to steer the vehicle safely. The above system of forces holds true and stays in equilibrium if we're talking about a point mass, or rather, an object whose entire mass is concentrated in a single point. In such a case, all the forces are acting on that single point. This, however, is not the case with a motorbike. The frictional force is acting on the tires, but the gravitational force is acting through the center of mass of the system consisting of both the bike and the rider. Since the three forces are balanced but do not lie in the same line, the bike will tend to rotate, producing a turning effect that will eventually lead to it fall off. This anomaly has to be compensated for to keep these brave riders safe!

In order to counter this dangerous turning effect, the rider has to lean at an angle away from the vertical. This will make the normal reaction from the wall produce a tendency to rotate (a torque) in the opposite direction. If the rider bends at the correct angle, the torques will be perfectly balanced out; therefore, there will be no rotating or turning effect on the bike and the impressive display can continue.

However, if the rider leans at an angle other than the correct one, then the unbalanced torques will cause the bike to rotate and fall. Therefore, the rider will have to push harder in the opposite direction to supply extra torque and maintain his balance.





PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

Differences

01. ***What are the differences between mass and weight?***

Ans: ***Difference Between Mass and Weight***

Comparison Chart	Mass	Weight
Definition	Mass is the quantity of matter in a body regardless of its volume or any forces acting on it.	Weight is a measurement of the gravitational force acting on an object.
Effect of gravity	Mass is always constant at any place.	The weight of an object depends on the gravity at that place.
Unit of Measurement	Mass is measured in kilogram (kg)	Weight is measured in Newton (N).
Balance used for measurement	Mass is measured using a pan balance, a triple beam balance, lever balance or electronic balance.	Weight is measured using a spring balance.

02. ***What is the difference between Rolling Friction and Sliding Friction?***

Ans: Following is the table with differences between rolling friction and sliding friction:

Rolling Friction	Sliding Friction
Rolling friction takes place when an object rolls on the surface.	Sliding friction takes place when two surfaces are rubbed against each other.
Rolling friction takes place due to the deformation of surfaces.	Sliding friction takes place due to interlocking between microscopic surfaces.
The coefficient of rolling friction is dependent on the radius of the rolling object, the depth to which the object can sink, and the toughness of the surface.	The coefficient of sliding friction depends on the texture of the surface and temperature to a certain extent. It is independent of external factors.
Coefficient of rolling friction: $F_r = \mu_r N$	Coefficient of sliding friction: $F_k = \mu_k N$

Scientific Reasons

01. ***(a) Why a wire fence is designed in the helmet of a batsman?***

Ans: When a helmet breaks, it's absorbing what's called "impulse"—a secondary effect of an initial force. Impulse, which gives objects momentum, is what transmits kinetic energy through a system. It takes into account not just force, but also how long that force was applied.
A wire fence is designed in the helmet of batsman helmet aims to reduce the risk of serious jaw and teeth injuries by reducing the impact of a force or collision to the face.

(b) How does it prevent injuries?

Ans: When a bike helmet breaks, it's absorbing what's called "impulse"—a secondary effect of an initial force. Impulse, which gives objects momentum, is what transmits kinetic energy through a system. It takes into account not just force, but also how long that force was applied.
A helmet aims to reduce the risk of serious head and brain injuries by reducing the impact of a force or collision on the head. A helmet works in three ways: It reduces the deceleration of the skull, and hence the brain movement, by managing the impact.

02. ***Riding a bicycle needs continuous pedalling.***

Ans: Riding a bicycle needs continuous pedalling because When the rider stops pedalling the bicycle, the force of friction between the tyres of the bicycle and the road acting in the direction opposite to the direction of motion of the bicycle, opposes the motion of the bicycle and this force is now unbalanced, thus slowing down the bicycle.

03. ***You always feel a pullback whenever you pull on your school bag or some heavier object.***

Ans: By putting a heavyweight on our shoulders in the wrong way, the weight's force can pull us backwards. So people who carry heavy backpacks sometimes lean forward.

04. ***Why momentum is considered equal to zero when a body comes to rest?***

Ans: We know that momentum is P = mv.

If a body comes to rest, it means its velocity, v = 0, therefore its momentum

$$P = mv = m(0) = 0$$

So, when a body comes to rest its momentum is considered equal to zero.

05. ***Why do you pull your hands while catching a fast–moving ball?***

Ans: A fast–moving ball tends to keep moving due to inertia. According to Newton's second law, the force with which a ball is moving is equal to its mass multiplied by its acceleration. When we catch a ball, the momentum of the ball is transferred from ball to hand. If we keep our hands stationary, the force with which momentum is transferred might hurt our hands. But as soon as we pull our hands back, it increases the time during which the high velocity of the moving ball decrease to zero and net momentum is decreased, thus reducing the force with which the ball makes an impact with our hands.

06. ***What is the reason that you experience a jerk whenever the school bus stops suddenly?***

Ans: When the school bus stops suddenly, we tend to fall forward because due to our inertia we tend to remain in a state of motion even though the bus has come to rest.

07. ***Why it is dangerous to jump from a moving bus?***

Ans: A man jumping out from a moving bus holds the inertia of motion. As the man lands on the ground, his feet come to rest instantly while the upper part of the body continues to move due to inertia of motion. Therefore, the person may fall forward. So, it is very dangerous to jump out of a moving bus.

08. ***Why mass does not differ, while weight differs from place to place?***

Ans: Weight of a body is the gravitational force on it and mass is the amount of matter in the body. Thus, weight is dependent on gravitational acceleration, g but mass does not depend on the value of g. Hence, the weight of a body will change from one place to another place because the value of g is different in different places. For example, the value of g on the moon is 1/6 times the value of g on earth. As mass is independent of g, so it will not change from place to place.

09. ***Why do we feel pushed outward while a car turns on a curved road?***

Ans: The force that pulls out from the center on a body in circular motion is called centrifugal force and it increases with acceleration. Centrifugal force results in a strong outward pull on our vehicle. So what we need to do before entering a curve is slow down.

10. ***Why do we use ball bearings in vehicles and other things?***

Ans: In the case of rolling friction the contact area between two surfaces is lesser than the contact area in the case of sliding bodies. Therefore ball bearings are used in vehicles that reduce the contact area as compared to the contact area of axel and bush. A pedestal fan with a ball bearing saves a lot of electricity therefore the customers always select a fan with a ball bearing rather than one with a bush and axel.

11. ***Why it is easier to walk wearing flat slippers than high heel sandals?***

Ans: Wearing flat slippers will likely be far more comfortable than high heel sandals. This is because the whole of the foot and arch are fully protected without putting too much pressure on sensitive areas such as the toes and heel. Flat slippers have a greater area in contact with the soft sand as compared to high heel sandals. Due to this, there is less pressure on the surface area and less reaction force and it is easy to walk on it.

12. ***Why leather sheet is used in brake drums of a motor bike?***

Ans: A drum brake is a brake that uses friction caused by a set of shoes or pads that press outward against a rotating cylinder-shaped part called a brake drum. The leather sheet is used in brake drums because it provides high friction to stop the motorbike.

Section D — Numerical

Worked Examples of the Textbook

01. ***A car of mass 800kg moving with a velocity of 2ms^{-1}. Its momentum can be calculated as:***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

$m = 800\ kg$ $v = 2\ ms^{-1}$ $p = ?$

Step 2: Write the formula and rearrange if necessary.

$p = mv$

Step 3: Put the value in the formula and calculate.

$p = (800kg)(2ms^{-1}) = 1600\ kg\ ms^{-1}$

Thus, momentum of the car is 1600kgms^{-1}.

02. ***A 60kg object is moving at a velocity of 5 meters per second. What is its momentum?***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

Mass of the object $= m = 60\ kg$

Velocity of the object $= v = 5\ ms^{-1}$

Momentum $= p = ?$

Step 2: Write the formula and rearrange if necessary.

$p = mv$

Step 3: Put the value in the formula and calculate.

$p = (60kg)(5ms^{-1}) = 300\ kgms^{-1}$

Thus, the momentum of object is 300kgms^{-1}.

03. ***Find the force that can stop a body to rest in 4 seconds from its initial velocity of 16ms^{-1}. The mass of the body is 3kg.***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

$m = 3\ kg$ $v_f = 0$ $v_i = 16\ ms^{-1}$

$t = 4\ sec$ $F = ?$

Step 2: Write the formula and rearrange if necessary.

$p_i = mv_i$ and $p_f = mv_f$

$$F = \frac{(p_f - p_i)}{t}$$

Step 3: Put the value in the formula and calculate.

Now $p_i = (3\ kg)(16\ ms^{-1}) = 48\ Ns$

$p_f = (5\ kg)(0) = 0$

Since $F = \frac{(p_f - p_i)}{t}$

$F = \frac{(0-48)}{4} = -12\ N$

Thus, 12N force is required in opposite direction to stop the body.

04. ***A gun of mass 8kg fires a bullet of mass 40 grams with a velocity of 100 ms^{-1}. Calculate the recoil velocity of the gun.***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

Mass of the gun $= m_1 = 8\ kg$

Mass of the bullet $= m_2 = 40\ gram = \frac{40}{1000} = 0.04\ kg$

Before Collision:

Velocity of the gun $= u_1 = 0\ ms^{-1}$

Velocity of the bullet $= u_2 = 0\ ms^{-1}$

After Collision:

Velocity of the gun $= v_1 = ?$

Velocity of the bullet $= v_2 = 100\ ms^{-1}$

Step 2: Write the formula and rearrange if necessary.

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

or $m_1u_1 + m_2u_2 - m_2v_2 = m_1v_1$

$v_1 = \frac{m_1u_1 + m_2u_2 - m_2v_2}{m_1}$

Step 3: Put the value in the formula and calculate.

$$v_1 = \frac{(8\ kg)(0\ ms^{-1}) + (0.04\ kg)(0\ ms^{-1}) - (0.04\ kg)(100\ ms^{-1})}{8\ kg}$$

$v_1 = -0.5\ ms^{-1}$

The gun will recoil with a velocity of $0.5ms^{-1}$. Here –ve sign shows the recoil in opposite direction.

05. ***Find the force that can accelerate a body of 50kg mass up to 5 ms^{-2}.***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

$m = 50\ kg \quad a = 5\ ms^{-2} \quad F = ?$

Step 2: Write the formula and rearrange if necessary.

$F = ma$

Step 3: Put the value in the formula and calculate.

$F = (50kg)(5ms^{-2}) = 250\ N$

Thus the force is 250N.

06. ***Find the force that stops a car of 1000kg mass from its velocity of 72km/h over a distance of 40 meters.***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

$m = 1000\ kg$ $\quad v_i = 72\ km/h = \frac{(72)(1000)}{3600} = 20\ ms^{-1}$

$v_f = 0$ (as the car comes to rest) $\quad S = 40\ m$

$a = ?$ $\quad F = ?$

Step 2: Write the formula and rearrange if necessary.

$2aS = v_f^2 - v_i^2$

$a = \frac{v_f^2 - v_i^2}{2S}$ and $F = ma$

Step 3: Put the value in formula and calculate.

$a = \frac{(0\ ms^{-1})^2 - (2ms^{-1})^2}{2(40\ m)} = -5\ ms^{-2}$

Now $F = ma$

$F = (1000\ kg)(-5\ ms^{-2}) = -5000\ N$

Thus an opposing force of 5000N acts on the car

07. ***A cyclist is making a turn along a circle of radius 20m, at a speed of 5m/s. If the combined mass of the cyclist plus the cycle is 60 kg, calculate the static friction that the road exerts on the tyres?***

Solution:

Step 1: Write the known quantities and point out quantities to be found.

$r = 20\ m$ $\quad v = 5\ ms^{-1}$

$m = 60\ kg$ $\quad F = ?$

Step 2: Write the formula and rearrange if necessary.

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

Step 3: Put the value in the formula and calculate.

$F_c = \frac{(60)(5)^2}{20} = \frac{(60)(25)}{20} = 75\ N$

Thus road must exert a force of 75N on tyres.

Solved Numerical

01. (a) ***Find the momentum of a body of mass 6kg moving with a velocity of 25ms^{-1}.***

Solution: *Data:* mass = m = 6 kg $\quad$ Velocity = v = $25ms^{-1}$

momentum = p = ?

Calculation: $p = mv$

$p = (6)(25) = \boxed{150\ kgms^{-1}}$ Ans.

(b) ***What will be the velocity if the momentum becomes 200Ns?***

Solution: *Data:* mass = m = 6 kg $\quad$ Momentum = p = 200 Ns

velocity = v = ?

Calculation: $p = mv$

$$v = \frac{p}{m}$$

$$v = \frac{200}{6} = \boxed{33.333\ ms^{-1}} \quad \text{Ans.}$$

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

Solution: *Data:* mass = m = 10 kg Initial Velocity = v_i = 10 ms^{-1}
Time = t = 5 sec Final Velocity = v_f = 2 ms^{-1}
Momentum before application of the force = p_i = ?
Momentum after application of the force = p_f = ?

Calculation:
Momentum before application of the force = $p_i = mv_i$

$$p_i = mv_i$$
$$p_i = (10)(10) = \boxed{100\ Ns}$$

Momentum after application of the force = $p_f = mv_f$

$$p_f = mv_f$$
$$p_f = (10)(2) = \boxed{20\ Ns}$$

03. ***(a) A force of 3400 N is applied on a body of mass 850 kg. Find the acceleration produced by the force.***

Solution: *Data:* Force = F = 3400 N Mass = m = 850 kg
Acceleration = a = ?

Calculation: According to the second law of motion:

$$F = ma$$

Therefore, $3400 = (850)a$

$$a = \frac{3400}{850} = \boxed{4\ ms^{-2}} \quad \text{Ans.}$$

(b) How much force should be applied on a body of mass 425kg to produce acceleration same as calculated in part b.

Solution: *Data:* Force = F = ? Mass = m = 425 kg
Acceleration = a = 4 ms^{-2}

Calculation: According to the second law of motion:

$$F = ma$$

Therefore, $F = (425)(4) = \boxed{1700\ ms^{-2}}$ Ans.

04. ***(a) Find the mass of a body which is accelerated by applying a force of 200N that speeds up it to 36 ms^{-2}.***

Solution: *Data:* Force = F = 200 N Acceleration = a = 36 ms^{-2}
Mass = m = ?

Calculation: According to the second law of motion:

$$F = ma$$

Therefore, $200 = m(36) = 36m$

$$m = \frac{200}{36} = \boxed{5.55\ kg} \quad \text{Ans.}$$

(b) What should be the acceleration of the same body if the applied force changes in 280N.

Solution: *Data:* Force = F = 280 N Acceleration = a = ?

Mass = m = 5 kg

Calculation: According to the second law of motion:

$F = ma$

Therefore, $280 = (5)a = 5a$

$a = \frac{280}{5} = \boxed{56\ ms^{-2}}$ Ans.

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

Solution:

Data:

Mass of the empty car = m_E = 1200 kg

Acceleration of the empty car = a_E = 4 ms^{-2}

Load of passengers and luggage = m_L = 300 kg

Acceleration of the car with load = a_L = ?

Total mass of the car with load

= $m = m_E + m_L = 1200 + 300 = 1500$ kg

Force = F = ?

Calculation: According to the second law of motion:

$F = ma$

Therefore, $F = (1200)(4) = 4800$ N

Now, the same engine with the load will produce the acceleration:

$F = ma$

$(4800) = (1500)a = 1500a$

$a = \frac{4800}{1500} = \boxed{3.2\ ms^{-2}}$ Ans.

06. ***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 = 9.8ms^{-2}, on Moon = 1 .6 ms^{-2} and on Mars = 3.7 ms^{-2}.

Solution:

Data: Mass of an object = m = 60 kg Weight of the object = W = ?

Calculation:

(i) the acceleration due to gravity on Earth = g = 9.8ms^{-2}

We know that $W = mg$

Therefore, $W = (60)(9.8) = \boxed{588\ N}$ Ans.

(ii) the acceleration due to gravity on Moon = g = 1.6 ms^{-2}

We know that $W = mg$

Therefore, $W = (60)(1.6) = \boxed{96\ N}$ Ans.

(iii) the acceleration due to gravity on Mars = g = 3.7 ms^{-2}

We know that $W = mg$

Therefore, $W = (60)(3.7) = \boxed{222\ N}$ Ans.

07. ***A car is running on a circular part of the highway having about a 1000m radius. The mass of the car is 600kg and its velocity is 72 kmh^{-1}. Find***

(i) Centripetal force exerted by the car.

(ii) Centripetal acceleration of car.

Solution: *Data*: Radius = r = 1000 m Mass of the car = m = 600 kg

Velocity of the car = 72 kmh $= \frac{72 \times 1000}{60 \times 60} = \frac{72000}{3600} = 20\ ms^{-1}$

The centripetal force exerted by the car = F_c = ?
Centripetal acceleration of car = a_c = ?

Calculation:

(i) ***We know that centripetal force is***

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

Therefore, $F_c = \frac{(600)(20)^2}{1000} = \frac{(600)(400)}{1000}$

$$= \frac{240000}{1000} = \boxed{240\ N}$$ Ans.

(ii) ***According to the second law of motion, F = ma***
Therefore, centripetal force will be

$F_c = ma_c$

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

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

$a_c = \frac{(20)^2}{1000} = \frac{400}{1000} = \boxed{0.4\ ms^{-2}}$ Ans.

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

Data: Mass of the block = m = 15 kg Force = F_s = 3 N
Coefficient of friction = μ = ?
Acceleration due to gravity = g = 9.8 ms^{-2}

Calculation: We know that $F_s = \mu mg$
Therefore, $3 = \mu(15)(9.8) = \mu(147)$

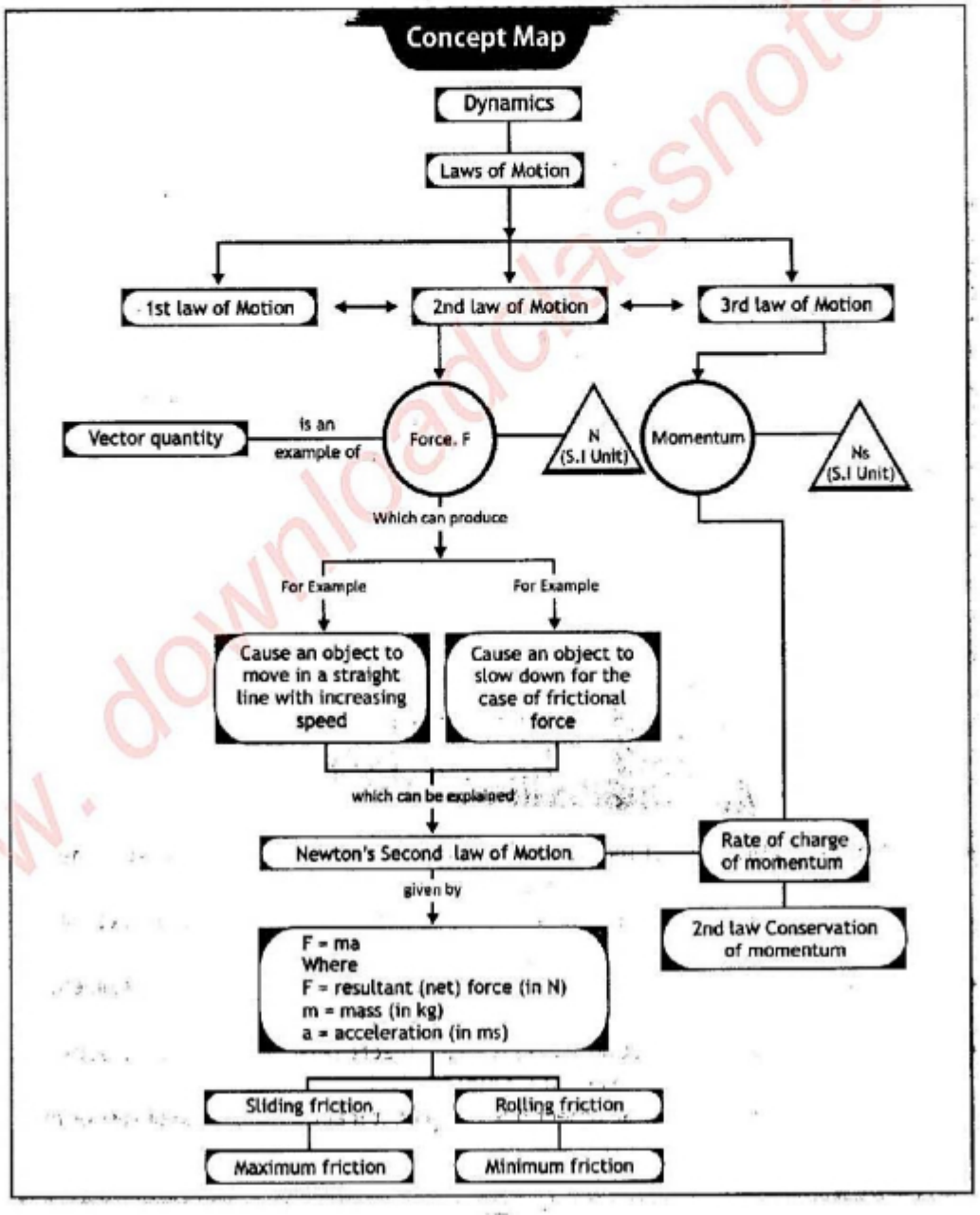
$$\mu = \frac{3}{147} = \boxed{0.0204}$$ Ans.

Summary

- Dynamics is the study of the cause of motion. In common force, the mass of the object and frictional forces affect the motion of the object.
- Force is the agent that changes the state of rest or motion of a body. It can accelerate a body.
- Momentum is defined as a quantity of motion contained in a body. Momentum is the product of the mass and velocity of a moving object.
- Newton's first law of motion explains that objects resist changing their state of rest or motion. It is also called the law of inertia.
- Inertia is the property of an object due to which it maintains its state of rest or motion.
- Newton's second law of motion states that a net force produces acceleration in the direction of force (F = ma).

PHYSICS NOTES FOR CLASS 9TH (FOR SINDH)

- Newton's third law of motion states that for every action, there is an equal and opposite reaction.
- Centripetal force is required to move a body along a circular path.
- Centrifugal force is the tendency of an object to move away from a circular path. It is always opposite and equal to centripetal force.
- Centrifuge equipment is helpful in many laboratories as well as daily life processes.
- The force that resists relative motion between two surfaces is called friction.
- Maximum static friction is called limiting friction. The static friction is always greater than kinetic friction.
- The Rolling friction is much lesser than the sliding friction due to the smaller contact area.
- Safety devices are designed to decrease the momentum of a body and provide extended time to remain safer.



End of Unit Questions Solution

SECTION - A: MULTIPLE CHOICE QUESTIONS

Tick Mark (✓) the correct answer:

See "Multiple Choice Questions (M.C.Qs)" - (1) to (10)

SECTION - B: STRUCTURED QUESTIONS

Momentum

01. ***(a) Define momentum with S.I Unit.***

Ans: See "Short and Detailed Answer Questions" – Q.2

(b) Find the momentum of a body of mass 6kg moving with a velocity of 25ms^{-1}.

Ans: See "Solved Numerical" – Q.1 (a)

(c) What will be the velocity if the momentum becomes 200Ns?

Ans: See "Solved Numerical" – Q.1 (b)

02. ***(a) When a free-falling object moves towards earth due to the pull of the earth on it, does earth also move towards that object due to reaction? Explain.***

Ans: See "Short & Detailed Answer Questions" – Q.23

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

Ans: See "Solved Numerical" – Q.2

03. ***(a) Why a wire fence is designed in the helmet of a batsman?***

Ans: See "Scientific Reasons" – Q.1 (a)

(b) How does it prevent injuries?

Ans: See "Scientific Reasons" – Q.1 (b)

Law of Motion

04. ***(a) State Newton's first law of motion. Give some common examples.***

Ans: See 'Short & Detailed Answer Questions' – Q.6

(b) Enlist some common observations that are caused by the property of inertia.

Ans: See 'Short & Detailed Answer Questions' – Q.7

See "Scientific Reasons" – Q.06

05. ***(a) Define Newton's second law of motion.***

Ans: See 'Short & Detailed Answer Questions' – Q.8

(b) A force of 3400 N is applied on a body of mass is 850 kg. Find the acceleration produced by the force.

Ans: See "Solved Numerical" – Q.3 (a)

(c) How much force should be applied on a body of mass 425kg to produce acceleration same as calculated in part b.

Ans: See "Solved Numerical" – Q.3 (b)

06. ***(a) Show the relationship between applied force and the acceleration produced in the body?***

Ans: See 'Short & Detailed Answer Questions' – Q.8 (Mathematical Expression)

(b) Find the mass of a body which is accelerated by applying a force of 200N that speeds up it to 36 ms^{-2}.

Ans: See "Solved Numerical" – Q.4 (a)

(c) *What should be the acceleration of the same body if the applied force changes in 280N.*

Ans: See "Solved Numerical" – Q.4 (b)

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

Ans: See "Solved Numerical" – Q.5

08. (a) *Enumerate at least three clear differences between mass and weight.*

Ans: See "Differences" – Q.1

(b) *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 = 9.8ms^{-2}, on Moon= 1 .6 ms^{-2} and on Mars= 3.7 ms^{-2}.

Ans: See "Solved Numerical" – Q.6

Circular Motion

09. (a) *Define the forces acting on an object in a circular motion.*

Ans: See "Short & Detailed Answer Questions' – Q.14 & Q.15

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

Ans. See the figure given in Q.14

(c) *A car is running on a circular part of the highway having about a 1000m radius. The mass of the car is 600kg and its velocity is 72 kmh^{-1}. Find*

(i) Centripetal force exerted by the car.

(ii) Centripetal acceleration of car.

Ans: See "Solved Numerical" – Q.7

(d) *List down some purposeful uses of centrifuge that humans are benefitting every day.*

Ans: See 'Short & Detailed Answer Questions' – Q.16

Friction

10. (a) *What is the force of friction? Explain with two examples from daily life.*

Ans: See 'Short & Detailed Answer Questions' – Q.18

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

Ans: See "Solved Numerical" – Q.8

11. (a) *How anti–lock braking system prevents the risk of sliding?*

Ans: See 'Short & Detailed Answer Questions' – Q.20 (v)

(b) *Enlist any four uses of rolling friction in everyday life.*

Ans: See "Short & Detailed Answer Questions" – Q.24

12. *Explore the following phenomenon relation with dynamics:*

(a) *When an air–filled balloon is released.*

Ans: See "Short & Detailed Answer Questions" – Q.25 (a)

(b) *Riding a bicycle needs continuous pedalling.*

Ans: See "Scientific Reasons" – Q.2

(c) *The biker riding in the death well.*

Ans: See "Short & Detailed Answer Questions" – Q.25 (b)

(d) *You always feel a pullback whenever you pull on your school bag or some heavier object.*

Ans: See "Scientific Reasons" – Q.3