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CHP#O4

DYNAMICS- II

Q#01: what do you know about parallel force? Also define like parallel and unlike parallel forces.

Ans:

Parallel Force:

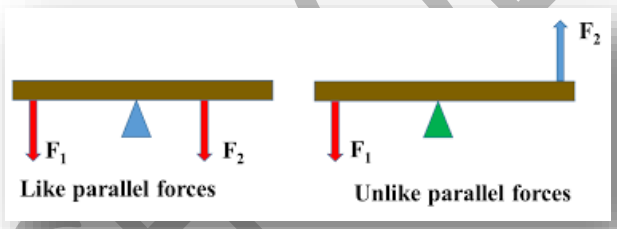
Parallel forces are a set of forces acting on an object that are parallel to each other. This means they have the same direction or opposite directions but do not intersect.

Like Parallel Forces: Forces that are parallel and act in the same direction.

Example: Multiple people pushing a car in the same direction.

Unlike Parallel Forces: Forces that are parallel but act in opposite directions.

Example: Tug- of – war where two teams pull the rope in opposite direction.



Q#02: What is moment of force or toque? On what factors it depends? Write its mathematical form.

Ans:

Moment of force or torque:

Turning effect produced in a body about a fixed point due to applied force is called moment of force or torque. It determines how effectively a force can cause an object to rotate about a specific axis or pivot point.

Factors Affecting Torque:

Magnitude of the Force (F): The greater the force applied, the greater the torque.

Distance from the Pivot Point (r): This is the perpendicular distance from the axis of rotation to the line of action of the force. The longer this distance, the greater the torque.

Angle of Application (θ): The angle between the force vector and the lever arm affects the torque. Maximum torque is generated when the force is applied perpendicular to the lever arm.

Mathematical Form:

The torque ($\boldsymbol{\tau}$) is calculated using the formula:

$\boldsymbol{\tau = F \times d}$

Where:

- tau (τ) is the torque.
- d is the perpendicular distance from the axis of rotation to the line of action of the force (often called the lever arm).
- F is the magnitude of the applied force.

The quantity torque (or moment of force) may be thought of as the cross product of force and distance and the SI unit for torque is Newton meter, N m.

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Q#03: What is an axis of rotation? How does the position of an axis of rotation affect the rotational motion of an object?

Ans: The axis of rotation is an imaginary line around which an object rotates or spin.

The position of the axis of rotation determines the path and speed of the points on the object. If the axis is centrally located, the object rotates symmetrically. If it is off-center, the object will rotate in a more complex manner and leading to wobbling.

Q#04: How does the direction of torque change when the force applied to a lever arm is reversed from clockwise to counterclockwise?

Ans: The direction of torque depends on the direction of the applied force relative to the pivot point. When the force applied to a lever arm is reversed from clockwise to counterclockwise, the direction of the torque also reverses.

Clockwise Force: When a force is applied in a direction that causes a clockwise rotation around the pivot point, the torque is considered to be in the clockwise.

Counterclockwise Force: When the force is applied in a direction that causes a counterclockwise rotation around the pivot point, the torque is considered to be in the counterclockwise.

Thus, reversing the applied force from clockwise to counterclockwise changes the direction of the torque.

Q#05: Define center of mass. What is effect of mass distribution in a body on its center of mass?

Ans:

Center of mass:

The center of mass of a body or system of a particle is defined as a point where the whole of the mass of the body or all the masses of a set of particles appeared to be concentrated.

Effect of Mass Distribution on Center of Mass:

Uniform Mass Distribution: If the object has the same amount of material everywhere (like a solid ball or cube with the same material throughout), the center of mass will be right in the middle of the object.

Non-Uniform Mass Distribution: If the object has different amounts of material in different places (like a seesaw with a heavy person on one end and a light person on the other), the center of mass will be closer to the heavier part.

Irregular Shapes: For objects with unusual shapes, the center of mass might not be at the geometric center. For example, if you have a boomerang, the center of mass is somewhere inside it but not necessarily in the middle of the material.

Examples:

A Uniform Ruler: If you balance a ruler on your finger, the center of mass is at the 50 cm mark, right in the middle.

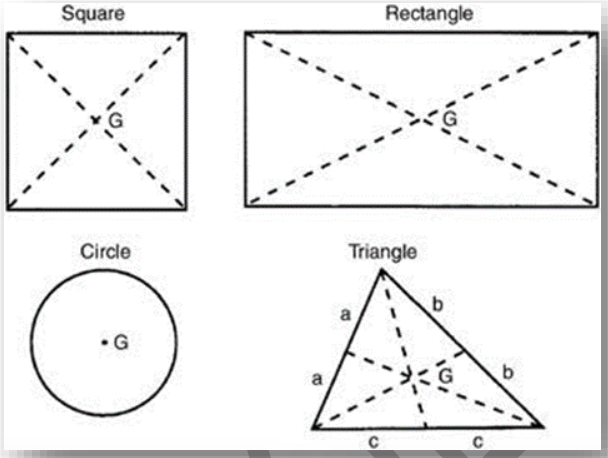
A Hammer: If you try to balance a hammer on your finger, the center of mass is closer to the heavy metal head, not the handle.

A Person with a Backpack: When you wear a backpack, the center of mass of your body moves towards the backpack.

Q#06: What is center of gravity? Where will be center of gravity of these regular bodies Circular, rectangular and square shaped objects, triangle shaped object, cylinder sphere.

Ans: **Center of gravity:**

The center of gravity is the point where whole weight of the body appear to act.

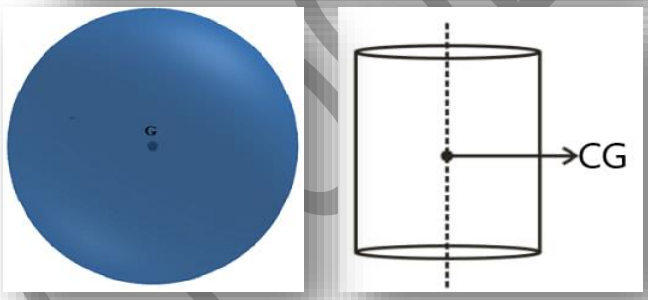


Center of gravity of regular bodies:

Circular object: The center of gravity of a circular object lies at its geometric center, which is the midpoint of the diameter.

Rectangular and square-shaped objects: For both rectangular and square objects, the center of gravity is at the intersection of their diagonals, which is also the geometric center.

Triangle-shaped object: The center of gravity of a triangle object is at the intersection of its medians, which is also two-thirds of the distance from each vertex to the midpoint of the opposite side.



Cylinder: The center of gravity of a cylinder lies along its axis of symmetry, which passes through the center of its circular faces.

Sphere: The center of gravity of a sphere is at its geometric center, which is also its center of mass.

Q#07: Differentiate between center of mass and center of gravity.

Ans.

Centre of mass (CM)	Centre of Gravity (GM)
It is the point where the total mass of the object can be considered to be concentrated	It is the point at which the entire weight of an object can be considered to act
It does not depend on gravitational field	It depends on gravitational field
For very heighted objects gravitational field is non-uniform. Their CM is geometrical center if mass distribution is uniform.	Foe very heighted objects its position is slightly below than center of mass due to non-uniformity of gravitational field.

Q#08: How can you find center of gravity of an irregular shaped thin lamina?

Ans:

1. Hang the Lamina: Hang the irregularly shaped thin lamina freely from a point. Ensure that it can swing freely without any obstructions.

2. Mark the Vertical Line: Use a plumb line (a weighted string or cord) to mark the vertical line directly beneath the point where the lamina is suspended. This vertical line represents the line of action of the force due to gravity.

3. Repeat the Process: Repeat the process by suspending the lamina from different points along its edge. Each time, mark the vertical line beneath the point of suspension.

4. Intersection of Lines: The center of gravity of the lamina is located at the point where these vertical lines intersect. This is because the center of gravity is the point where the weight of the lamina acts, and when suspended freely, the weight will always align with the plumb line.

5. Verification: Verify the location of the center of gravity by repeating the process multiple times or by using other methods to confirm the result.

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Using a plumb line is a practical method for finding the center of gravity of irregularly shaped objects, especially when other geometric methods are not feasible.

Q#09: What is equilibrium? Describe the conditions of equilibrium. State principle of moments.

Ans: Equilibrium:

An object is in equilibrium in a reference coordinate system when all external forces (including moments) acting on it are balanced. This means that the net result of all the external forces and moments acting on this object is zero.

Examples: A book kept on a table at rest. A car moving with a constant velocity.

Conditions for equilibrium:

Translational Equilibrium:

For an object to be in translational equilibrium, the following condition must be met:

Sum of Forces Must Be Zero:

The vector sum of all the forces acting on the object must be zero. Let n number of forces F_1 , F_2 , F_3, ……. , F_n are acting on a body such that

$F_1 + F_2 + F_3 + \ldots\ldots + F_n = 0$

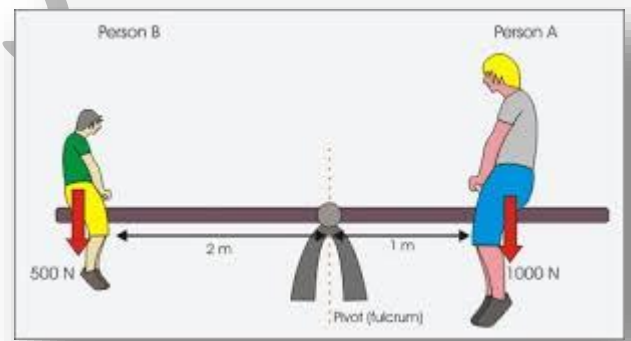
$\sum F = O$

The symbol $\sum$ is a Greek letter called Sigma used for summation.

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

$\sum F_x = 0$

$\sum F_y = 0$



Rotational Equilibrium:

For an object to be in rotational equilibrium, the following condition must be met:

Sum of Moments (or Torques) Must Be Zero: The sum of all the torques (moments) about any axis must be zero.

$\sum \tau = 0$

Principle of moments:

The principle of moments states that when in equilibrium, the total sum of the anti-clockwise moment is equal to the total sum of the clockwise moment.

Examples:

Seesaw, Balanced scale, Wrench etc.

Q#10: Define stability? What are stable, unstable and neutral equilibrium.

Ans: Stability:

Stability refers to the ability of a system or entity to remain unchanged or to return to its original state after a disturbance.

Stable equilibrium: When a particle is displaced slightly from a position, then a force acting on it brings it back to the initial position, it is said to be in stable equilibrium position.

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 a stable equilibrium.

Unstable equilibrium: When a particle is displaced slightly from a position, then a force acting on it tries to displace the particle further away from the equilibrium position, it is said to be in unstable equilibrium.

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.

Neutral equilibrium: When a particle is slightly displaced from a position then it does not experience any force acting on it and continues to be in equilibrium in the displaced position, it is said to be in neutral equilibrium.

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.

Q#11: Propose how the stability of an object can be improved.

Ans: **Lowering the center of gravity:** Positioning the center of mass closer to the ground makes the object less prone to tipping, as there is less leverage for destabilizing forces.

1. **Widening the base:** Increasing the width of the object's base provides a larger area of support, reducing the likelihood of tipping over.
2. **Adding weight to the base:** Increasing the mass at the bottom of the object helps to improve its stability by making it harder to tip over.

Q#12: Differentiate between static equilibrium and dynamic equilibrium. Also explain types of dynamic equilibrium.

Ans:

Static equilibrium	Dynamic equilibrium
A system is in static equilibrium when it is at rest, and all the forces and torques acting on it are balanced. There is no net force or net torque, so there is no movement.	A system is in dynamic equilibrium when it is moving at a constant velocity. The forces and torques are still balanced, but the system is in motion rather than at rest.
There is no motion; the object remains stationary.	There is motion; the object is moving at a constant speed in a straight line (uniform motion).
Example: A book resting on a table, a suspended object hanging motionless, or a building standing still.	**Example:** A car cruising at a constant speed on a straight road, a satellite orbiting the Earth in a stable orbit, or a plane flying at a constant altitude and speed.

<u>Types of dynamic equilibrium</u>:

Dynamic Translational equilibrium: When a body is moving with uniform linear velocity the body is said to be in dynamic translational equilibrium.

Example: a paratrooper falling down with constant velocity.

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

Example: when the ceiling fan is rotating with unchanging speed.

Q#13: Define force of friction. What causes friction? What are advantage and disadvantage of friction? How can be friction reduced?

Ans: **Friction:**

The force of friction is a resistive force that acts against the relative motion or tendency of such motion of two surfaces in contact. It acts parallel to the surfaces in contact and opposite to the direction of motion or attempted motion.

Causes of Friction: Friction is primarily caused by the interactions between the surface irregularities of the materials in contact. These interactions can include:

1. **Rough Surfaces:** Even smooth-looking surfaces have tiny bumps that catch on each other.
2. **Stickiness**: Surfaces can stick to each other a little bit at a microscopic level.
3. **Pressing Together:** When you press two surfaces together, they resist moving past each other.

Advantages of Friction:

- **Walking and Driving:** Friction allows us to walk without slipping and cars to drive without skidding.
- **Stopping:** Brakes use friction to stop vehicles.
- **Writing:** Pens and pencils need friction to write on paper.
- **Machinery:** Friction is necessary for belts and gears to work in machines.
- **Lighting Matches:** Friction generates heat to light matches.

Disadvantages of Friction:

- **Wearing Out:** Friction causes materials to wear down over time.
- **Energy Loss:** Friction turns some energy into heat, wasting energy.
- **Less Efficiency:** Friction in machines can make them less efficient.
- **Noise:** Friction can cause annoying noises.
- **Overheating**: Too much friction can cause things to overheat and get damaged.

Methods of reducing friction:

- **Lubrication:** Using oil or grease makes surfaces slide over each other more easily.
- **Smoothing Surfaces:** Making surfaces smoother reduces friction
- **Using Bearings:** Bearings reduce friction by rolling instead of sliding.
- **Choosing the Right Materials:** Some materials slide over each other more easily.
- **Streamlining:** Designing things to cut through air or water more easily reduces friction.

In simple terms, friction is what makes it possible for us to walk and stop, but it also causes things to wear out and lose energy. We can reduce friction by using lubricants, making surfaces smoother, and using special materials and designs.

Q#14: What is rolling friction and how does it differ from sliding friction?

Ans: **Rolling Friction:**

Rolling friction happens when an object rolls over a surface, like a wheel or a ball.

Sliding Friction:

Sliding friction occurs when two surfaces slide against each other, like pushing a book across a table.

Key Differences:

1. Strength: Rolling friction is weaker than sliding friction, which is why wheels make movement easier.

2. Contact: Rolling friction involves rolling objects and slight deformations, while sliding friction is about direct contact and rubbing between surfaces.

Q#15: What is drag force? On which factors drag force depends.

Ans: **Drag force:**

Drag force is the resistance that slows down objects moving through air or water.

It depends on:

- How fast the object is moving (faster means more drag).
- The shape of the object (smooth shapes have less drag).
- How thick the air or water is (denser or thicker fluids create more drag).
- The size of the object (bigger objects generally have more drag).

These factors determine how much force the fluid pushes back on something trying to move through it.

Example: A streamlined car shape experiences less drag than a boxy truck shape because the air flows more smoothly around it.

Q#16: Analyse the dynamics of an object reaching terminal velocity.

Ans: **Terminal velocity:**

It is defined as the highest velocity attained by an object falling through a fluid. It is observed when the sum of drag force and buoyancy is equal to the downward gravity force acting on the object. The acceleration of the object is zero as the net force acting on the object is zero.

Example: Think of a skydiver. When they jump out of a plane, they accelerate due to gravity. But as they fall faster, the air resistance they feel increases until they reach a speed where they stop speeding up. This is their terminal velocity. From then on, they fall at that steady speed unless something changes, like their body position or the air density.

Understanding terminal velocity helps us predict how fast things fall through air or water, which is important in sports, engineering, and understanding natural phenomena like falling raindrops.

Q#17: What is frictional dissipation, and how does it affect mechanical systems?

Ans: **Frictional dissipation:**

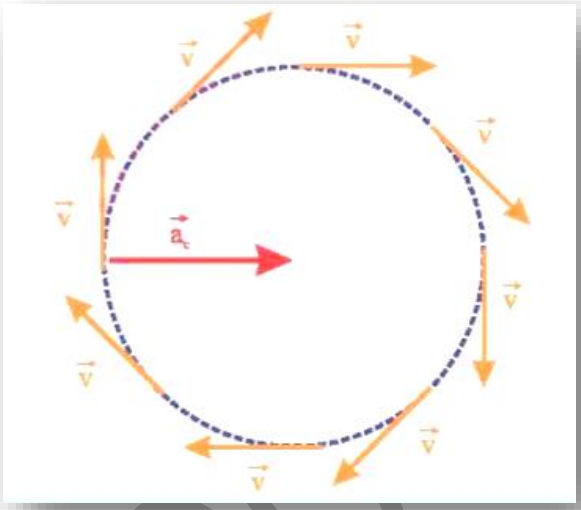
Frictional dissipation refers to the energy that is lost due to frictional forces within mechanical systems. When two surfaces rub against each other, kinetic friction converts mechanical energy into heat, sound, and sometimes wear and tear. This energy loss manifests as a decrease in the efficiency of mechanical systems.

In practical terms, frictional dissipation affects mechanical systems in several ways:

- **Energy Loss:** Frictional forces cause a portion of mechanical energy to be converted into heat. This can lead to inefficiencies in machines, as the intended mechanical work output is reduced.
- **Heat Generation:** Frictional dissipation often results in heat being generated at the contact surfaces. In some cases, this heat can lead to thermal expansion, which may affect the dimensional stability of the components involved.
- **Noise Production:** Friction between components can also produce noise, which can be undesirable in certain applications. Noise can indicate inefficiencies or excessive wear within the system.

Q#18: Define centripetal force. Describe the motion of a body in a circular path under the action of centripetal force.

Ans: **Centripetal force:**



Centripetal force is the force that acts on a body moving in a circular path and is directed towards the center of the circle around which the body is moving. It is responsible for keeping the body in its circular trajectory rather than letting it move in a straight line.

When a body moves in a circular path under the action of centripetal force:

1**. Direction of Motion:** The body continuously changes its direction of motion because it is constantly being pulled towards the center of the circle.

2. Constant Speed: The speed of the body remains constant if the centripetal force remains unchanged. This is because centripetal force does not affect the speed of the body however the direction is continuously changing giving rise to change in velocity.

3. Acceleration: Despite the constant speed, there is acceleration because acceleration is defined as any change in velocity (including direction). The centripetal force provides this acceleration by continuously changing the direction of the velocity vector of the body.

4. Magnitude of Centripetal Force: The magnitude of the centripetal force required to keep the body in its circular path depends on the mass of the body, its speed, and the radius of the circular path. It is given by the formula:

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

where

m is the mass of the body.

v is its speed.

r is the radius of the circular path.

In summary, centripetal force acts as a center-seeking force that allows a body to continuously change direction while moving in a circle, keeping it from moving in a straight-line tangent to the circle.

Q#19: Define orbital motion, what is the difference between natural satellites and artificial satellites.

Ans: **Orbital motion:**

Orbital motion means the way objects move around each other in space because of gravity. For example, the Earth orbits around the Sun, and the Moon orbits around the Earth.

Natural satellites: These are objects like moons that naturally orbit planets due to gravity. For instance, our Moon orbits around the Earth.

Artificial satellites: These are human-made objects launched into space to orbit Earth or other planets. They are used for things like communication, weather forecasting, and scientific research. Unlike natural satellites, humans create and send artificial satellites into space.

Q#20: Define orbital velocity. How do scientist use the concept of orbital speed to launch satellites into specific orbits? What factors influence the chosen speed?

Ans: **Orbital velocity:**

Orbital speed is the speed needed to achieve the balance between gravity's pull on the satellite and the inertia of the satellite's motion. This is approximately 27,359 km per hour at an altitude.

Mathematically:

$$V_{avg} = \frac{2\pi r}{T}$$

Scientists use the concept of orbital speed extensively when launching satellites into specific orbits around Earth or other celestial bodies. Here's how it works:

1. **Achieving Orbit:** To place a satellite into orbit, a rocket is launched with sufficient initial velocity so that the satellite can overcome Earth's gravitational pull and remain in free fall around the planet. This initial velocity is known as the orbital velocity required for a specific orbit altitude.

2. Specific Orbits: Different types of orbits (e.g., low Earth orbit, geostationary orbit, polar orbit) require different orbital speeds due to variations in altitude and orbital characteristics. For example, a satellite in a low Earth orbit (LEO) travels faster than one in a geostationary orbit (GEO).

3. Factors Influencing Speed:

Orbital Altitude: The higher the orbit, the slower the required orbital velocity because gravitational force decreases with distance from the Earth's surface.

Type of Orbit: Orbits such as polar, equatorial, or highly elliptical orbits have different orbital speed requirements due to their specific orbital parameters.

Gravitational Influence: Orbital velocity is influenced by the gravitational pull of the central body (in this case, Earth), which varies slightly with altitude and can be perturbed by other celestial bodies.

In summary, orbital velocity is crucial for determining how fast a satellite needs to travel to maintain its orbit. Scientists and engineers use this concept to plan and execute satellite launches, ensuring satellites are placed accurately into their designated orbits based on mission requirements and orbital dynamics.

Q#21: Summarizes the physical parameters of the planets in solar system.

Ans: <u>Selected data for the solar system</u>:

Our solar system consists of our star, the Sun, and everything bound to it by gravity - the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; dwarf planets such as Pluto; dozens of moons; and millions of asteroids, comets, and meteoroids. In table we are summarizes the physical parameters of the plants in solar system.

Planet	Distance from Sun (Gm)	Mass (10^{24})	g (N/Kg)	Orbital period (yr.)	Density (kg/m^3)	Average surface temperature (°C)
Mercury	57.9	0.330	3.7	0.241	5429	167
Venus	108.2	4.87	8.9	0.615	5243	464
Earth	149.6	5.97	9.8	1	5514	15
Mars	228.0	0.642	3.7	1.88	3934	-65
Jupiter	778.5	1898	24.7	11.9	1326	-110
Saturn	1432.0	568	9.0	29.4	687	-140
Uranus	2867.0	86.8	8.7	83.8	1270	-195
Neptune	4515.0	102	11.0	164	1638	-200
Sun	5906.4	1990000	274	-	1408	5600

Conceptual Questions

Q#01: 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: A long wrench is used to loosen or tighten the nuts on a car tire because it gives you more leverage, making it easier to apply more force. However, using a very long wrench on a small nut isn't a good idea. It can cause too much force, which might damage the nut or nearby parts.

Q#02: 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 placed at the edge of a door to make it easier to open and close. This placement uses leverage, meaning you can apply less force to move the door. If the knob were in the middle, it would be much harder to push or pull the door, requiring more effort and making it awkward to use.

Q#03: 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: The feather will reach terminal velocity first because of its larger surface area and lower mass, experiencing less air resistance compared to the bowling ball. However, in the absence of air resistance, both objects will fall at the same rate due to gravity, and the bowling ball will hit the ground first due to its higher mass.

Q#04: Why do ice skates effortlessly slide on ice, while your shoes cause skidding?

Ans: Ice skates slide effortlessly on ice because the pressure and friction from the blades create a thin layer of water that reduces friction. Shoes, on the other hand, have a larger surface area and don't create enough pressure to form this water layer, leading to higher friction and skidding.

Q#05: 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: It's easier to push a car on flat tyres than on inflated ones because flat tyres increase the contact area with the road, reducing the pressure and making it easier to overcome the initial static friction. The frictional force between the tyres and the road decreases because the car's weight is distributed over a larger area, lowering the pressure and, consequently, the resistance to motion.

Q#06: 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: Standing with your legs spread apart provides better stability on a crowded school bus compared to standing with your legs joined. It creates a wider base of support, improves balance, and helps absorb movements, reducing the risk of being pushed over.

Q#07: Why a moving bicycle is easier to balance? Relate this to the principles of rotational motion.

Ans: When a bicycle is moving, the spinning wheels help keep it steady and prevent it from tipping over. This happens because of how the wheels rotate, which makes it easier to balance compared to when the bike is not moving.

Q#08: 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 very small base touching the surface, making it easy to fall over. Factors like the pencil's weight distribution and any slight push can cause it to topple.

Q#09: While driving what happens if the driver takes the curve too fast? How does centripetal force play a role in keeping the car from skidding off the road?

Ans: If a driver takes a curve too fast, the car may skid off the road because the tires can't grip enough. Centripetal force keeps the car on the curve by pulling it inward, relying on tire friction with the road.

Q#10: 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 because they orbit the Earth at the same rate the Earth rotates, which is approximately 3.07 kilometers per second (about 1.91 miles per second). This specific speed ensures that the satellite remains fixed relative to a specific point on the Earth's surface, allowing for continuous communication with ground stations.

Q#11: Why tyres of vehicles are wrapped with chains during snow in Murree hill area?

Ans: Tyres of vehicles are wrapped with chains during snow in Murree hill areas because snow chains provide more friction, and by increasing the friction between the road and tyre makes driving much safer as it reduces the chances of skidding on icy surfaces.

Q#12: Your car is stuck in mud track; two men sit on the bonnet of your car. This helps you to take your car out of mud. How sitting of men on car's bonnet did help you?

Ans: So, to increase friction, we need to increase the pressing force. So, when two men sit on the bonnet, the pressing force increased due to increase in weight and friction also increase which will help to take the car out of the mud track.

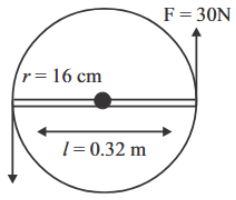
Assignment Questions

1. A 500 kg car is traveling at 30 m/s. Calculate the work done by friction to bring it to a stop. Also find the heat produced in stopping the car. **(Ans. 225 KJ, 225 KJ)**

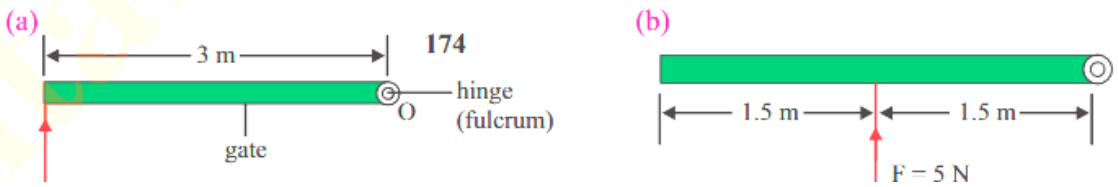
2. A skydiver jumps out of an airplane and if average acceleration produces in the skydiver is 4 m/s to reach the terminal velocity of 54 m/s, calculate the time it takes for them to reach terminal velocity. **(Ans. 13.5 sec)**

3. A box of mass 30 kg is resting on a horizontal surface. A horizontal force of 120 N is applied to the box, causing it to move with a constant velocity. Calculate the friction experienced by the box. If applied force is suddenly removed, then find the deceleration produced to stop the box. (**Ans. 120 N, 4ms^{-2}**).

4. The steering of a car has radius 16 cm. Find torque produced by the couple of 50 N. (**Ans. 16 Nm)**



5. In Figure (a) force F acts on a gate at its edge, and in Figure (b) it acts at the center. Find moment of force about 'o' in both cases. (**Ans. 15 Nm, 7.5 Nm)**



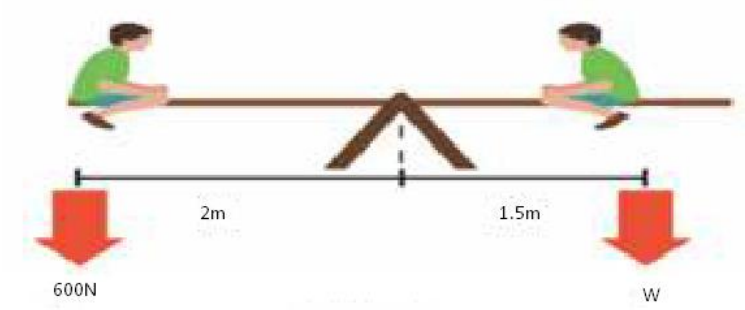
6. Ahmad is trying to loosen a rusty bolt using a wrench. He applies a force of 20N at the end of the wrench, which is 30cm long.

a) Calculate the torque exerted on the bolt. **(Ans. 6Nm)**

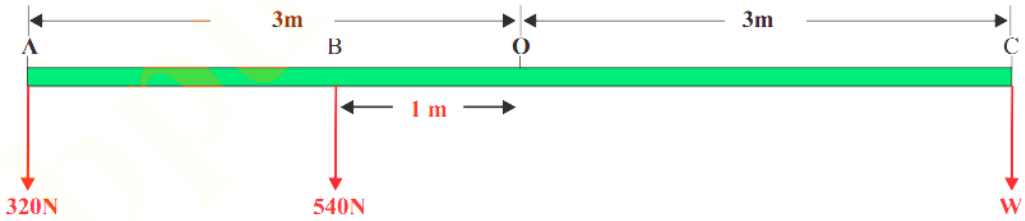
b) If Ahmad uses a longer wrench that is 50cm, but applies the same force, how does the torque change? **(Ans.10Nm)**

7. Asthma pushes a door open by applying a force of F at a point 80cm from the hinges. If torque produce has a value of 12 N m, (a) what is the value of Asthma's force (b) If she pushed by force of 10 N which causes the torque of value 5 N m, then find the distance of point of application of force from pivot point. **(15N, 0.5N)**

8. This seesaw is balanced. What is the weight in newtons of the person on the right? **(Ans. 800 N)**



9. The see-saw in Figure balances when Shani of weight 320 N is at A, Tom of weight 540 N is at B and Harry of weight W is at C. Find W. **(Ans. 500N)**

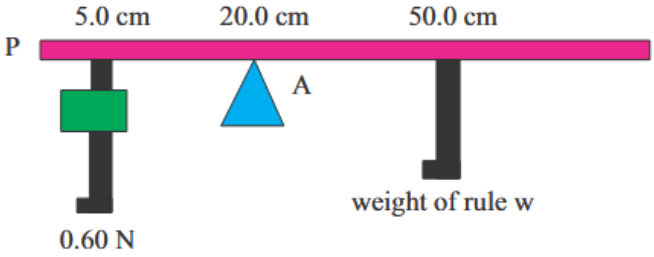


10. If a satellite orbits Earth at an average radius of 20,000 km and takes 10 hours to complete one orbit, what would be its average orbital speed?

11. A wrench is used to loosen a bolt. If the applied force is 40 N, and the wrench is 0.2 meters long, calculate the moment of the force. (8 Nm)

12. A seesaw is 4 meters long, and two children are sitting on it. Child A weighs 30 kg and sits 1 meter from one end, while child B weighs 40 kg and sits 2 meters from the other end. Calculate the net moment and the direction of rotation of the seesaw. (300 Nm clockwise)

13. In Figure shows a uniform metre rule PQ that is balanced by a counterweight placed at the 5.0 cm mark. The pivot A is at the 20.0 cm mark. What is the weight of the rule? (10 N)



14. A meter rule scale is used to measure the weight of an unknown object. If a 20 N weight is placed on one side of the scale, and the scale balances when the object is placed 0.1 meters from the pivot, what is the weight of the unknown object? (100 N)

15. A car with a mass of 1200 kg is traveling around a curve with a radius of 50 meters. If the car's velocity is 20 m/s, calculate the centripetal force acting on the car. (9600 N)

16. A 0.5 kg mass is attached to a string and swung in a horizontal circular path with a radius of 1 meter. If centripetal force provide by tension is 10 N, then find the speed of the mass? (4.47 m/s)

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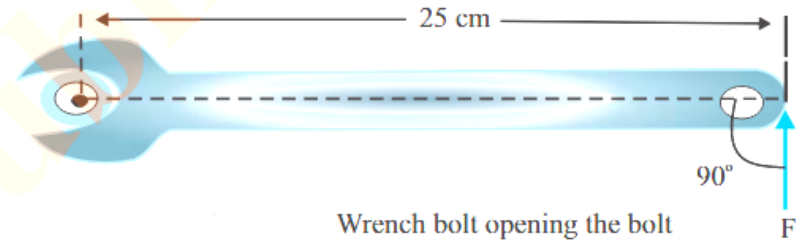
17. A car is making a turn on a circular track with a radius of 20 meters. The car's speed is 18 m/s, and it experiences a centripetal force of 6,000 N. Calculate the mass of the car. (370.37 kg)

18. A stone of mass 0.1 kg is attached to a string and is whirled around in a horizontal circle. If tension in the string is 2 N, and the stone's speed is 10 m/s. Calculate the length of the string. (5 m)

19. Wrench a bolt is to be tightened with a torque of 8.0 N m. If you have a wrench that is 0.35 m long, what is the least amount of force you must exert? (22.86 Nm)

20. What is the torque on a bolt produced by a 15N force exerted perpendicular to a wrench that is 25 ms-1 as shown in figure? **(3.75 Nm)**



Wrench bolt opening the bolt