Chapter # 4

Dynamics-2

Q#1 Define parallel forces*?*

Ans: In a plane if a number of forces acting on the body such that there point of action are different but forces are parallel to each other than the forces are called parallel forces.

Q # 2 Difference between like and unlike parallel forces?

Ans: Parallel Forces:

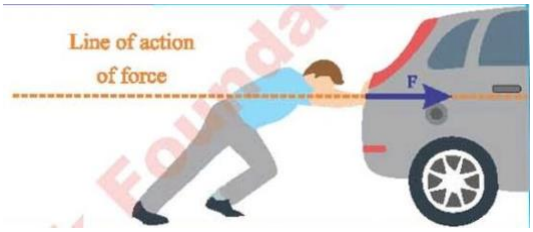
- ⇨ Force that are parallel to each other but have same direction are called parallel forces.
- ⇨ For example, when we push a cart with both hands, we are applying like parallel forces from each support.

Unlike parallel forces:

- ⇨ Force that are parallel to each other but have opposite direction are called parallel forces.
- ⇨ When we apply force with our both hands on handle of a bike to turn it the force from one hand may be greater or equal, we are applying unlike parallel forces.

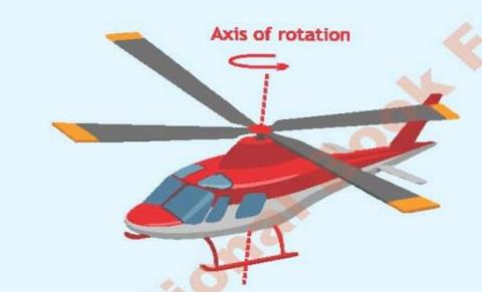
Q# 3 What is meant by line of action of force?

Ans: The line along which a force acts is called line of action of force.



Q# 4 Define Axis of rotation?

Ans: Axis of rotation is a line about which rotation takes place. This line remain fixed during rotational motion, while the other points of the body move in circles about it. it may be a pivot, hinges or any other support.



Q# 5 Define the term torque or moment of force?

Ans: Definition:

The turning effect of a force is called torque or moment of the force.

Mathematically: The moment of the force or torque is determined by the product of force F and its moment arm L.

$$\text{Torque} \qquad \tau = Fx\,L$$

SI unit:

SI unit of torque is newton-metre (Nm). It is a vector Quantity.

Factors: It depend upon three factors

1) Force.
2) Moment arm
3) Angle b/w force and moment arm.

Q # 6 Define moment arm?

Ans: The perpendicular distance between the axis of rotation and the line of action of the force is called the moment arm of the force. It is represented by the distance L.

Q# 7 Why the handle of a door is fixed near the outer edge of a door?

Ans: We can open or close a door more easily by applying a force at the outer edge of a door rather than near the hinge**.** Because in this case moment arm is large and by apply small force we can open or close the door more easily . According to formula:

$$\tau = Fx\,L$$

Q # 8 Why applying force along the hinges does not produce rotation in a door?

Ans: As the force is being applied at the hinge, its perpendicular distance from the hinge will be zero and hence its moment about the hinge will be zero. Hence, it won't cause the door to rotate. So

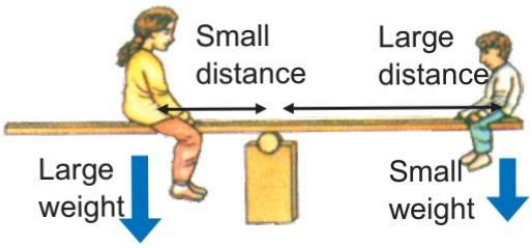
Torque = 0

Q# 9 Can a small child play with a fat child on the seesaw? Explain how?

Ans: yes it is possible

Reason:

If we decrease the moment arm of fat child than both can play.



Q#10 Difference b/w Centre of mass and Centre of gravity?

Ans: Centre of mass:

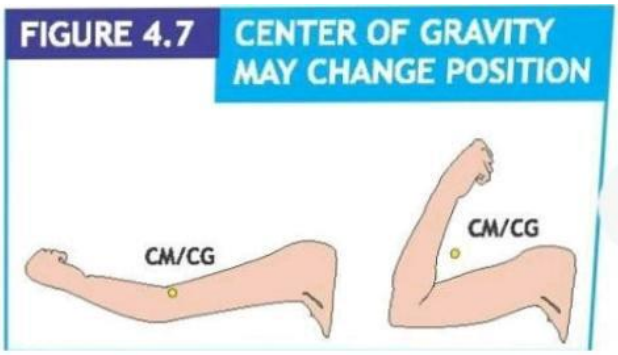
- ⇨ Centre of mass of a system is such a point where an applied force causes the system to move without rotation.
- ⇨ It depend upon mass of the body.
- ⇨ It is independent of the change in Gravitational field.

Centre of gravity;

- ⇨ A point where the whole weight of the body appears to act vertically downward is called centre of gravity of a body.
- ⇨ It depend upon Gravitational acceleration (g) .
- ⇨ It depend upon Gravitational field .

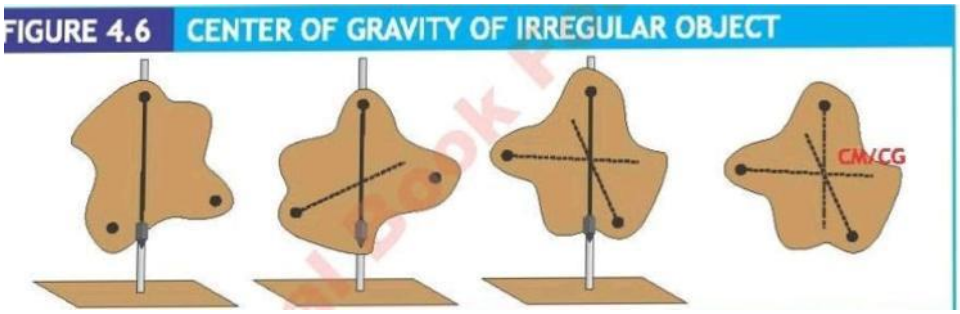
Q#11 When Would the centre of mass of object be different than its centre of gravity?

Ans: The CM/CG doesn't always lie inside the mass and may change its location depending upon the Orientation of the object. For example the arm is stretched out the CM/CG lies inside the Mass distribution, but when the arm is bent, the CM/CG shifts to the new location outside the Mass distribution as shown in figure



Q#12 How we find centre of mass/ Centre of gravity of irregular object?

Ans: For irregular objects one way to determine the center of gravity is to hang it randomly from at Least three different points, and then connecting vertical lines drawn with the help of plumb line These line will meet each other at a common point which will be the centre of gravity CG of the Irregular object (sheet) as shown in figure:



Q#13 Is centre of gravity and centre of mass always lies at same point?

Ans: The center of mass and center of gravity (CM/CG) are same for small objects. But since the value Of acceleration due to gravity decrease with altitude, therefore for tall objects (like mountains and building) there is a slight difference.

Q# 14 What is plumb line?

Ans: A simple method to find the centre of gravity of a body is by the use of a plumb line. A plumb line consists of a small metal bob (lead or brass) supported by a string. When the bob is suspended freely by the string, it rests along the vertical direction due to its weight acting vertically downward.

Q# 15 What is Rigid body?

Ans: A body is composed of large number of small particles. If the distances between all pairs of particles of the body do not change by applying a force then it is called a rigid body.

Q#1 Define Equilibrium also give Example?

Ans; <u>Definition:</u>

A body is said to be in equilibrium doesn't have any acceleration (linear or angular)

Example:

A car moving with uniform velocity on a levelled road and an aeroplane flying in the air with uniform velocity are the examples of bodies in equilibrium.

Q#2 Write conditions of Equilibrium?

Ans: For a body in equilibrium, it must satisfy certain conditions. There are two conditions for a body to be in equilibrium.

1) First Condition.
2) Second Condition.

1) <u>First condition of equilibrium :</u>

A body is said to satisfy first condition for equilibrium if the resultant of all the forces acting on it is zero. Let n number of forces acting on a body such that:

$$\mathbf{F_1 + F_2 + F_3 + \ldots + F_n} = 0$$

or

$$\sum \mathbf{F} = 0 \quad \ldots \ldots \ldots (4.9)$$

The symbol $\sum$ is a Greek letter called sigma used for summation. Equation 4.9 is called the first condition for equilibrium.

The first condition for equilibrium can also be stated in terms of x and y-components of the forces acting on the body as:

$$F_{1x} + F_{2x} + F_{3x} + \ldots + F_{nx} = 0$$

$$\text{and} \quad F_{1y} + F_{2y} + F_{3y} + \ldots + F_{ny} = 0$$

$$\text{or} \quad \sum F_x = 0 \quad \ldots \quad \ldots \quad \ldots \quad (4.10)$$

$$\text{and} \quad \sum F_y = 0 \quad \ldots \quad \ldots \quad \ldots \quad (4.11)$$

A book lying on a table or a picture hanging on a wall, are at rest and thus satisfy first condition for equilibrium. A

⇨ **Second condition for equilibrium:**

A body satisfies second condition for equilibrium when the vector sum of all the torque acting on it is zero. Mathematically,

$$\vec{\tau}_{net} = \vec{\tau}_1 + \vec{\tau}_2 + \vec{\tau}_3 + \ldots\ldots + \vec{\tau}_n = 0$$

Q#3 A small boy Is thrown straight up by his father, At the top he comes to rest for of moment will he be in equilibrium?

Ans: No he is not in equilibrium.

Explanation.

At the top of his path he came to rest. The velocity may Be zero, but the net force is not zero It has gravitational acceleration which is acting vertically downward.

Q# 19 A fan is rotating uniformly, Is it In equilibrium ?

Ans: Yes , It is in equilibrium.

Explanation: A rotating ceiling fan satisfies second condition for equilibrium because ceiling fan rotating constantly at constant speed in equilibrium as net torque acting on it zero.

Q# 20 Think of a body which is at rest but not in equilibrium?

Ans: A ball thrown vertically upward will be momentarily at rest at the top of his path but it is not in equilibrium.. A pendulum and an oscillating spring-mass are other examples.

Q# 21 Why a body cannot be in equilibrium due to single force acting on it?

Ans: A single force produces acceleration so net force is not zero for a body in equilibrium we need at least two forces that are equal in magnitude and opposite In direction.

Q# 22 Give an example of a moving body which is in equilibrium.

Ans: A paratrooper coming down with terminal velocity (constant velocity) also satisfies first condition for equilibrium and is thus in equilibrium.

Q#1 How many types of equilibrium are there?

Ans: The equilibrium is divided into two types

1) Static equilibrium:

2) Dynamic equilibrium:

- **Static equilibrium**:
  When a body is at rest under the action of several forces acting together and several torques acting the body is said to be in static equilibrium.
  For example:
  A book resting on the table is in static equilibrium, the weight mg of the book is balanced by a normal reaction force from the table surface.
- **Dynamic equilibrium:**
  When a body is moving at uniform velocity under the action of several forces acting together the body is said to be in dynamic equilibrium.
  For example:
  when the ceiling fan is rotating with unchanging speed.
  It is further divided in to two types.
  Dynamic Translational Equilibrium: When a body is moving with uniform linear velocity the body is said to be in dynamic translational equilibrium.

For example:

A paratrooper falling down with constant velocity is in dynamic translational equilibrium.

Dynamic Rotational Equilibrium:

When a body is moving with uniform rotation the body is said to be in dynamic rotational equilibrium.

For example:

when the ceiling fan is rotating with unchanging speed.

Q# 2 Define stability?

Ans: A measure of the ability of an object to return to lts original position when the force that changed its position is removed is called stability. Stable objects are very difficult to topple over while unstable objects topple over very easily.

Q#3 Write states of equilibrium?

Ans: There are three states of equilibrium:

1) Stable equilibrium
2) Unstable equilibrium
3) Neutral equilibrium

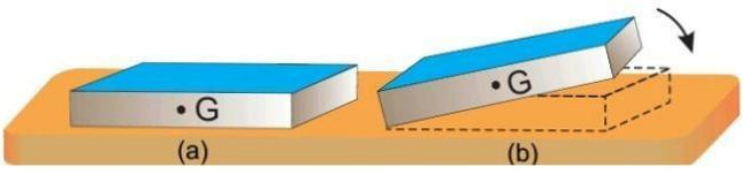
Stable equilibrium:

A body is in stable equilibrium if when slightly tilt and after releasing it returns to its original position.

Position of centre of mass:

Its centre of mass rises when it is displaced. It regain its position back because its weight has a moment of force about the point of contact that acts to reduce the displacement.

For Example: consider a book lying on the table. Tilt the book slightly about its one edge by lifting it from the opposite side it returns to its previous position when sets free. Such a state of the body is called stable equilibrium.



returns to its previous position when sets free. Such a state of the body is called stable equilibrium.

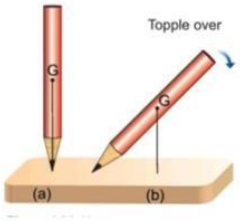
UNSTABLE EQUILIBRIUM

A body is in unstable equilibrium if it moves further away from its previous position when slightly is placed and released.
Position of centre of mass:

centre of mass falls when it is displaced, because there is a moment which increases the displacement.

for example Take a pencil and try to keep it in the vertical

position on its tip. Whenever you leave it, the pencil topples over about its tip and falls down. This is called an unstable equilibrium:



NEUTRAL EQUILIBRIUM

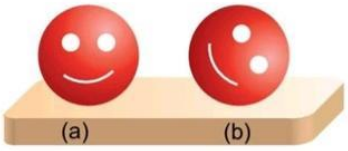
A body is in neutral equilibrium if it stays in its new position when displaced.

Position of centre of mass:

Its centre of mass does not rise or fall because there is no moment to increase or decrease the displacement.

For example: Take a ball and place it on a horizontal surface. Roll the ball over the surface and leave it after displacing from

its previous position. It remains in its new position and does not return to its previous position. This is called a neutral equilibrium.



Q#4 Propose how the stability of an object can be improved.

Ans: An object's stability can be improved by:

(a) lowering the centre of mass; or

(b) increasing the area of support; or

(c)by both.

Q# 5 what is role of centre of gravity on stability?

Ans: The position of the centre of gravity of an object affects its stability. The Lower the Centre of Gravity (G) is, the more Stable the object. The Higher it is the more likely is to the object is to Topple over if pushed it .

Increasing the area of the base will also increase the stability of an object, the bigger the area the more stable the object.

Q#6 Why the height of vehicles is kept as low as possible?

Ans: To make them stable, their centre of mass must be kept as low as possible. It is due to this reason, racing cars are made heavy at the bottom and their height is kept to be minimum

Q# 1 Define friction?

Ans: Friction (denoted by letter 'f ') is the resistance to relative motion that occurs whenever two materials are in contact with each other, whether they are solids, liquids, or gases. Since it is a force therefore it is a vector quantity and has unit as newton (N).

Q# why friction opposes motion?

Ans: No surface is perfectly smooth. A surface that appears smooth has pits and bumps that can be seen under a microscope.

Q# what are the factors upon which friction depends?

Ans: friction depends upon many factors such as

1) Nature of surface.
2) Pressing force .
3) Normal Force

Q# Write advantages of friction?

Ans:

- ⇨ Friction between the soles of our shoes (or feet) and the ground help us walk.
- ⇨ Friction between tyre and road helps to drive cars.
- ⇨ Friction holds the screw and nails in wood.

Q# Write disadvantages of friction?

Ans:

- ⇨ It slows down moving objects and causes heating of moving parts in machinery.
- ⇨ Energy is wasted to overcome friction in machinery.
- ⇨ Produce wear and tear.

Q# Write methods to Reduce friction?

Ans: There are many ways to reduce unwanted friction, few are discussed below.

- ⇨ **By polishing:** If we polish the rough surfaces, they become smooth and friction is reduced.
- ⇨ **By using Ball Bearing:** This method converts the sliding friction is converted into rolling friction by use of ball bearings
- ⇨ **By applying Lubricants (oil or Grease) to surfaces:** Friction of certain liquids is less than that of solid surfaces, therefore, oil or grease is applied between the parts of machinery.

Q# what id meant by force of limiting friction?

Ans: Friction can be increased to certain maximum value. It does not increase beyond this. The maximum value of friction is known as the force of limiting friction (F). It s depends on the normal reaction (pressing force) between the two surfaces in contact.

Q# What is meant by coefficient of friction?

Ans: The ratio between the force of limiting friction F and the normal reaction R is constant. s This constant is called the coefficient of friction

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

$$F_s = \mu R$$

Q# Difference between Rolling and sliding friction?

Ans: Rolling friction:

- ⇨ Rolling friction takes place when an object rolls on the surface.
- ⇨ Rolling friction takes place due to the deformation of surfaces.
- ⇨ It is less than sliding friction

Sliding friction:

- ⇨ Sliding friction takes place when two surfaces are rubbed against each other.
- ⇨ Sliding friction takes place due to interlocking between microscopic surfaces.
- ⇨ It is greater than Rolling friction.

Q# Define terminal velocity?

Ans: The constant maximum velocity that is attained and maintained by an object while falling through air (or any other resistive medium) is called terminal velocity.

Q# In winter when we rub our hands together we feel the sensation of warmth why?

Ans: It is because friction causes the increase in the temperature our hands, which makes our hands warm.

Q#1 Does wider tyres increase friction and thus roads grip of our car?

Ans: It seems intuitive that wider tyres will provide for more narrow friction, and wide however, tyres of the same friction weight is same It is because friction does not depend on the area of contact. The wider tyre simply spreads the weight of the car over more surface area thereby reducing heat and Wear.

Q#2what is the function of treads on tyres?

Ans: Treads (traction) on tyres also does not increase Friction. These treads are much larger compared to microscopic roghness which lock the contact surfaces together and produce friction while sliding. The treads are made in the tyre only to displace water from the road to avoid skidding. Many racing cars use tires without treads.

Q#3 What is drag force?

Ans: when an object moves through a fluid, the fluid exerts a retarding force that tends to reduce the speed of the object. This retarding force experienced by an object moving through a fluid is called the drag .

$$F = 6\pi\eta r v_t$$

Q#4 Write factors upon which drag force depends?

Ans: The drag force depends upon the

- ⇨ Size, shape and orientation of the object
- ⇨ Type (Properties) of the fluid
- ⇨ Speed of the object relative to the fluid

QQ#5 what do you know about shooting stars?

Ans: We have noticed shooting stars (a small piece of rock or dust that meteors are heated, and hey glow. A meteor compresses air in front of it. When they plow through the atmosphere, Heats up, in turn Heating the meteor. The intense heat vaporizes most meteors, creating what we Call shooting star

Q#1 Difference between Centripetal and Centrifugal force?

Ans: <u>Centripetal force:</u>

- ⇨ It is a force which keeps a body to move in a circular path.
- ⇨ It is real force and has Real effects.
- ⇨ Acceleration is always towards centre.
- ⇨ Formula:

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

<u>Centrifugal force</u>:

- ⇨ It is the outward push that we experience in a circular Motion
- ⇨ It is the pseudo (Imaginary) force but has real effects
- ⇨ Acceleration is always outward from centre
- ⇨ Formula

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

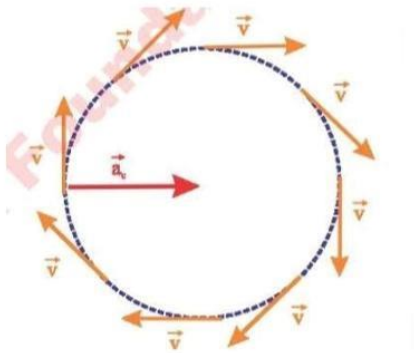
Q#2 What is the direction of velocity and acceleration when body moves in a circular path?

Ans: <u>Direction of velocity:</u>

The direction of velocity is always perpendicular to acceleration i.e is it always along the tangent line.

<u>Direction of a acceleration:</u>

The acceleration of the body is always directed towards centre:



Q#3 Which force is responsible for keeping the planets to move around the sun?

Ans: Centripetal force keeps the planets to move around the sun it is provided by the gravitational force of the planets.

Q#4 what is an orbit?

Ans: An orbit is a regular, repeating path that one object in space takes around another one.

Q#5 What is a satellite?

Ans: it is an object that revolve around a planet.

OR

An object in a orbit is known as satellite.

Q#6 What are artificial satellites?

Ans: Scientists have sent many objects into space. Some of these objects revolve around the Earth. These are called artificial satellites.

Q# calculate average orbital speed of a satellite?

Ans: The orbital speed of the body is the speed at which it orbits around the center of the system. This system is usually around a massive body. The relationship between speed, distance and time is:

Speed = distance / time

This means that in one orbit, a satellite travels a distance equal to the circumference of a circle (the shape of the orbit). This is equal to *2nr where r'is the radius a circle, thus:

Distance = 2nr

The time it takes for an object to orbit around another object is called its orbital period 'T'. Earth completes its orbital period around the sun every 365 days. The further away a planet is from the sun, the longer its orbital period. The planet Neptune, for example, takes almost 165 years to orbit the sun.

Time = orbital period = T

So:

$$v_{ave} = \frac{2\pi r}{T} .$$

Which means that for particular distance from the centre of earth, all the satellite should have the same orbital speed irrespective of the size of satellite.

Q# What do you know about GPS?

Ans: Many applications of satellite technology affect our lives. An increasingly important application is the network of 24 satellites called the Global Positioning System (GPS), which can be used to determine the position of an object. These satellites revolve around the Earth twice a day with a speed of 3.87 km/s.

Q# Two satellites are following one another in the same circular orbit. If one satellite tries to catch another (leading one) satellite, can it be done by increasing its speed?

Ans: No, if the speed of the satellite is somehow increased , its radius will also increase and it will be unable to catch up the leading satellite.

Exercise shot Questions:

Q# 1 Why long spanner is used to open or tight nuts of vehicle's tyre? While tightening a small nut, extra-long wrench is not suitable. Why?

Ans: long spanner provides a greater moment of force than a short one hence less force is applied. That's why long spanner is used to open or tight nuts of vehicle's tyre.

If we use such a large wrench for tightening a small bolt, a large torque will produce. This may damage or break the bolt. So extra-long wrench is not suitable for tightening a small nut.

Q# 2 Why door knobs are fixed at the edge of door? What will happen it the door knob is at the middle of the door?

Ans: Door knobs are fixed at the edge of door because doors are opened through the application of torque. To make it as easy as possible to open the door, the knobs are placed as far from the hinge as is feasible This maximizes the lever arm, reducing the amount of force needed to open the door.

If the door knob is at the middle of the door then greater force is required as compared to the door knob at the edge of the door. Because the knob at the middle of the door decreases the moment arm which means greater force is required to open the door.

Q# 3. If you drop a feather and a bowling ball from the same height, which one will reach the terminal velocity first? Which one of them will hit the ground first?

Ans: A feather has a much larger surface area relative to its mass compared to a bowling ball. This means the feather experiences a much higher air resistance relative to its weight. Thus, the feather will reach its terminal velocity first.

If feather and a bowling ball were dropped in a vacuum (where there is no air resistance), both the feather and the bowling ball would accelerate at the same rate due to gravity and hit the ground at same time**.**

Q# 4. Why do ice skates effortlessly slide on ice, while your shoes cause skidding?
Ans: Ice skates slide effortlessly on ice primarily due to the formation of a thin layer of water between the skate blade and the ice, significantly reducing friction.

Regular shoes have a much larger surface area and do not exert the same pressure on the ice. Shoes typically have rubber soles, which are designed for grip rather than sliding. When you try to slide with shoes, the increased surface area and materials increase friction, causing skidding rather than smooth sliding,

Q# 5. Explain why it's easier to push a car on flat tyres than inflated ones. What happens to the frictional force between the tyres and the road?

Ans: When pushing a car, the ease or difficulty can be significantly affected by the condition of its tyres. Pushing a car on flat tyres is generally easier than pushing one with fully inflated tyres due to differences in the frictional forces at play.

It is easier to push a car on flat tyres than inflated ones because in case of flat tyres the friction between road and tyres is less than the inflated ones.

Q# 6. When standing on a crowded school bus, which stance would provide better stability and prevent you from being pushed over: legs joined or legs spread apart?

Ans: Legs spread apart would provide better stability and prevent you from being pushed over. Because this often lowers your center of gravity slightly, contributing to increased stability. A lower center of gravity means that it takes more force to move your center of gravity outside your base of support.

Q# 7. Why a moving bicycle is easier to balance? Relate this to the principles of rotational motion.

Ans: A moving bicycle is easier to balance because the spinning wheels create angular momentum. This angular momentum resist changes in their orientation and help keep the bike upright. The faster the wheels spin the stronger this stabilizing effect is, making it easier for the rider to maintain balance,.

Q# 8. Why is a pencil standing on its tip unstable and what factors affect the stability of an object balanced on a point?

Ans: A pencil standing on its tip is unstable because it has a high center of gravity and a very small base of support. Stability is affected by the diagram position of the center of gravity, the size of the base of support, and the line of action. For an object to be stable, its center of gravity .CG should be low and its base of support should be wide, ensuring that the line of action remains within the base.

Q# 9. While driving what happens if the driver take the curve too fast? How does centripetal force play a role in keeping the car from skidding off the road?

Ans : When a driver takes a curve too fast, several things can happen. One of the primary risks is that the car may skid off the road due to the centrifugal force acting on it Centripetal force keeps the car moving in a curved path by acting toward the center of the curve. It's provided by the friction between the tires and the road surface.

Q# 10. Consider a situation where you swing a ball connected to a string in a circle. How does the tension in the string vary as the ball moves across different points in its circular path, and what forces are involved?

Ans: As the ball moves in a circle, the tension in the string varies. At the top of the circle, tension IS lowest as it only opposes gravity. At the bottom, tension iS highest. Countering gravity and providing centripetal force. Throughout, forces involved are tension, gravity,. And centripetal force.

Q # 11. Why is it important for communication satellites in geostationary orbit to maintain a specific speed?

Ans: Communication satellites in geostationary orbit must maintain a specific speed to stay synchronized with the rotation of the Earth. This ensures they remain fixed relative to specific point on the Earth's a surface, allowing uninterrupted communication with ground-based receivers**.**

NUMERICAL PROBLEMS

1. Calculate the torque acting on spanner of length 20cm to loosen a nut by a force of 50N. I the same nut is to be loosen up by force of 100N, what should be length of spanner?

Data:

$\tau = ?$

$l_1 = 20cm = 0.2m$

$F_1 = 50N$

$F_2 = 100N$

$l_2 = ?$

Solution:

$\tau = F_1 l_1$

$\tau = (50)(0.2)$

$\boxed{\tau = 10Nm}$

$\tau = F_2 l_2$

$l_2 = \frac{\tau}{F_2}$

$l_2 = \frac{10}{100}$

$l_2 = 0.1m$ $\quad \boxed{l_2 = 10cm}$

2. A long uniform steel bar of length 1.0m is balanced by a pivot at its middle. Two mass m and m_2 are suspended at a distance of 0.2m and 0.3m respectively from the pivot. Ignorin mass of the steel bar, if mass $m_1 = 0.6kg$ find mass m_2.

Data:

$l = 1m$

$l_1 = 0.2m$

$l_2 = 0.3m$

$m_1 = 0.6kg$

$m_2 = ?$

Solution:

$w_1 l_1 = w_2 l_2$

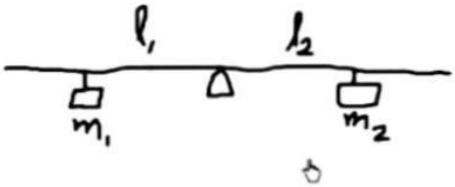
$m_1 g l_1 = m_2 g l_2$

$m_1 l_1 = m_2 l_2$

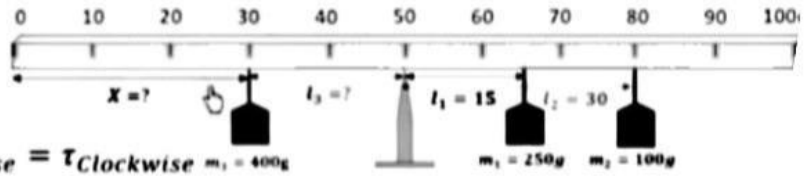
$m_2 = \frac{m_1 l_1}{l_2}$

$m_2 = \frac{(0.6)(0.2)}{0.3}$

$\boxed{m_2 = 0.4kg}$



3. Two masses, 250g and 100g are hanging at positions 65cm and 80cm, respectively, on uniform meter rod, pivoted at 50cm mark as shown. Where should a third mass of 400g b positioned to balance the road?



Data:

$m_1 = 250g = 0.25kg$

$m_2 = 100g = 0.1kg$

$l_1 = 15cm = 0.15m$

$l_2 = 30cm = 0.3m$

$x = ?$

$m_3 = 400g = 0.4kg$

Solution:

$\tau_{AntiClockwise} = \tau_{Clockwise}$

$w_3 l_3 = w_1 l_1 + w_2 l_2$

$m_3 g l_3 = m_1 g l_1 + m_2 g l_2$

$m_3 l_3 = m_1 l_1 + m_2 l_2$

$(0.4)l_3 = (0.25)(0.15) + (0.1)(0.3)$

$(0.4)l_3 = 0.0375 + 0.03$

$(0.4)l_3 = 0.067$

$$l_3 = \frac{0.0675}{0.4}$$

$l_3 = 0.169m = 16.9cm$

$x = 50 - l_3$

$x = 50 - 16.9$

$\boxed{x = 33.1cm}$

4. A car weighing 1200kg enters a roundabout with a diameter of 60 meters at a speed o 25km/h. Calculate the centripetal force acting on the car as it navigates the curve.

Data:

$m = 1200kg$

$D = 60m$

$r = \frac{D}{2} = \frac{60}{2} = 30m$

$v = 25kmh^{-1}$

$= \frac{25 \times 1000}{3600} ms^{-1}$

$= 6.94ms^{-1}$

$F_c = ?$

Solution:

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

$$F_c = \frac{(1200)(6.94)^2}{30}$$

$\boxed{F_c = 1927N}$

5. A geostationary satellite revolves around earth in an orbit of radius 42000km. Find orbita speed of the satellite at this height.

Data:

$T = 1day = 86400s$

$r = 42000km$

$= 42000 \times 10^3 m$

$v_o = ?$

Solution:

$$v_o = \frac{2\pi r}{T}$$

$$v_o = \frac{2(3.14)(42000 \times 10^3)}{86400}$$

$$v_o = \frac{263760000}{86400}$$

$$v_o = 3052.78ms^{-1}$$

$$v_o = 3.05278 \times 10^3 ms^{-1}$$

$$\boxed{v_o = 3.05278kms^{-1}}$$