

Chapter 8

Vectors & Scalars

A Physical Quantity

Any physical property that can ...

be measured

2 types...

Scalar Quantity

Vector Quantity

Scalar Quantity

Has magnitude only
... no direction

time

volume

mass

energy etc.

Vector Quantity

Has magnitude
and direction

displacement

velocity

acceleration

force etc.

Representing Vectors

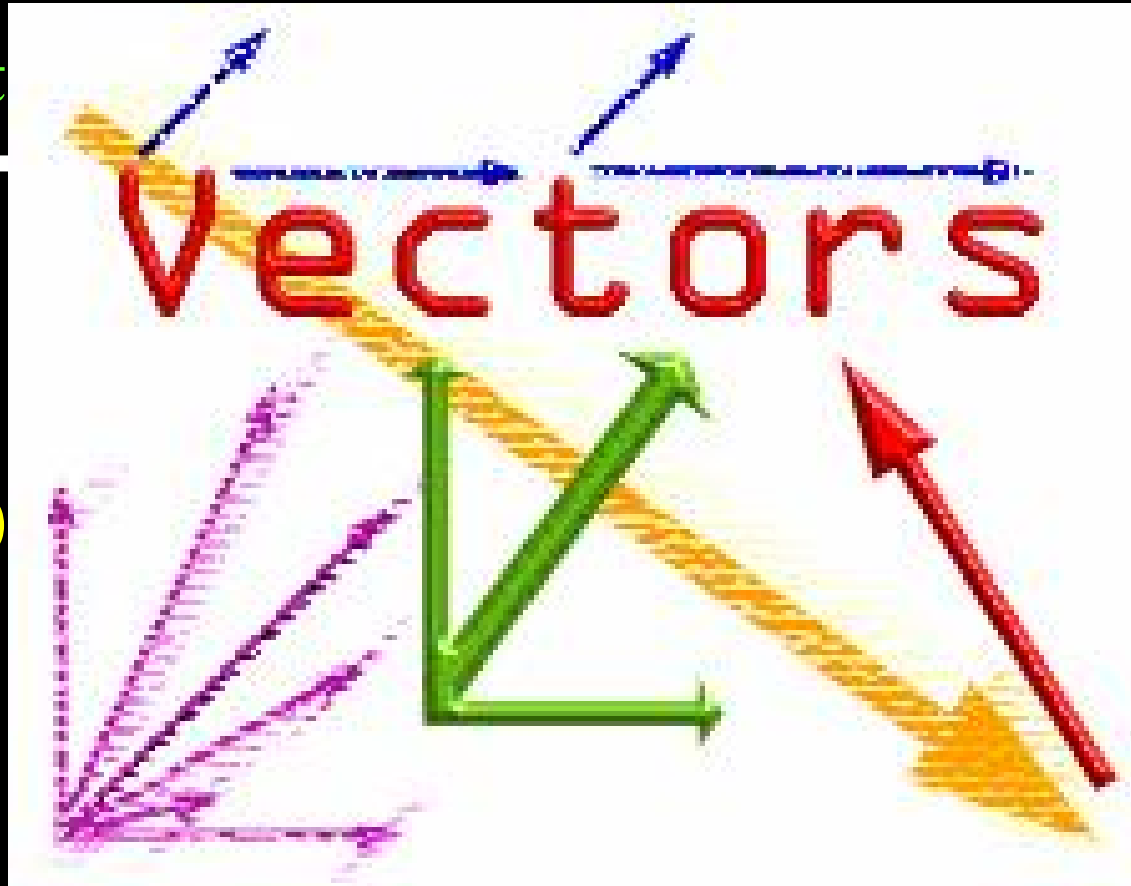
3 N t

ght



10

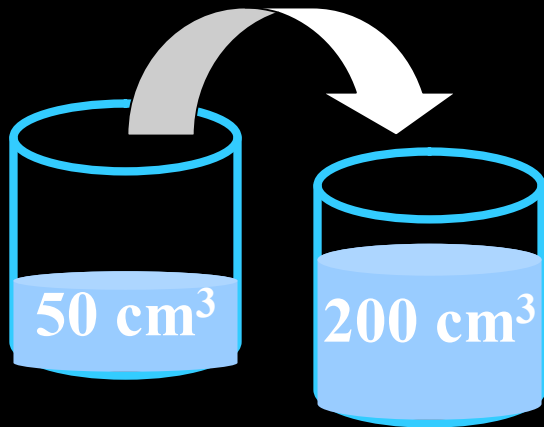
rth-East



Adding

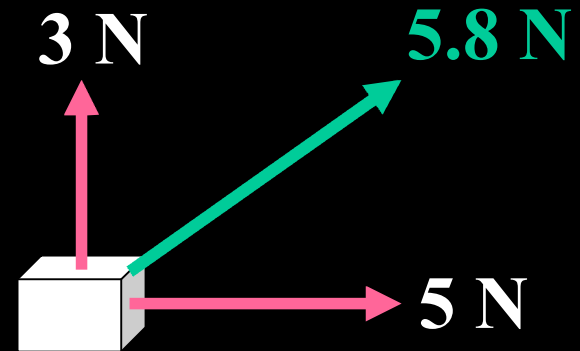
Scalars

... Easy



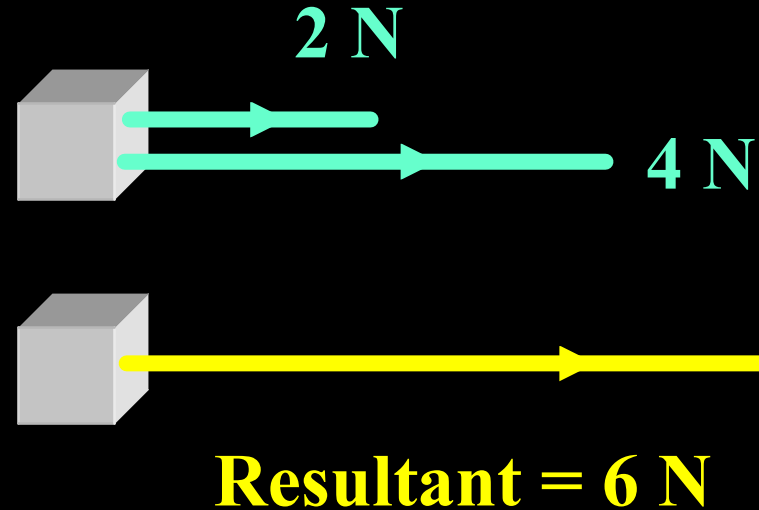
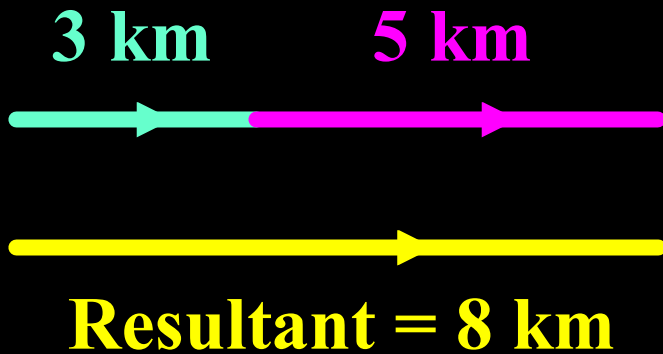
Vectors

... more difficult
... due to direction



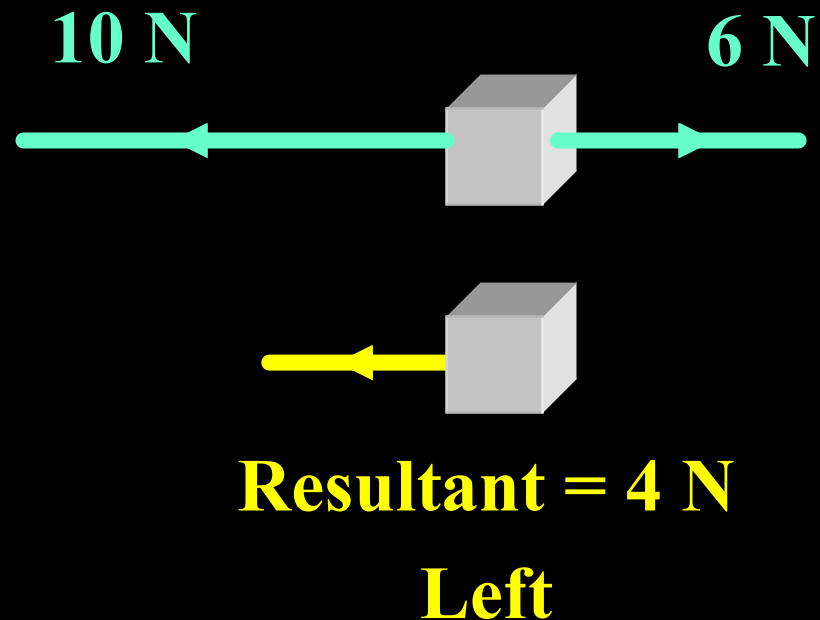
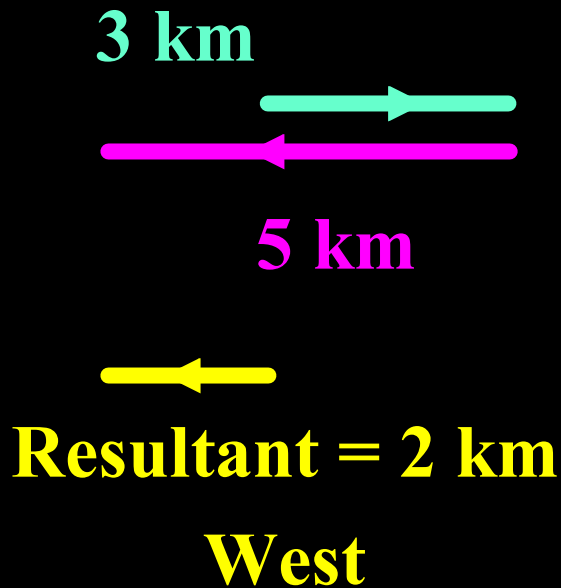
Adding Vectors

- Finding the Resultant



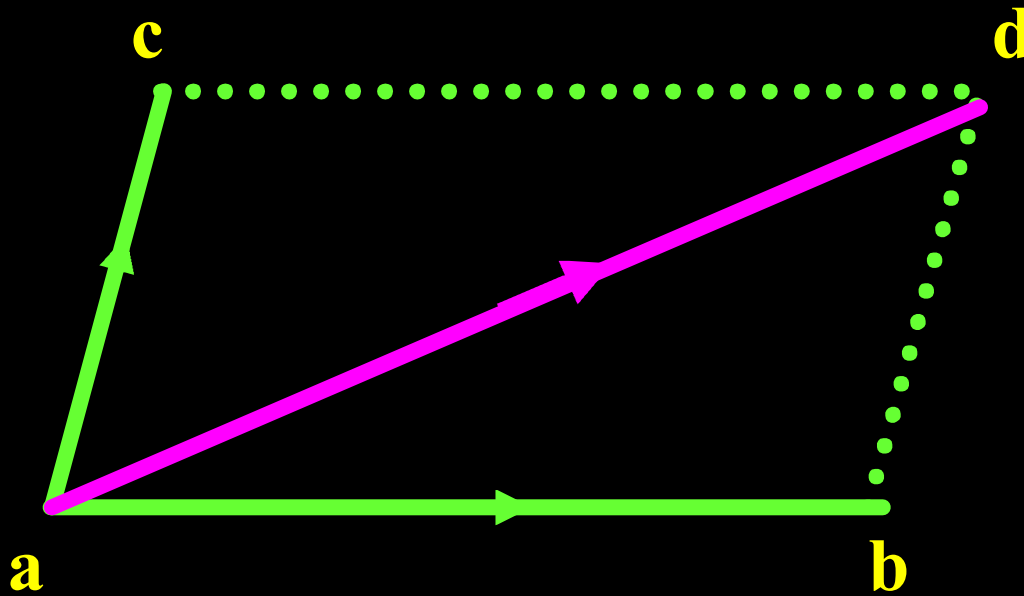
Adding Vectors

- Finding the Resultant



Adding Vectors - Finding the Resultant

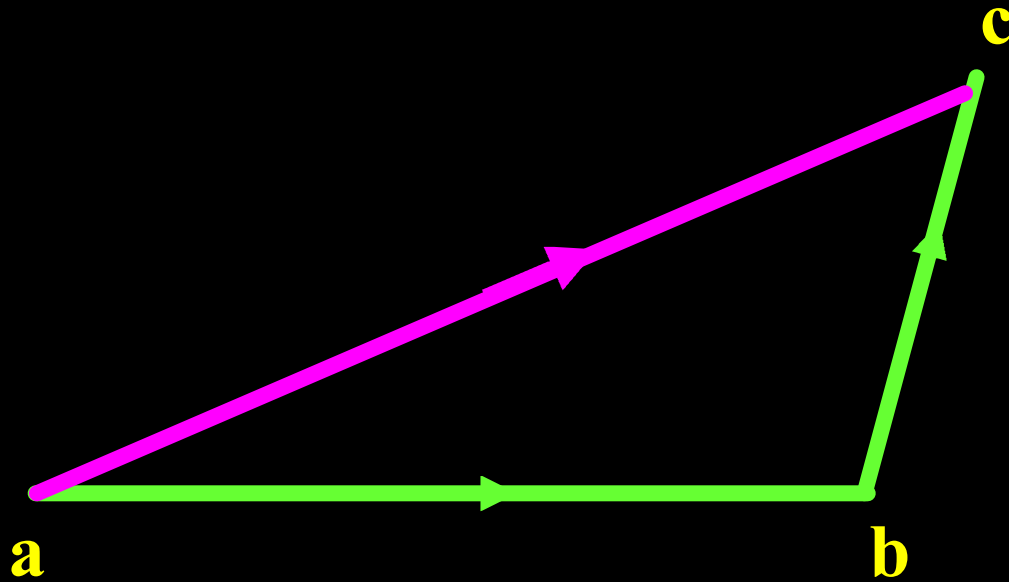
Using the Parallelogram Law



Tail to tail ...

Adding Vectors - Finding the Resultant

Using the Triangle Law



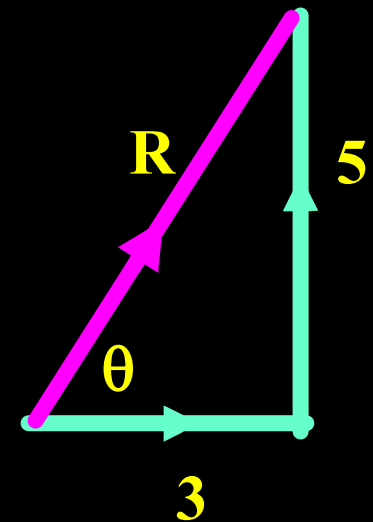
Head to tail ...

P1 A horse undergoes a displacement of 3 km East followed by a displacement of 5 km North. What is its overall displacement from its starting position, i.e. find the resultant of the two vectors?

$$R^2 = 5^2 + 3^2 = 34$$

$$R = \sqrt{34} = 5.83 \text{ km}$$

$$\tan \theta = \frac{5}{3} \quad \theta = 59^\circ$$



5.83 km East 59° North

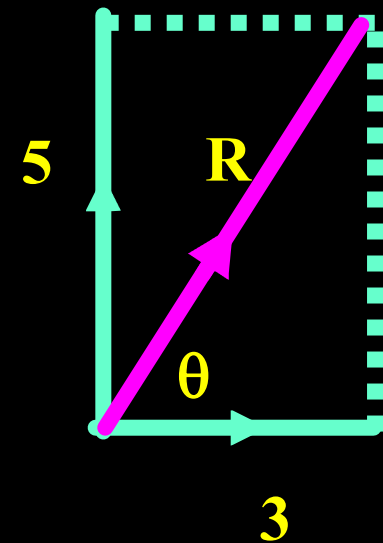
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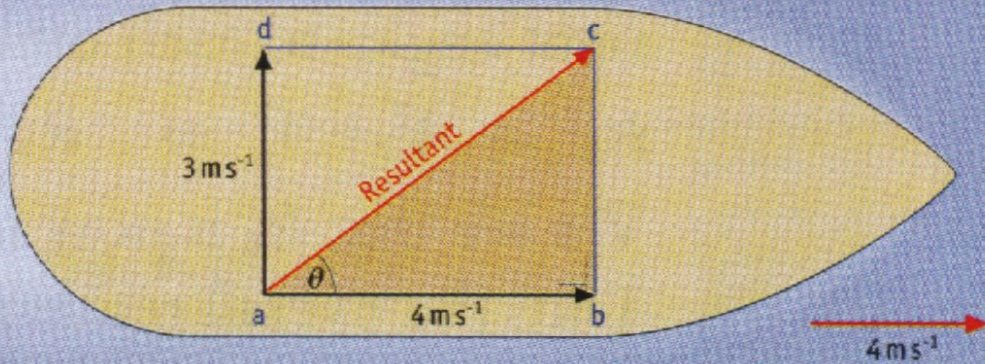
$$R = 5.83 \text{ km}$$

$$\tan \theta = \frac{5}{3} \quad \theta = 59^\circ$$

5.83 km East 59° North



P2 A ship moves parallel to a straight river bank at 4 m s^{-1} .
A man walks at 3 m s^{-1} across the ship at right angles to
the direction of forward motion of the ship.
Find the overall velocity of the man.

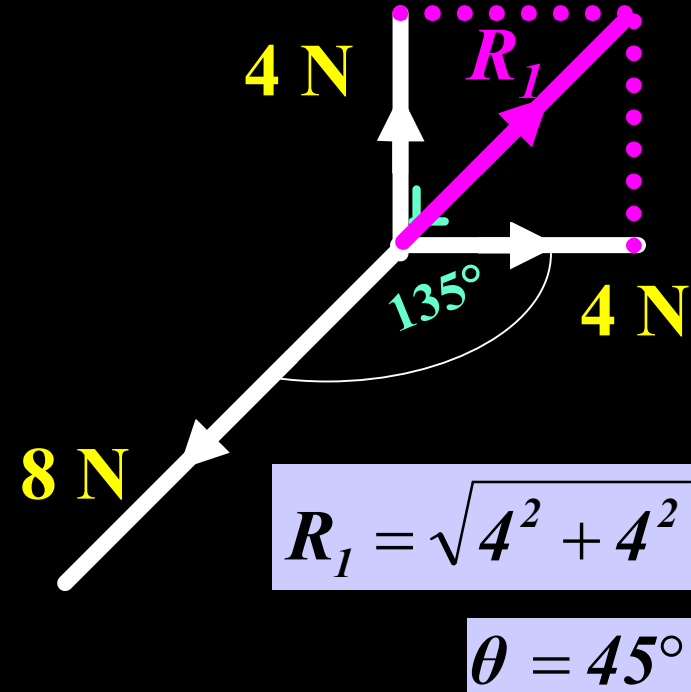
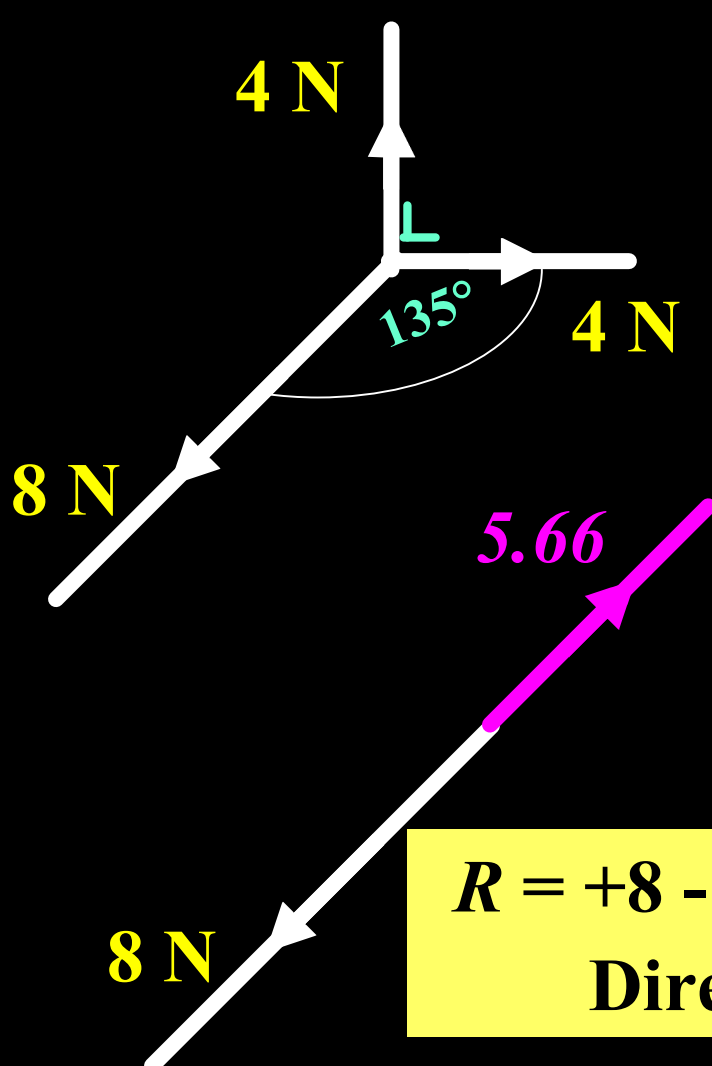


$$R = \sqrt{3^2 + 4^2} = 5$$

$$\tan \theta = \frac{3}{4} \quad \theta = 36.87^\circ$$

5 m s^{-1} at 36.87° to ...

P3 Find the resultant of these three forces:



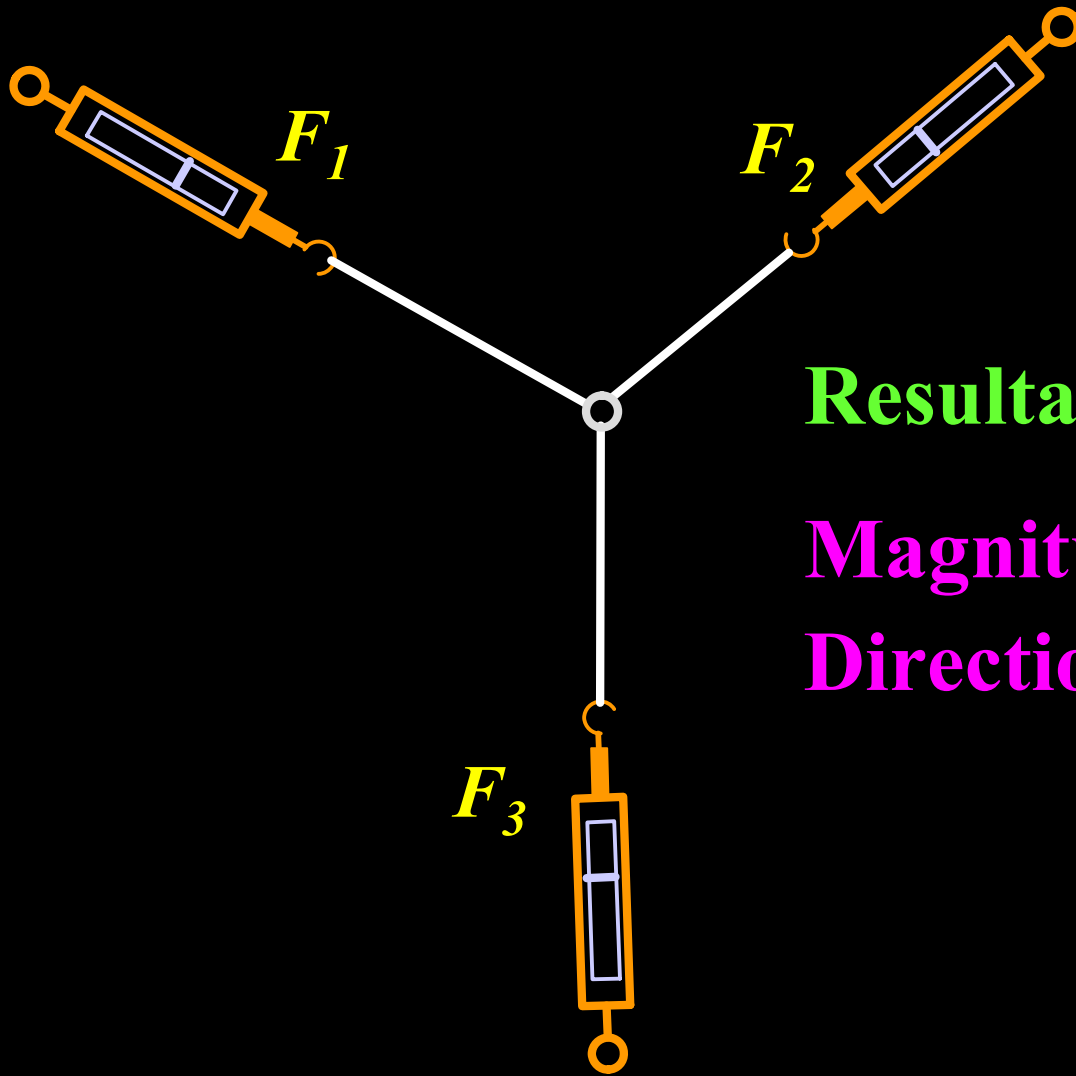
$$R_1 = \sqrt{4^2 + 4^2} = 5.66$$

$$\theta = 45^\circ$$

$$R = +8 - 5.66 = 2.34 \text{ N}$$

Direction = ??

Experiment - To Find The Resultant Of Two Forces



Resultant of F_1 and $F_2 = ??$

Magnitude = F_3

Direction ... opposite to F_3

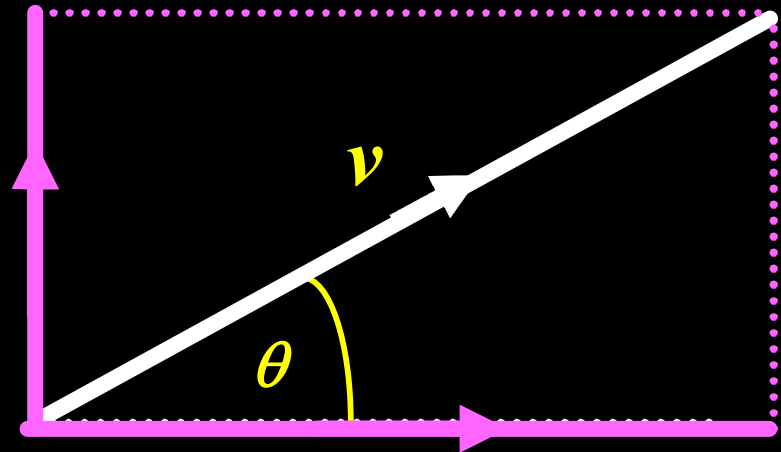
**Going the opposite way
to finding the resultant ...**

Resolving A Vector Into Components

Components

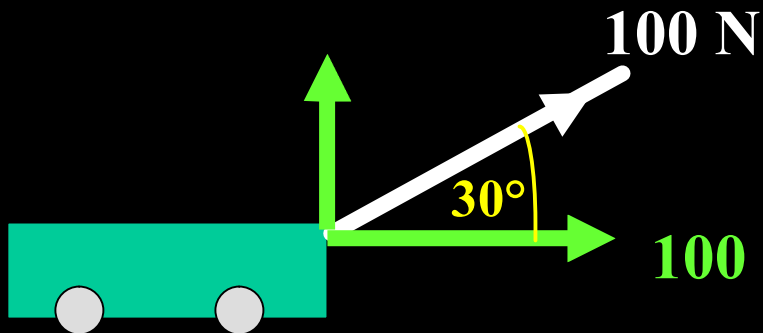
Perpendicular Components

$$y = v \sin \theta$$



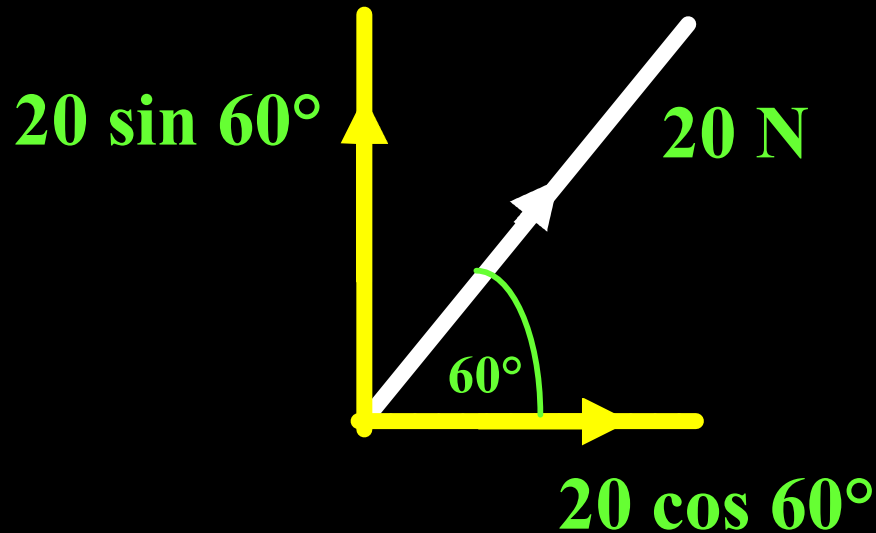
$$x = v \cos \theta$$

$$100 \sin 30^\circ = 50 \text{ N}$$



$$100 \cos 30^\circ = 86.6 \text{ N}$$

P4 Find the vertical and horizontal components of a vector of magnitude 20 N acting at 60° to the horizontal.



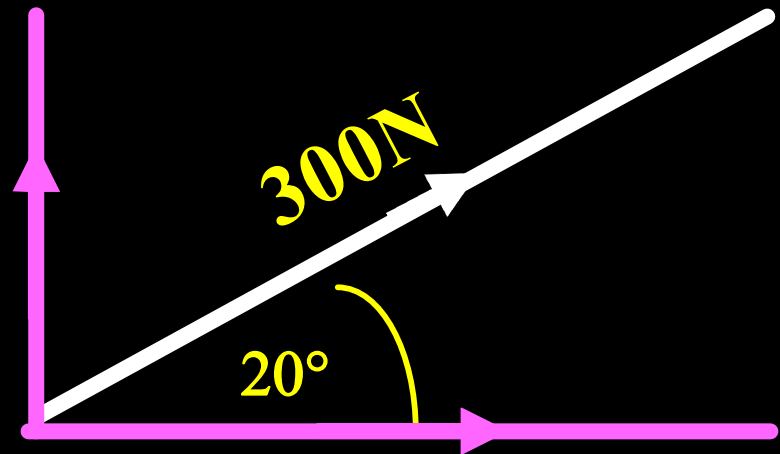
Horizontal = 10N

Vertical = 17.3 N

P5 A man pulls a rope which is tied to a cart with a force of 300 N. The rope makes an angle of 20° with the horizontal. Find the effective vertical force on the cart due to the rope and the effective horizontal force on the cart due to the rope.

$$300 \sin 20^\circ$$
$$102.6 \text{ N}$$

Effective
Vertical



$$300 \cos 20^\circ$$
$$282 \text{ N}$$

Effective
Horizontal

P6 A stone of weight **50 N** rests on a sloped roof. The roof is inclined at **20°** to the horizontal. Resolve the weight of the stone into components parallel and perpendicular to the roof.

