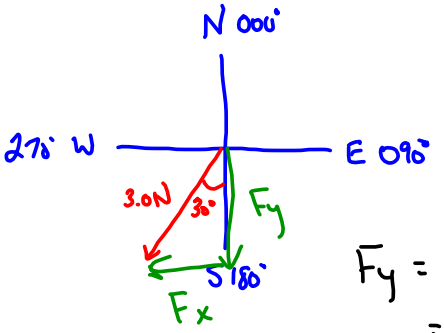
So, last year...

- vectors
- bearings and directions
- vector addition

Vector Components

What are the principal components (orthogonal) of the following vector?

$$\vec{F} = 3.0\ \text{N}\ 210^\circ$$

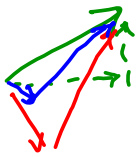


$\vec{F}$ = vector

$F = |\vec{F}|$ = size of $\vec{F}$

$F_y = F\cos\theta$
$= 3.0\cos 30^\circ$
$= 2.6\ \text{N}$

$F_x = F\sin\theta$
$= 3.0\text{N}\sin 30^\circ$
$= 1.5\text{N}$



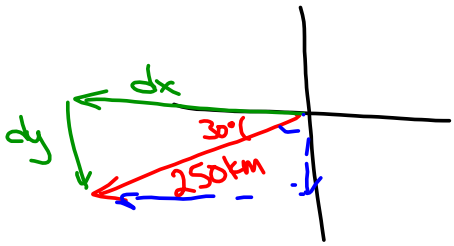
principal – main
with a bearing N-S, E-W

orthogonal = perpendicular
(in ≤ 3 dimensions)

Example 1:

What are the components in the principal directions of the vector

$$\vec{d} = 250 \text{ km } 240^\circ$$



$d_x = d\cos 30^\circ = 250\cos 30^\circ = 217 \text{ km}$

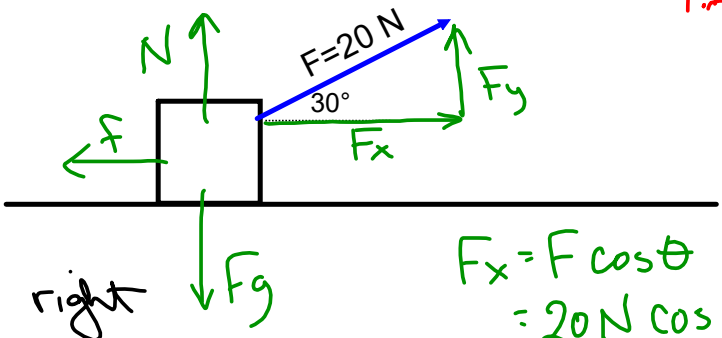
$d_y = d\sin 30^\circ = 250\sin 30^\circ = 125 \text{ km}$

$\vec{d_x} = 217 \text{ km W}$

$\vec{d_y} = 125 \text{ km S}$

Example 2:

What are the principal components of the force vector in the following situation? How can we describe them?



$\vec{F}_x = 17N$ right

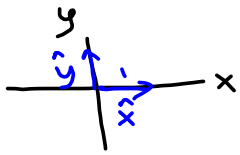
$\vec{F}_y = 10N$ up

$F_x = F\cos\theta$
$= 20N \cos 30°$
$= 17N$

$F_y = F\sin\theta$
$= 20N \sin 30°$
$= 10N$

Unit Vectors

Unit vector is a vector of length 1 in a particular direction.



$\hat{n}$ (n-hat) is a vector of length 1 in the increasing n direction

$\hat{x}$ = a vector of length 1 in +x direction

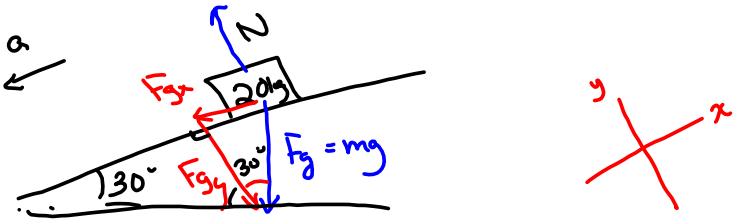
$\hat{y}$ = " " " " " " +y "

So... last question $\vec{F}_x = 17N\,\hat{x}$ $\vec{F}_y = 10N\,\hat{y}$

$$\vec{F} = 17N\hat{x} + 10N\hat{y}$$

Example 3:

A mass of 20 kg sits on a plane that is inclined at an angle of 30°
a) What are the components of the weight vector parallel and perpendicular to the plane?
b) If the incline is frictionless, what is the acceleration of the mass?



$F_{gx} = F_g \sin 30° = 20 \cdot 9.807 \sin 30° = 98N$

$F_{gy} = F_g \cos 30° = 20 \cdot 9.807 \cos 30° = 170N$

a) $\vec{F}_{gx} = -98N\,\hat{x}$

$\vec{F}_{gy} = -170N\,\hat{y}$

b) $\sum \vec{F} = m\vec{a}$

$\vec{F}_{gx} = m\vec{a}$

$\vec{a} = \frac{-98N\,\hat{x}}{20kg} = -4.9 m/s^2\,\hat{x}$

Homework: Read pp 459-463
p.459 Problems 1-3