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Chapter 4
Momentum And It's Application

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Chapter Description

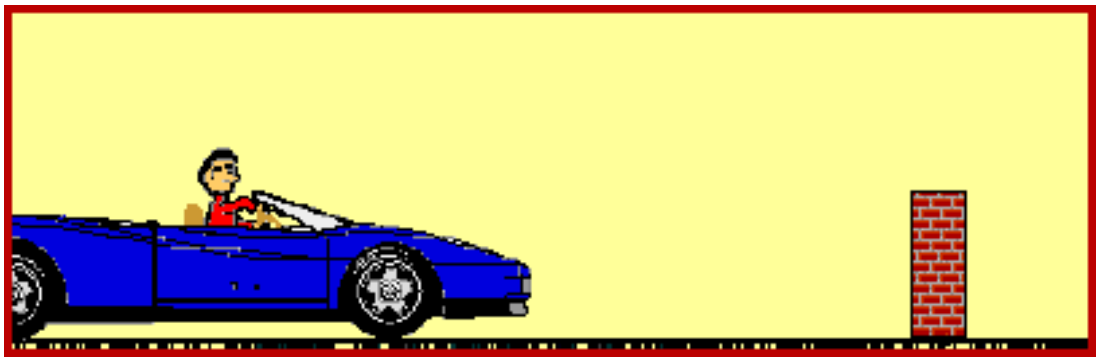
- Course outcome :
  - Introduce the momentum equation for a fluid
  - Demonstrate how the momentum equation and principle of conservation of momentum is used to predict forces induced by flowing fluids

WEEK	TOPIC	
9	4.1	**Derivation of Momentum Equation**
	4.2	**The Force of Impact on:** • Flat Plate • Inclined Plate • Curved Vane

Newton's Law

- Newton's laws are relations between motions of bodies and the forces acting
- on them.

- **Newton's first law** : *a body at rest remains at rest, and a body in motion remains in motion at the same velocity in a straight path when the net force acting on it is zero*. Therefore, a body tends to preserve its state of inertia can also called "Law of Inertia".



natural tendency of objects to keep on doing what they're doing.

Newton's Law

- **Newton's second law** : *the acceleration of a body is proportional to the net force acting on it and is inversely proportional to its mass.*

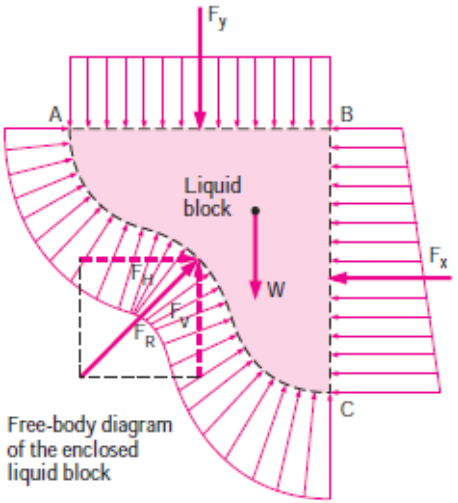
Acceleration is produced when a force acts on a mass. The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object).

heavier objects require **more force** to move the same distance as lighter objects

Newton's Law

- **Newton's third law** : *when a body exerts a force on a second body, the second body exerts an equal and opposite force on the first*. Therefore, the direction of an exposed reaction force depends on the body taken as the system.

As the man jumps off the boat, **he exerts the force on the boat** and the **boat exerts the reaction force on the man**. The man leaps forward onto the pier, while the boat moves away from the pier



Newton's Law

- For a rigid body of mass m, Newton's second law is expressed as:

$$\vec{F} = m\vec{a} = m\frac{d\vec{v}}{dt} = \frac{d(m\vec{v})}{dt}$$

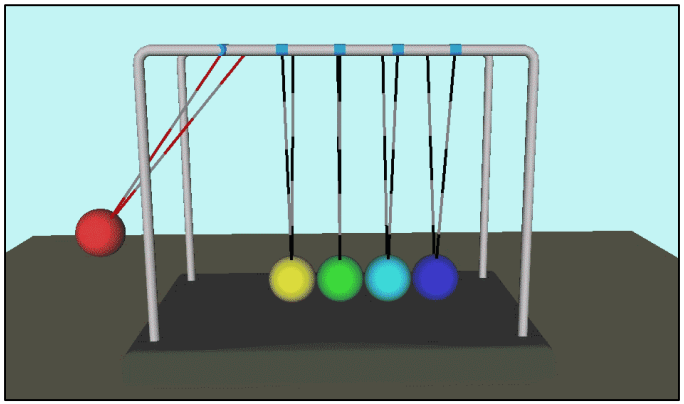
the net force acting on the body

acceleration of the body under the influence of *F*

The momentum equation is a statement of Newton's Second Law, relates the sum of the forces acting on an element of fluid to its acceleration

product of the mass and the velocity of a body is called : ***Linear Momentum*** or just the ***Momentum*** of the body.

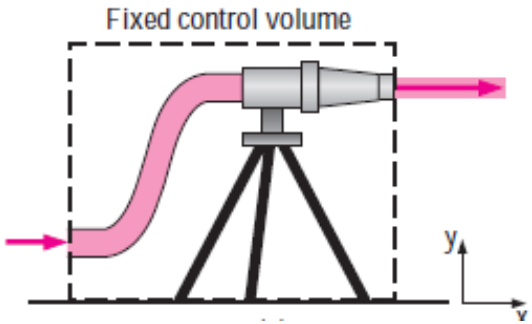
also stated as *the rate of change of the momentum of a body is equal to the net force acting on the body*



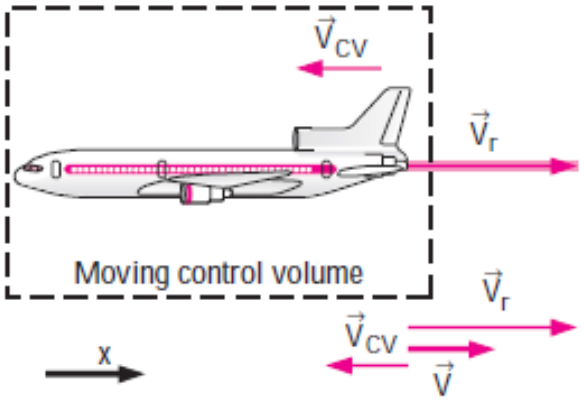
momentum is the product of mass and velocity, and its direction is the direction of velocity.

Control Volume

- A control volume can be selected as any arbitrary region in space through which fluid flows, and its bounding control surface can be **fixed**, **moving**, and even **deforming** during flow.



Control volume can be thought of as an arbitrary volume in which the mass of the continuum remains constant.



As a continuum moves through the control volume, the mass entering the control volume is equal to the mass leaving the control volume.