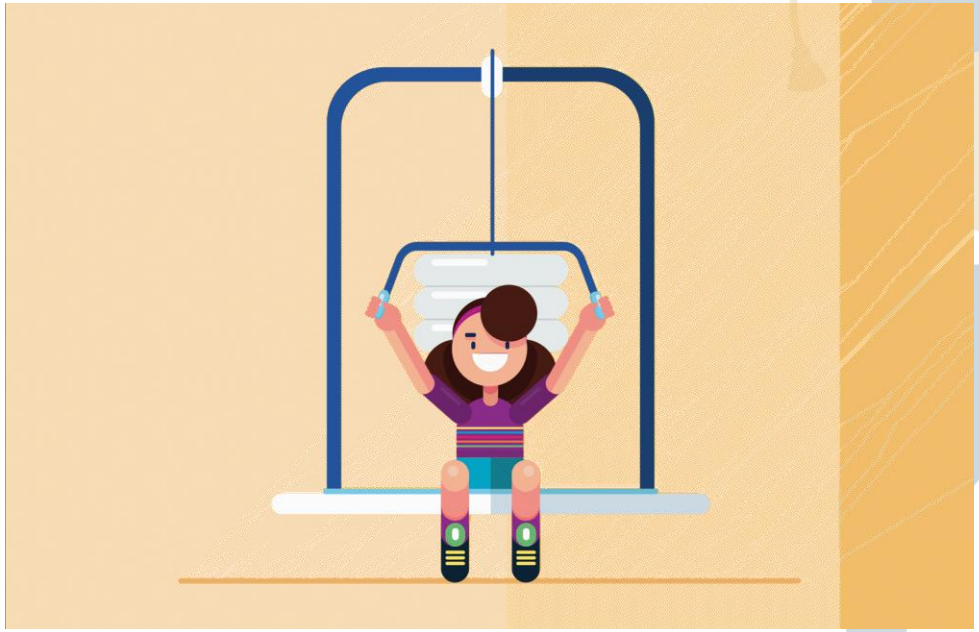
Physics – Grade 10

Unit Four – Mechanics



Chapter 16 – Forces and Interaction

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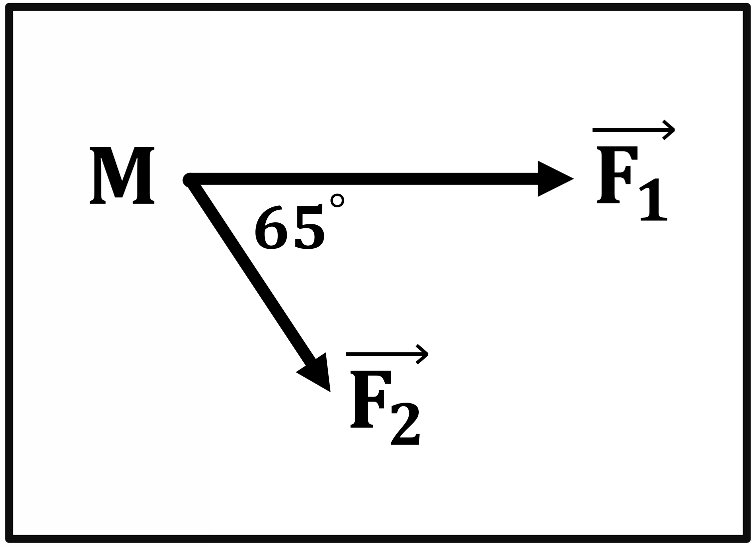
Think then Solve

Exercise 1:

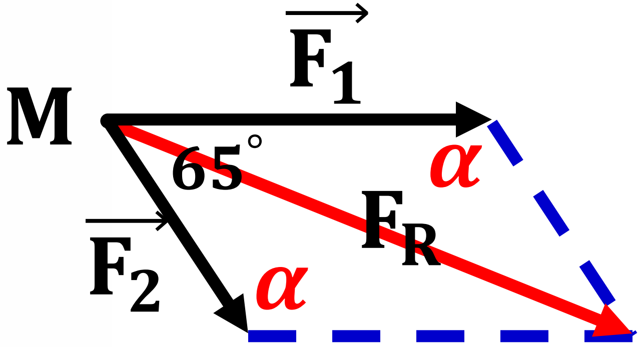
The figure below shows two forces of respective magnitudes $F_1 = 7.5N$ and $F_2 = 5N$ issued from the same point M.



1. Determine the resultant force F_R using the parallelogram method.
2. Determine the resultant force F_R using the projection method.
3. Determine the resultant force F_R using the scale $1cm \rightarrow 2.5N$

Exercise 1:

1)Resultant force using parallelogram method.



Step 1: complete the parm

Step 2: apply the rule:

$$F_R^2 = F_1^2 + F_2^2 - 2F_1F_2\cos(115^\circ)$$

$$F_R^2 = (7.5)^2 + (5)^2 - 2(7.5)(5)\cos(115^\circ)$$

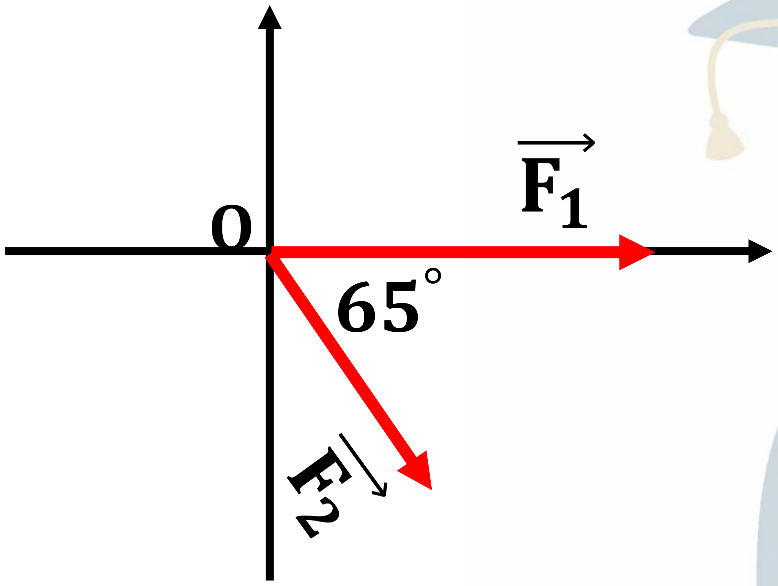
$$F_R^2 = 56.25 + 25 + 31.69 \Rightarrow F_R^2 = 112.94N$$

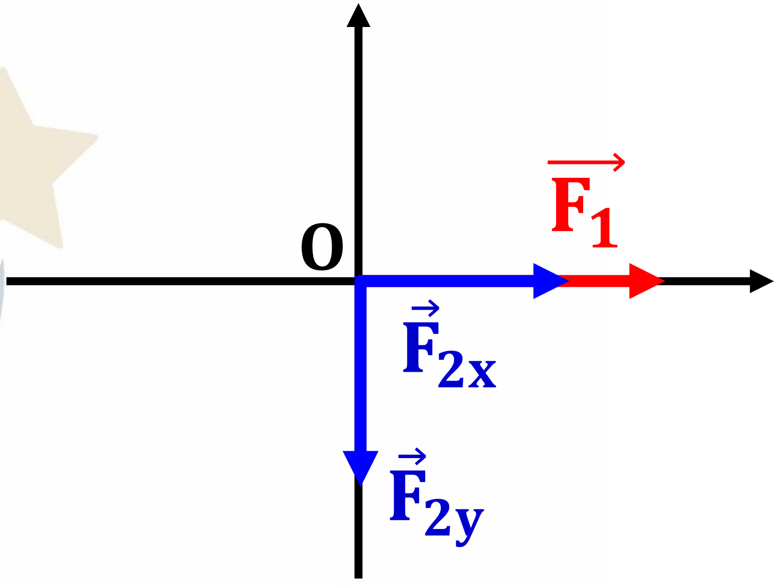
$$F_R = \sqrt{112.94}$$

$$F_R = 10.6N$$

Exercise 1:

2)Resultant force using the projection method.





F_1 is directed along x-axis

F_2 must be projected as F_{2x} along x-axis and F_{2y} along y-axis

Exercise 1:

$$F_{2\,x} = F_2 cos(65)$$

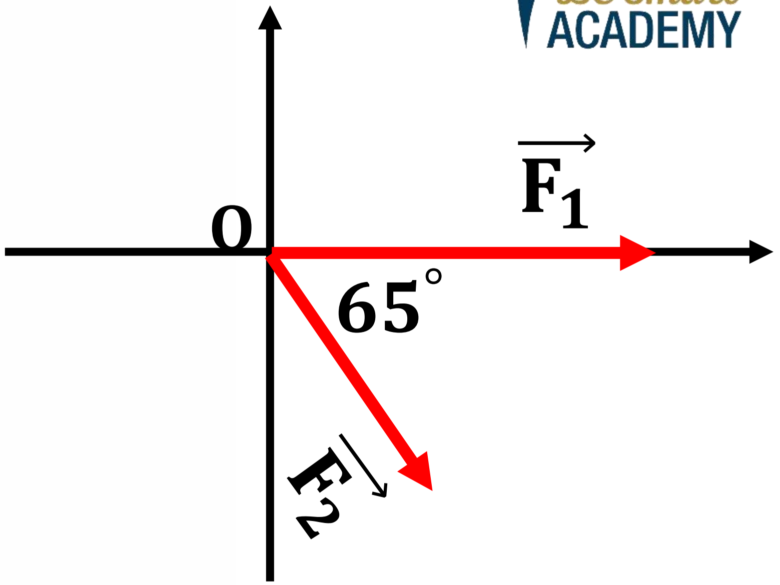
$$F_{2\,x} = 5 \times cos(65)$$

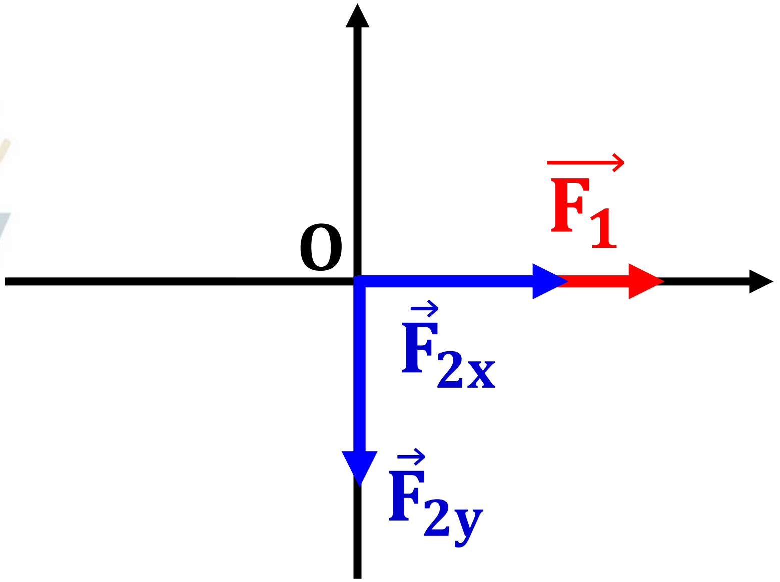
$$F_{2\,x} = 2.11N$$

$$F_{2\,y} = F_2 sin(65)$$

$$F_{2\,y} = 5 \times sin(65)$$

$$F_{2\,y} = 4.53N$$





Exercise 1:

$$\vec{F}_x = \vec{F}_{1x} + \vec{F}_{2x}$$

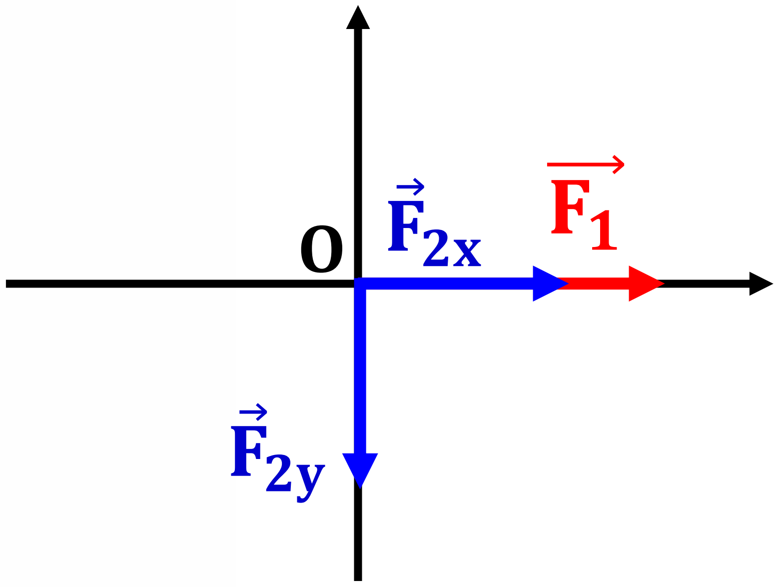
$$\vec{F}_x = 7.5 + 2.11$$

$$\vec{F}_x = 9.61N$$

$$\vec{F}_y = \vec{F}_{1y} + \vec{F}_{2y}$$

$$\vec{F}_y = 0 + 4.53$$

$$\vec{F}_y = 4.53N$$



Exercise 1:

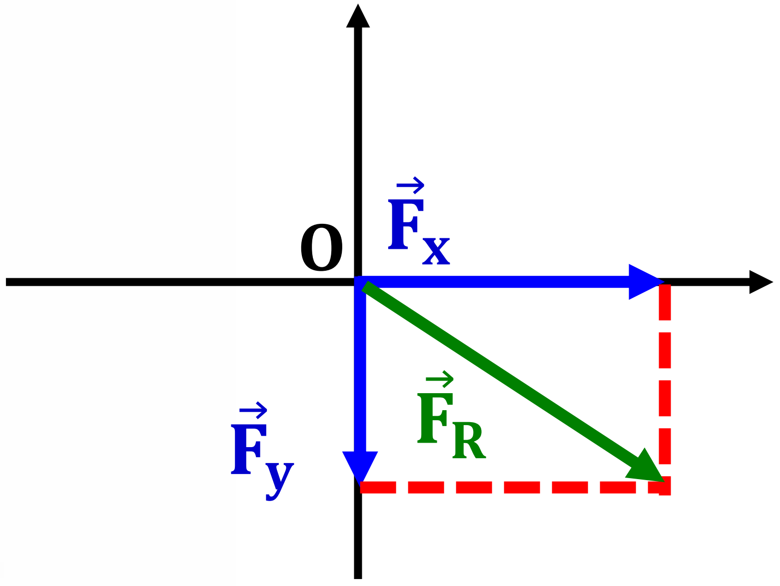
$$F_R = \sqrt{F_x^2 + F_y^2}$$

$$F_R = \sqrt{(9.61)^2 + (4.53)^2}$$

$$F_R = \sqrt{92.35 + 20.52}$$

$$F_R = \sqrt{112.87}$$

$$F_R = 10.6N$$

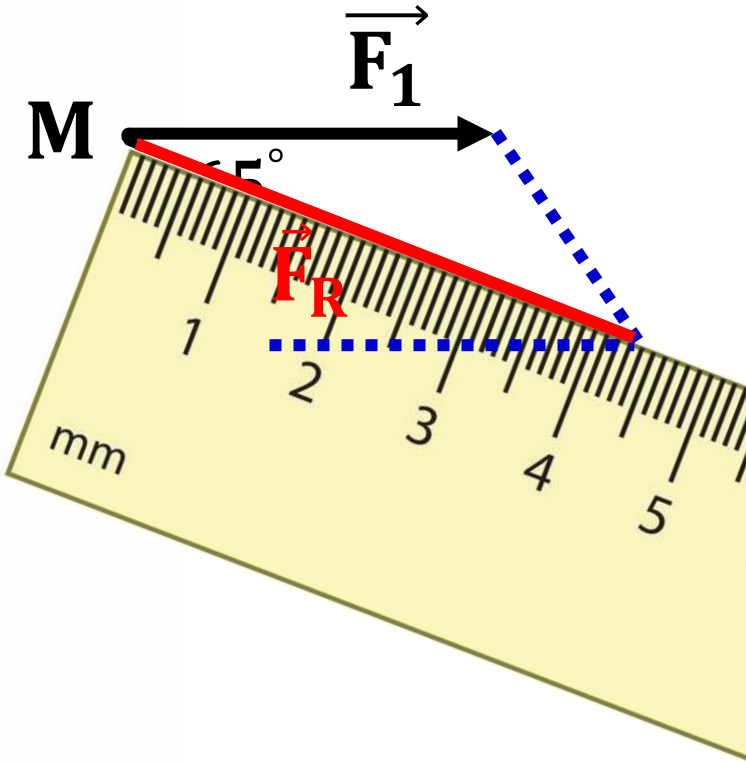


Exercise 1:

3)Resultant force using graphical method (Scale).

Step 1: complete the parm

Step 2: use the ruler to measure the length of the resultant force.

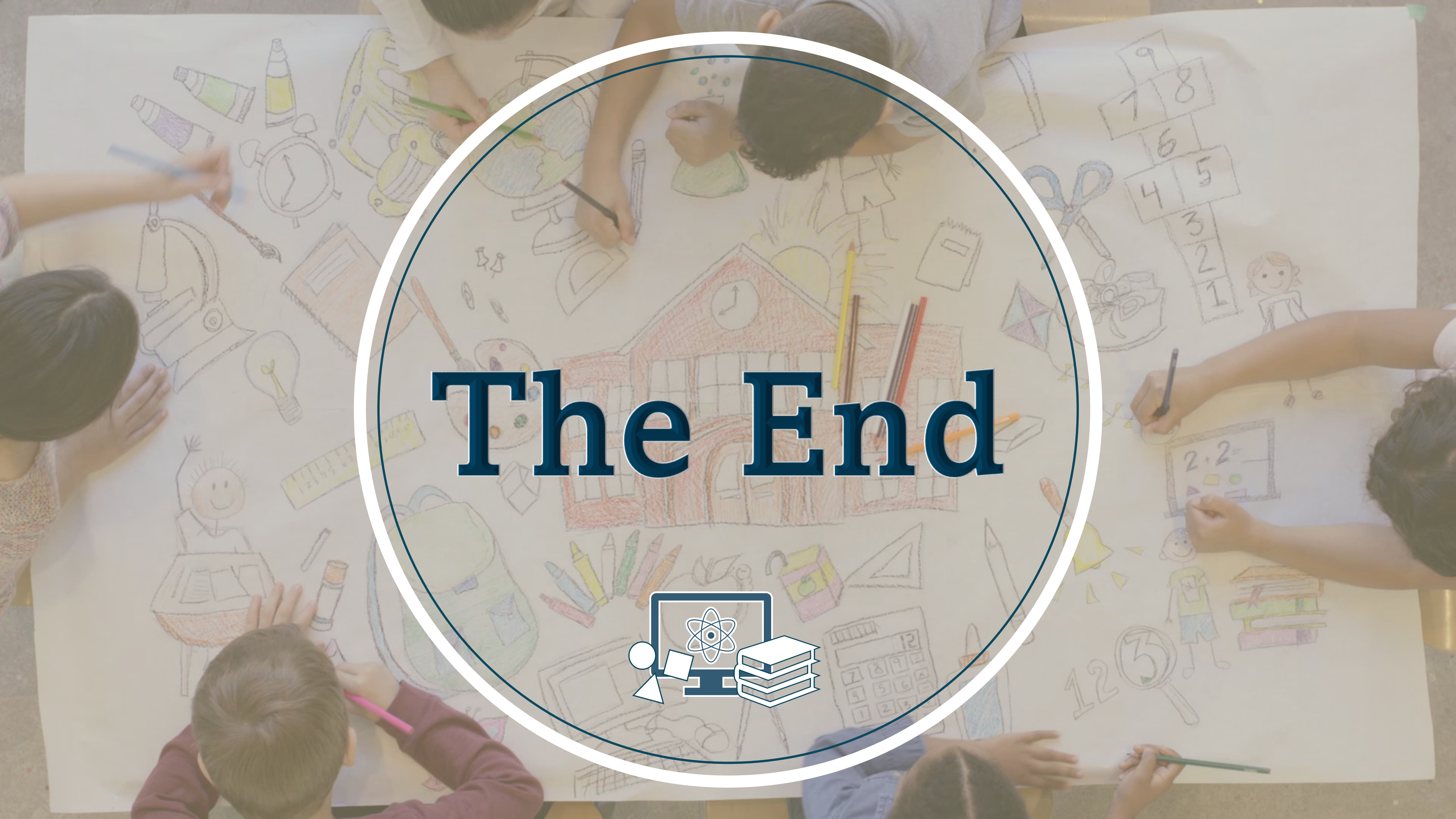


Step 3: use the scale $1cm \rightarrow 2.5N$ to determine the value of the resultant force

$$1cm \rightarrow 2.5N$$

$$4.25cm \rightarrow F_R = ?$$

$$F_R = \frac{4.25 \times 2.5}{1} = 10.6N$$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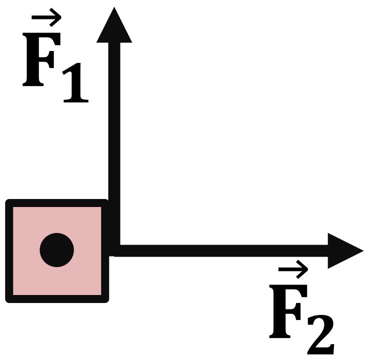
Think then Solve

Exercise 2:

A box is pulled along a horizontal floor by two forces perpendicular to each other and of equal magnitudes $F_1 = F_2 = 25N$ as shown in the figure below.



1) Use a scale drawing $1cm \rightarrow 10N$ to find the resultant force $\vec{F}$ pulling the box.

2) Confirm the above result using analytical method (calculation).

3) Redraw the figure and replacing the two forces by $\vec{F}_1$ and $\vec{F}_2$ by $\vec{F}$ then complete the free body diagram by all forces.

Exercise 2:

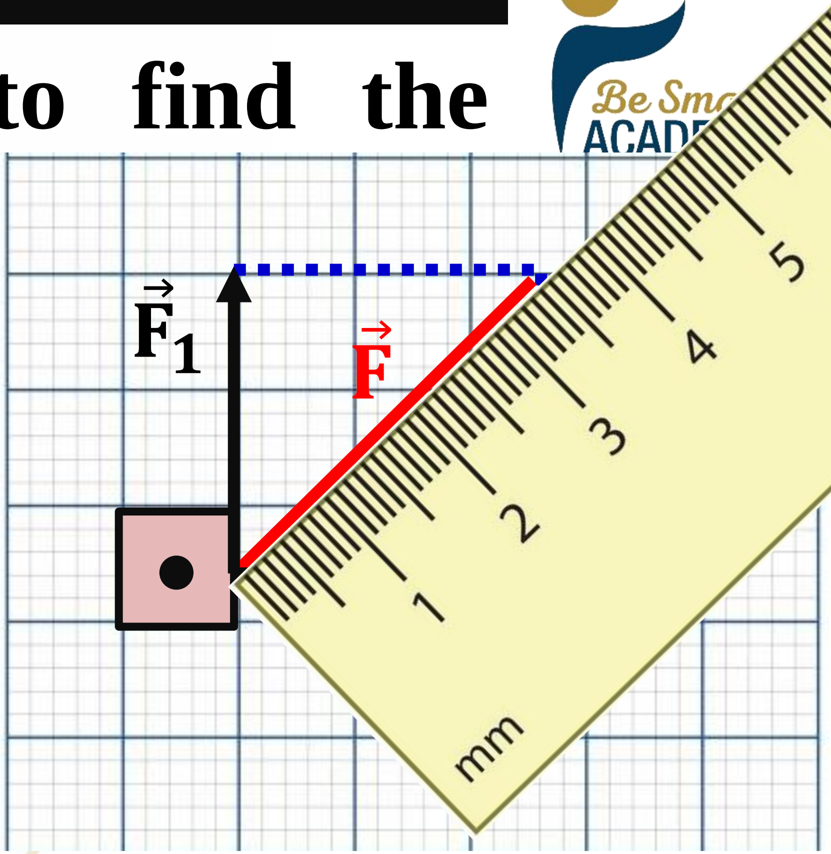
4)List the forces acting on the box

5) what is the effect of the resultant force.

6)Determine the characteristics of the resultant force.

Exercise 2:

1) Use a scale drawing $1cm \rightarrow 10N$ to find the resultant force $\vec{F}$ pulling the box.



Step 1: complete the parm

Step 2: use the ruler to measure the length of the resultant force.

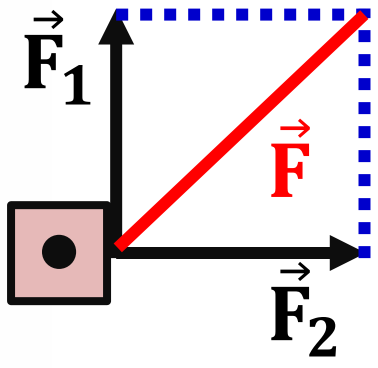
Step 3: use the scale $1cm \rightarrow 2.5N$ to determine the value of the resultant force

$$1cm \rightarrow 10N$$
$$3.5cm \rightarrow F_R = ?$$

$$F_R = \frac{3.5 \times 10}{1} = 35N$$

Exercise 2:

2) Confirm the above result using analytical method (calculation).



$$F = \sqrt{F_1^2 + F_2^2}$$

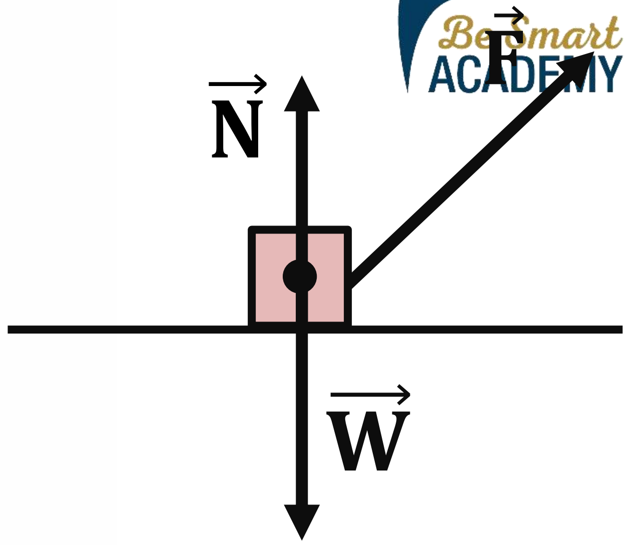
$$F = \sqrt{(25)^2 + (25)^2}$$

$$F = \sqrt{625 + 625} \Rightarrow F_R = \sqrt{1250}$$

$$F_R = 35.3N$$

Exercise 2:

3)Redraw the figure and replacing the two forces by $\vec{F}_1$ and $\vec{F}_2$ by $\vec{F}$ then complete the free body diagram by all forces.



The forces are represent on the figure

4)List the forces acting on the box

The forces are:

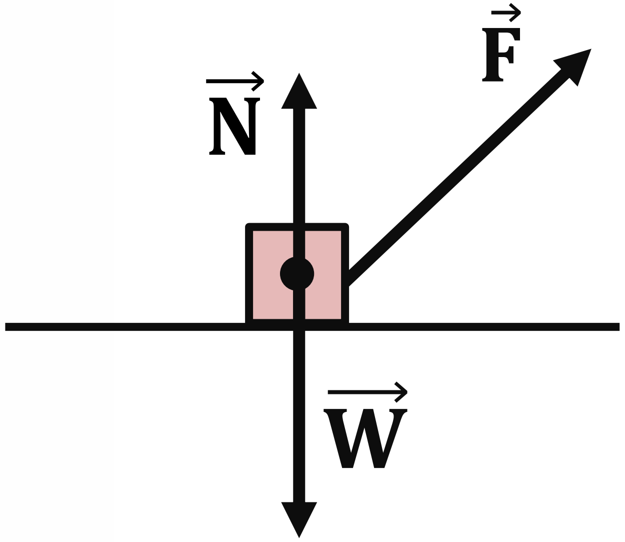
- **Weight ($\vec{W}$)**
- **Normal ($\vec{N}$)**
- **The resultant force ($\vec{F}$)**

Exercise 2:

5) what is the effect of the resultant force.

The resultant force set the box in motion

6) Determine the characteristics of the resultant force.

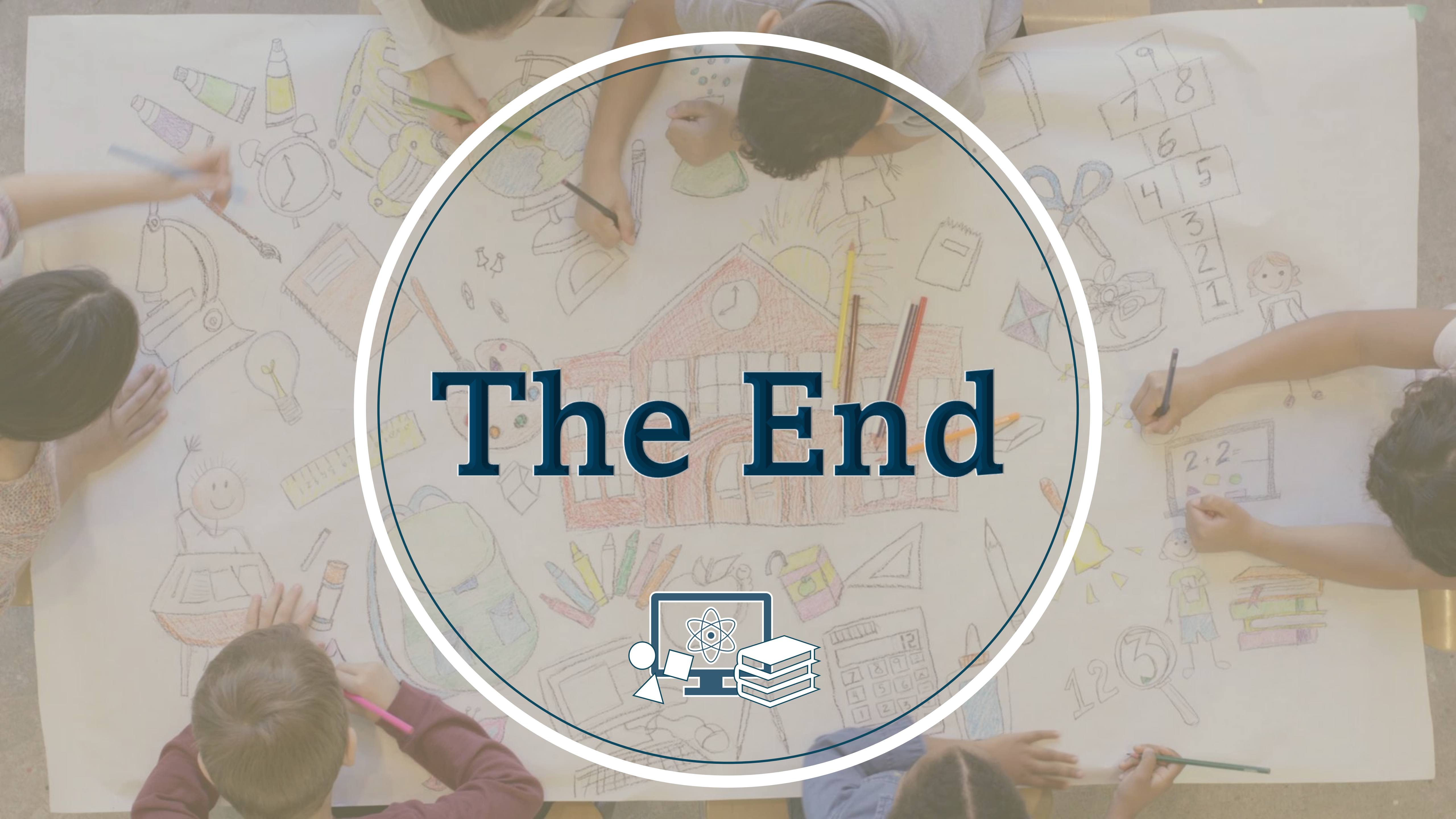


Point of application: Contact point

Line of action: Oblique

Direction: Up to right

Magnitude: $F = 35N$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