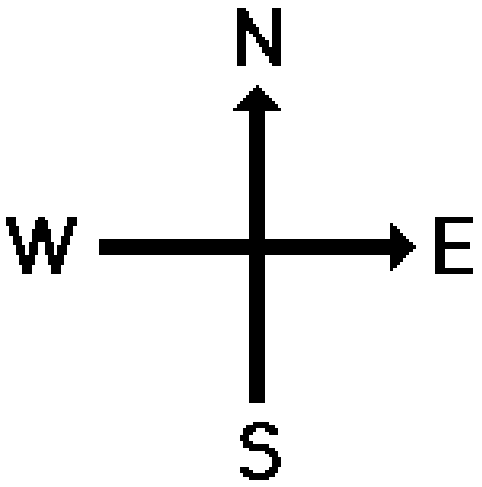
Chapter 5
Displacement and Forces in Two Dimensions

Vectors:

- Vectors have both _____and _____.
- Vectors must be added using _____ _____.
- You can add vectors _____as long as you _____ their _____.

Measuring Angles

- GEOGRAPHICAL :



- MATHEMTATICAL:

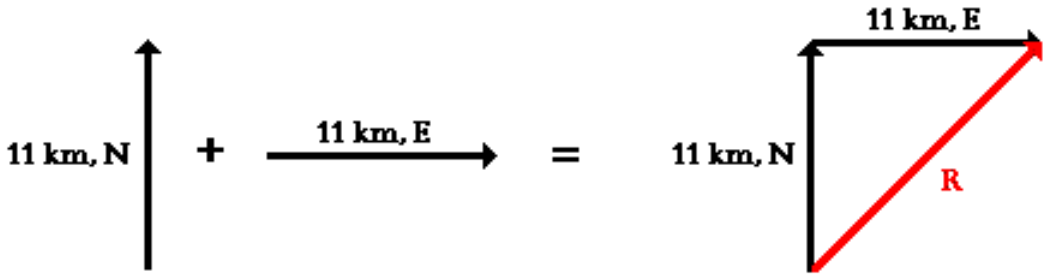
Vector Direction Examples

- 35 m/s, 40º E of N

- 10 N, 210º

Resultant Vector

- The _____.
- Always drawn from the _____ to the _____.
- Direction should always be measured between the _____ and the _____.



$$11^2 + 11^2 = R^2$$

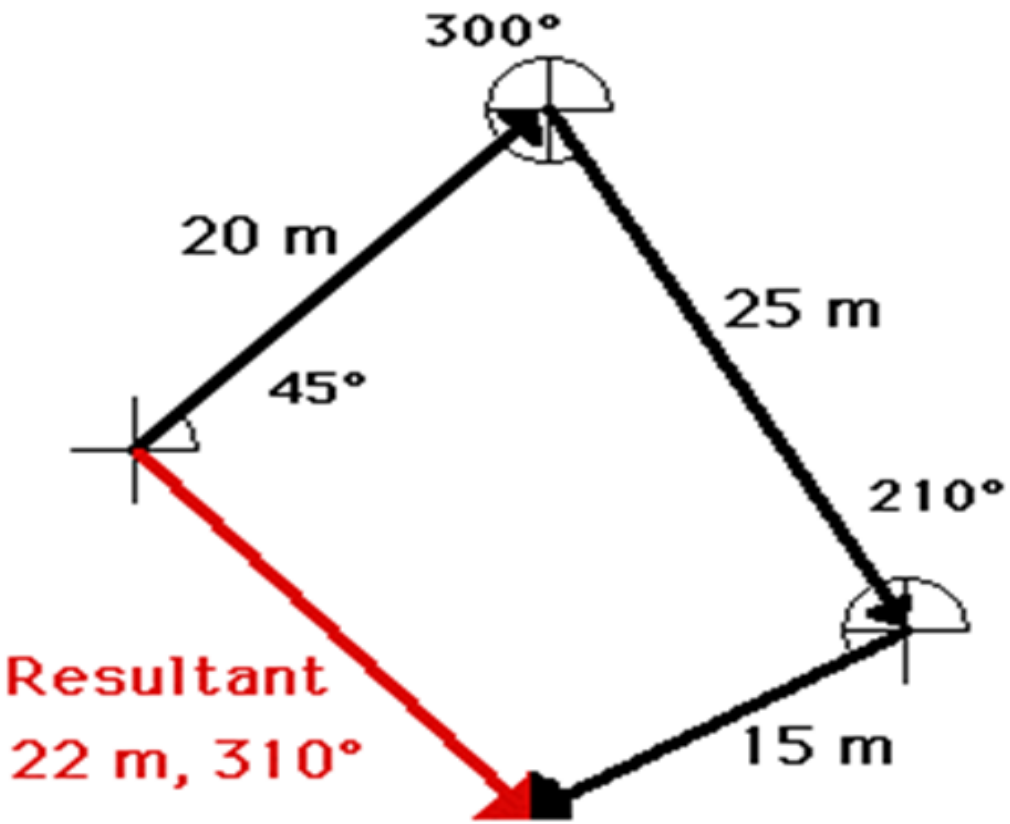
$$242 = R^2$$

$$15.6 = R$$

Adding Vectors Method 1:

1. Scaled Vector Diagram/Graphically

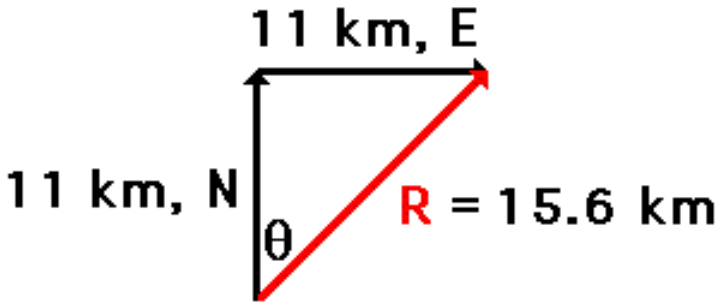
- Decide on a _____
- Using a _____ to measure the _____ and a _____ to measure _____ draw the vectors tip to tail.
- Draw the _____ from the _____ of the first to the _____ of the last vector.
- Use a ruler to measure the _____ of the resultant vector. Convert using _____.
- Use a protractor to measure the _____ _____.


300°
20 m
25 m
45°
210°
Resultant
22 m, 310°
15 m

Adding Vectors Method 2:

1. Mathematical Method

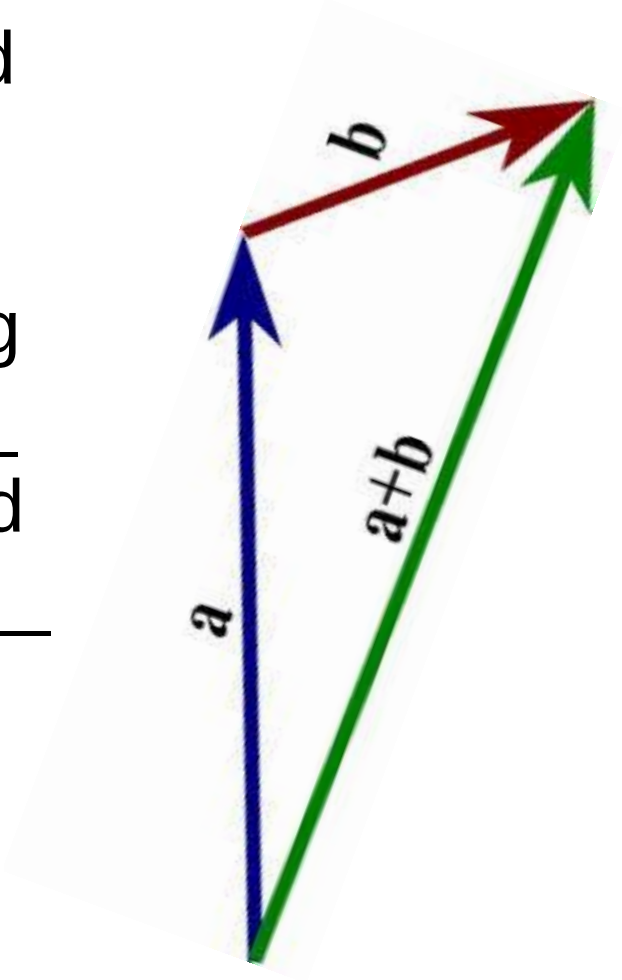
- If the two vectors being added are at _____, the magnitude can be found using the _____ and the direction can be found using _____ _____.



$$\sin\Theta = \frac{11\ \text{km}}{15.6\ \text{km}} = 0.7051$$

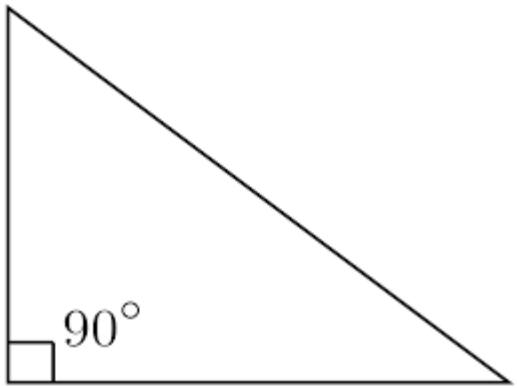
$$\Theta = \sin^{-1}(0.7051) = 45°$$

- If the two vectors being added are _____ _____, the magnitude can be found using the _____ and the direction can be found using _____

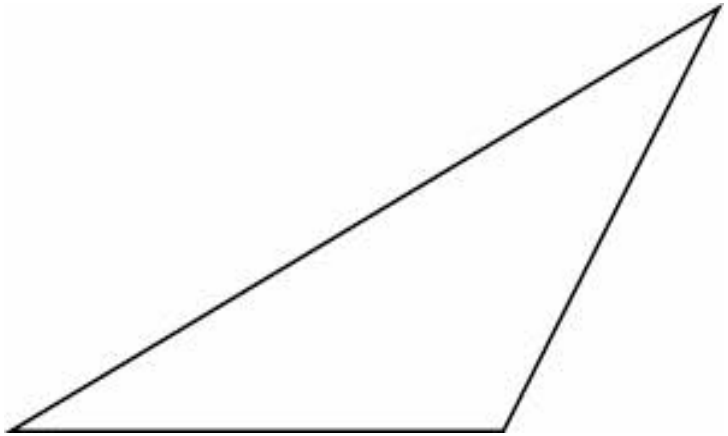


Trig Review:

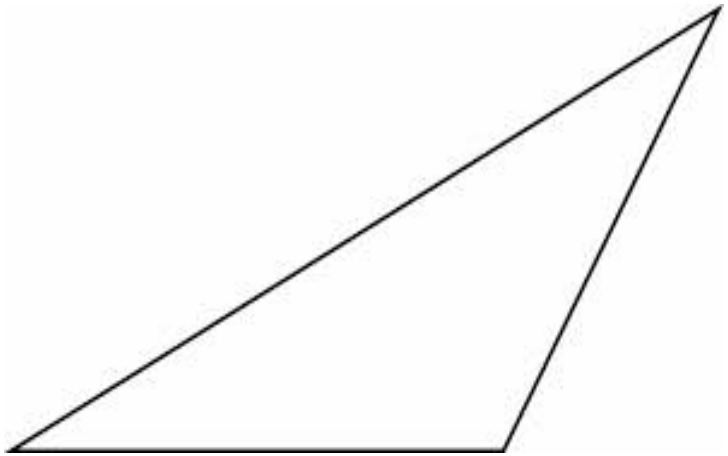
Trig Functions



Law of Cosines



Law of Sines



EX:

Add these vectors.

- 2.0 m/s, 90 deg
- 7.0 m/s, 0 deg

EX:

Add the following vectors.

15 km South

13 km East

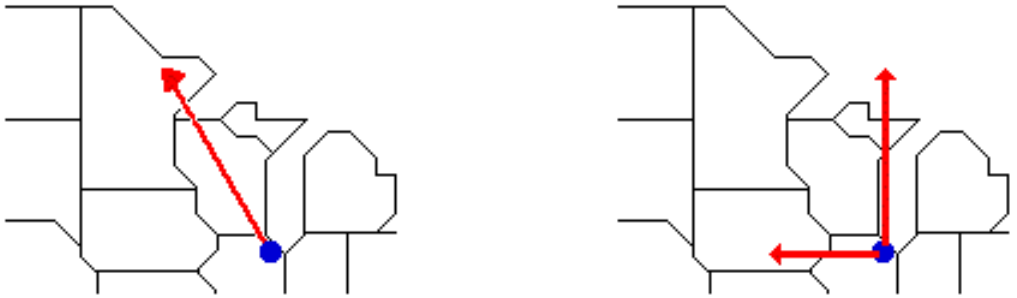
Examples:

1. A person walks 100m N and loses all sense if direction. Without knowing the direction, she walks 100m again. Draw a vector representation and determine the range of her displacement.

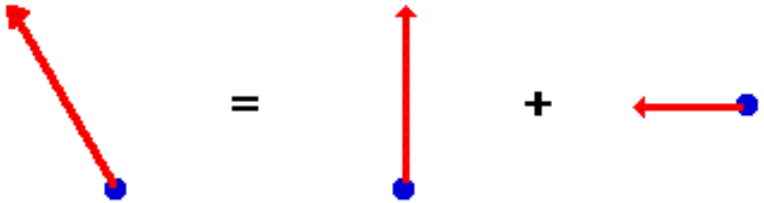
2. You are traveling from SMCC to Jackson for the football game. You travel 30 km west, 20 km north, and 10 km west. Find your displacement (magnitude and direction) both graphically and mathematically.

3. A person jogs 15 km west and then turns to the right at a 45 degree angle and continues to run 25 more kilometers. Find the resultant vector for the jogger.

Components of a Vector – the _____ that make up the _____



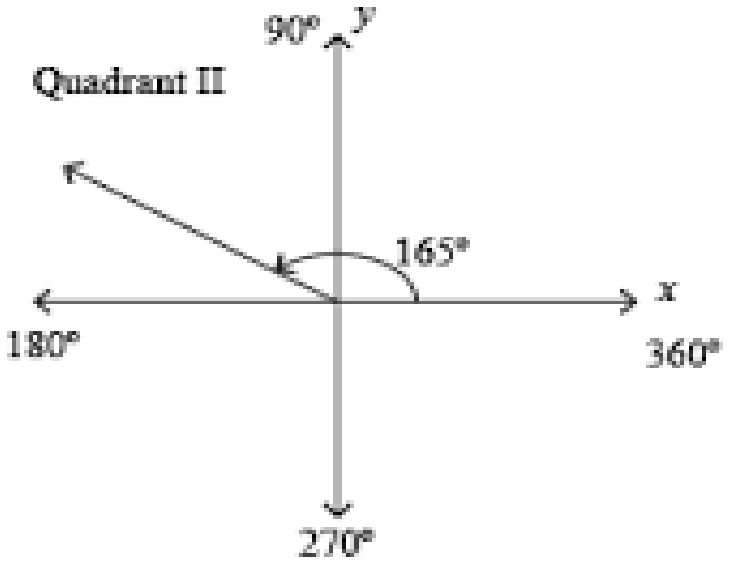
The plane's northwest displacement is equivalent to a northward plus a westward displacement.



Components

- You can use _____ to find the components.

*Be careful if the angle is bigger than ___degrees.
You may have to use a _____
to find the components.



Method 3: Vector Resolution/Components

Two or <u>more</u> vectors can be added by:

- Resolving each vector into its _____ _____.
- _____all the x-components to form the _____:

$$R_x = A_x + B_x + C_x \ldots$$

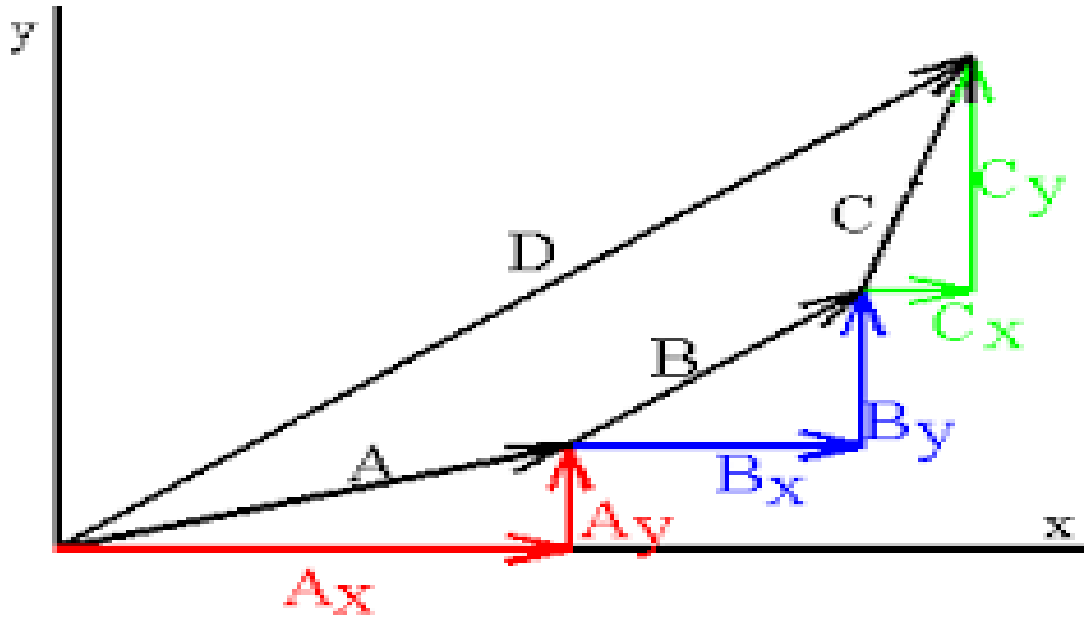
- _____ all the y-components to form the _____:

$$R_y = A_y + B_y + C_y \ldots$$

- Use the _____ _____ to find the _____ of the resultant R.

$$R^2 = R_x^2 + R_y^2$$

- Use _____ to find the _____ of R.


y
D
C
Cy
Cx
B
By
A
Bx
Ay
x
Ax

Examples:

A bus travels 23 km on a straight road that is 30º N of E. What are east and north components of its displacement?

EX:

Add the following three vectors using the component method: A is 4 m south, B is 7.3 m northwest, C is 6 m 30º south of west.

Example:

You're a pilot & are instructed to go around a massive thunderstorm. The control tower tell you take a detour & follow these 3 paths :

100 km, 45^{o} N of E ,

65 km, 10^{o} S of E

20 km, 5^{o} S of E

What is the plane's displacement from where it began it's detour?

FRICTION

- _____ friction force: the force exerted on _____ when the objects are in _____

  EX:

- μ = “mu” = _____
- F_f is proportional to the force _____

  _____

FRICTION

- _____ **friction force**: the force exerted on one surface by another surface when there is _____between the two surfaces.

  EX:

FRICTION

- Eventually there is a _____ to this static friction force – once the _____ is _____than the _____ _____, the object will begin to _____.
- Until this point, _____ exactly _____ the _____.

- Maximum Static Friction Force:

FRICTION

- Besides the _____, friction also depends on the _____ _____ that are in contact.
- Different surfaces have _____ _____
- **Table p.317**

EX: You push a 25 kg wooden box across a wooden floor at a constant speed of 1 m/s. How much force do you exert on the box?

EX:

A small child is dragging a heavy, rubber-soled shoe by its laces across a sidewalk at a constant speed of 0.35 m/s. If the shoe has a mass of 1.56 kg, what is the horizontal component of the force exerted by the child? $\mu = 0.65$

EX:

- If the child pulls with an extra 2 N in the horizontal direction, what will be the acceleration of the shoe?

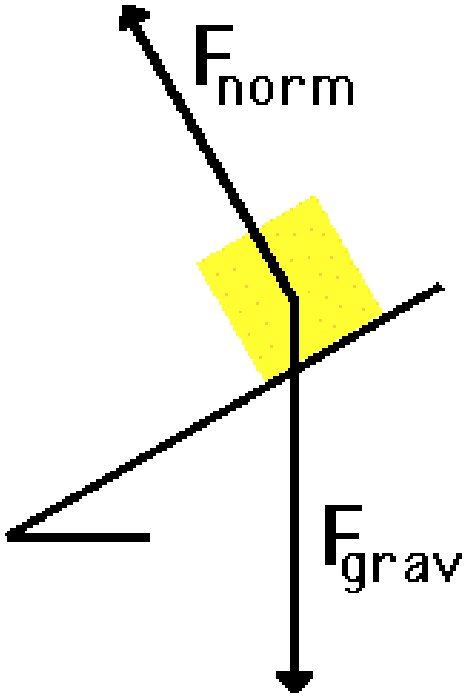
Inclined Planes

Inclined Plane_____

_____

The force of _____
acts in the _____
direction.

The _____force acts
in a direction _____
to the surface.

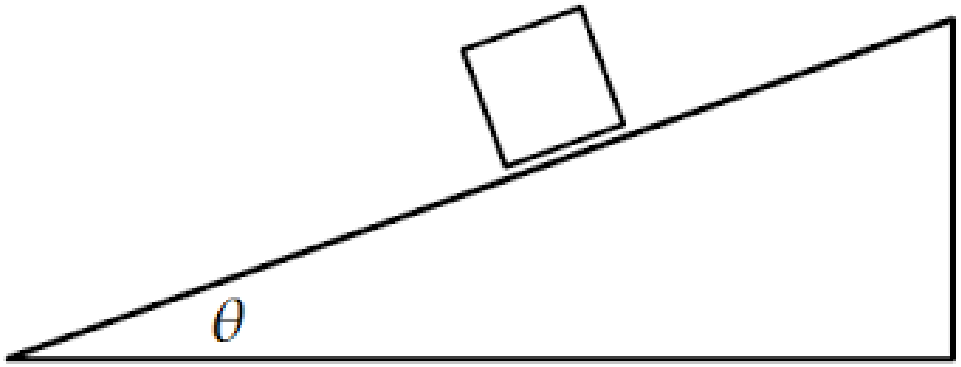


Components

Analyzing forces on inclined planes will involve resolving the _____ into _____.

- one _____ to the surface:_____
- one _____ to the surface: _____

The _____ force is the force that can cause an object to _____



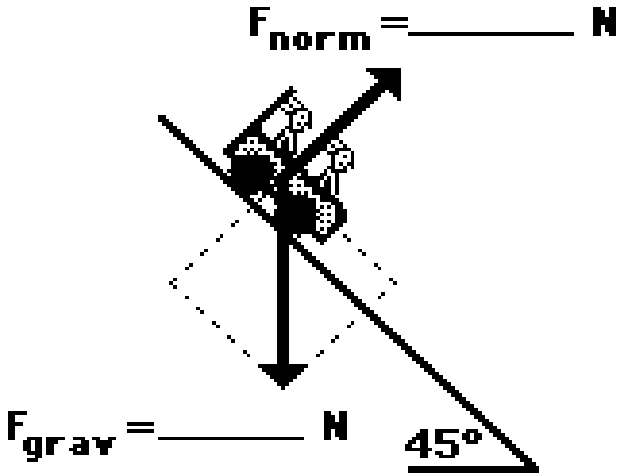
Forces on an Inclined Plane

The _____ always _____ the angle between _____ and _____.

Use _____ to find the components.

Practice

Diagram A

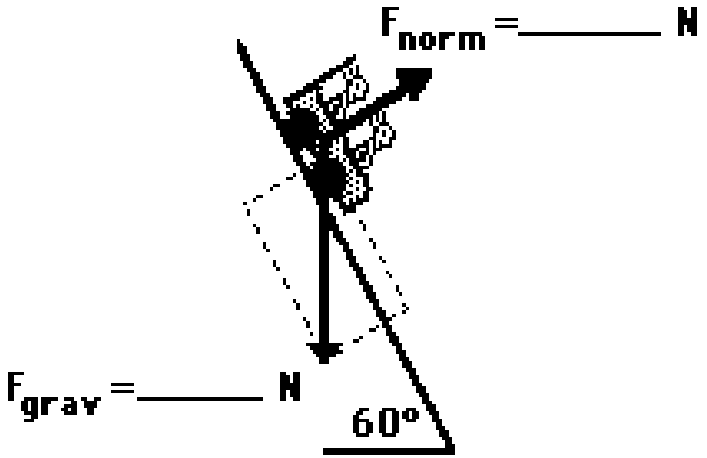


m=1000 kg

a=_____m/s/s

F_{net} =_____N

Diagram B



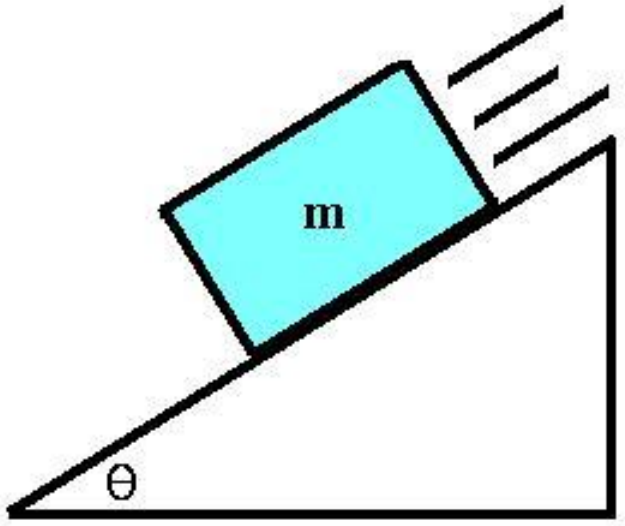
m=1000 kg

a=_____m/s/s

F_{net} =_____N

Example

A trunk weighing 562 N is resting on a plane inclined 30º above the horizontal. Find the normal and frictional forces.



Example

A 62 kg person on skis is going down a hill sloped at 37º. The coefficient of kinetic friction between the skis and the snow is 0.15. How fast is the skier going 5 s after starting from rest?

Equilibrant

Equilibrant – a _____ that puts an object in _____.

To find the equilibrant:

- Find the _____ of all the forces on the object.
- The equilibrant is the _____ but _____.

EX: What is the equilibrant for an 8 N force applied at 0º,a 6 N force applied at 90º, and a 7 N force applied at 60º?

EX: What is the tension in each cable?