Lesson 5- Forces and Velocity

Section 7.1-7.2

A **Force** (F) is a vector which describes a **push** or a **pull**.

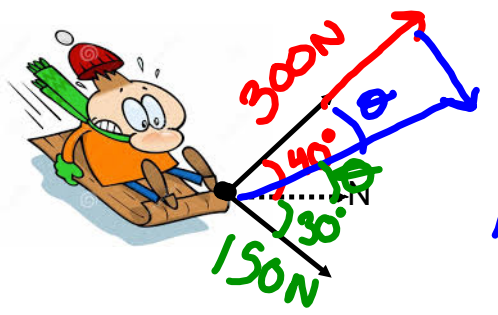
The **unit** of force is a **Newton** (N).

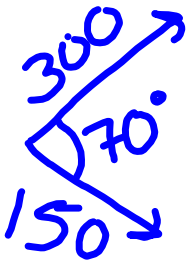
The **Earth's Gravitational Force** (Force of Gravity) acting on a 1 kg object is 9.8 N.

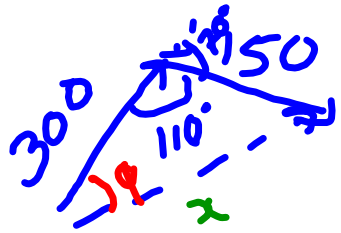
The **Force of gravity** on any mass is F=mg where m is the mass of the object and g is 9.8m/s^2

Apr 30-1:12 PM

Example 1: Tom is on sled that is pointing north. Jimmy pulls with a force of 150 N in a direction N 30° E. Ned pulls twice as hard in a direction N 40° W. In what direction will the sled move and with how much force (What is the resultant vector)?







$x = \sqrt{300^2 + 150^2 - (2 \times 150 \times 300 \times \cos 110)}$

$x = 378.53\,N$

$\theta = \sin^{-1}\left(\frac{\sin 110}{378.5} \cdot 150\right)$

$\doteq 21.9$

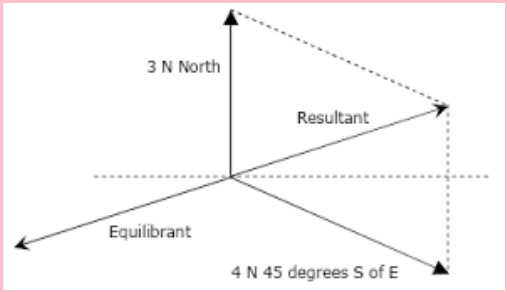
$\therefore$ direction $= 40 - 21.9$

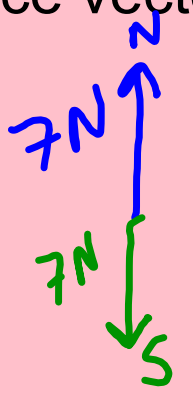
$\doteq 18.1$

N 18.1° W

Equilibrant of forces: The equilibrant of several forces is the single force that opposes the resultant force.

State of Equilibrium: When the equilibrant is applied to the object the net force vector is the zero vector ($\vec{0}$)

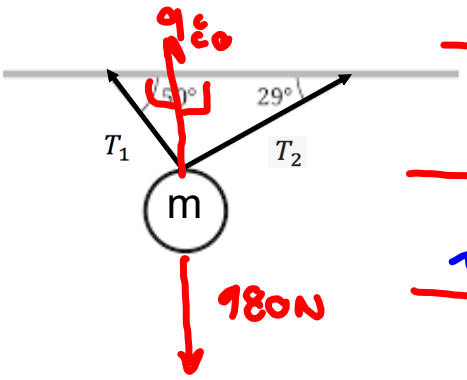




May 2-1:47 PM

Example 2: A 100 kg mass is suspended from a ceiling by two lengths of rope that make angles of 50° and 29° with the ceiling. Determine the magnitude of the tension in each rope.

Hint: The equlibrant is the force of gravity acting on the mass.



$F = mg$
$= 980N$

$|r| = 980N$

$F = mg$
$= 100kg \cdot 9.8 m/s$
$= 980N$

$\frac{\sin 79}{980N} = \frac{\sin 61}{T_1}$

$T_1 = 873.1N$

$\frac{\sin 79}{980N} = \frac{\sin 40}{T_2}$

$T_2 = 641.7N$

Representing Velocity with Diagrams and Vectors

Key points to remember:

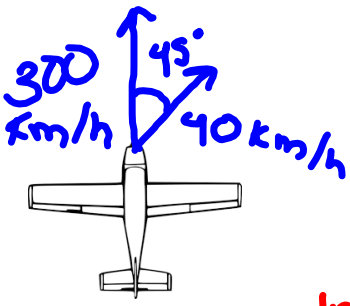
- The ***velocity of an object*** is referred to as their ***speed***.
- The ***velocity of wind/water*** is referred to its ***speed relative to a fixed point*** (usually the ground).
- The ***ground velocity*** or velocity of the airplane relative to the ground is the ***resultant velocity*** of the airplane.

May 2-1:47 PM

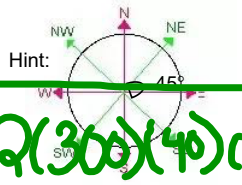
Example 3: A plane heading north flies with a velocity of 300 km/h. There is a wind of 40 km/h heading north east.

a) What is the resultant velocity of the plane?

b) If the pilot wants to travel to a destination due north, in what direction should she direct the plane?



Hint:



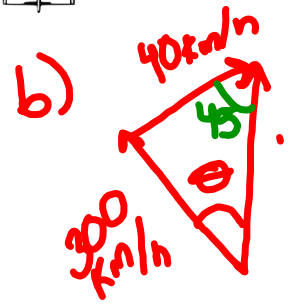
$|r| = \sqrt{300^2 + 40^2 - 2(300)(40)\cos 135}$

$= 329.5 \text{ km/h}$

$\frac{\sin\theta}{40} = \frac{\sin 135}{329.5}$

$\theta = 4.9°$

b)



$\frac{\sin 45}{300} = \frac{\sin A}{40}$

$A = 5.4°$

Homework: Page 362 #1-4oral, 5, 6, 8, 10, 11, 12,15,18

Page 369 #4, 6, 9, 11, 13

May 2-10:50 PM