

"What one man calls God, another calls the laws of physics."

-Nikola Tesla

## TOPIC 3: DYNAMICS





### CHAPTER ANALYSIS



- Simple chapter
- Understand Newton's Three Law of Motion



- Tested in MCQ and Section A mainly
- Important chapter that is closely linked to chapter like Kinematics & WEP



- Light-medium overall weightage
- Constitute to around 3.5% of marks for past 5 year papers



### FORCE TYPES OF FORCES NEWTON'S THREE LAW OF MOTIONS

**KEY CONCEPT** 





### FORCE



#### **FORCE**

Forces are **vector quantities** that have both **magnitude** & **direction**.

Force has the SI unit: Newton (N).



Length of arrow represents magnitude of force
 Direction of arrow indicates direction of force





#### **TYPES OF FORCES**

Force	Symbol	Direction of force	Diagram
Weight	W	Vertically downwards from center of gravity	↓ W
Tension	Т	Against weight of object / in the direction of the force	T T
Normal Reaction	N	Perpendicular to surface	N
Friction / Air resistance	f	Against motion of object / body	f

### FORCE



5



### **NEWTON'S FIRST LAW**



Newton's First Law can be easily understood as 'momentum'.

An object at rest has no momentum, hence it does not move.

A moving object will keep moving due to momentum.

#### **NEWTON'S FIRST LAW OF MOTION**

**Newton's First Law of Motion** states that an object at rest will remain at rest and an object in motion will continue in motion at constant speed in a straight line unless a resultant force acts on it.

Newton's First Law is closely associated with the term: inertia.



#### Because of inertia you feel jerk when brakes are applied

**Inertia** is defined as the tendency for a body to continue with its state of rest or motion.

Inertia is dependent only on the **mass** of the body.

The heavier the body, the larger the inertia, the harder it is for a body to start moving when at rest or changing direction when in motion.



### **NEWTON'S SECOND LAW**



Take note that F is *resultant force*.

For this example, F = 25N. Since mass is 10 kg, acceleration is  $2.5ms^{-2}$ 



#### NEWTON'S SECOND LAW OF MOTION

**Newton's Second Law of Motion** states that the resultant force acting upon an object is equal to the product of the mass and acceleration of the object, the direction of the force is the same as that of the object's acceleration.

**Resultant force** is defined as the overall force acting on the body after accounting for all forces acting on the body.

Formula:

F = ma







### **NEWTON'S THIRD LAW**

# Newton's Third Law of Motion



"When I push you, actually you also pushed me" – Newton's Third Law

#### **NEWTON'S THIRD LAW OF MOTION**

Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction.

If body A exerts a force on body B, Body B will exert an equal and opposite force on body A.

#### Action reaction forces are:

- Equal in magnitude
- Act on different bodies
- Opposite in direction
- Same type of force



#### KEY CONCEPT

### FREE BODY DIAGRAMS VECTOR DIAGRAMS FRICTION





### FREE BODY DIAGRAMS

#### **FREE BODY DIAGRAM**

A free body diagram is a diagram which shows all forces acting on the body.











### **VECTOR DIAGRAMS**





#### **VECTOR BODY DIAGRAM**

#### Addition:





-B

Subtraction:





Example:



**Resultant Vector** 



### FRICTION





#### **FRICTION**

Friction is a contact force that **exists between any 2 surfaces in contact** with each other.

Friction will always **oppose relative motion** between two surfaces in contact.

#### **Useful friction**

- Friction between the floor & the soles of our shoes prevent us from slipping
- Friction allows us to grip objects
- Friction allows car tyres to have traction and allowing the car to move forward
- Friction allow matchsticks to generate a spark and a flame

#### Friction as a nuisance

- Wear & tear of machineries
- Soles of shoes getting flatten
- Reduced efficiency of machineries

#### **Reducing friction**

- Lubricants like oil, grease & water
- Ball bearings
- Streamlined shape

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