1. LAWS OF MOTION

Learning Objectives

At the end of this lesson students will be able to:

- Understand the concepts of force and motion.
- Explain inertia and its types.
- State the three laws of Newton.
- Apply Newtonian concept of force and motion.
- Define force, momentum and impulse.
- Distinguish between mass and weight
- Analyze weightlessness and the principle of conservation of momentum.
- Explain the law of gravitation and its applications.
- Understand the variations in 'g' due to height and depth.
- Solve numerical problems related to force and motion

Important Key Points and Results

i. Action of Forces

Action of forces	Diagram	Resultant force (F_{net})
Parallel forces are acting in the same direction	$F_1 \longrightarrow$ $F_2 \longrightarrow$	$F_{net} = F_1 + F_2$
Parallel unequal forces are acting in opposite directions	$F_1 \longrightarrow \quad \longleftarrow F_2$	$F_{net} = F_1 - F_2$ (if $F_1 > F_2$) $F_{net} = F_2 - F_1$ (if $F_2 > F_1$) F_{net} is directed along the greater force.
Parallel equal forces are acting in opposite directions in the same line of action ($F_1 = F_2$)	$F_1 \longrightarrow \quad \longleftarrow F_2$	$F_{net} = F_1 - F_2$ ($F_1 = F_2$) $F_{net} = 0$

ii. Apparent weight of a person in a moving lift

Case 1: Lift is moving **upward** with an acceleration 'a'	Case 2: Lift is moving **downward** with an acceleration 'a'	Case 3: Lift is at **rest**.	Case 4: Lift is **falling down freely**
$R - W = F_{net} = ma$ $R = W + ma$ $R = mg + ma$ $R = m(g+a)$	$W - R = F_{net} = ma$ $R = W - ma$ $R = mg - ma$ $R = m(g-a)$	Here, the acceleration is zero $a = 0$ $R = W$ $R = mg$	Here, the acceleration is equal to g $a = g$ $R = m(g-g)$
$R > W$	$R < W$	$R = W$	$R = 0$
Apparent weight is **greater** than the actual weight.	Apparent weight is **lesser** than the actual weight.	Apparent weight is **equal** to the actual weight.	Apparent weight is equal to **zero**.