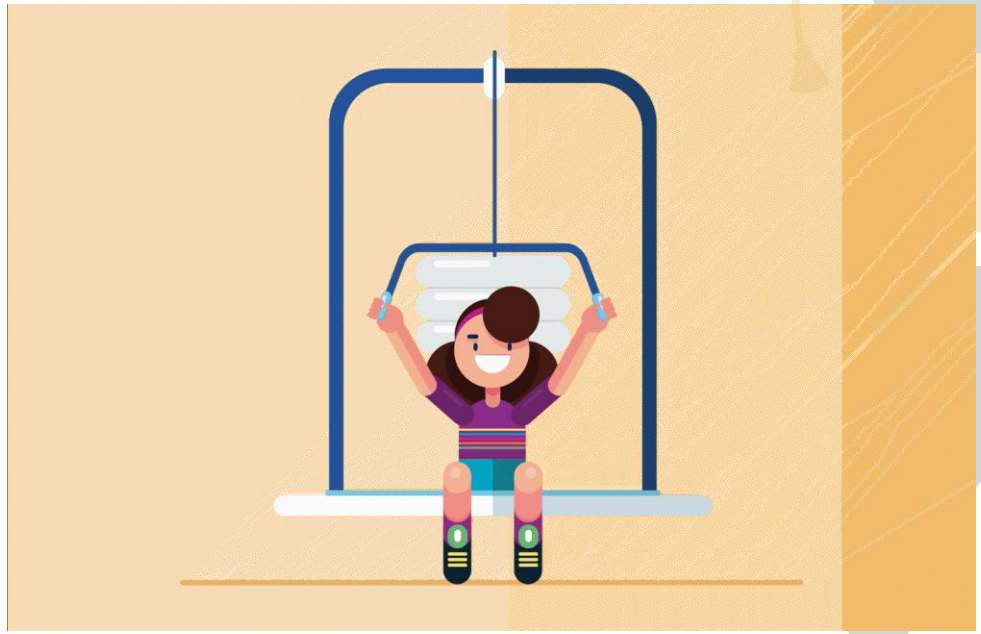
# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

1. Define mechanical action
2. Determine the effect of a force
3. Determine the characteristics of a force.

# Mechanical action

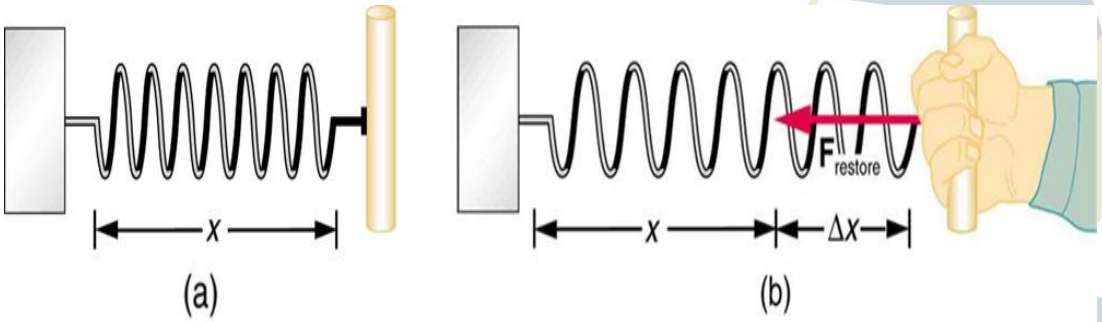
## What is Forces (mechanical action)?

**When you squeeze a ball, you apply a certain action called a force or mechanical action.**

**When you push or pull a car, you apply a certain action called a force or mechanical action.**

# Mechanical action

## What is Forces (mechanical action)?




**When you push a box, you exerts a certain action called a force or mechanical action.**

**When you kick a ball, you apply a certain action called a force or mechanical action.**

# Mechanical action

## What is Forces?

**A force is a mechanical action exerted by an object (A) on another object (B).**

**A mechanical action is an action done by an object (A) on another object (B).**

# Effect of a force

**When a force is applied to a certain object, this force may have an effect on this object. A force is capable to:**

**1. Set a body in motion: a body at rest and set it in a motion**

- **Example: A girl pulls a wagon.**

**2. Deformation of a body: change the shape of the body**

- **Example: A person Changes the form of a tank.**

# Effect of a force

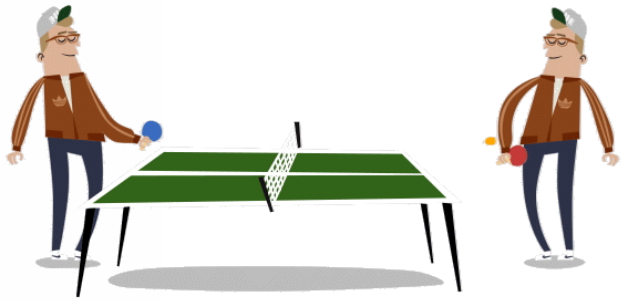
## 3. Modify the motion of a body:

**a. Stop the motion:** a body was in motion, a force stop the body.

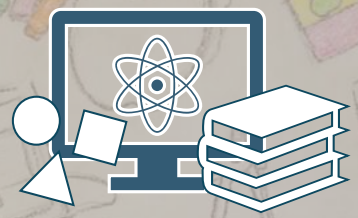
- Example: a goalkeeper catch the ball.

**b. Change the direction & speed**

- Example: a persons play tinis ball goalkeeper catch the ball.

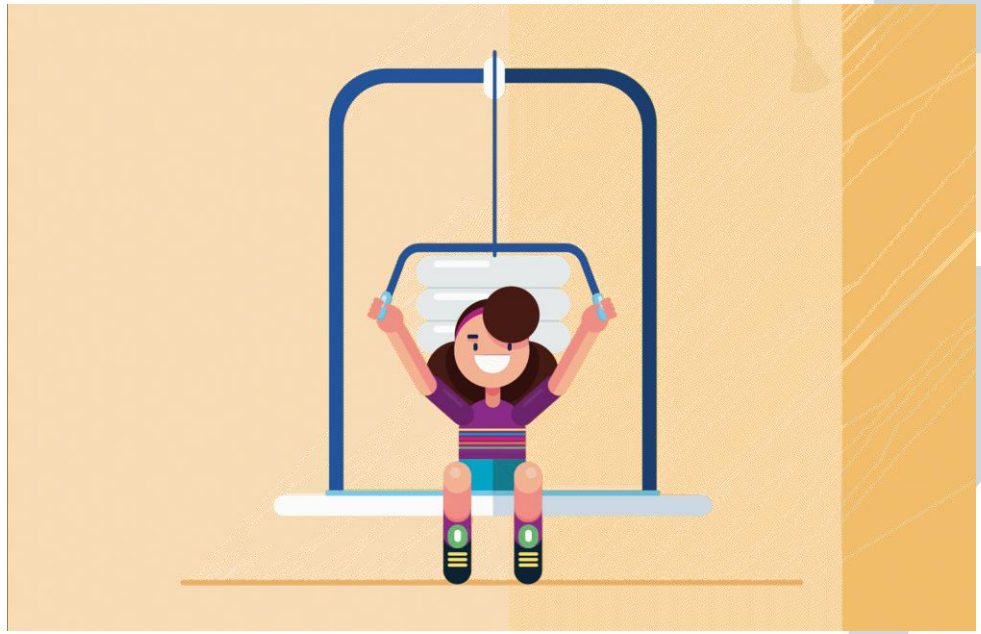


# The End



# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# Objectives

1. To Give the characteristics of a force.

# Characteristics of a force

**A force is characterized by:**

**1. Point of application.**

**2. Line of action.**

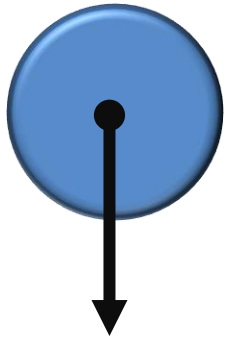
**3. Direction.**

**4. magnitude**

# Characteristics of a force

**1.Point of application: is the point where the applied force starts.**

**The point of application may be center of gravity or point of contacts between the two bodies.**



**The point of application is the center of this ball.**

**The point of application is the point of contact between the hands of the boy and the car**

# Characteristics of a force

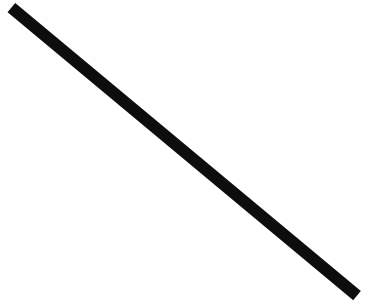
2. **Line of action:** is the line containing the force that applied on the body.

The line of action may be: horizontal, vertical or oblique.

The line of action is Horizontal.



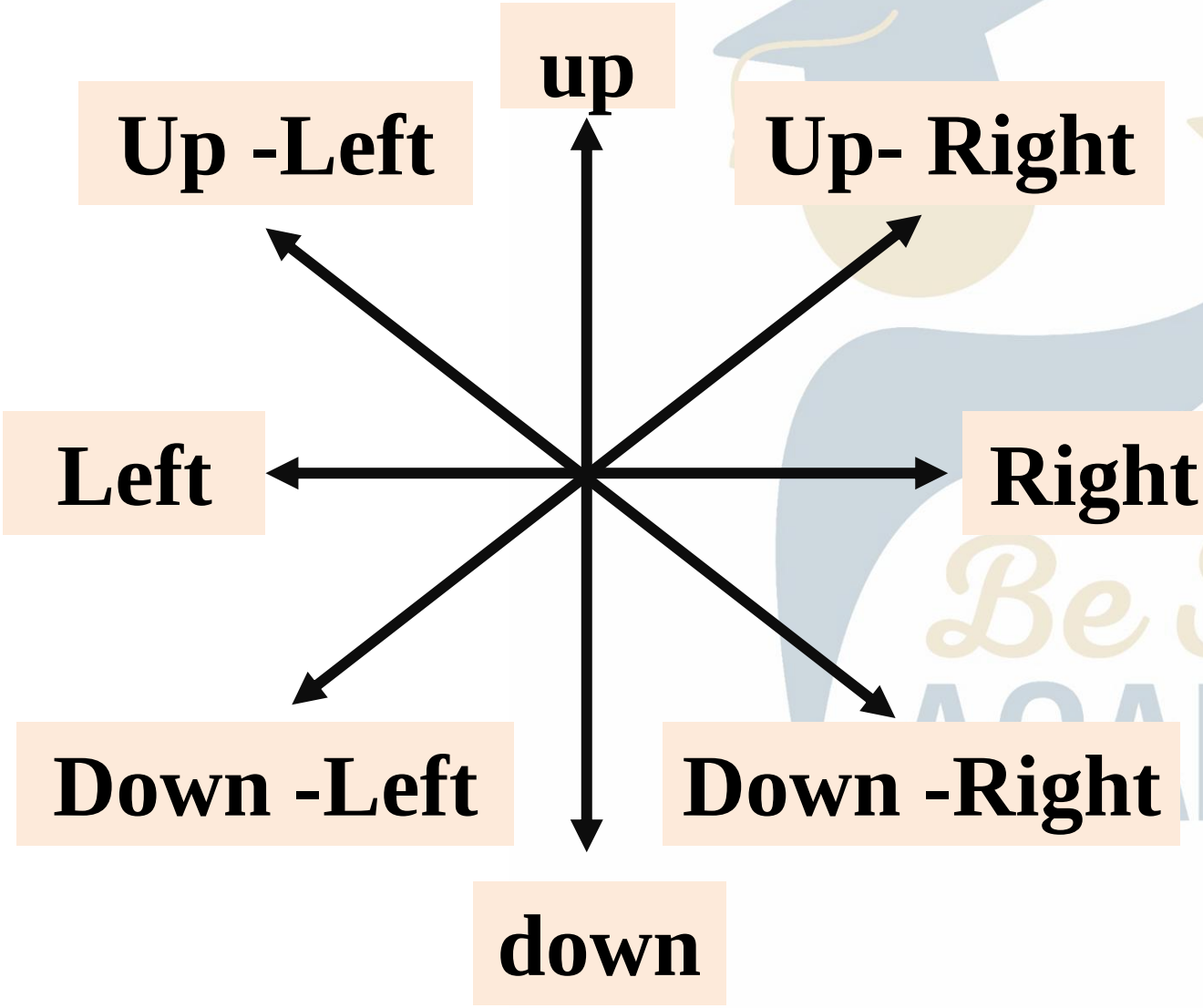
The line of action is vertical.

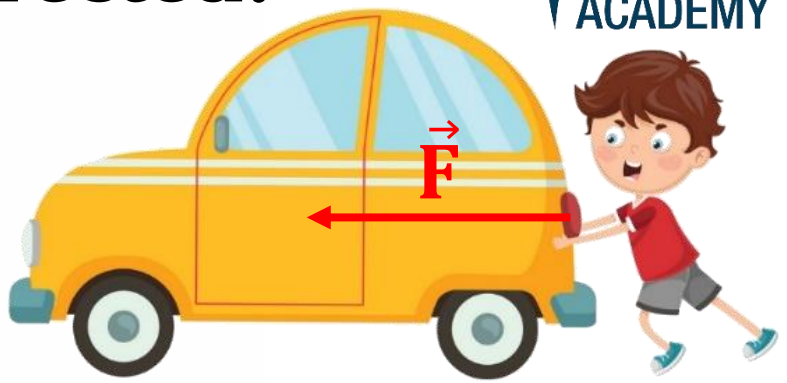


The line of action is oblique.

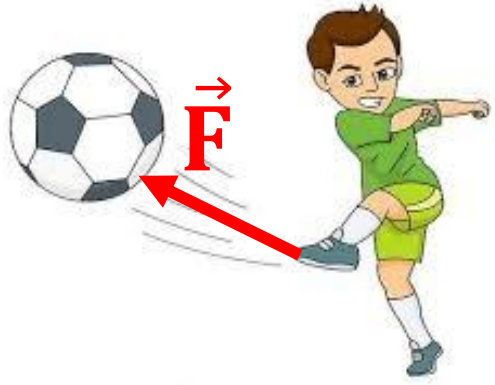
# Characteristics of a force

**3.Direction:** it refers to how the force is directed:




**Direction: Left**

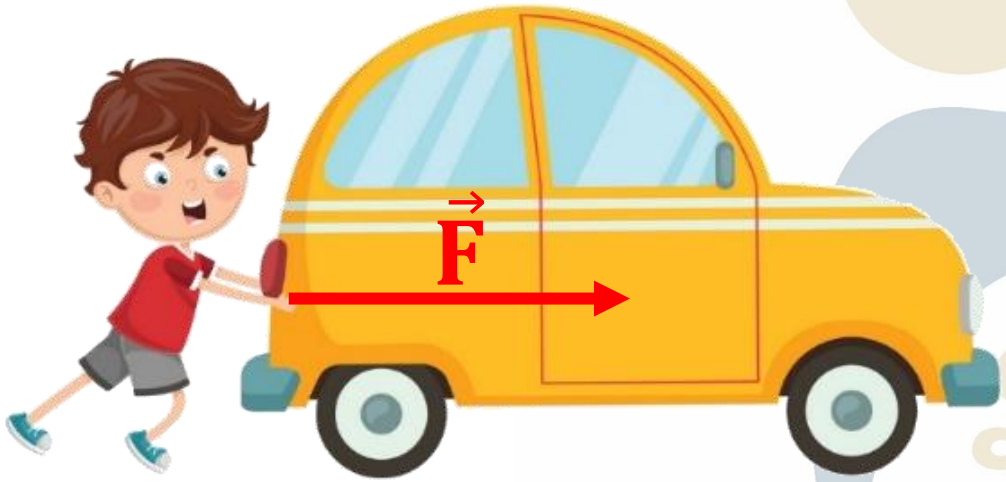


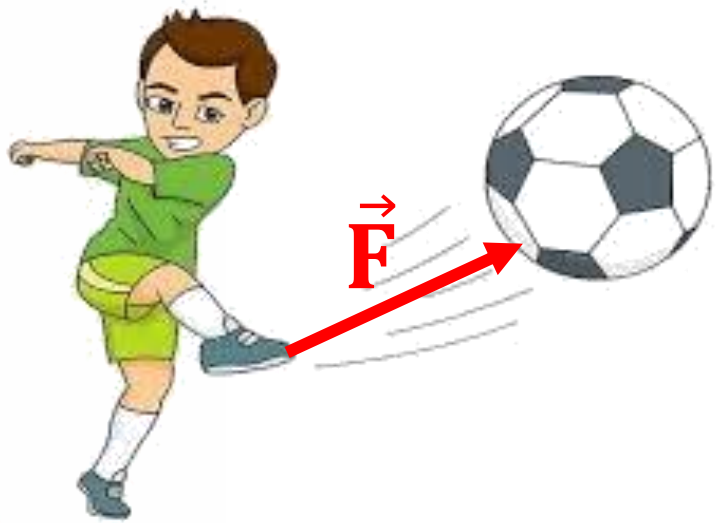

**Direction: up-Left**

# Characteristics of a force

**4.Magnitude:** **is the value of the applied force.**

**The SI unit of a force is Newton (N)**




**A boy pushes a car by a force of magnitude F=500N**

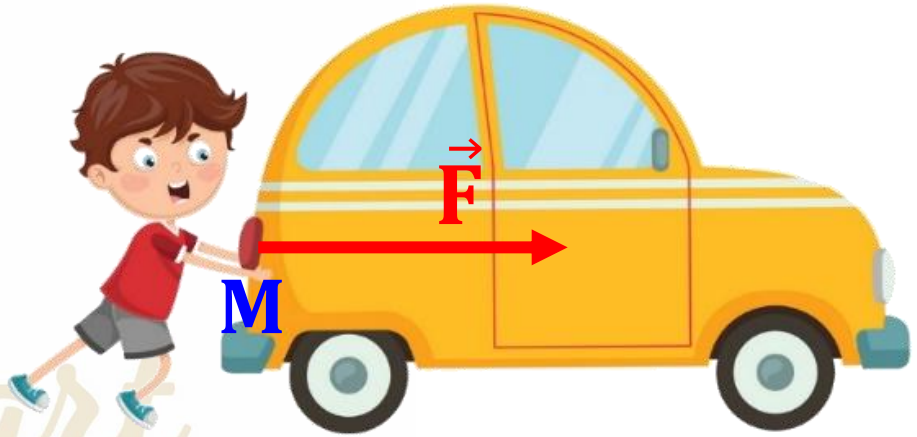
**A player kick the ball by a force of magnitude F=200N**

# Characteristics of a force

## Application1:

**A boy is pushing a car by a force $\vec{F}$ of magnitude $F = 250N$ as shown in the figure below.**

**1. Give a definition of a force.**




**A force is a mechanical action exerted by a body on another body**

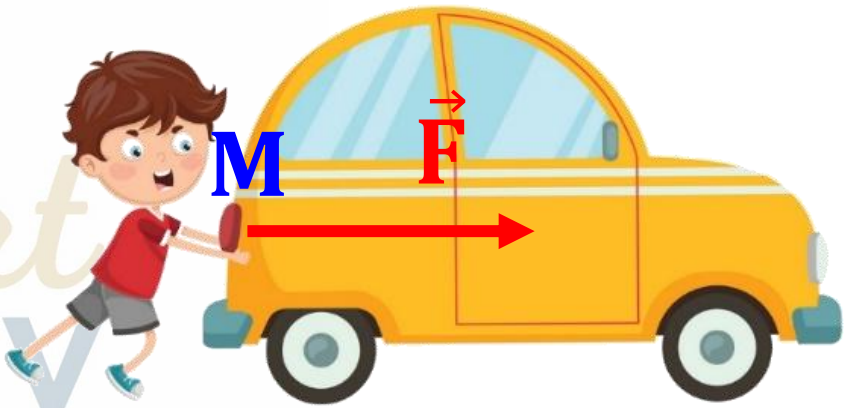
# Characteristics of a force

2. Give the effect of the force done the boy on the car.

The force exerted by the boy on the car set the car in motion

3. Give the characteristics of the above applied force.

- Point of application: point M
- Line of action: Horizontal
- Direction: To right.
- Magnitude: F=250N



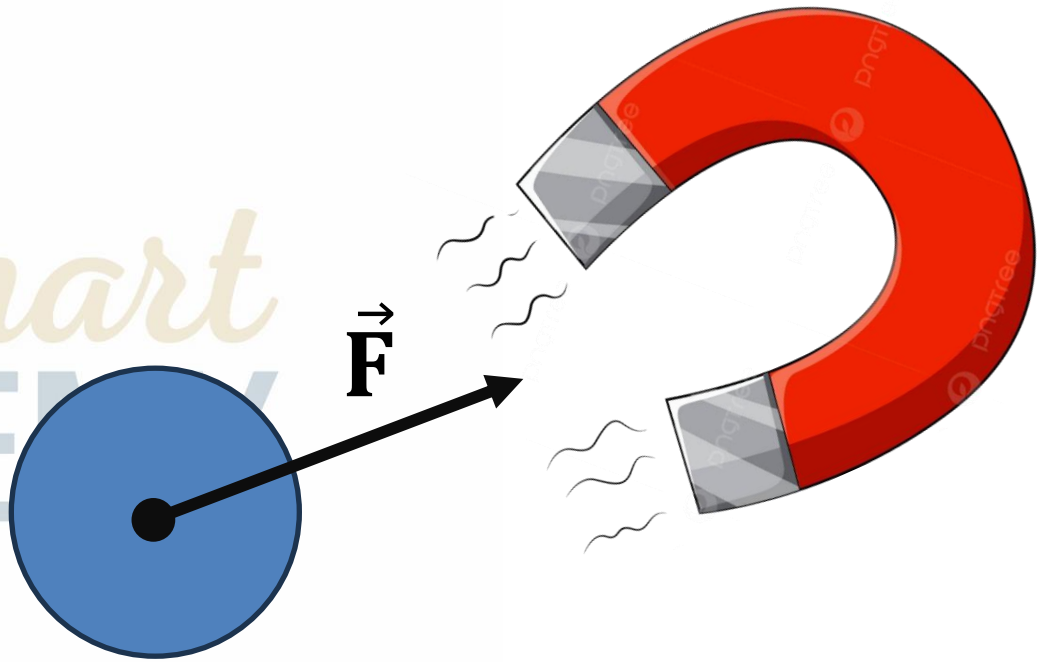
# Characteristics of a force

## Application 2:

**The magnet attract the iron ball by a force of magnitude F=20N.**

**The iron ball moves towards the magnet as shown in the figure.**

**1)Give the effect of the force $\vec{F}$ exerted on the iron ball.**

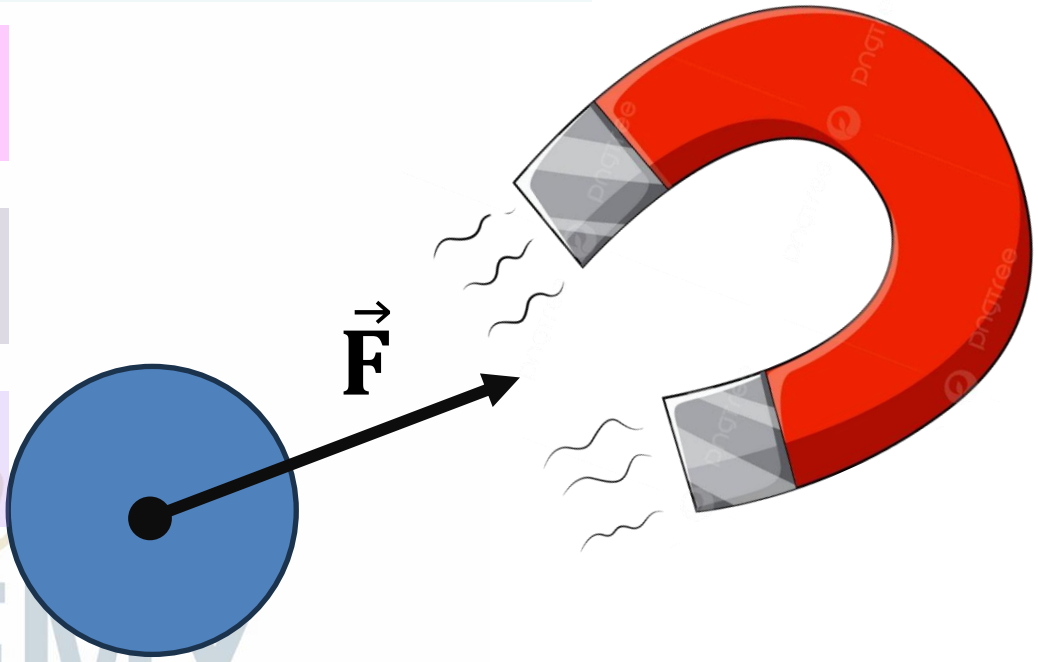



**The force exerted by the magnet on the iron ball set the ball in motion**

# Characteristics of a force

2)Give the characteristics of the force $\vec{F}$.

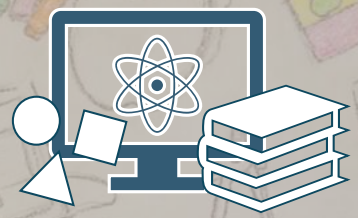
- **Point of application: center of gravity of the ball**
- **Line of action: oblique**
- **Direction: up to right.**
- **Magnitude: F=20N**



# Characteristics of a force

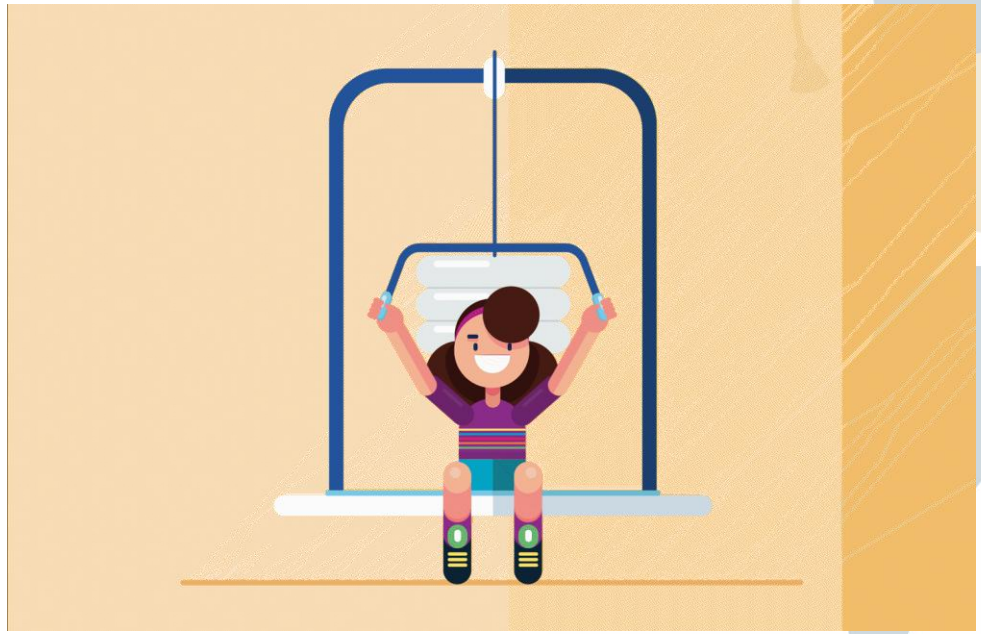
| Characteristics of a Force ($\vec{F}$) | | | | |
|---|---|---|---|---|
| Point of application | Contact point | | Center of gravity | |
| Line of action | Horizontal | Vertical | Oblique | |
| Direction | Right<br>Left | Down<br>Up | Up to right<br>Up to left | Down to right<br>Down to right |
| magnitude | Given or to be calculated | | | |

# The End



# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

1. Represent a force using a scale

# Representation of a force vector ($\vec{F}$)

**A force is represented by a vector labeled as $\vec{F}$.**

**How to draw the vector of the force on the figure??**

1) **Indicate of the point of application of the applied force .**

2) **Indicate the direction of the force.**

3) **Use the given scale to convert the magnitude of the force into length in cm.**

4) **Draw the vector of the force from the point of application along the line of action using your ruler.**

# Representation of a force vector ($\vec{F}$)

## Application 3:

**A boy push the box by a force of magnitude 10N as shown in the figure.**

**Represent the vector of the force on the figure, knowing that the used scale is $1cm \rightarrow 2N$**


**Notice that the boy apply the force at point M to move the box to Right**

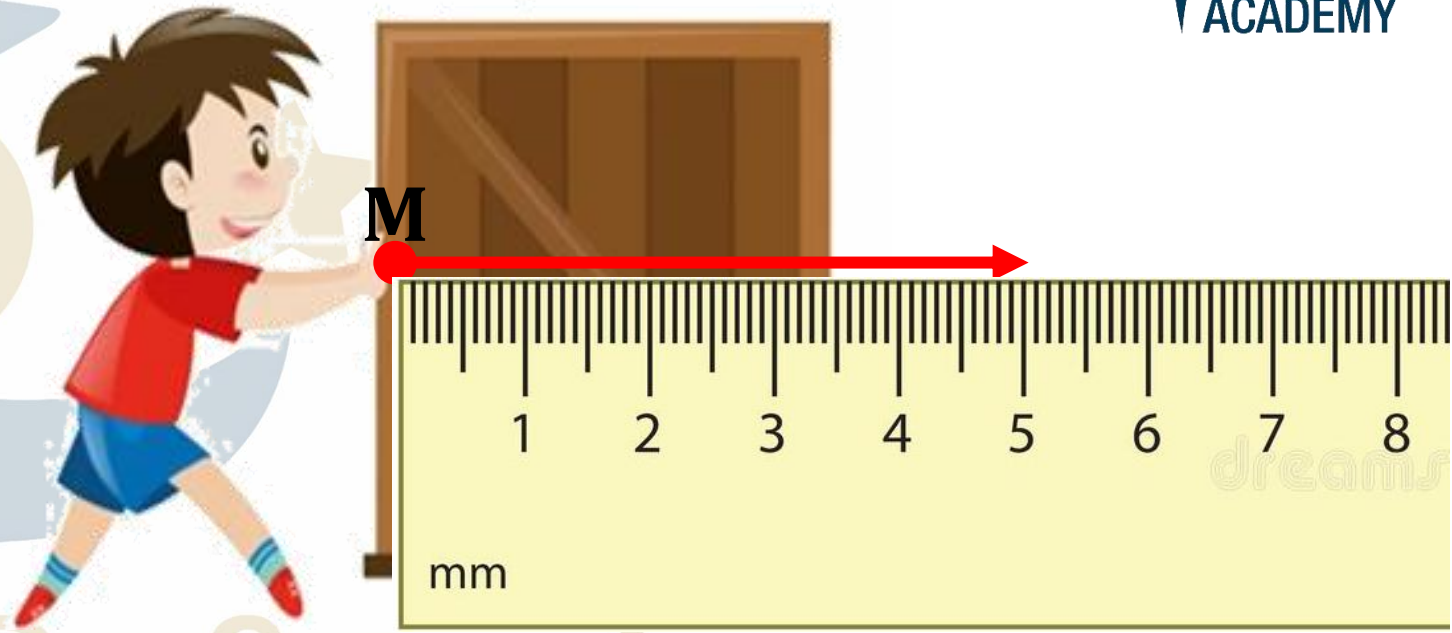
# Representation of a force vector ($\vec{F}$)

$$1cm \rightarrow 2N$$

$$x \rightarrow 10N$$

$$x = \frac{1cm \times 10N}{2N}$$

$$x = 5cm$$



# Representation of a force vector ($\vec{F}$)

## Application 4:

**A played kick a ball by a force of magnitude 25N as shown in the figure.**

**1.Give the effect of the force done by the player on the ball.**


**The force applied to the ball set the ball in motion)**

# Representation of a force vector ($\vec{F}$)

## 2. Give the characteristics of the applied force.

**Point of application: point A**

**Line of action: oblique**

**Direction: up – Left**

**Magnitude: F=25N**

# Representation of a force vector ($\vec{F}$)

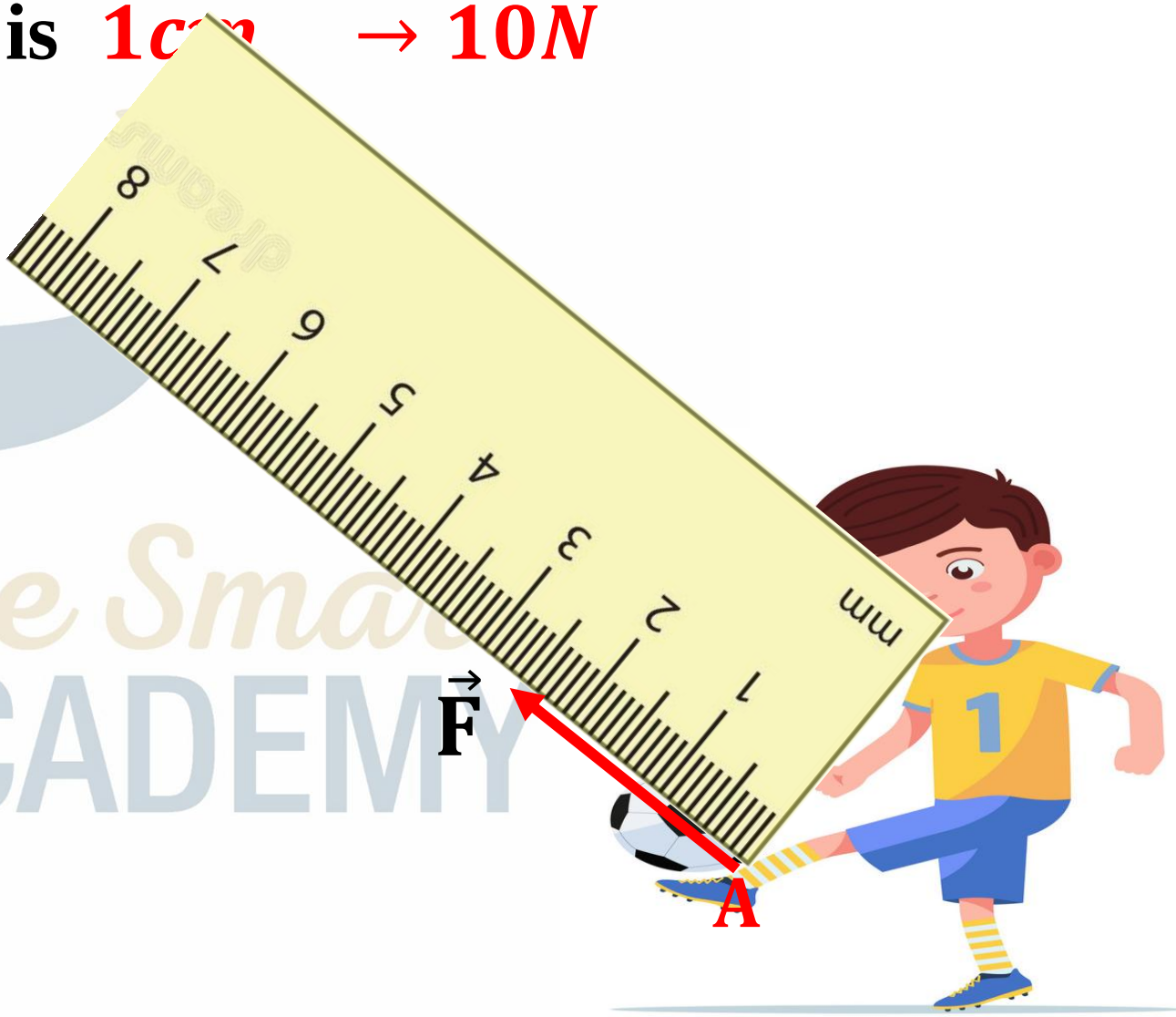
3. Represent the vector of the force on the figure, knowing that the used scale is $1cm \rightarrow 10N$

$$1cm \rightarrow 10N$$

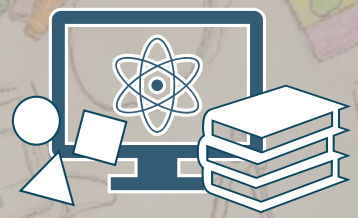
$$x \rightarrow 25N$$

$$x = \frac{1cm \times 25N}{10N}$$

$$x = 2.5cm$$

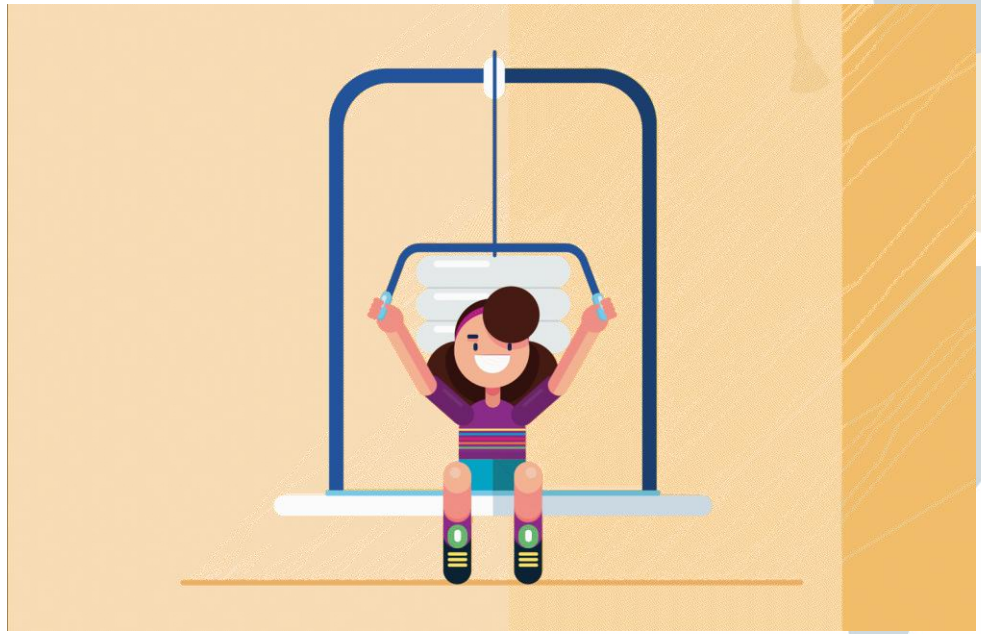


# The End



# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

1. To classify the forces
2. Characteristics of the forces acting from a distance

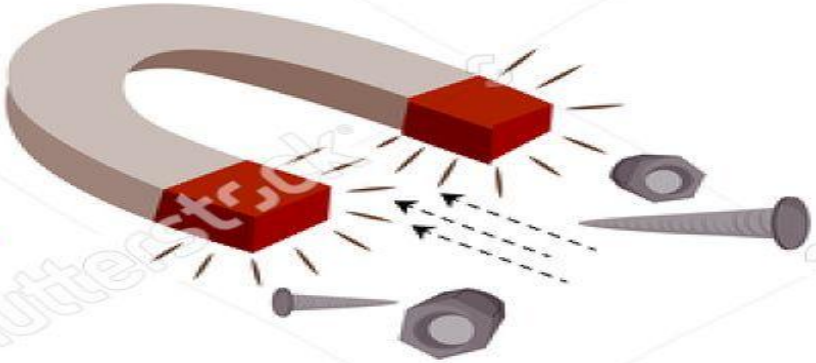
# Types of Force

Friction Force

Gravity Force

Applied Force

Spring Force



Magnetic Force

Tension Force

# Classification of force vector

## Types of forces

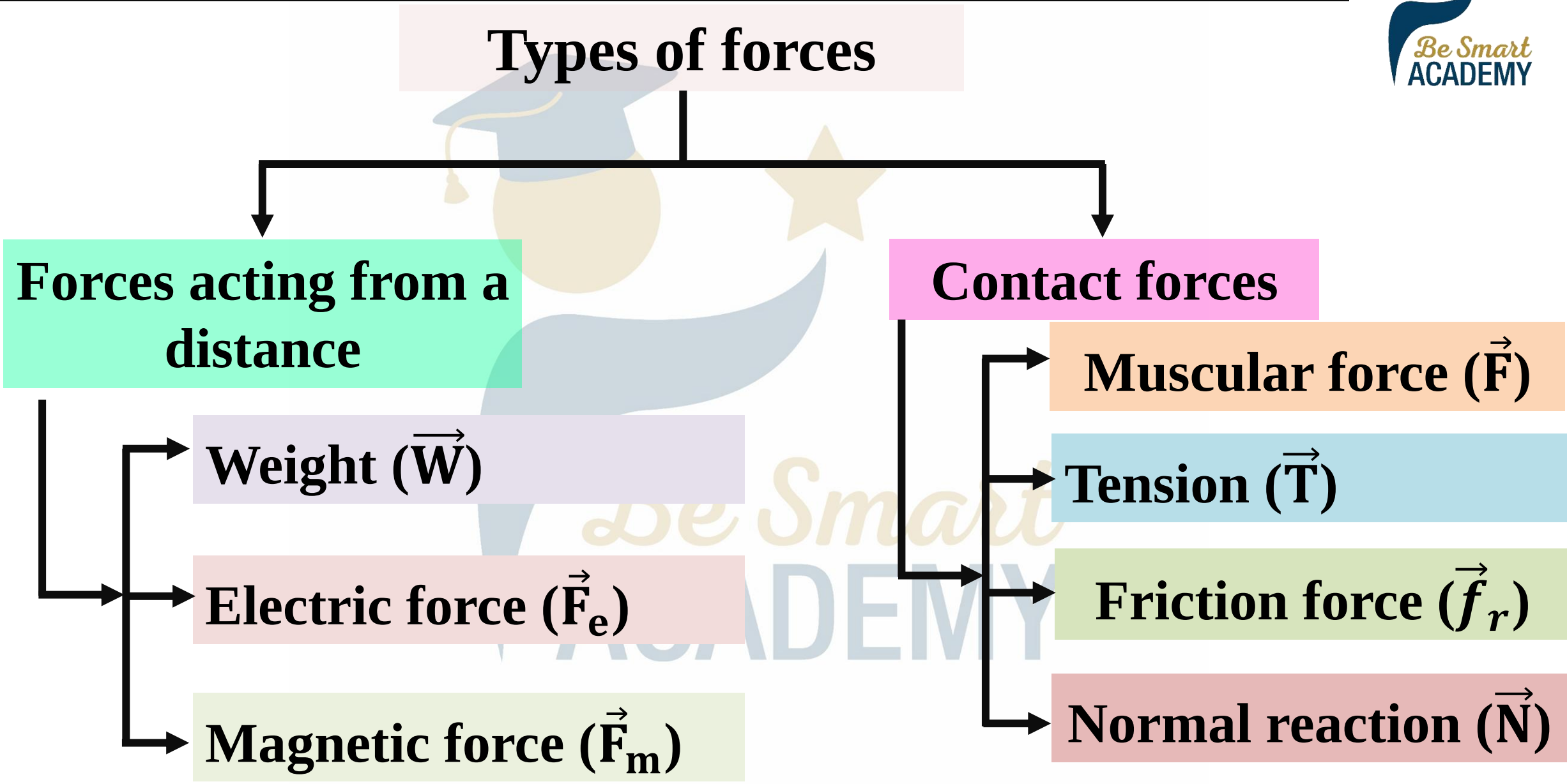
### Contact forces

Forces exerted by body (A) on another body (B), due to **contact** between the two bodies.

### Acting from a distance

are forces exerted by a body (A) on another body (B), but **without contact** between the two bodies.

# Classification of forces



# Classification of forces

## Forces acting from a distance:

**No contact between the two bodies.**

**1.Weight (gravitational force) $\overrightarrow{W}$:**

**2.Electric force ($\vec{F}_e$).**

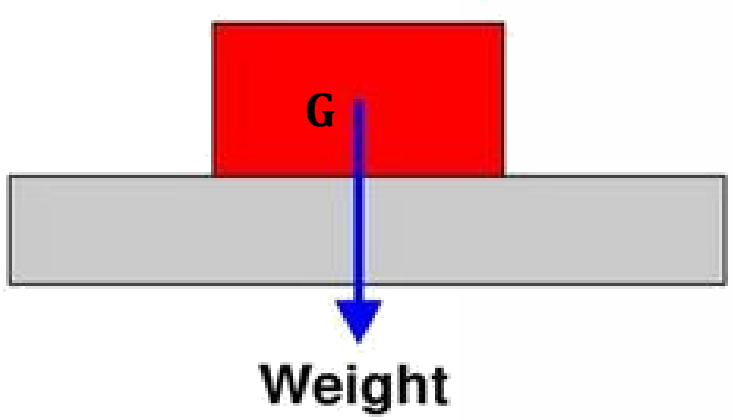
**3.Magnetic force ($\vec{F}_m$)**

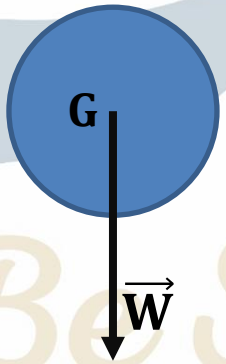
**The point of application of all these forces is the center of gravity of the body**

# Characteristics of forces acting from a distance

## 1.Weight (gravitational force) $\overrightarrow{W}$:

The earth attracts any body by a force called gravitational force (weight).




- Line of action: vertical.
- Direction The weight ($\overrightarrow{W}$) is vertical and downward.
- Magnitude of weight: $W = m \times g$

### Characteristics of Weight $\overrightarrow{W}$:

- Point of application: center of gravity of the body (G).

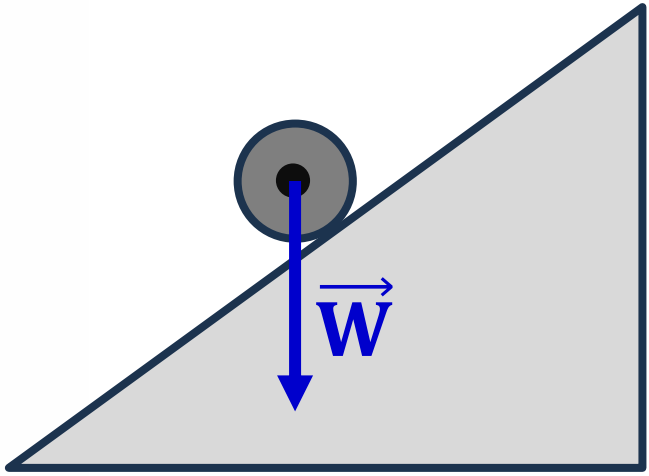
# Characteristics of forces acting from a distance

## Application 5:

**A car considered as a particle of mass $m = 500kg$ moves up an inclined plane as shown in the figure.**

**Determine the characteristics of the weight.**

**Given $g = 10N / kg$.**



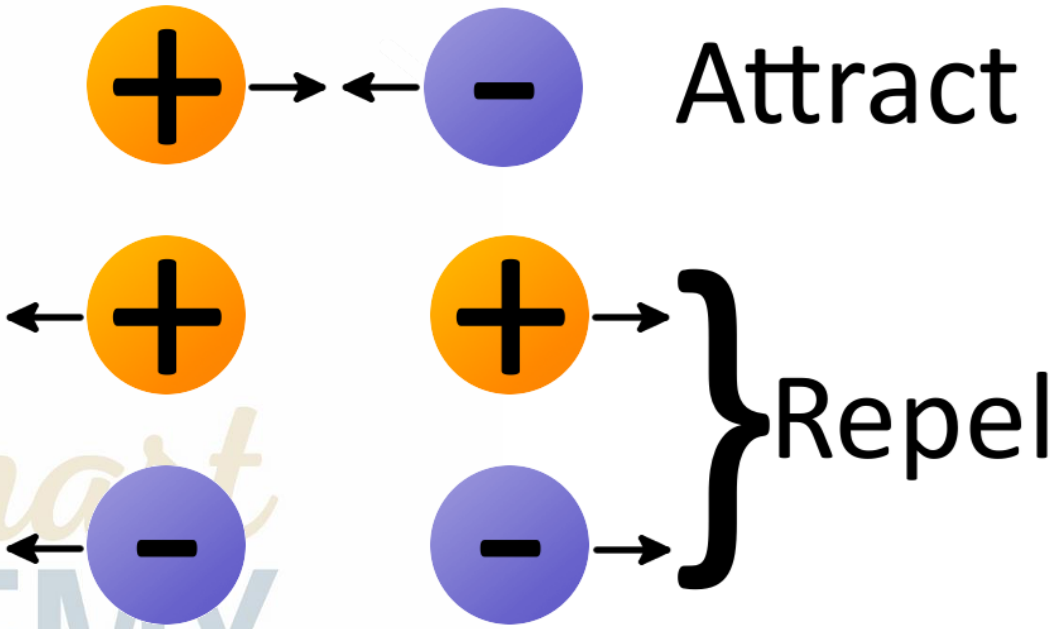

- **Point of application:** Center of gravity of the car.
- **Line of action:** Vertical.
- **Direction:** Downward.
- **Magnitude of weight:** $W = m \times g = 500 \times 10 = 5000N$

# Characteristics of forces acting from a distance

## 2.Electric force ($\vec{F}_e$):

**Two charged bodies exert on each other an action-reaction pair of forces at a distance.**

- **Two unlike charges attract each other.**
- **Two like charges repel each other**

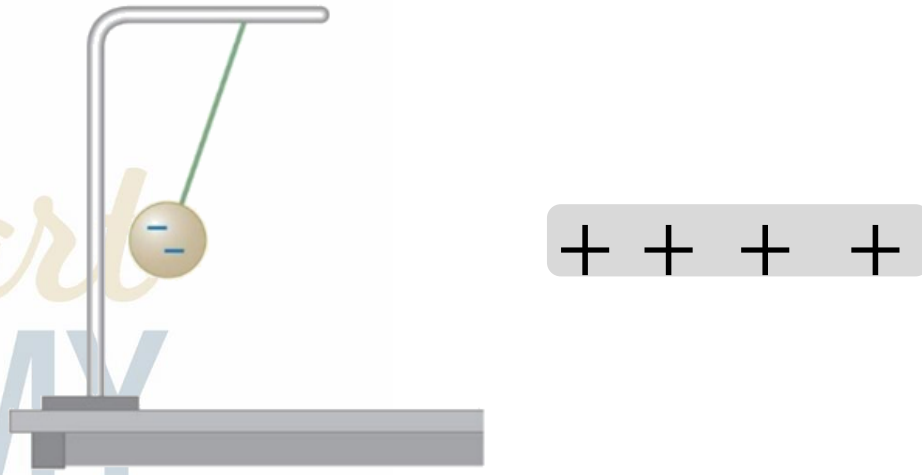


# Characteristics of forces acting from a distance

## Application 6:

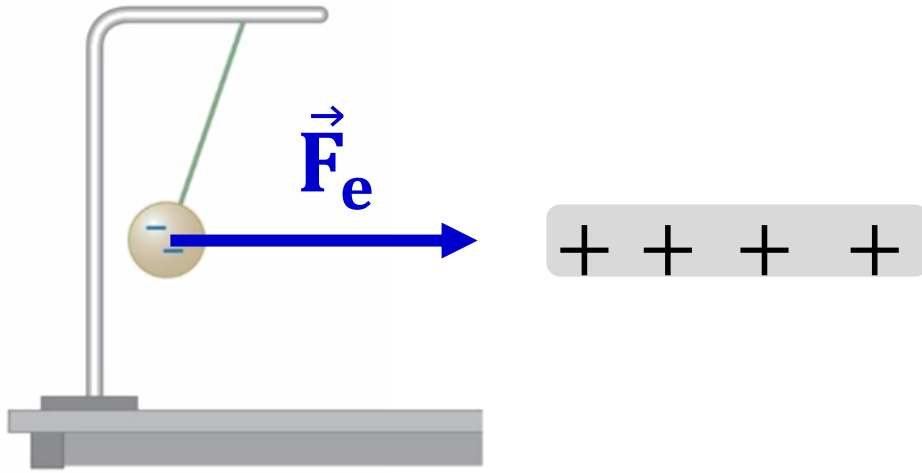
**A negatively charged metallic ball is hooked to the free end od a rope. A positively charged rod approaches the ball, so a force $F_e = 10N$ exerted between the two bodies as shown.**

**Determine the characteristics of the electric force exerted between the ball and the rod**



# Characteristics of forces acting from a distance

**The rod attract the ball by an electric force as shown in the figure.**




- **Point of application:**

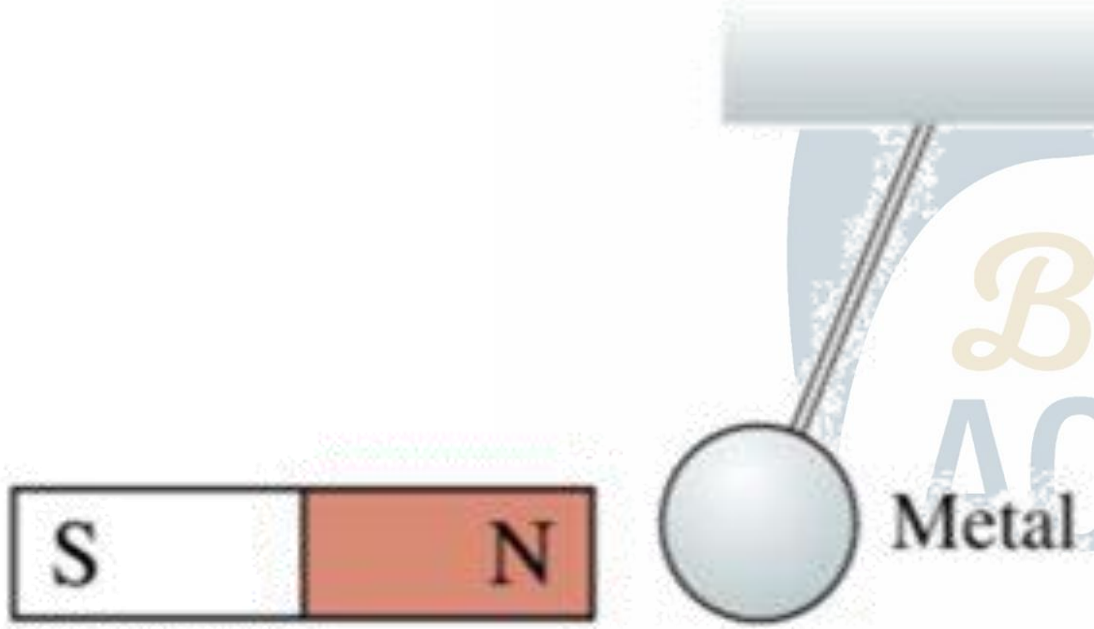
  **Center of gravity the ball (G)**

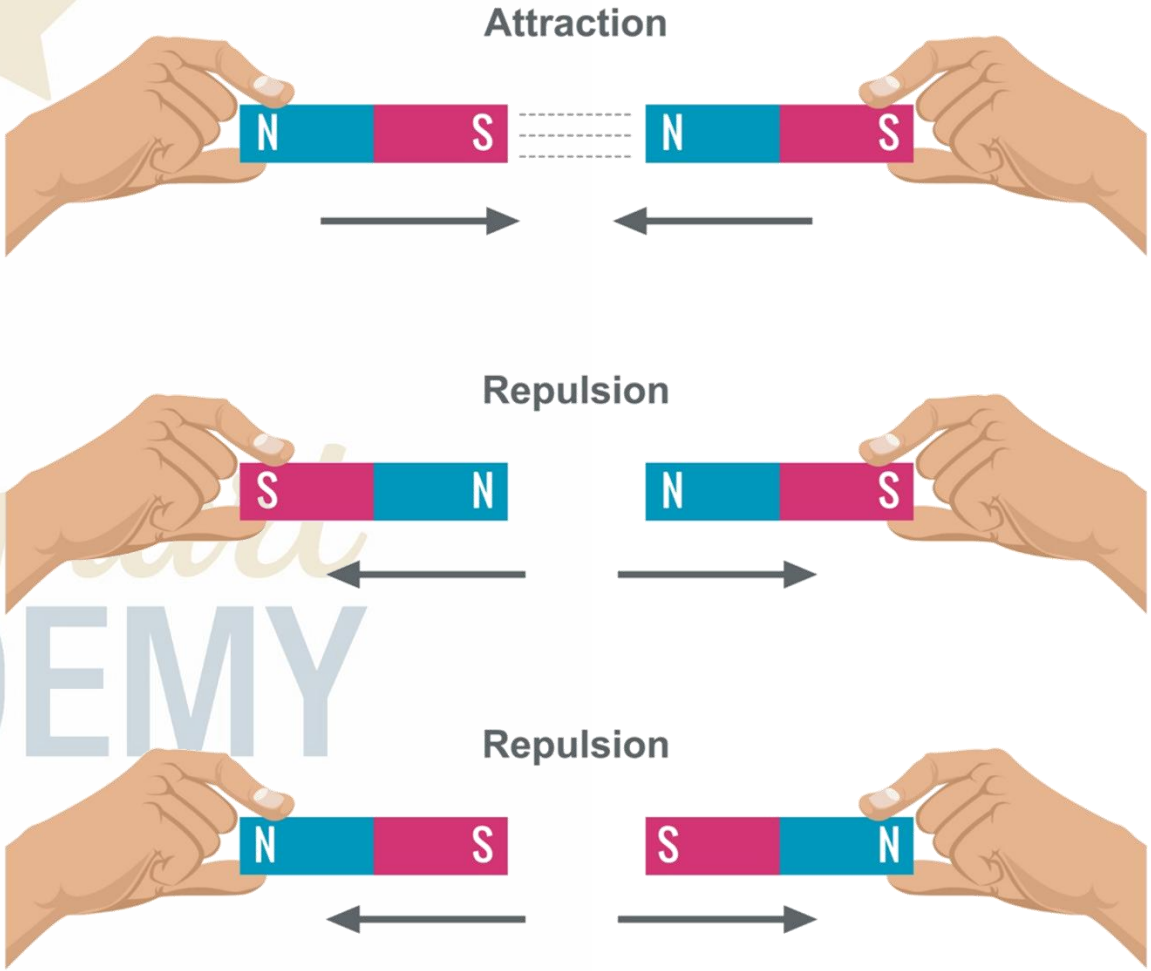
- **Line of action:** **Horizontal**
- **Direction:** **To Right**
- **Magnitude:** $F_e = 10N$

# Characteristics of forces acting from a distance

## 3.Magnetic force ($\vec{F}_m$):

**A magnet exerts a force on another object or two magnets exert forces on each other**



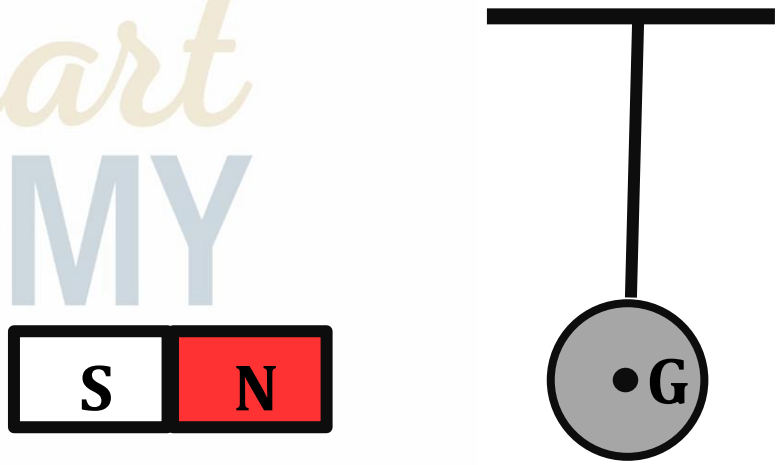



# Characteristics of forces acting from a distance

## Application 7:

**A metallic ball of center of gravity G, is hooked to the free end od a rope. A magnet approaches the ball, so a force $F_m = 12N$ exerted by the magnet on the ball as shown.**

**Determine the characteristics of the magnetic force exerted by the magnet on the ball.**

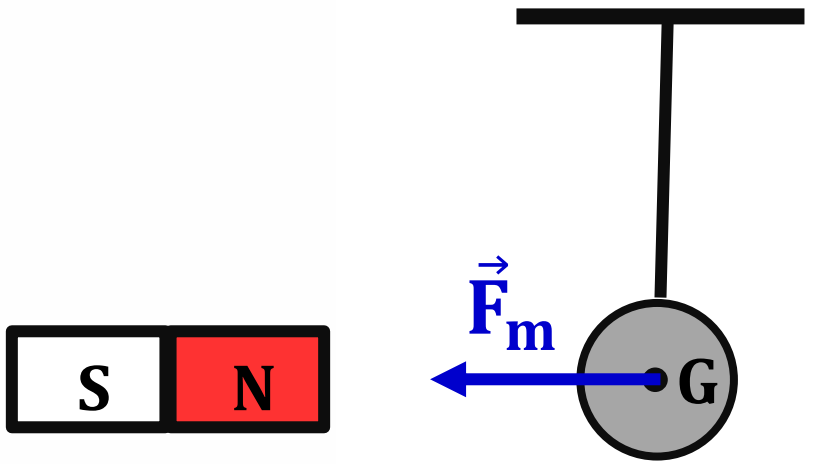


# Characteristics of forces acting from a distance

**The magnet attract the ball by a magnetic force $\vec{F}_m$.**

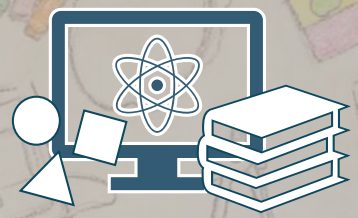
- **Point of application:**

**Center of gravity the ball (G)**



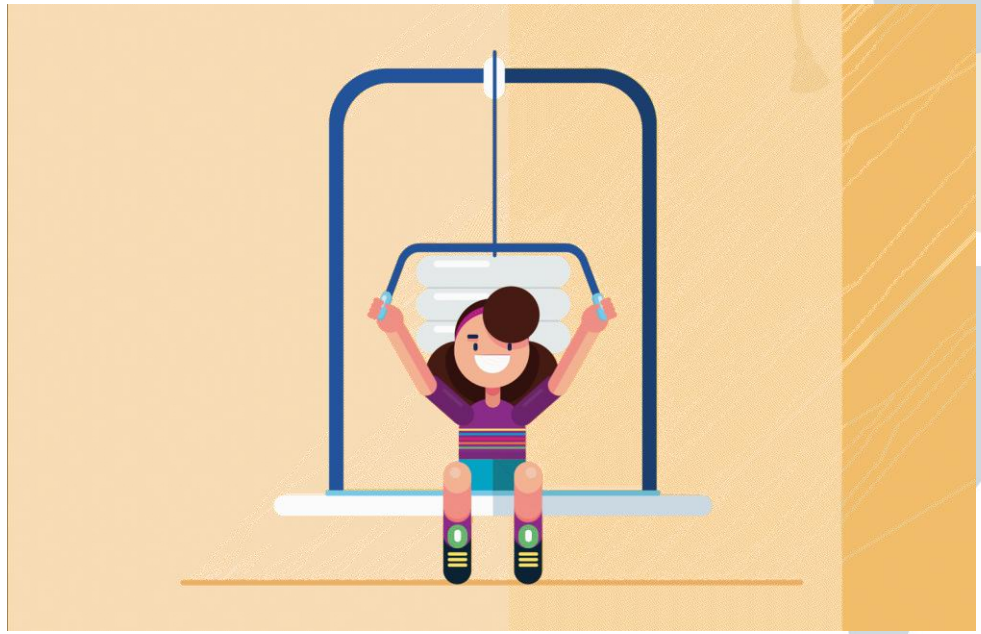

- **Line of action: Horizontal**
- **Direction: Left**
- **Magnitude: $F_m = 12N$**

# The End



# Physics – Grade 10

## Unit Four – Mechanics



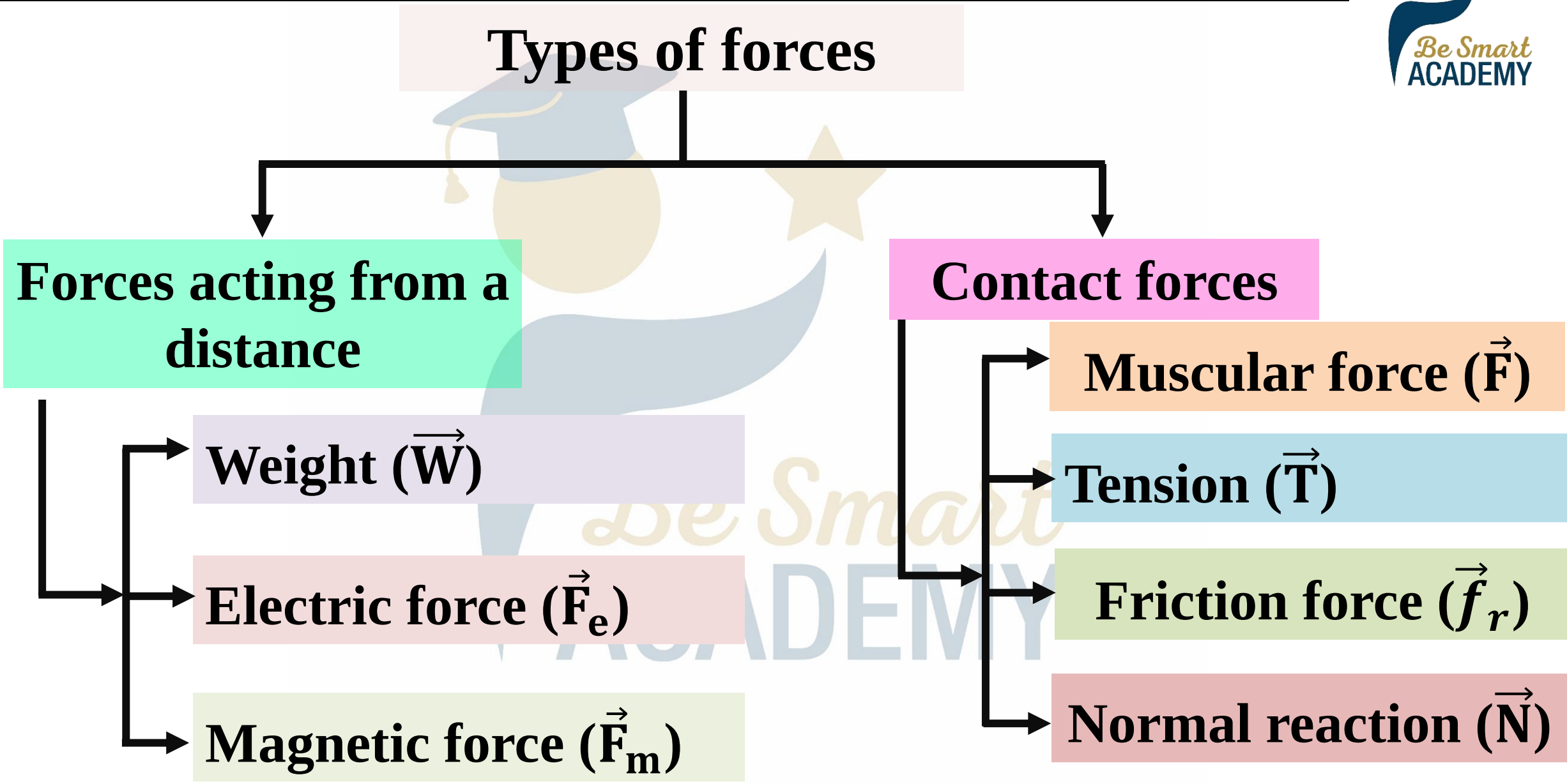
## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

3 Characteristics of contact forces

# Classification of forces



# Characteristics of contact forces

**Contact forces:** are the forces due to contact between two bodies.

1. Muscular force $\vec{F}$:
2. Normal reaction force $\vec{N}$
3. Tension force $\vec{N}$.
4. Friction force $\vec{f}_r$

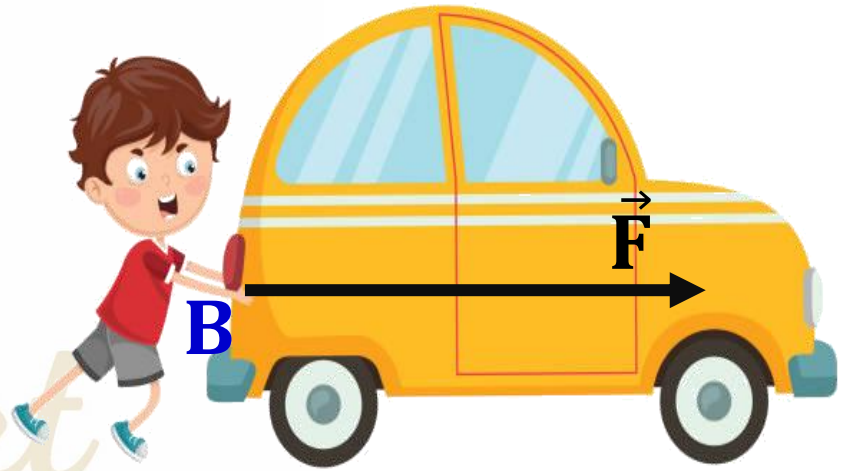
The point of application of all these forces is the **contact point between the two bodies**.

# Characteristics of contact forces

## 1. Muscular force ($\vec{F}$):

**Muscular force is the force exerted by the arms or by the legs to push or pull a certain body.**

**There is a contact point between the hands of the boy and the car.**




**Characteristics of muscular force:**

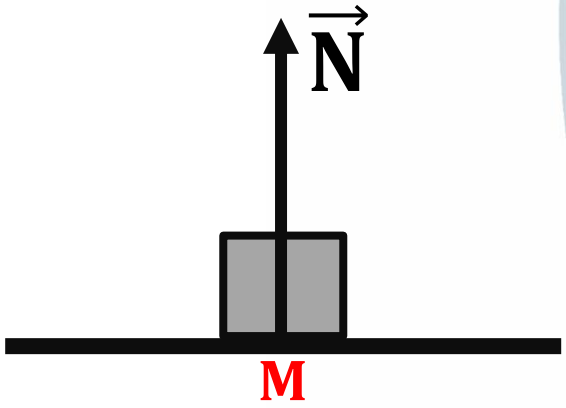
- **Point of application: contact point B**
- **Line of action: Horizontal**
- **Direction: To Right**
- **Magnitude: Given or to be calculated**

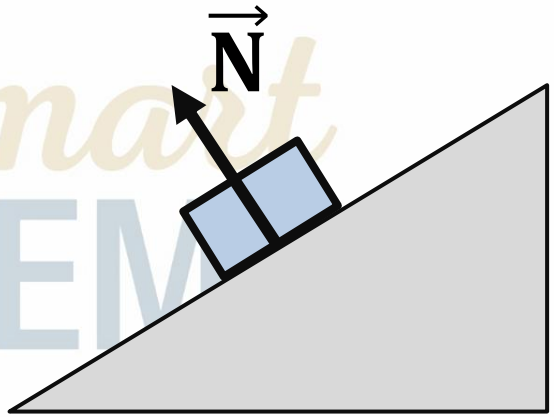
# Characteristics of contact forces

## 2.Normal reaction of support ($\vec{N}$):

**Normal reaction is the force exerted by surface of support (road, table…) on the objects placed on it.**

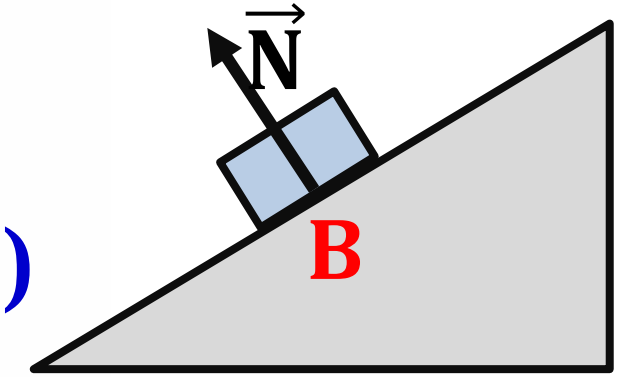
**Normal reaction is always ⊥ to the surface.**



# Characteristics of contact forces

## Characteristics of normal reaction force:




- **Point of application:**

**Contact point between the surface and box (B)**

- **Line of action:** **Oblique**
- **Direction:** **Up to Left**
- **Magnitude:** **Given or to be calculated**

# Characteristics of contact forces

## 3. Friction force ($\vec{f}_r$):

**Friction force is the force that resists (opposite) the motion of the body.**

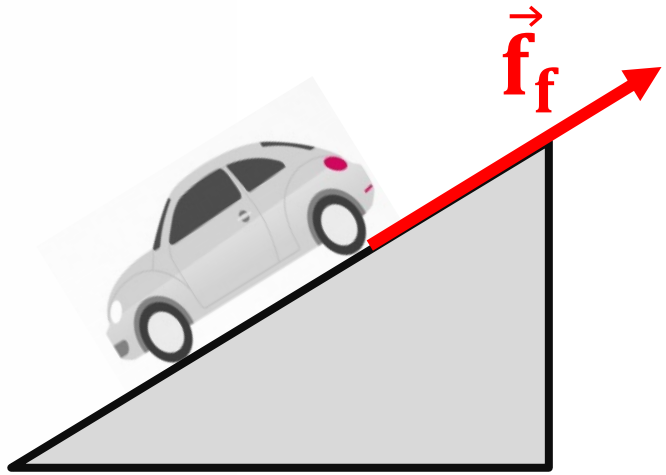
**There is a contact point between the surface and the body.**

# Characteristics of contact forces

## Characteristics of friction force:

- **Point of application:**

**Contact point between the surface and the wheels of the car**




- **Line of action:** **Oblique**

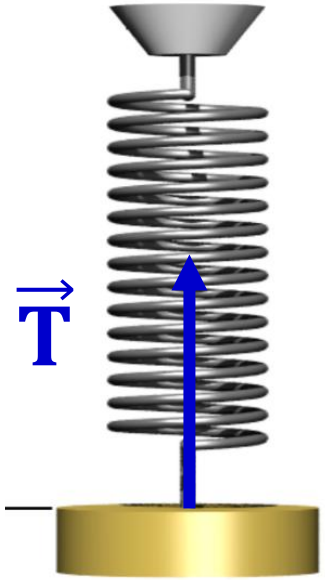
- **Direction:** **Up to right**

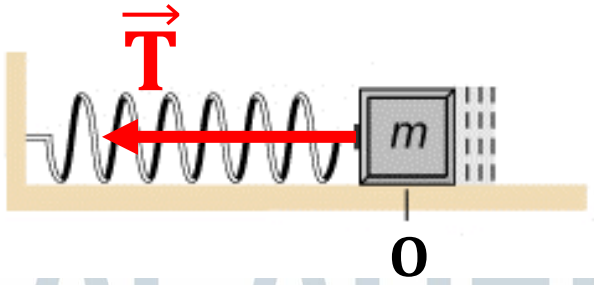
- **Magnitude:** **Given or to be calculated**

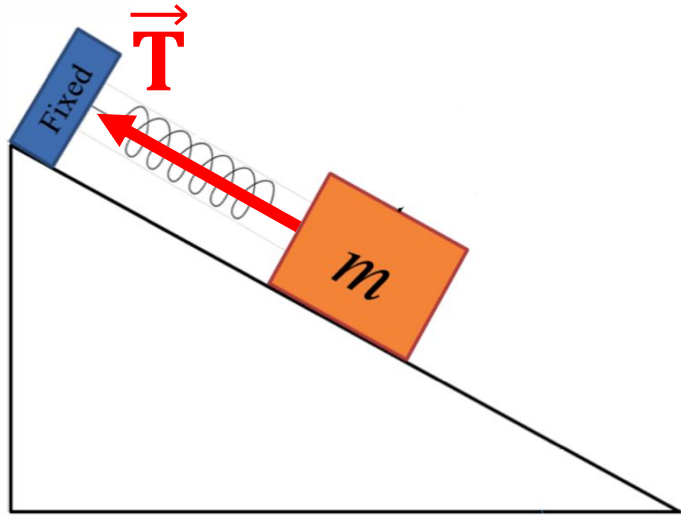
# Characteristics of contact forces

## 4. Tension force ($\vec{T}$):

**Tension is a force exerted by a spring (string) on object that is attached to it.**



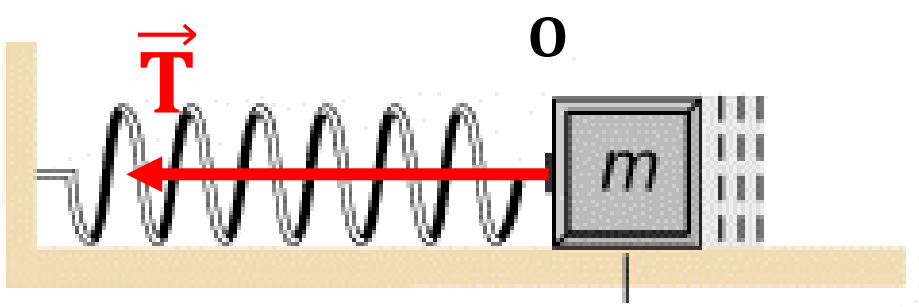



# Characteristics of contact forces

## Characteristics of tension force:

- **Point of application:**

**The contact point between the box and the spring (O).**

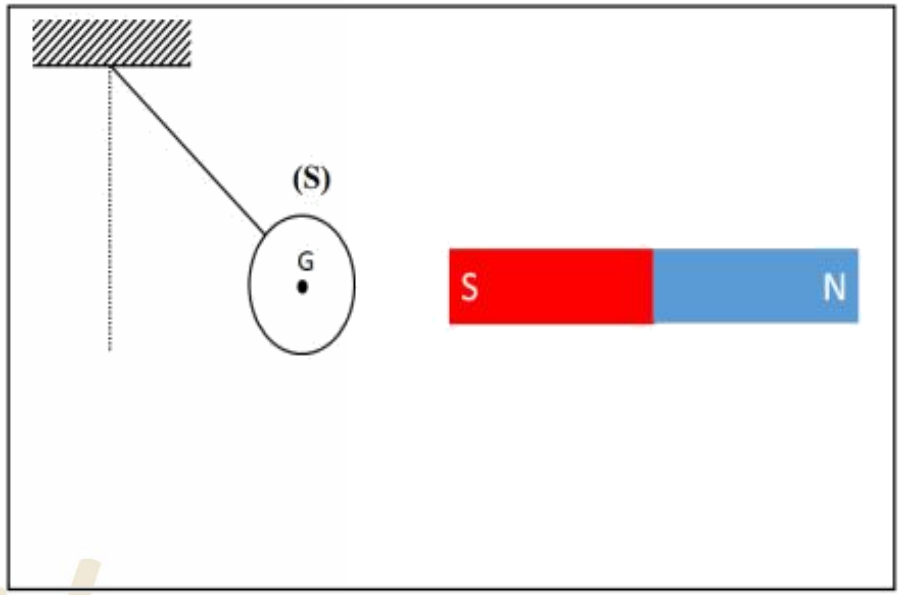



- **Line of action:** **Horizontal**
- **Direction:** **To Left**
- **Magnitude:** **given to be calculated**

# Characteristics of contact forces

## Application 8:

A magnet attracts an iron ball ( S ) that is suspended from its extremity to a wire as shown in the figure.



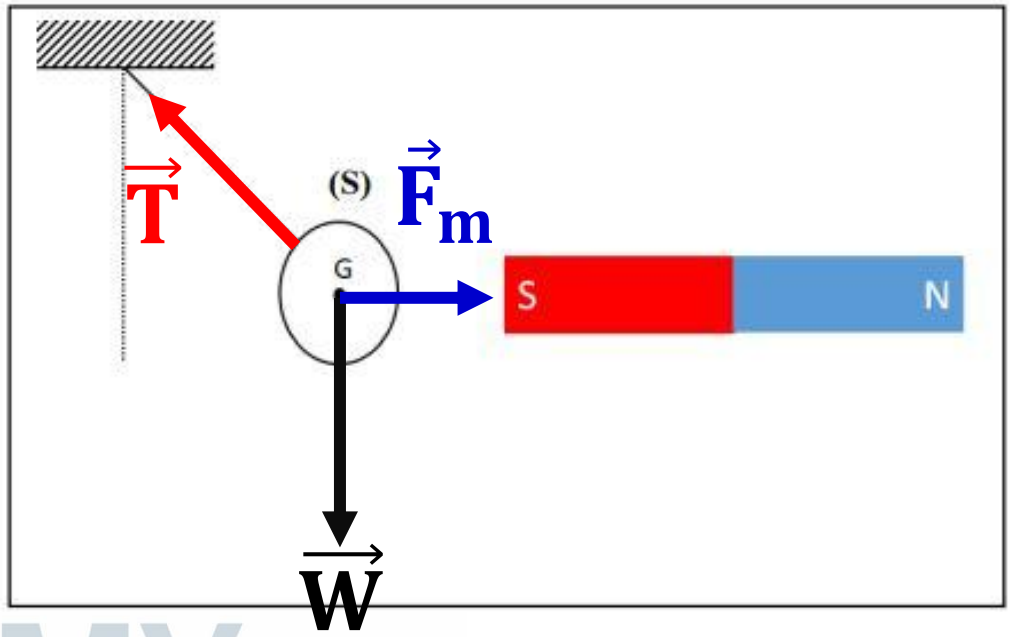

1. Name and represent the forces acting on the iron ball (S).
2. Determine the type of each force.
3. Give the point of application , line of action and the direction of each force .

# Characteristics of contact forces

**1.Give the name of the forces acting on the iron ball (S).**

**The forces acting on the iron ball (S) are:**

- **Weight ($\vec{W}$)**
- **Magnetic force ($\vec{F}_m$)**
- **Tension force ($\vec{T}$)**



# Characteristics of contact forces

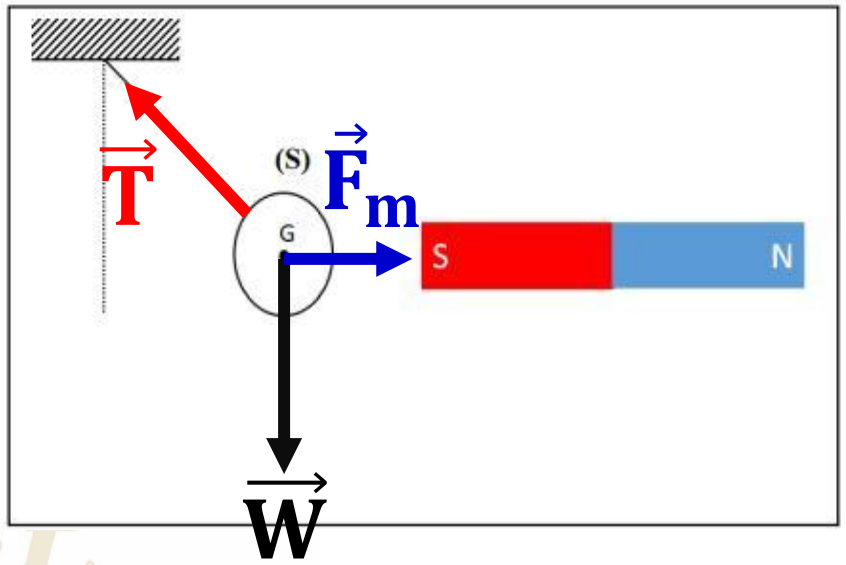
## 2. Determine the type of each force.

- **Weight ($\vec{W}$): Acting from a distance.**
- **Magnetic force ($\vec{F}_m$): Acting from a distance.**
- **Tension force ($\vec{T}$): Contact force**

# Characteristics of contact forces

**3.Give the point of application, line of action and the direction of each force.**

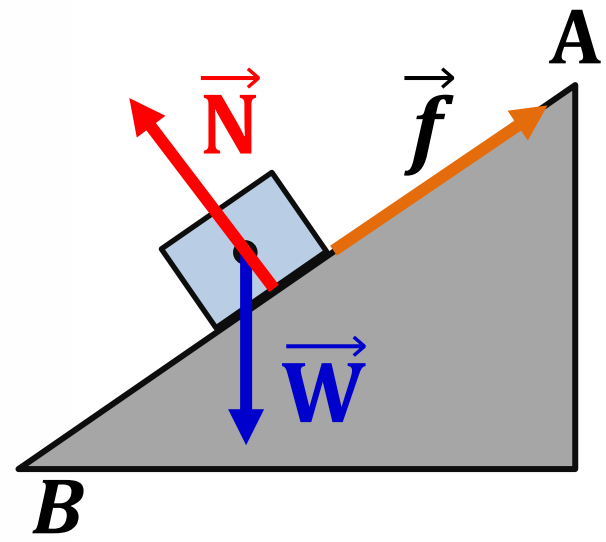
| Force | Point of application | Line of action | direction |
|---|---|---|---|
| Weight | Center of gravity of the ball (G) | Vertical | downward |
| Magnetic force | Center of gravity of the ball (G) | horizontal | Right |
| Tension | Contact point between the ball and the wire | Oblique | Up-left |



# Characteristics of contact forces

## Application 9:

**A particle (S) of mass $m = 2kg$ slides on a rough surface starting from the top at point A as shown in the figure. Given $g = 10N/kg$**




**1.Name and represent the forces acting on the body.**

- **Weight of the body ($\vec{W}$).**
- **Normal reaction ($\vec{N}$).**
- **Friction ($\vec{f}$)**

# Characteristics of contact forces

**2.Classify the forces into acting from a distance or contact forces.**

**Acting from a distance:** **Weight ($\vec{W}$):**

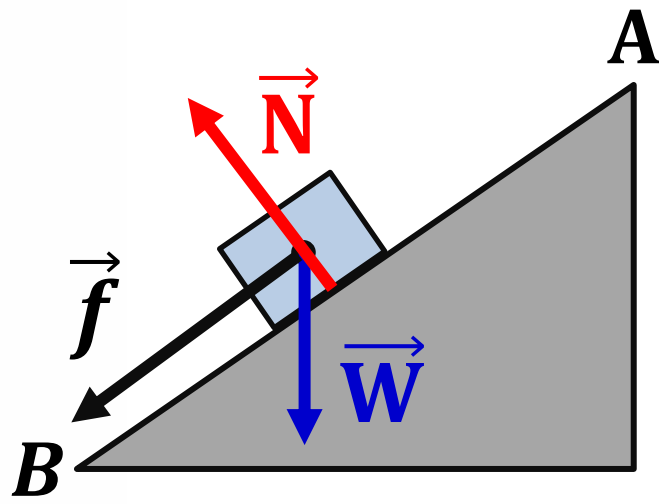
**Contact forces:** **Normal reaction ($\vec{N}$) and Friction ($\vec{f}$)**

# Characteristics of contact forces

## 3. Determine the characteristics of gravitational force.

**Point of application:**

**Center of gravity of box.**




**Line of action:** **Vertical**

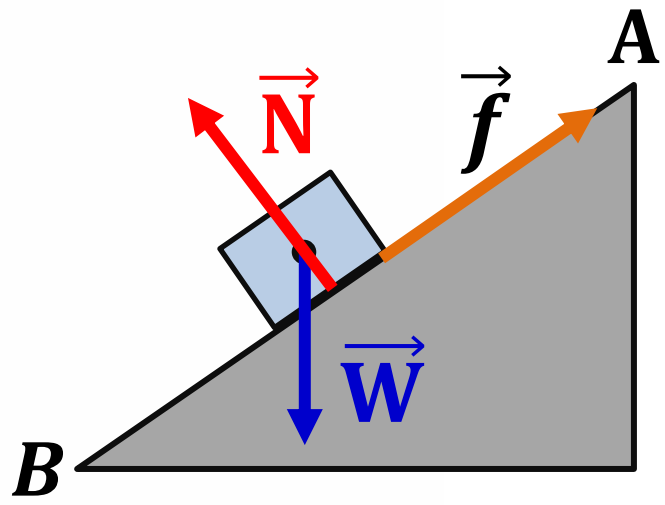
**Direction:** **Downward**

**Magnitude:** **Magnitude: $W = m \times g = 2 \times 10$**

$$W = 20N$$

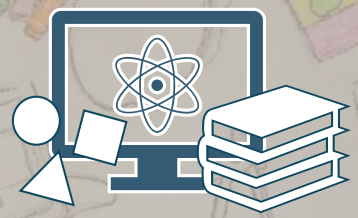
# Characteristics of contact forces

4. Give the point of application, line of action and the direction of other forces.



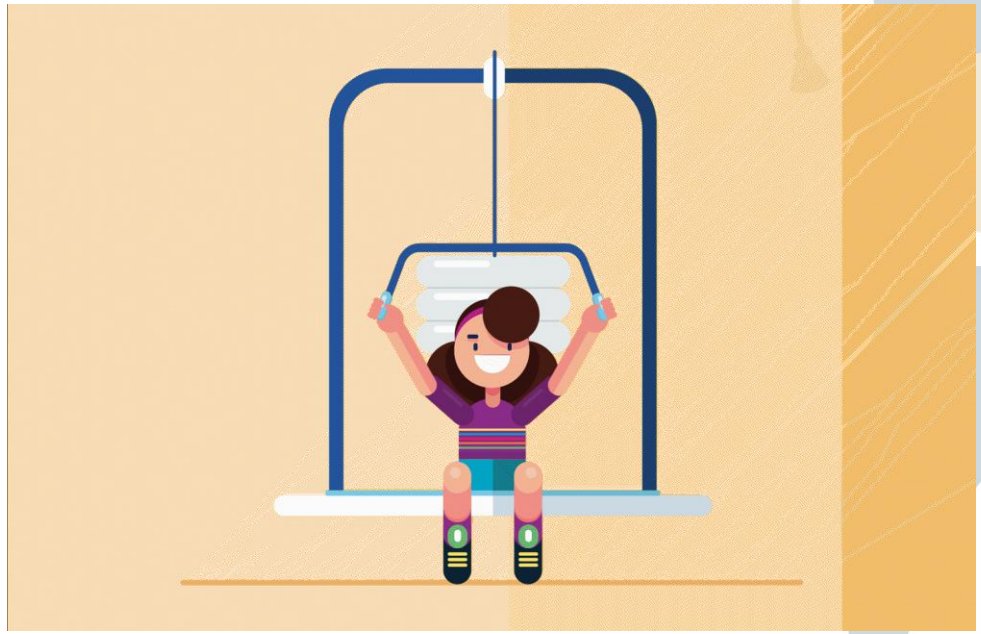

| force | Point of application | Line of action | direction |
|---|---|---|---|
| Normal force | Contact point between the ball and the surface | Oblique | Up-left |
| Friction | Contact point between the ball and the surface | Horizontal | Left |

# The End



# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

1. State and apply principle of interaction

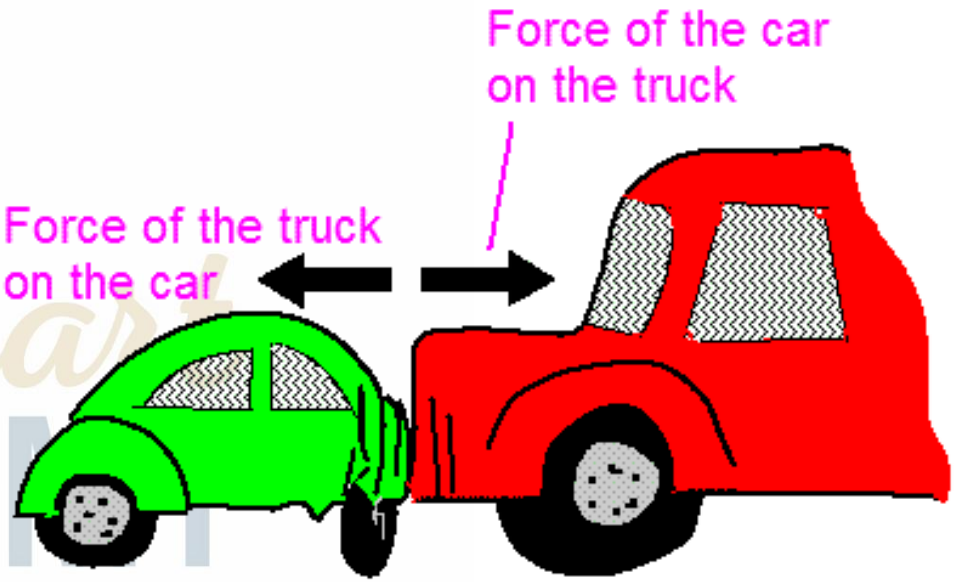
# Principle of interaction

## Statement of principle of interaction:

**If a body (A) exerts on a body (B) a force $\vec{F}_{A/B}$, then the body (B) exerts on a body (A) a force $\vec{F}_{B/A}$.**

**These two forces have:**

- **Same magnitude.**
- **Same line of action.**
- **Opposite directions**

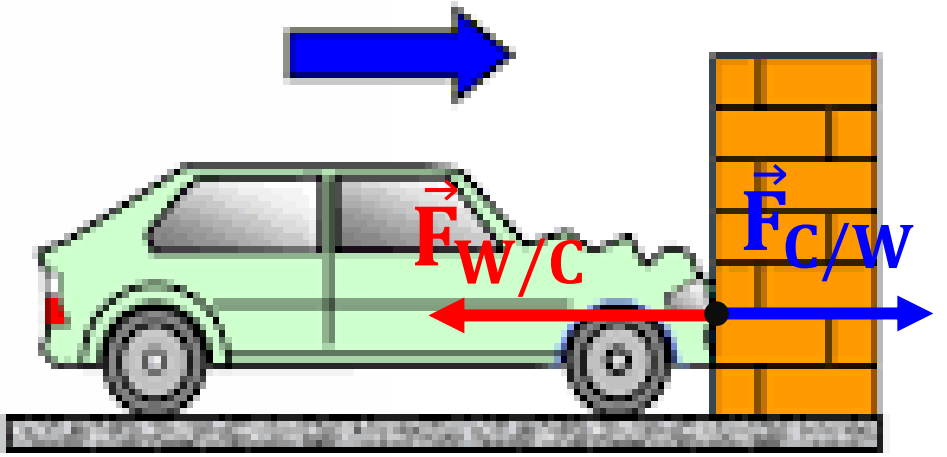


# Principle of interaction

**The car exerts on the wall a force $\vec{F}_{C/W}$, then the wall exerts a force on the car $\vec{F}_{W/C}$.**

**The two forces have:**

- **Same magnitude.**
- **Same line of action.**
- **Opposite directions**




**Vector relation:** $\vec{F}_{C/W} = -\vec{F}_{W/C}$

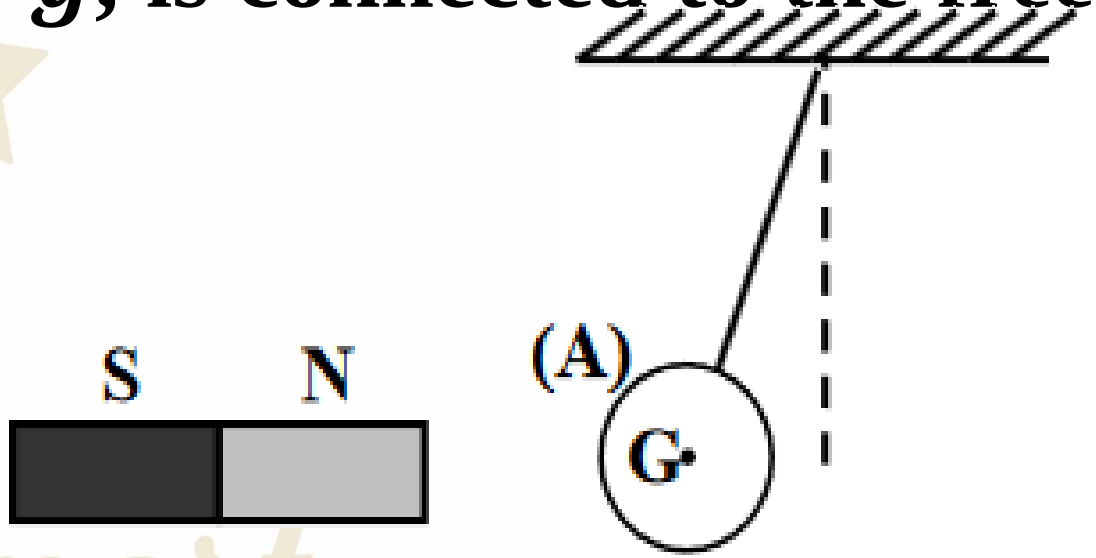
**Magnitude:** $F_{C/W} = F_{W/C}$

# Principle of Interaction

## Application:

**An iron ball (A), of mass $m = 200\ g$, is connected to the free end of a string. Take: g = 10 N/kg.**

**A magnet (SN) approached to (A) attracts it by a force $\vec{F}$ as shown in the figure. The ball exerts on the magnet a force $\vec{F}'$.**




1. **F and $\vec{F}'$ verify a certain principle. Give the name this principle.**

**F and $\vec{F}'$ verifies the principle of interaction.**

# Principle of Interaction

**2. State this principle.**

**If a body (A) exerts on a body (B) a force $\vec{F}$, then the body (B) exerts on a body (A) a force $\vec{F}'$ such that $\vec{F}$ and $\vec{F}'$ have same line of action, same magnitude and opposite directions.**

**3. Write down the vector relation between $\vec{F}$ and $\vec{F}'$.**

$$\vec{F} + \vec{F}' = \vec{0}$$

$$\vec{F} = -\vec{F}'$$

# Principle of Interaction

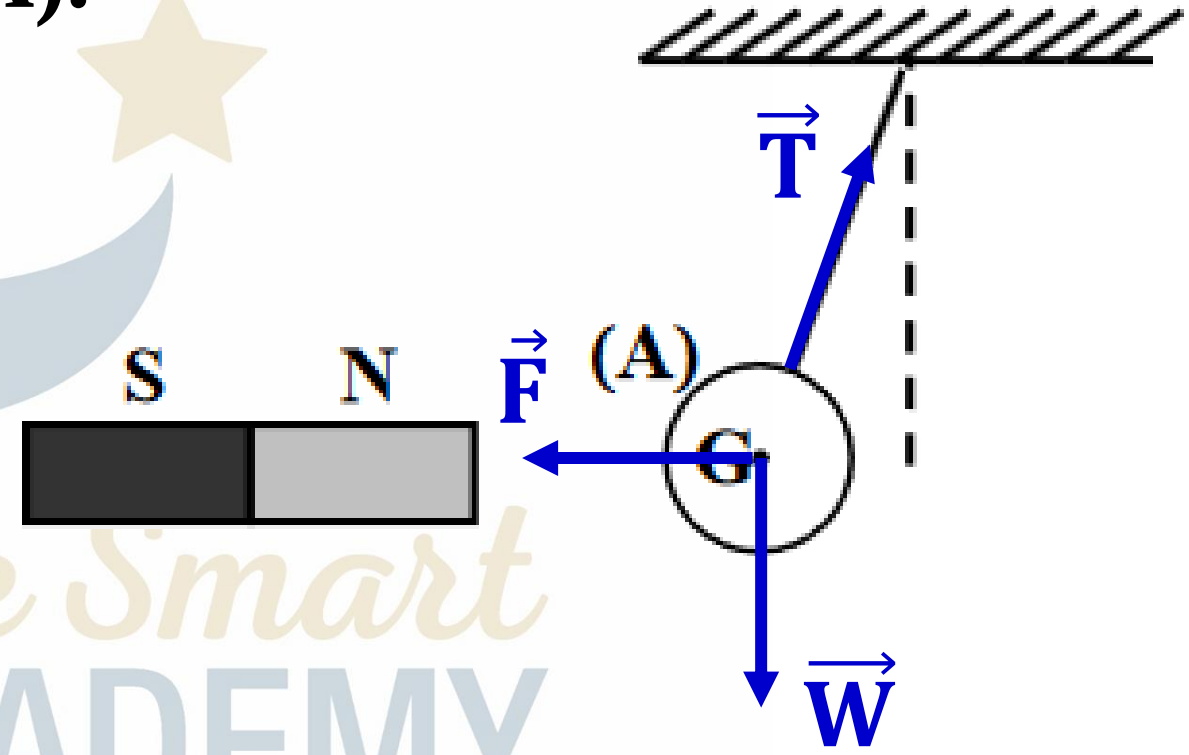
4. Redraw the figure and show on it , without scale, the three forces acting on (A).

**The forces acting on (A) are:**

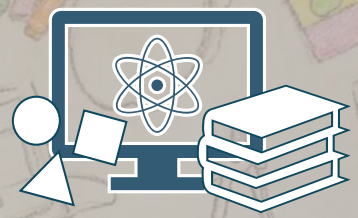
**Weight ($\vec{W}$)**

**Tension ($\vec{T}$)**

**Force of interaction ($\vec{F}$)**

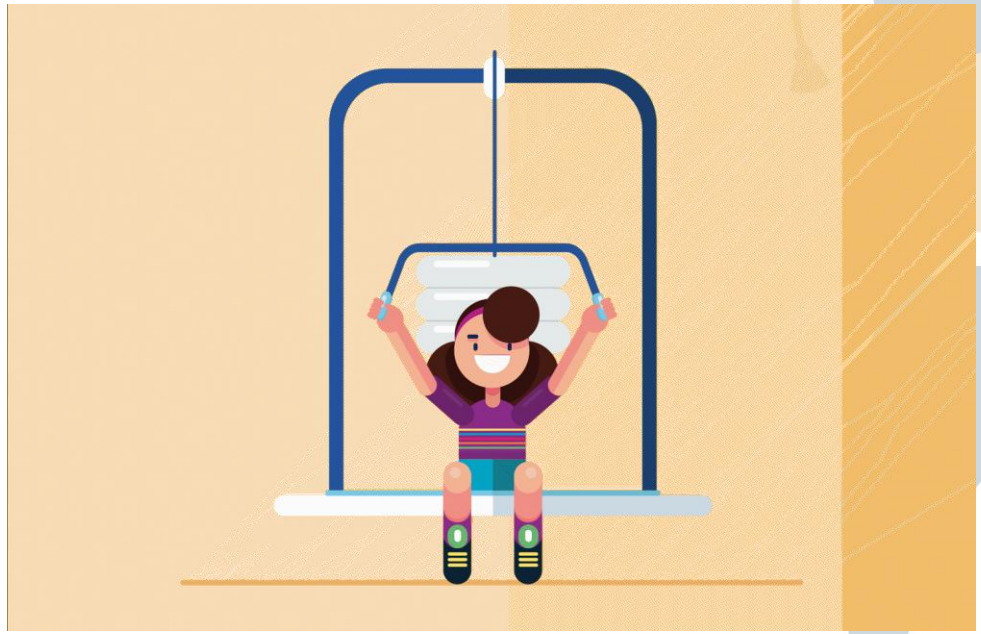


# The End



# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

1. Resultant of collinear forces
2. Resultant of non - collinear forces: perpendicular forces
3. Resultant of non - collinear forces: analytical method

# Resultant of collinear forces

## Two collinear forces having same direction:

$\vec{F}_1 = 5N$ And $\vec{F}_2 = 3N$


**The direction of the resultant force $\vec{F}_R$ is the same as that of $\vec{F}_1$ and $\vec{F}_2$**

**The magnitude of the resultant force is the sum of the two forces.**

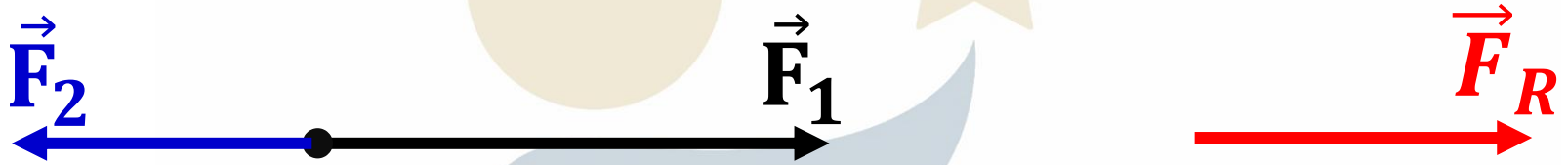
$$F_R = F_1 + F_2 = 5 + 3$$

$$F_R = 8N$$

# Resultant of collinear forces

## Two collinear forces having opposite direction:

$\vec{F}_1 = 5N$ And $\vec{F}_2 = 3N$




**The direction of the resultant force $\vec{F}_R$ is like that of the force with the larger magnitude.**

**The magnitude of the resultant force is the absolute value of the difference between the two forces.**

$$F_R = |F_1 - F_2| = |5 - 3|$$

$$F_R = 2N$$

# Resultant of non – collinear forces

## Two non - collinear forces: perpendicular forces

$\vec{F}_1 = 4N$ And $\vec{F}_2 = 3N$

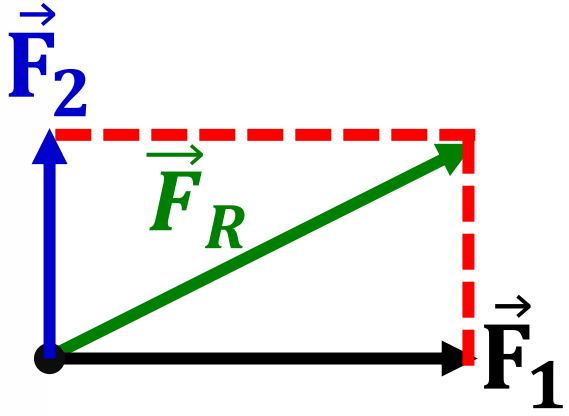
The resultant force $\vec{F}_R$ is the diagonal of the completed rectangle

The magnitude of the resultant force is:

$$F_R = \sqrt{F_1^2 + F_2^2} \Rightarrow F_R = \sqrt{(4)^2 + (3)^2}$$

$$F_R = \sqrt{16 + 9} = \sqrt{25}$$

$$F_R = 5N$$



# Resultant of non – collinear forces

## Two non - collinear forces: non – perpendicular forces

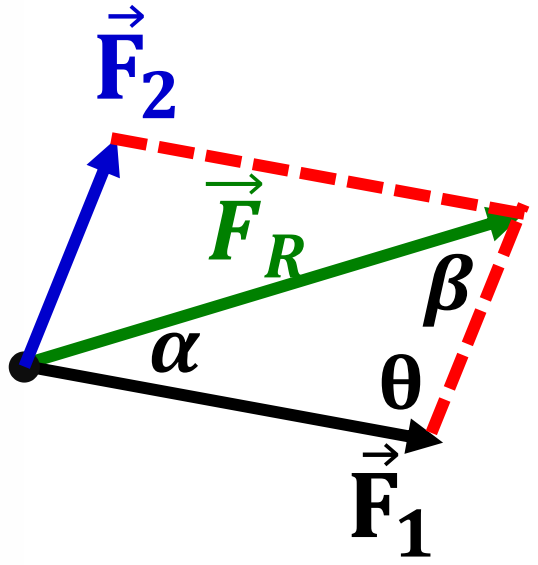
$\vec{F}_1 = 4\text{N}$ And $\vec{F}_2 = 3\text{N}$

The resultant force $\vec{F}_R$ is the diagonal of the parallelogram

The magnitude of the resultant force is:

$$F_R^2 = F_1^2 + F_2^2 - 2F_1F_2\cos(\theta)$$

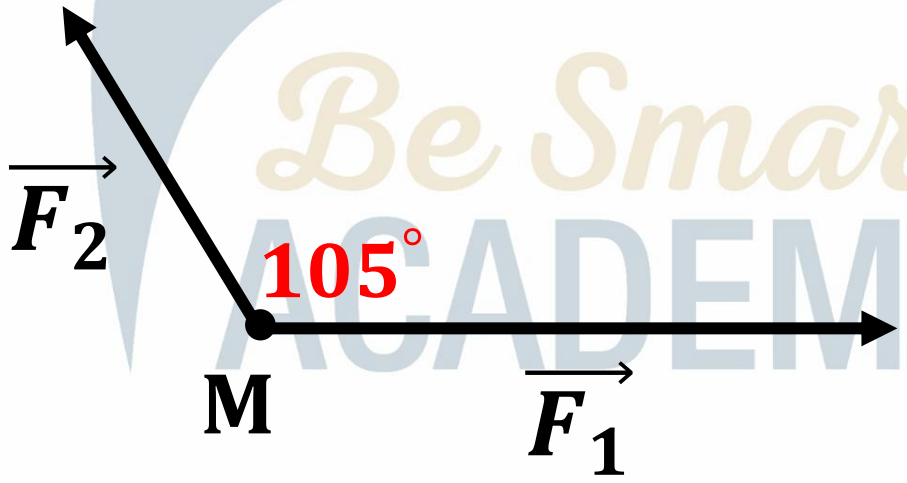
$$\frac{F_R}{\sin(\theta)} = \frac{F_1}{\sin(\beta)} = \frac{F_2}{sin(\alpha)}$$



# Resultant of non – collinear forces

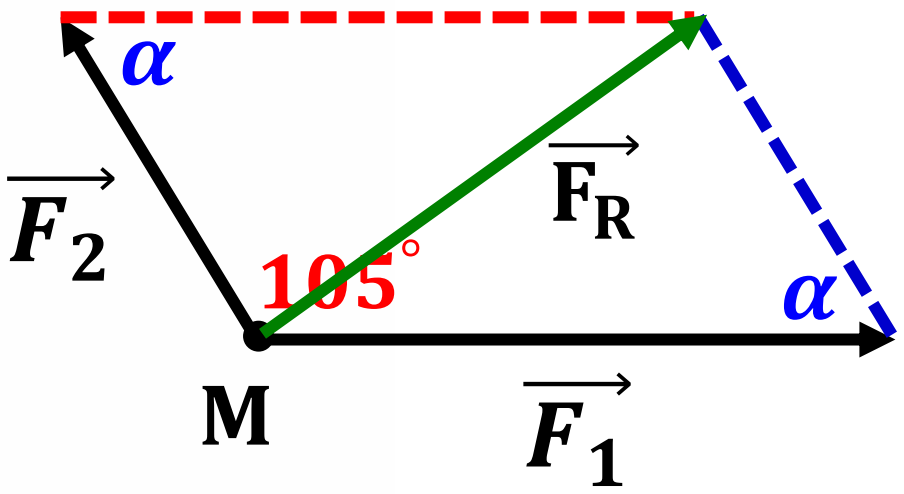
## Application 10:

**Two non colinear forces of magnitudes $F_1 = 8N$ and $F_2 = 5N$ respectively making an angle $105^\circ$ as shown in the figure. Determine the resultant force $F_R$ (magnitude and direction) of the two forces $F_1$ $and$ $F_2$ action on point M**



# Resultant of non – collinear forces

$$\alpha = 180^\circ - 105^0 \rightarrow \alpha = 75^\circ$$




$$F_R^2 = F_1^2 + F_2^2 - 2F_1F_2cos(\alpha)$$

$$F_R^2 = (8)^2 + (5)^2 - 2(8)(5)\cos(75^\circ)$$

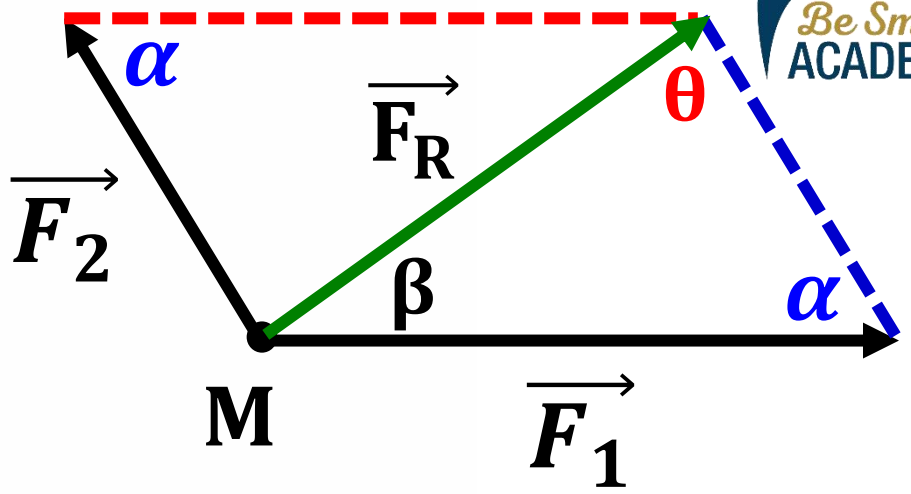
$$F_R^2 = 68.3 \rightarrow F_R = \pm\sqrt{68.3} = \pm 8.26N$$

**but $(-)$ is rejected then: $F_R = +8.26N$**

# Resultant of non – collinear forces

## Apply Law of sine:

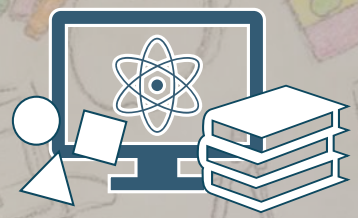
$$\frac{\sin(\theta)}{F_1} = \frac{\sin(\beta)}{F_2} = \frac{\sin(\alpha)}{F_R}$$




$$\frac{\sin(\alpha)}{F_R} = \frac{\sin(\beta)}{F_2} \Rightarrow \frac{sin(75^\circ)}{8.26} = \frac{sin(\beta)}{5}$$

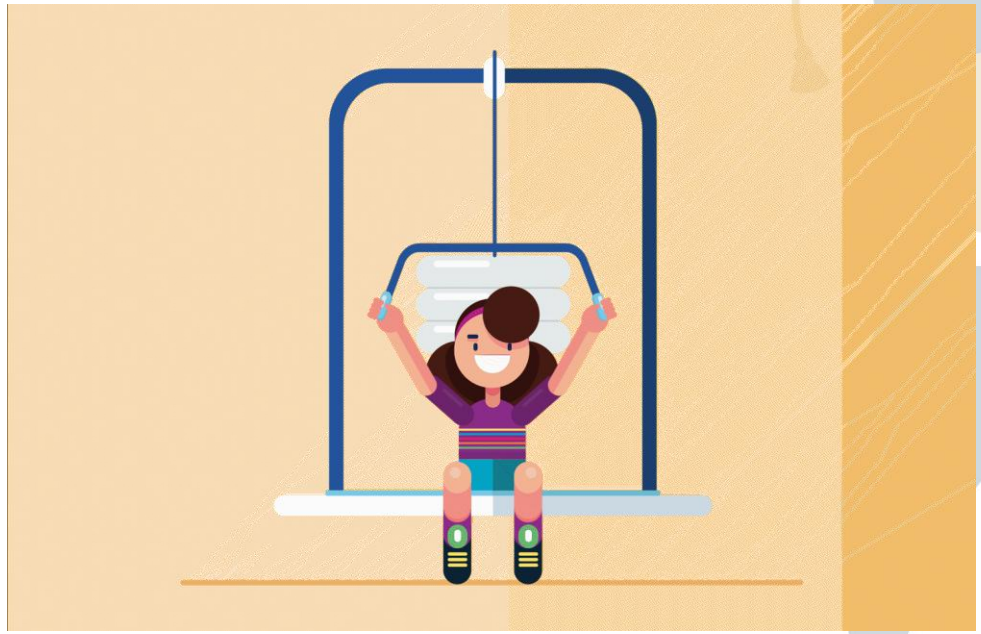
$$sin(\beta) = \frac{5 \times sin(75^\circ)}{8.26} \Rightarrow sin(\beta) = 0.584 \Rightarrow \beta = 35.8^\circ$$

# The End



# Physics – Grade 10

## Unit Four – Mechanics



## Chapter 16 – Forces and Interaction

Prepared & presented by: Mr. Mohamad Seif

# OBJECTIVES

2 Resultant of non - collinear forces: projection method

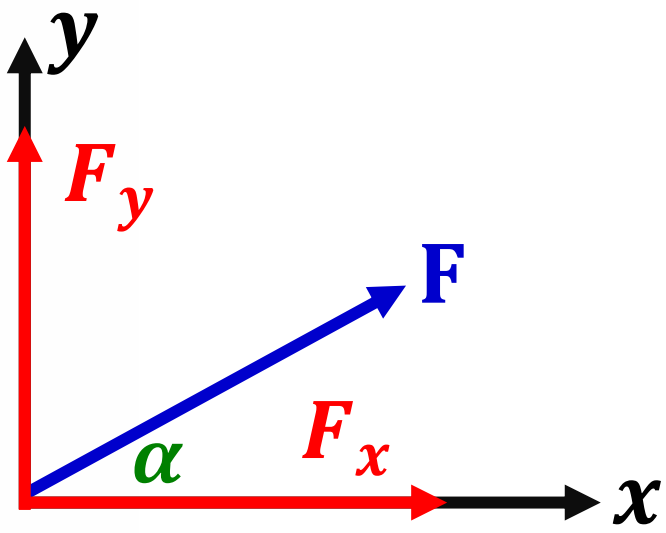
3 Resultant of non - collinear forces: Graphical method

# Resultant of non – collinear forces

## Non collinear forces: Projection method:

Any force F making an angle $\alpha$ with the horizontal axis, can be decomposed to its components $F_x$ $and$ $F_y$

$$F_x = Fcos(\alpha) \qquad F_y = Fsin(\alpha)$$




The components $F_x$ and $F_y$ always perpendicular then:

$$F = \sqrt{F_x^2 + F_y^2}$$

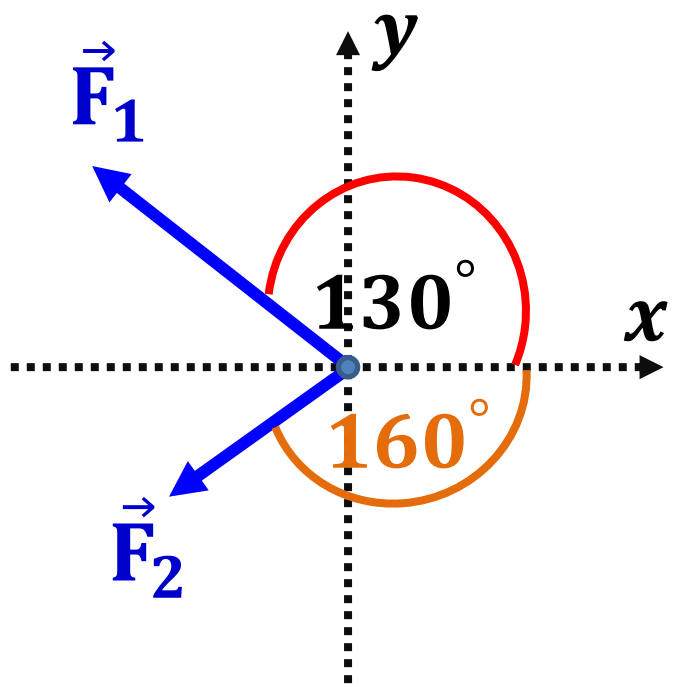
$$\alpha = \tan^{-1}\frac{F_y}{F_x}$$

# Resultant of non – collinear forces/ Projection method

## Application 11:

**The figure below shows two non collinear forces of magnitudes $F_1 = 8\text{N}$ and $F_2 = 6\text{N}$**

**Using the projection method, determine the resultant force $F_R$ (magnitude and direction) of the two forces.**



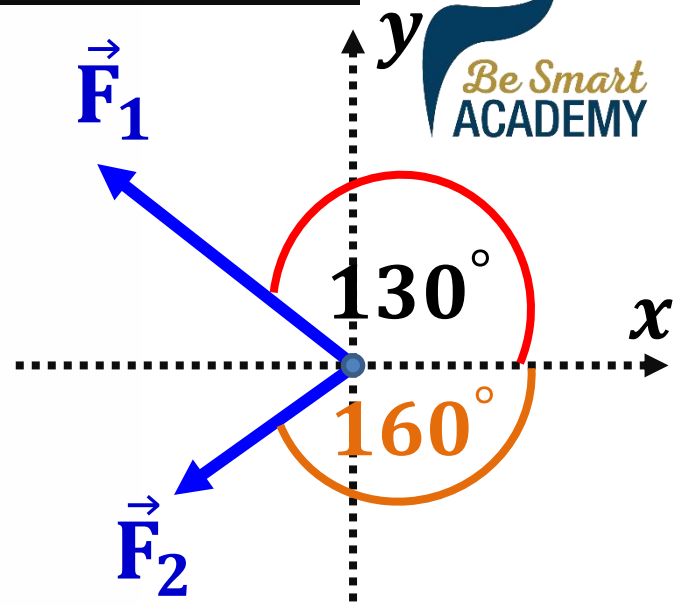
# Resultant of non – collinear forces/ Projection method

$$F_{1\,x} = F_1 \cos(\alpha) = 8 \times cos(130)$$

$$F_{1x} = -5.14N$$

$$F_{1\,y} = F_1 \sin(\alpha) = 8 \times sin(130)$$

$$F_{1\,y} = +6.12N$$

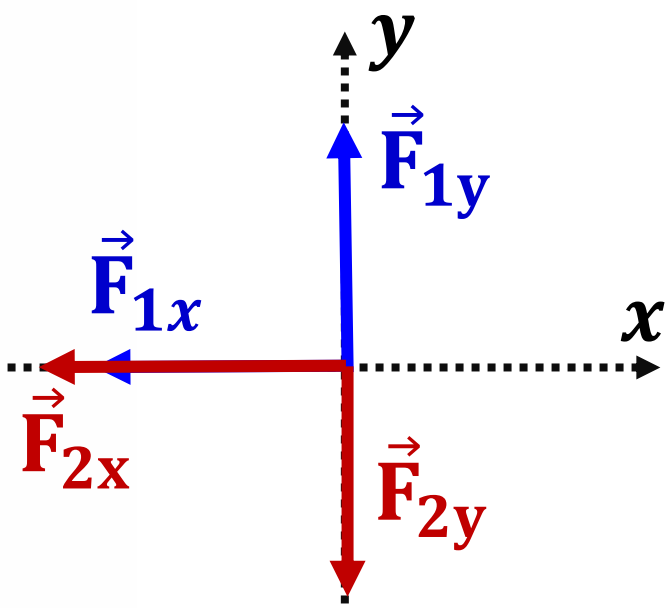



$$F_{2\,x} = F_2 \cos(\beta) = 6 \times cos(160)$$

$$F_{2\,x} = -5.64N$$

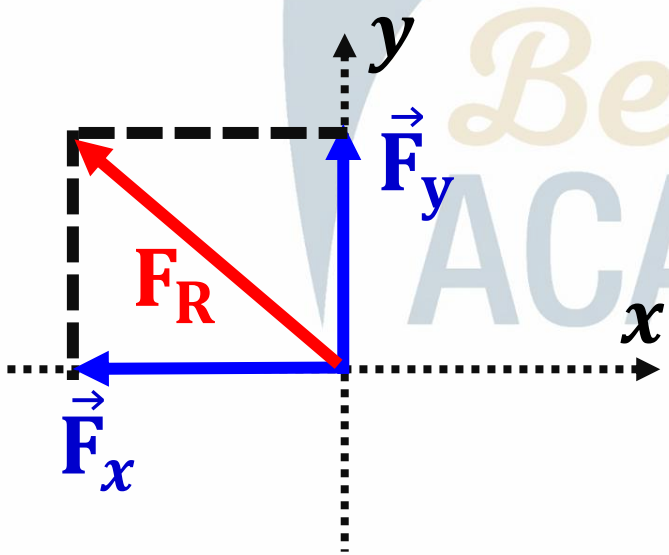
$$F_{2\,y} = F_2 \sin(\beta) = 6 \times sin(160)$$

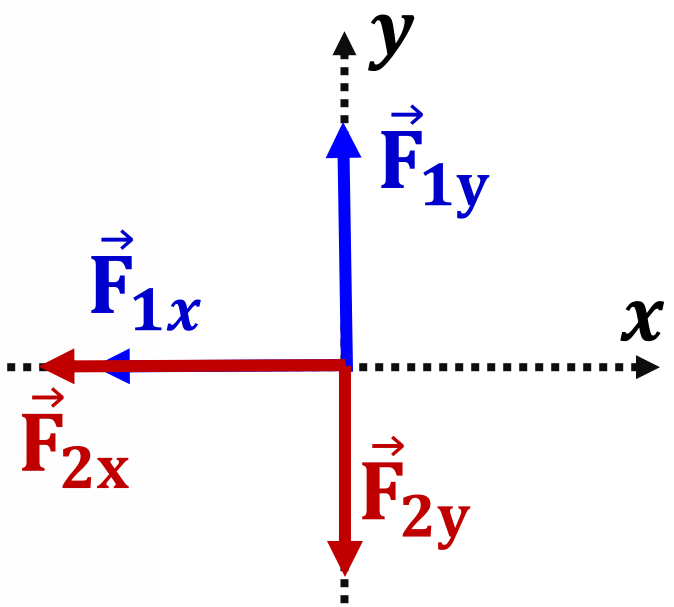
$$F_{2\,y} = -2.05N$$



# Resultant of non – collinear forces/ Projection method

| $\vec{F}$ | $\overrightarrow{F_x}$ | $\overrightarrow{F_y}$ |
|---|---|---|
| $\overrightarrow{F_1}$ | $F_{1x} = -5.14$ | $F_{1y} = +6.12$ |
| $\overrightarrow{F_2}$ | $F_{2x} = -5.64$ | $F_{2y} = -2.05$ |
| $\overrightarrow{F_R}$ | $F_x = -10.78N$ | $F_y = 4.08N$ |



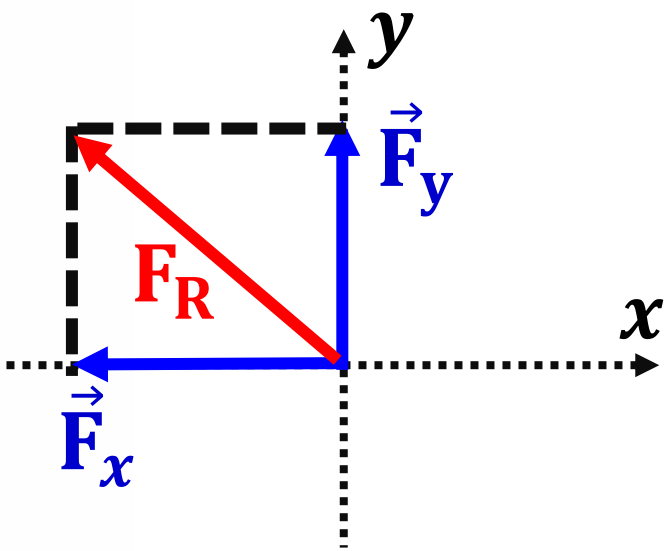



# Resultant of non – collinear forces/ Projection method

$$F_R = \sqrt{F_x^2 + F_y^2}$$

$$F_R = \sqrt{(10.78)^2 + (4.08)^2}$$

$$F_R = 11.52N$$




$$\theta = tan^{-1}\frac{F_y}{F_x} = tan^{-1}\frac{+4.08}{-10.78} = tan^{-1}(-0.378)$$

$$\theta = -20.7^{\circ}$$

# Resultant forces: graphical method

## Resultant forces: Graphical method using a Scale

### Application 12:

Consider a force of magnitude $F_1 = 4.5N$ issued from point O and directed to right.

Another force of magnitude $F_2 = 3N$ issued from the same point and directed upward and perpendicular to $F_1$.

Represent the two forces and calculate the magnitude of the resultant force using the scale $1cm \rightarrow 1.5N$

# Resultant forces: graphical method

$$1cm \rightarrow 1.5N$$

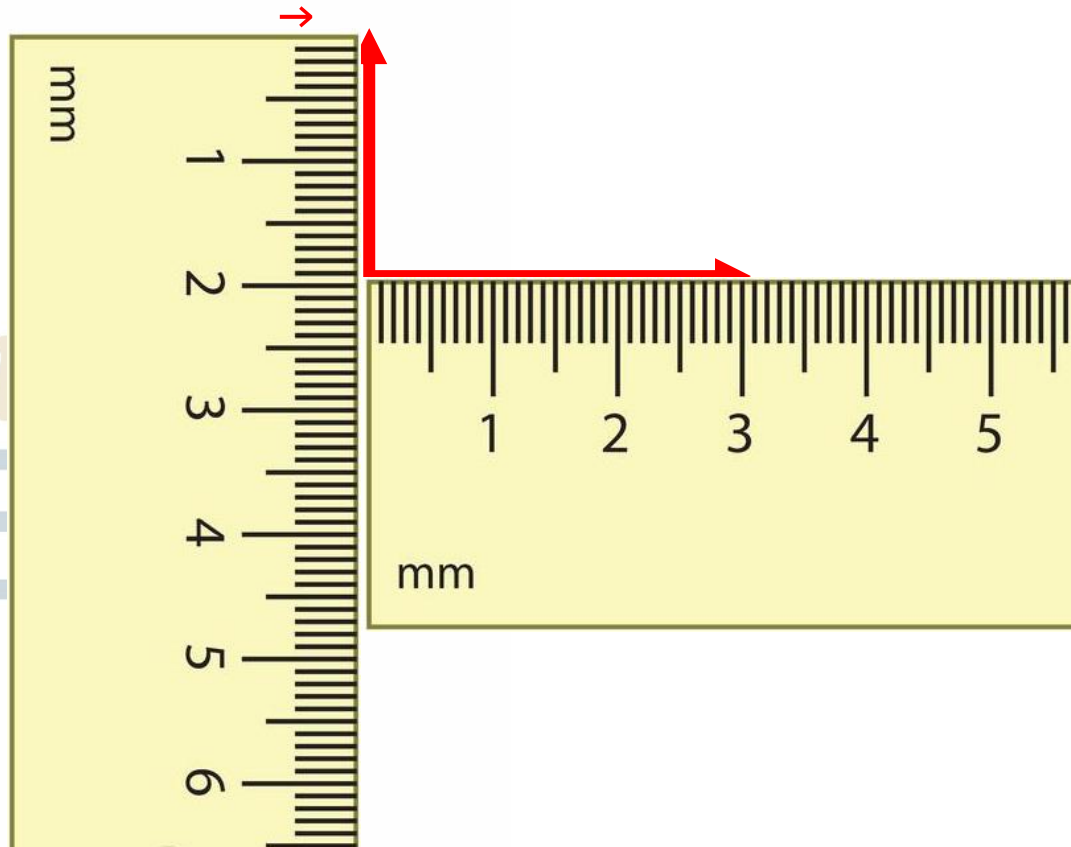
$$x = ?? \rightarrow 4.5N$$

$$x = \frac{1cm \times 4.5N}{1.5N} = 3cm$$

$$1cm \rightarrow 1.5N$$

$$x = ?? \rightarrow 3N$$

$$x = \frac{1cm \times 2N}{1.5N} = 2cm$$



# Resultant forces: graphical method

**To draw the resultant force complete the parm:**

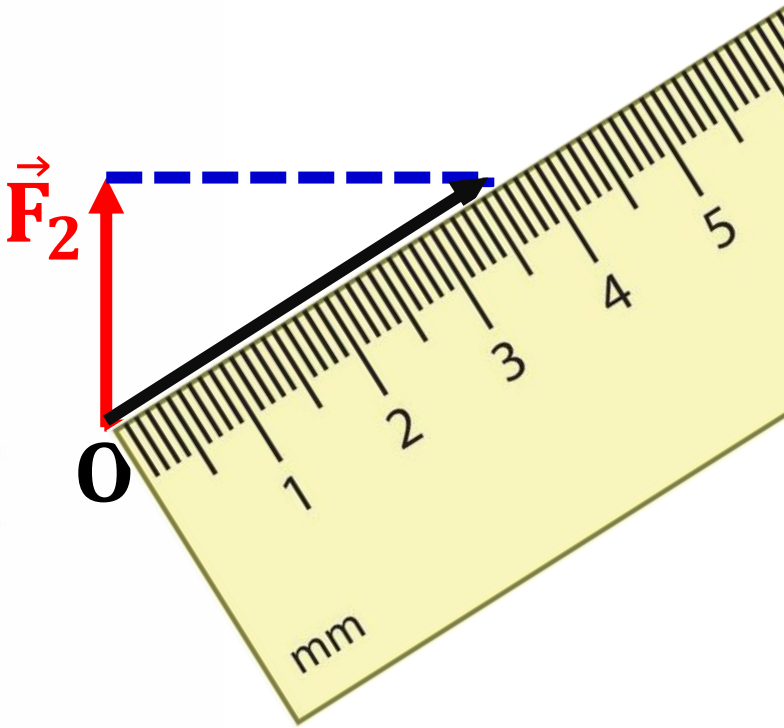
**Using a ruler to measure the length of $F_R$:**

$$1cm \rightarrow 1.5N$$

$$3.5cm \rightarrow F_R = ??$$

$$F_R = \frac{3.5cm \times 1.5N}{1.5cm}$$

$$F_R = 5.4N$$



# The End