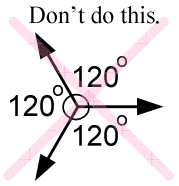
# Vectors (The Force Table)

Name_____ ID_____ TA_____

Partners_____

Date_____ Section_____

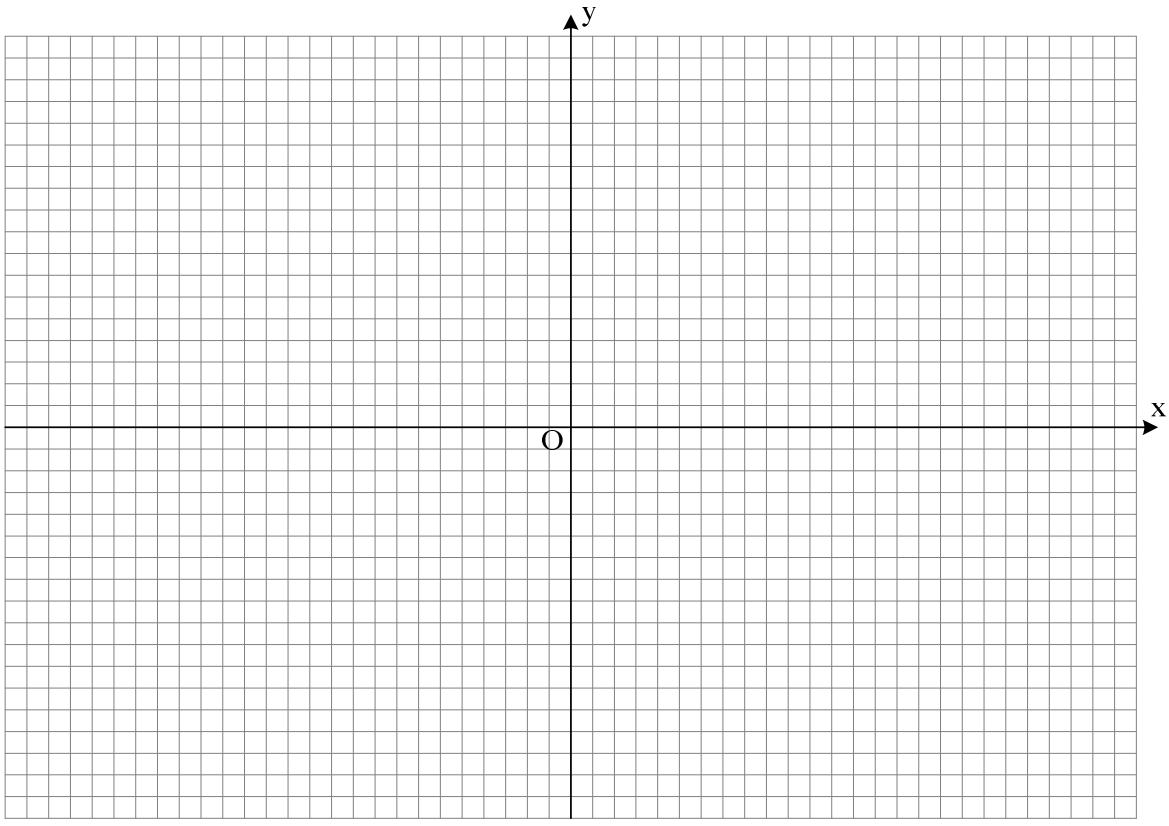


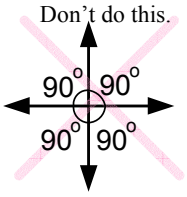

## 1. Static equilibrium with three forces

| | Mass (kg) | Force (=9.8m/s$^2$×Mass) | Angle | $F_x$ (= Fcosθ) | $F_y$ (= Fsinθ) |
|---|---|---|---|---|---|
| Force 1 | | | | | |
| Force 2 | | | | | |
| Force 3 | | | | | |
| Sum of x- and y- components of each force ⇒ | | | | | |

Do the force components add up to zero?

- Draw the force vectors on the following graph and determine their sum graphically.



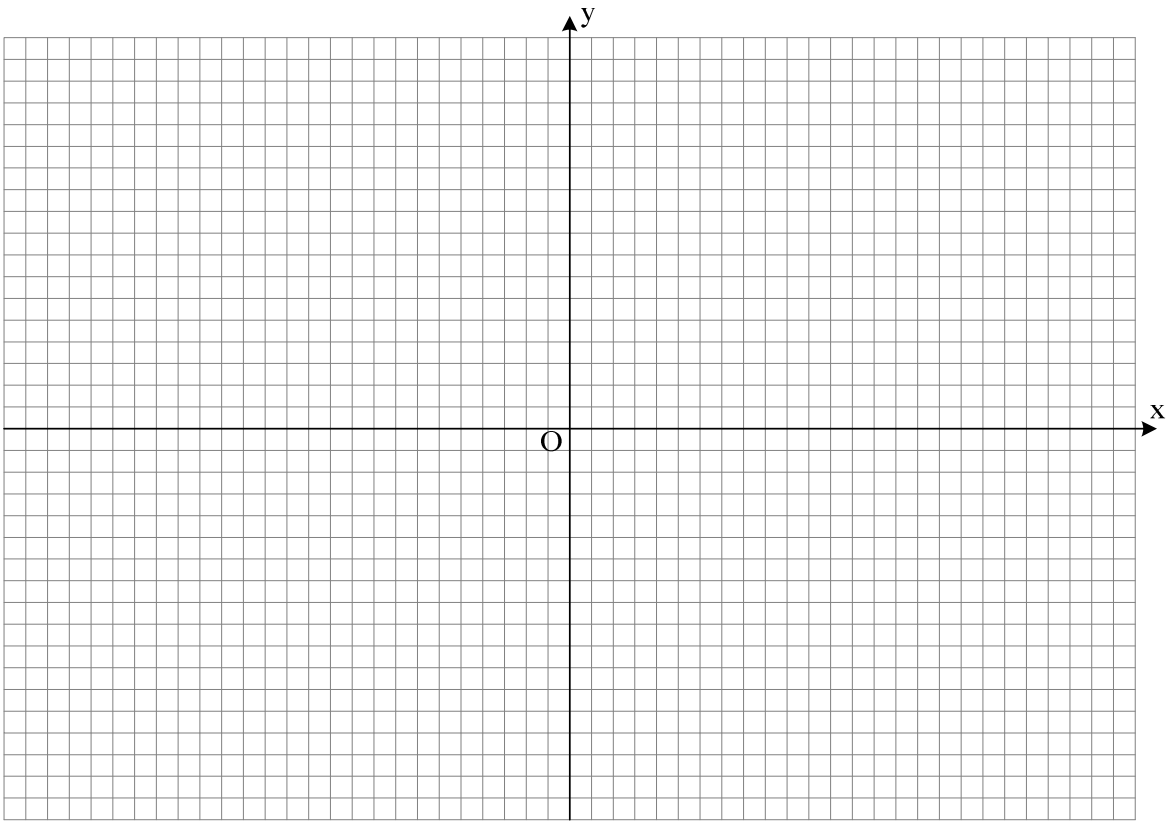



## 2. Static equilibrium with four forces

| | Mass (kg) | Force (=9.8m/s$^2$×Mass) | Angle | $F_x$ | $F_y$ |
|---|---|---|---|---|---|
| Force 1 | | | | | |
| Force 2 | | | | | |
| Force 3 | | | | | |
| Force 4 | | | | | |
| Sum of x- and y- components of each force ⇒ | | | | | |

Do the force components add up to zero?

- Draw the force vectors on the following graph and determine their sum graphically.



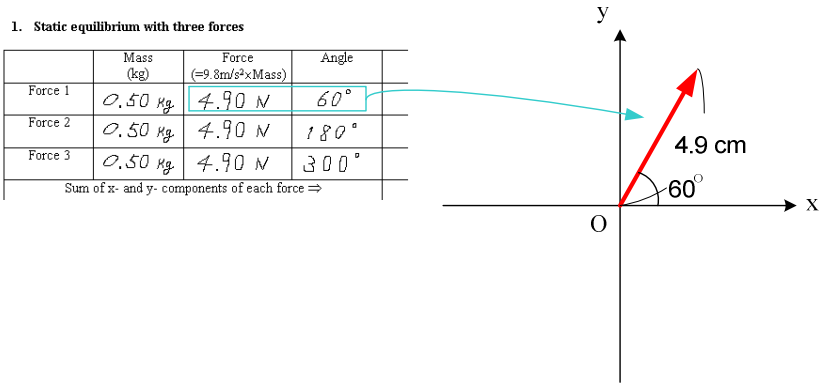
# How to add vectors graphically

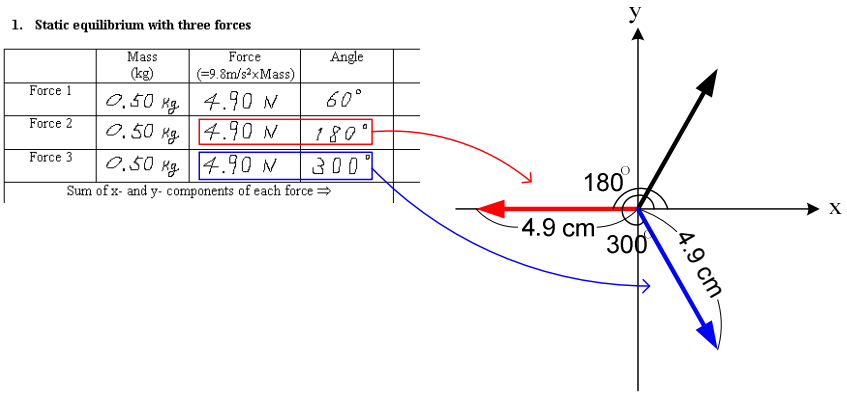
**1.** After the experiment, you have the information of all the vectors (the magnitudes and directions). The force column corresponds to the magnitude, and angle column corresponds to the direction.

**1. Static equilibrium with three forces**

| | Mass (kg) | Force (=9.8m/s²×Mass) | Angle |
|---|---|---|---|
| Force 1 | 0.50 kg | 4.90 N | 60° |
| Force 2 | 0.50 kg | 4.90 N | 180° |
| Force 3 | 0.50 kg | 4.90 N | 300° |
| Sum of x- and y- components of each force ⇒ | | | |

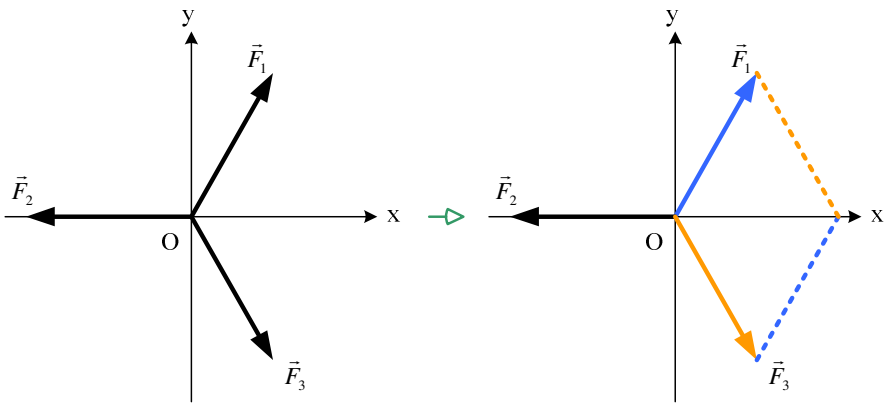
**2.** Draw each force vector as follows. Force 1 has magnitude, 4.9 N, and direction 60°. For convenience' sake, the units of magnitude should be replaced by cm.



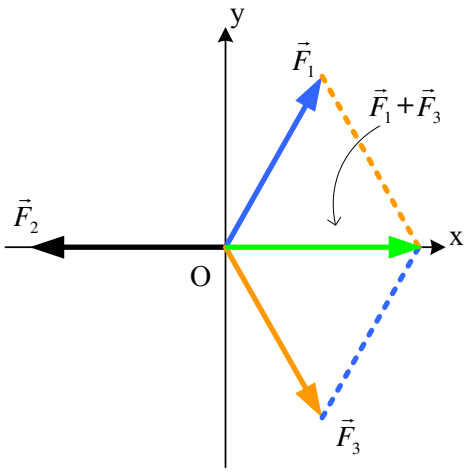



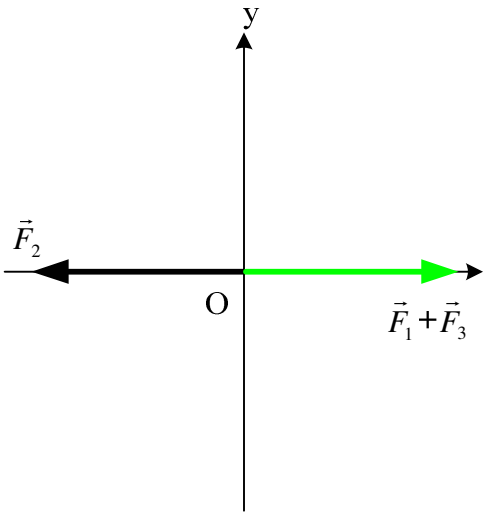

**3.** Do the same thing for the second and third force-vectors. The angles are always taken from the positive side of x-axis.

**4.** After you draw all the vectors (for the second part, you need to draw four vectors), pick out two vectors. Then, make a parallelogram as shown.



**5.** The diagonal will be the sum of two vectors. (Be careful about how you take the diagonal. The start point of the vector is origin.)




**6.** Two vectors added becomes one vector as shown. You repeat the same thing as above until it is reduced one vector. Now, there are two vectors, which are $\vec{F}_1+\vec{F}_3$ and $F_2$. If either one is tilted, you can make a parallelogram. However, in this example, those vectors are the same magnitude and opposite directions. Therefore the sum of two vectors is cancelled each other.

**7.** In this case, the sum of three vectors becomes a zero vector as shown. However, considering the experimental uncertainty, you likely obtain a small vector from origin as the error.