1. Define inertia. Give its classification.

The inherent property of a body to resist any change in its state of rest or the state of uniform motion, unless it is influenced upon by an external unbalanced force, is known as 'inertia'.

Types of inertia :

a) Inertia of rest
b) Inertia of motion
c) Inertia of direction

2. Classify the types of force based on their application.

Like parallel forces:

Two or more forces of equal or unequal magnitude acting along the same direction, parallel to each other are called like parallel forces.

Unlike parallel forces:

If two or more equal forces or unequal forces act along opposite directions parallel to each other, then they are called unlike parallel forces.

3.If a 5 N and a 15 N forces are acting opposite to one another. Find the resultant force and the direction of action of the resultant force

Resultant force = $F_2 - F_1$

= 15–5

= 10 N

Direction : In the direction of greater force, i.e F_2

4. Differentiate mass and weight.

Difference between mass and weight

Mass	Weight
1. Fundamental quantity.	Derived quantity.
2. It is the amount of matter contained in a body.	It is the gravitational pull acting on the body.
3. Its unit is kilogram.	Its unit is newton.
4. Remains the same.	Varies from place to place.
5. It is measured using physical balance.	It is measured using spring balance.

5. Define moment of a couple. Write its SI unit.

Rotating effect of a couple is known as moment of a couple. Moment of a couple is measured by the product of any one of the forces and the perpendicular distance between the line of action of two forces.

The SI unit is newton metre.

6.State the principle of moments.

When a number of like or unlike parallel forces act on a rigid body and the body is in equilibrium, then the algebraic sum of the moments in the clockwise direction is equal to the algebraic sum of the moments in the anticlockwise direction

7. State Newton's second law of motion.

"The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force".

8. Why a spanner with a long handle is preferred to tighten screws in heavy vehicles?

The turning effect of a force is called moment of force.

Moment of force =Force x Perpendicular Distance

$$M = F \times d$$

The spanner with a long handle, 'd' is large. Therefore the moment of force is also large and hence it is easier to rotate the object.

9.While catching a cricket ball the fielder lowers his hands backwards. Why?

In cricket, a fielder pulls back his hands while catching the ball. He experiences a smaller force for a longer interval of time to catch the ball, resulting in a lesser impulse on his hands.

10. How does an astronaut float in a space shuttle?

Astronauts are not floating but falling freely around the earth due to their huge oribital velocity. Since space station and astronauts have equal acceleration, they are under free fall condition. Hence, both the astronauts and the space station are in the state of weightlessness.

PROBLEM 1:

Two bodies have a mass ratio of 3:4 The force applied on the bigger mass produces an acceleration of 12 ms^{-2}. What could be the acceleration of the other body, if the same force acts on it.

Given :

$m_1 : m_2 = 3 :4$,

$a_2 = 12\ ms^{-2}$, $a_1 = ?$

Solution :

Force = mass x acceleration

$F_2 = m_2 \times a_2$,

$F_2 = 4 \times 12 = 48N.$

$F_1 = m_1 \times a_1$,

$a_1 = F_1 / m_1$

[given same force applied, so $F_1 = F_2$]

$a_1 = 48/3$

$a_1 = 16\ ms^{-2}$.

PROBLEM 2:

A ball of mass 1 kg moving with a speed of 10 ms^{-1} rebounds after a perfect elastic collision with the floor. Calculate the change in linear momentum of the ball.

Given

m = 1kg,

u = 10 ms^{-1}

v = -10 ms^{-1} [Negative sign indicates rebounds]

Solution :

Initial momentum = mu

= 1 x 10

=10 $kgms^{-1}$

Final momentum = mv

= 1 x -10

= -10 $kgms^{-1}$

Change in momentum = mv – mu

= -10-10

=-20$kgms^{-1}$

PROBLEM 3:

A mechanic unscrew a nut by applying a force of 140 N with a spanner of length 40 cm. What should be the length of the spanner if a force of 40 N is applied to unscrew the same nut?

Given :

$F_1 = 140$ N,

$d_1 = 40$ cm

$F_2 = 40$ N

$M = Fx\ d$

$F_1 x d_1 = F_2 x\ d_2$ [same torque]

$140 \times 40 = 40 \times d_2$

$d_2 = 140$ cm

[or]

$d_2 = 1.4$ m

PROBLEM 4:

The ratio of masses of two planets is 2:3 and the ratio of their radii is 4:7 Find the ratio of their accelerations due to gravity.

$$g = \frac{GM}{R^2}$$

$M_1 : M_2 = 2 : 3$

$R_1 : R_2 = 4 : 7$

$$g_1 = \frac{GM_1}{R_1^2} \quad \ldots\ldots\ldots\ldots (1)$$

$$g_2 = \frac{GM_2}{R_2^2} \quad \ldots\ldots\ldots\ldots (2)$$

Divde equ(1) by equ (2)

$$\frac{g_1}{g_2} = \frac{GM_1}{R_1^2} \times \frac{R_2^2}{GM_2}$$

$$\frac{g_1}{g_2} = \frac{2}{4^2} \times \frac{7^2}{3}$$

$$\frac{g_1}{g_2} = \frac{2}{16} \times \frac{49}{3}$$

$$\frac{g_1}{g_2} = \frac{49}{24}$$

The ratio of $g_1 : g_2 = 49 : 24$