**Statics**

What do you mean by Resultant Force?

Ans: Resultant Force:

The sum of all forces acting upon a body is called Resultant Force. If two forces acting on a body then sum of both is called Resultant forces. If we take the difference of two Forces, then their resultant is also called Resultant Force.

Explanation:

(i) Consider the diagram in which, two opposites but equal forces :" F_1" and "F_2" are acting upon a block. The block remains at rest under the influence of these force, because the magnitude of forces equal.

F_1
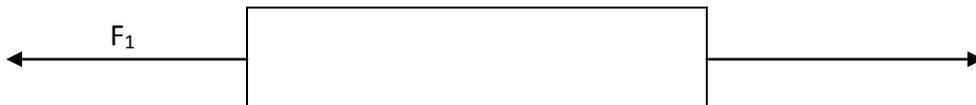
(ii) Consider another body, two forces F_1 and F_2 are acting upon it in opposite direction. Here the magnitude of F_2 is greater, so the body will move towards greater force.

F_1

(iii) Consider another case, two forces "F_1 and "F_2" acting on the body making a certain angle with each other then. The resultant F formed between F_1 and F_2.

F_1
F
F_2
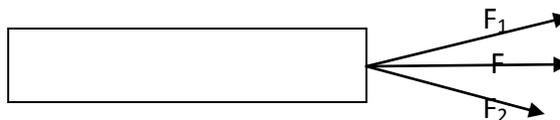
(iv) Now consider the case in which two forces F_1 and F_2 acting on a body with certain angle. In this case, the forces can be represented in magnitude and direction by two adjacent sides of a parallelogram. The resultant force is a vector represented by the diagonal "F_R". This is called Parallelogram of forces.

F_1

F_2

(a)

F_1

F_R

F_2
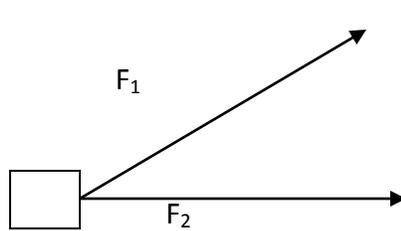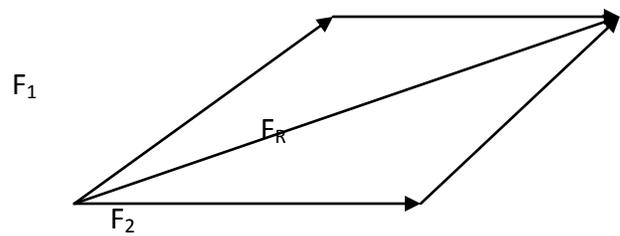
(b)

Q2. Define equilibrium. Write the types of equilibrium?

Ans. EQUILIBRIUM:

When the effect of all the forces acting on a body in such a way that it does not change its state of rest or motion, the body is said to be in equilibrium OR "In other words, we can say that bodies in equilibrium may remain in state of rest or move with uniform velocity".

TYPES OF EQUILIBRIUM:

STATIC EQUILIBRIUM:

i. If a body remains at the state of rest then it said to be Static Equilibrium for example

ii. A book lying on a table.

Iii .Stationary building and bridges etc.

DYNAMIC EQUILIBRIUM:

If a body moving with uniform velocity then the body is said to be in dynamic equilibrium For example;

a. A car moving with uniform velocity.

b. A train moving with uniform velocity etc.

Q3. State the first condition of Equilibrium?

Ans. FIRST CONDITION OF EQUILIBRIUM:

If two or more than two forces acting upon a body in such a way that their line of action is straight line and they cancel the effect of each other then the body will remain In equilibrium.

"In other words, a body will b in equilibrium if the resultant of all forces acting on it, is zero. "

EXPLANATION:

The force acting on a position x-axis of a body equal to the force acting on negative x-axis of body or the sum of all force acting on x-axis of a body is zero. Then body is said to be in equilibrium.

$$F_1x + F_2x + F_3x \ldots\ldots\ldots\ldots\ldots = 0$$

$$\sum Fx = 0$$

Where $\sum$. denotes the sum and Fx force acting on x-axis. If the sum of the all force acting on y-axis of a body is zero then the body is said to be in equilibrium.

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

$$\sum Fy = 0$$

Where Fy is force acting on y-axis.

Q4. State the second condition of Equilibrium.
**Ans: SECOND CONDITION OF EQUILIBRIUM:**
If two or more than two force are acting on a body in such a way that some force try to move the body in clockwise direction and some forces try to move the body in anti clockwise direction. The sum of all these forces becomes zero then body will remain in equilibrium.
OR
A body will be in equilibrium when the algebraic sum of all the torques acting upon it is zero.

$$\sum \tau = 0$$

Where τ is denoted torque of F
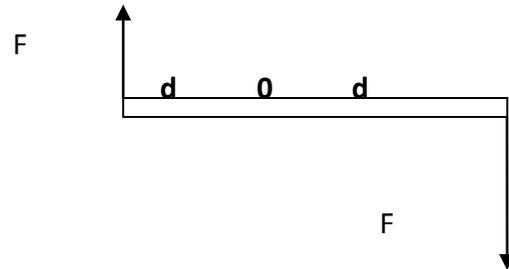
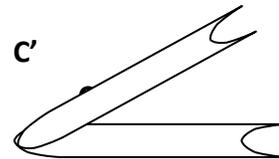**Q5. How many types of equilibrium. Explain each.**
Ans. STATE OF EQUILIBRIUM:
There are three state of equilibrium
i. Stable Equilibrium
ii. Unstable Equilibrium
iii. Neutral Equilibrium F
STABLE EQUILIBRIUM:
In stable equilibrium if the body slightly disturbed the center of gravity of the body is raised and then comes to its origin it position.
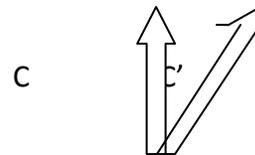
Example:
A book is lying horizontally on the surface of the table. If this book is slightly raised from the one corner, the center of gravity of book slightly raised then by leaving the c book the center of gravity of the book comes to its original position.
UNSTALBE EQUILIBRIUM:
In unstable equilibrium , if the body is slightly disturbed the center of gravity is lowered and does come its original position.

Example:
If a pencil is kept in vertical and it is slightly lowered and the pencil falls down and center of gravity does not come to its original position.
NEUTRAL EQUILIBRIUM:
In neutral equilibrium the center of gravity of the body neither raised nor lowered when it is disturbed. Every time center of gravity of body is changed due to the new position of the body.

Example:

If a ball is rolled on the surface of earth, the center of gravity of ball acquires the new c c position every time according to the position of the ball. The CG of ball neither raised nor lowered when the ball is disturbed. Neutral equilibrium

C
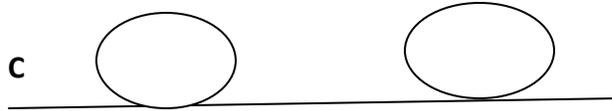
Q6. Define Centre of Gravity.
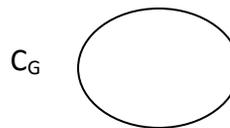
Ans. CENTRE OF GRAVITY:

The center of gravity of a body is that point of the body at which whole weight of a body always acts and through which resultant force due to earth's attraction passes.

Q7. Give the center of gravity of following bodies.

(i) Sphere (ii) Triangular Plate (iii) Cylinder (iv) Plane square rectangular
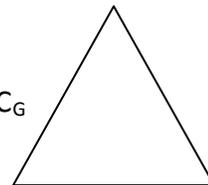
Ans: Sphere:

Centre of gravity of sphere is center of sphere. C_G

TRIANGULAR SPHERE:

 Centre of gravity of the triangular sphere plate is intersection of medians. C_G

CYLINDER:

Centre of gravity of cylinder is mid-point of axis.

C_G

PLATE SQUARE RECTANGULAR:

Centre of gravity of plate square rectangular is intersection of diagonals. C_G

Q8. Write the experiment to find the center of gravity of irregular shaped object?

**Ans: CENTRE OF GRAVITY OF IRREGULAR SHAPED OBJECT:**

i. Suppose, we have to find the center of gravity of an irregular shaped metallic plate.

ii. Drill few small holes near the edges of the plate.

iii. using a hole "A", suspend the plate from a nail fixed horizontally in a wall.

iv. The plate will come to rest in a position so that its center of gravity is vertically below the point of suspension.

Q9. What do you mean by moment of force arm?
Ans: MOMENT OF FORCE ARM:
The perpendicular distance between the axis of rotation of the body and line of the act in of the force is called Force Arm.
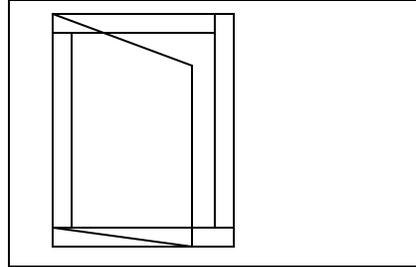
Q10. Define Torque, Positive Torque and Negative Torque.
Ans. TORQUE:
The turning effect of a force about the axis of rotation is called Torque.
OR
"If a body is freely rotating about an axis by the application of the force turning effect is produce in the body the turning is called Torque."
OR
"The produce of force and Moment arm of Force arm is called Torque."
Mathematically:

Torque = Force x Moment of Force arm
$$\tau = Fr$$
Where t is torque, |F| is magnitude of force, |r| moment of force arm.

NEGATIVE TORQUE:
If a force is applied on a body then it rotates in clockwise direction then it is called negative Torque.
POSITIVE TORQUE:
If a force is applied on a body then it rotates in anticlockwise direction. The torque is called Positive Torque.

Q11. On what factors does torque is depends?
Ans. To understand, the factors on which the torque depends. If "F" force is applied on a point "B" of door then it not easily opens. Similarly, force "F" applied on a point "A" door then door opens easily So it is proved that if the perpendicular direction between force and axis of rotation is greater, torque is greater. So torque, depends upon following two factors; The distance from the axis of rotation to the line of action of force or moment Arm of the force. The magnitude of the force.

Q12. What is meant by maximum toque and minimum torques?

Ans: MAXIMUM TORQUE:

When the angle between force and force arm is 90°, then torque is maximum.

MINIMUM TORQUE:

When the angle between force and force arm is "0", the torque is minimum.

Q13. Give the units of Torque in different systems.

Ans.

SYSTEM

UNITS

(I) C.G.S. System : Dynes-cm

(ii) M.K.S. System: Newton-meter

(iii) S.I. System: Newton-meter

(iv) F.P.S. or B.E. System: Lbs-ft.