How to Solve for Net Force by Using Free Body Diagrams
Practice Using a Graphic Organizer

Step 1: Read the word problem carefully. Draw the free body diagram using vector arrows to represent all forces affecting the object. List all of the forces acting upon the object.

- Group North and South forces together
- Group East and West forces together.

Step 2. Determine the net force in the N-S direction and the net force in the E-W direction.

- Calculate the net force acting upon the object in the North and South direction. North is (+) and South is (-)

$$F_{N-S} = F_{(North)} + F_{(South)}$$

- Calculate the net force acting upon the object in the East and West direction. East is (+) and West is (-)

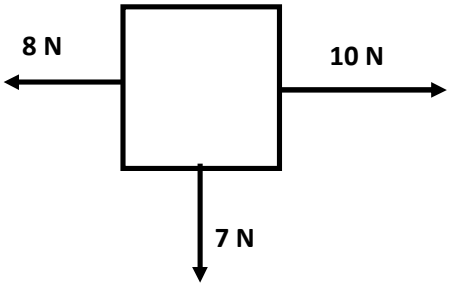
$$F_{E-W} = F_{(East)} + F_{(West)}$$

Step 3. Redraw the free body diagram using only the net forces that remain in the N-S direction and the E-W direction.

Step 4. Determine the overall net force acting upon the object. Use the Pythagorean Theorem only if forces in two directions remain and a right triangle can be formed.

Step 5. Calculate the acceleration of the object by using the object's mass and the net force.

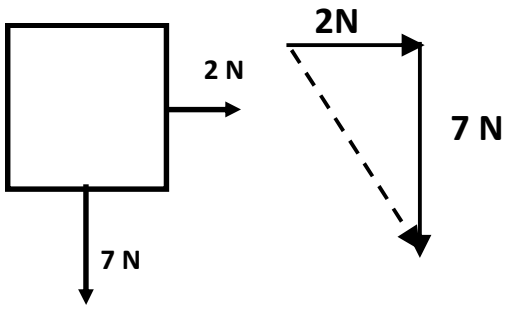
$$a = \frac{F}{m}$$



Example 1: A 25 kg box is being influenced by three forces: 8 N west, 10 N east, and 7 N south. Calculate the net force influencing the box.

Step 1: List all forces acting upon the object.
8 N west; 10 N east; 7 N south; 0 N north

Redrawn with net force vectors



Step 2: Calculate the net force in the north-south direction.

$$F_{(N-S)} = 0N + (-7N) = -7N$$

Step 2: Calculate the net force in the east-west direction.

$$F_{(E-W)} = 10N + (-8N) = +2N$$

Step 3: Redraw the free body diagram with only the remaining vectors. The remaining forces acting upon the box are 7 N south and 2 N east.

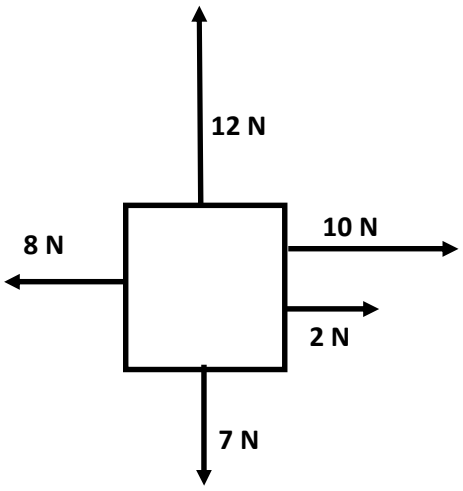
Step 4: Solve for the net force. Form a right triangle using the forces. Use the Pythagorean Theorem to solve for the overall net force and direction.

$$F_{NET} = \sqrt{(2N)^2 + (-7N)^2} = 7.3N\,@\,SE$$

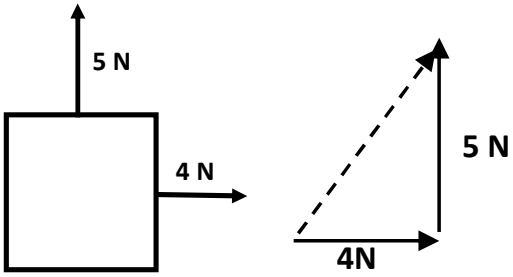
The net force acting upon the object is 7.3 N to the south east. The object will accelerate to the southeast.

Step 5. Solve for the acceleration. The mass of the box is 25 kg.

$$a = \frac{F}{m} = \frac{7.3N}{25kg} = 0.292\,\frac{m}{s^2}\,@\,SE$$



Redrawn with net force vectors



Example 2: A 40 kg box is being influenced by five forces: 8 N west, 10 N east, 2 N east, 12 N north, and 7 N south. Calculate the net force influencing the box.

Step 1: List all forces acting upon the object.
7 N south; 12 N north
8 N west; 10 N east; 2 N east

Step 2: Calculate the net force in the north-south direction.

$$F_{(N-S)} = 12N + (-7N) = 5N$$

Step 2: Calculate the net force in the east-west direction.

$$F_{(E-W)} = -8N + 10N + 2N = 4N$$

Step 3: Redraw the free body diagram with only the remaining vectors. The remaining forces acting upon the box are 5 N north and 4 N east.

Step 4: Solve for the net force. Form a right triangle using the forces. Use the Pythagorean Theorem to solve for the overall net force and direction.

$$F_{NET} = \sqrt{(4N)^2 + (5N)^2} = 6.50N @ NE$$

The net force acting upon the object is 6.50 N to the northeast. The object will accelerate to the northeast.

Step 5. Solve for the acceleration. The mass of the box is 40 kg.

$$a = \frac{F}{m} = \frac{6.50N}{40kg} = 0.162 \frac{m}{s^2} @ NE$$