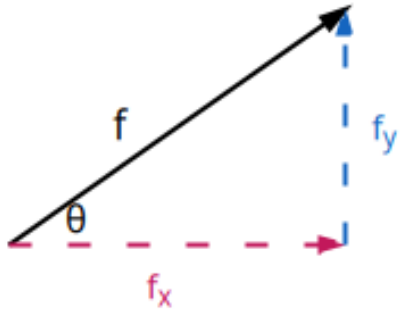
4.5 Resolution of Vectors into Rectangular Components Lesson with solutions

This document was composed and formatted by Annie Bernatchez.

The course material originated from www.jensenmath.ca

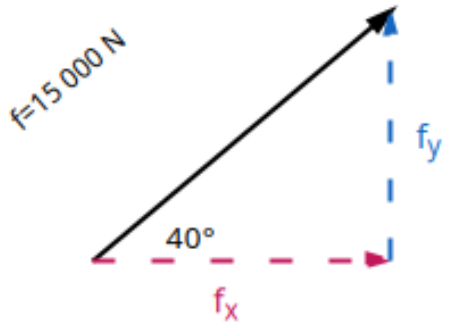
Resolving a Vector into its Components

In many situations involving forces, we are interested in a process that is the opposite of composition. This process is called RESOLUTION, which means taking a single force and decomposing it into two components. When we resolve a force into two components, it is possible to do this in an infinite number of ways because there are infinitely many parallelograms having a particular single force as the diagonal. However, the most useful and important way to resolve a force vector occurs when this vector is resolved into two components that are at right angles to each other. These components are usually referred to as the horizontal and vertical components or RECTANGULAR VECTOR COMPONENTS.

If $\vec{f}$ is resolved into its respective horizontal and vertical components, $\vec{f_x}$ and $\vec{f_y}$, then: $\lvert\vec{f_x}\rvert = \lvert\vec{f}\rvert\cos\theta$ $\lvert\vec{f_y}\rvert = \lvert\vec{f}\rvert\sin\theta$ Where θ is the angle that $\vec{f}$ makes with the x-axis.	

Example 1: A tow truck is pulling a car from a ditch. The tension in the cable is 15 000 N at an angle of 40° to the horizontal.

a) Draw a diagram showing the resolution of the force into its rectangular vector components.



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b) Determine the magnitudes of the horizontal and vertical vector components of the force.

$\lvert\vec{f_x}\rvert = 15000\cos 40$ $\lvert\vec{f_x}\rvert \approx 11490.7$ N	$\lvert\vec{f_y}\rvert = 15000\sin 40$ $\lvert\vec{f_y}\rvert \approx 9641.8$ N

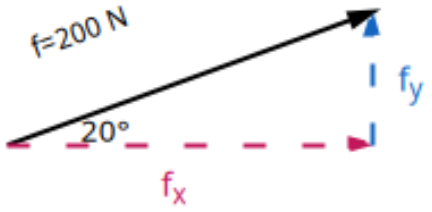
Example 2: Kayla pulls on a rope attached to her sleigh with a force of 200 N. If the rope makes an angle of 20° with the horizontal, determine:

a) the force that pulls the sleigh forward $= \lvert\vec{f_x}\rvert$

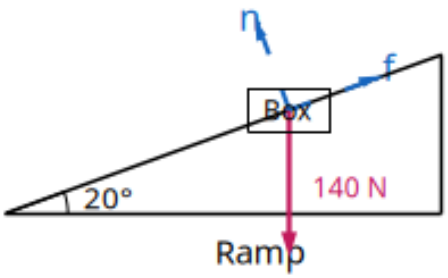
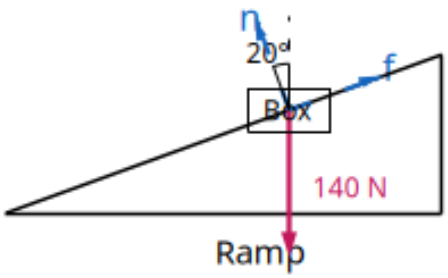
$\lvert\vec{f_x}\rvert = 200\cos 20$
$\lvert\vec{f_x}\rvert \approx 187.9$ N

b) the force that tends to lift the sleigh $= \lvert\vec{f_y}\rvert$

$\lvert\vec{f_y}\rvert = 200\sin 20$
$\lvert\vec{f_y}\rvert \approx 68.4$ N



Example 3: A box weighing 140 N is resting on a ramp that is inclined at an angle of 20°. Resolve the weight into rectangular vector components that keep the box at rest.

Position Diagram	Vector Diagram
	

The force acting perpendicular to the ramp, $\vec{n}$, and the force of friction on the ramp, $\vec{f}$, are holding the box in a state of equilibrium. Therefore, the resultant must be equal to the opposite of the force of the box.

$\lvert\vec{n}\rvert = 140\cos 20$ $\lvert\vec{n}\rvert \approx 131.6$ N	$\lvert\vec{f}\rvert = 140\sin 20$ $\lvert\vec{f}\rvert \approx 47.9$ N

The box is kept at rest by a force of 131.6 N acting perpendicular to the ramp and by friction of 47.9 N parallel to the surface of the ramp.

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