Chapter 4

Turning Effects of Force

1. Define like and unlike parallel forces. ?

   Like parallel force: If the parallel forces are acting in the same direction, these are called like parallel forces. Three forces F_1 , F_2 and F_3 are shown in figure acting on a rigid body at different points. Here, the forces F_1 and F_2 are like parallel forces.

   Unlike Parallel forces: If parallel forces are acting in opposite direction to one another, they are called unlike parallel forces. From figure, two forces F_1 & F_3 are unlike parallel forces and F_2 & F_3 are also unlike parallel forces.

2. What are rectangular components of a vector and their values?

   Rectangular components:

   "The components of a vector which are perpendicular to each other are called rectangular components of a vector." There values are determined by using following equating $Vx = V\cos\Theta$ and $Vy = V\sin\Theta$

Where v is the vector's magnitude and Θ is the angle it makes with the x-axis.

3. What is the line of action of a force?

   The line of action of a force is an imaginary line along the direction of the force's application, extending infinitely in both directions.

4. Define moment of a force. Prove that τ = rFsinθ, where θ is angle between r and F.

   Moment of a force: Moment of a force or torque is defined as the product of the force and the moment arm.

   Proof of τ = rFSinΘ, Torque depends on:

   r: Distance from the axis of rotation

   F sinΘ = The perpendicular component of the force (F⊥) causing rotation.

   $\boldsymbol{\tau}$ =rxF⊥ =rFsinΘ

   where 0 is angle between r and F

5. With the help of a diagram, show that the resultant force is zero but the resultant torque is not zero.

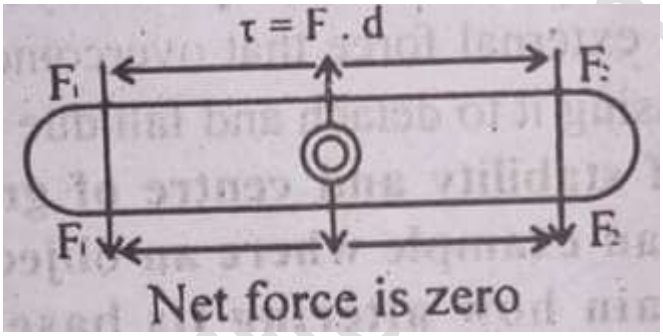
   This happens when equal and opposite forces act on an object but do not pass through the same line (a couple).

Here's a diagram.

1. Two forces F_1 and F2

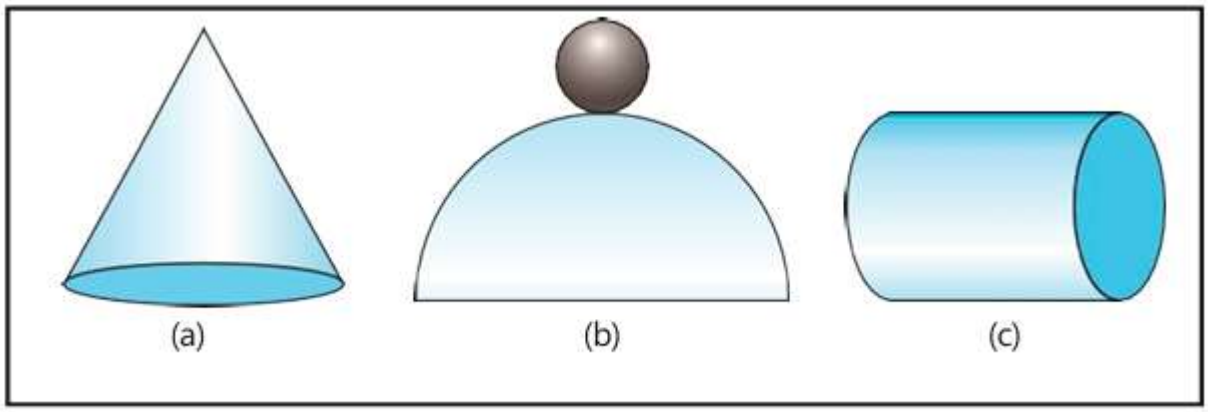
$\vec{F}$ = -F2 (resultant force = 0)

2. These forces are separated by a distance d,



creating a torque:

6.Identify the state of equilibrium in each case in the figure given below.



a: Neutral equilibrium

b: Unstable equilibrium

c: Neutral equilibrium

6. Give an example of the body which is moving yet in equilibrium.

A car moving at a constant velocity on a straight road is an example of the body which is moving yet in equilibrium.

7. Define centre of mass and centre of gravity of a body.

Centre of mass:

The centre of mass is the point where the entire mass of a body can be considered to be concentrated.

Centre of gravity:

The centre of gravity is the point where the entire weight of a body can be considered to be concentrated.

7. What are two basic principles of stability physics which are applied in designing balancing toys and racing cars?

Centre of Gravity:

A lower centre of gravity improves stability by reducing the chance of tipping or rolling

Base of support:

A wider base of support enhances balance by increasing the area chance of tipping or rolling. over which the object's weight is distributed.

10. How can you prove that the centripetal force always acts perpendicular to velocity?

Centripetal force always acts perpendicular to velocity by observing uniform circular motion. The force points toward the centre of the circle, while velocity is tangential to the circular path. Since the angle between the radius (force direction) and the tangent (velocity direction) is 90°, the force is perpendicular to velocity.

Constructed Response Questions

1. A car travels at the same speed around two curves with different radii. For which radius the car experiences more centripetal force? Prove your answer.

The car experiences more centripetal force on the curve with the smaller radius. mv2 .

Proof : Centripetal force Fc= $\frac{mv2}{r}$

For constant speed (v) and marss (m), Fc is inversely proportional to the radius (r). Smaller radius means larger (Fc).

2.A ripe mango does not normally fall from the tree. But when the branch of the tree is shaken, the mango falls down easily. Can you tell the reason?

The shaking provides an external force that overcomes the weak attachment of the mango to the branch, causing it to detach and fall due to gravity.

3.Discuss the concepts of stability and centre of gravity in relation to objects toppling over. Provide an example where an object's centre of gravity affects its stability, and explain how altering its base of support can influence stability.

Stability depends upon the object's centre of gravity and base of support. If the centre of gravity is low and within the base, the object is move stable.

For example:

A tall narrow glass is less stable than a wide-bottomed bowl because its higher centre of gravity is move likely to move outside the base when

tilled.Widering the base of support or lowering the centre of gravity increases stability.

4.Why an accelerated body cannot be considered in equilibrium?

An accelerated body is not in equilibrium becasue a net force is acting on it causing a change in its velocity.

5.Two boxes of the same weight but different heights are lying on the floor of a truck. If the truck makes a sudden stop, which box is more likely to tumble over? Why ?

The taller box is more likely to tumble over because its centre of gravity is higher, making it less stable and more prove to tipping when the truck suddenly stops.

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- **https://stepacademyofficial.com/**

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