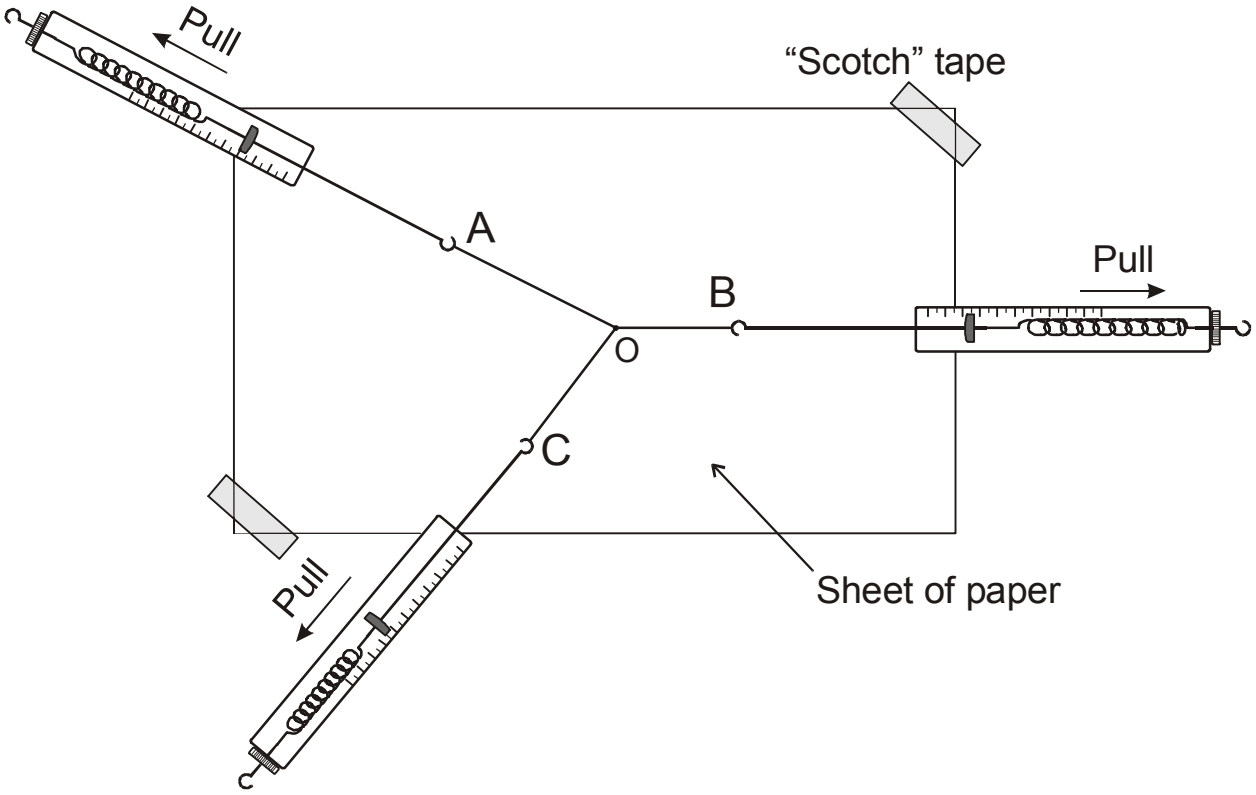
Can Forces be Added in the same way as Displacements?

Displacements can be added by drawing a scale diagram (either a triangle or a parallelogram).

The aim of this experiment is to see if forces can be added using the same method. (If forces can be added in the same way as displacements, we are probably justified in assuming that all vector quantities can be added this way.)

Hold three spring balances (also called dynamometers) as shown in the diagram below.



If the point O is stationary, then the three forces are in equilibrium. This means that force **A** is balancing the *combined effects* of forces **B** and **C**.

Similarly, force **B** balances the *combined effects* of forces **A** and **C** (or force **C** balances the *combined effects* of forces **A** and **B**).

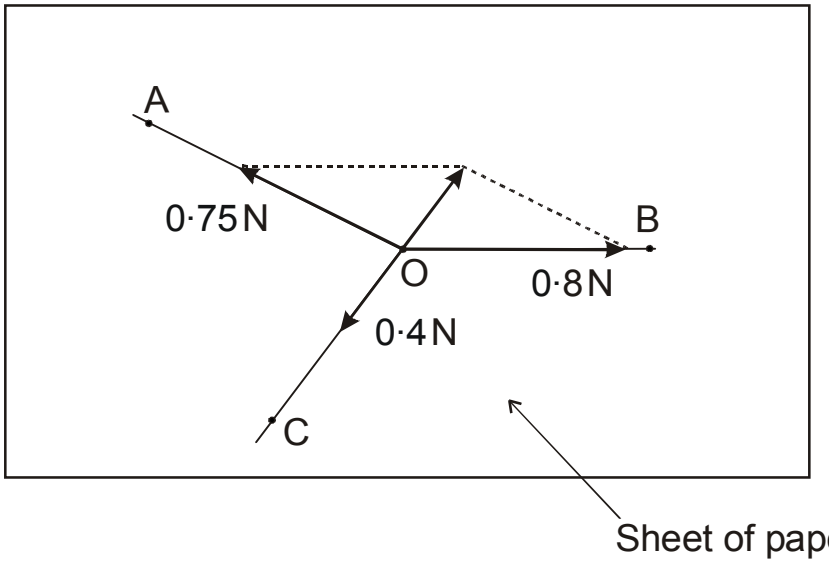
1. Accurately mark on the paper the positions of points **O**, **A**, **B** and **C**. Write beside **A**, **B** and **C** the magnitudes of the forces (readings of the spring balances).
2. Draw lines joining **O** to **A**, **O** to **B** and **O** to **C**, so that your diagram records the precise positions of the three pieces of thread as well as the strengths of the three forces.

3. Repeat the procedure with forces of different magnitudes pulling along different directions.

Analysis of the results

Using a *suitable scale* add arrows to the diagram representing the three forces. For example, if your scale is: 1 cm represents 0·1 Newtons, a force of magnitude 0·8 N would be represented by an arrow 8 cm long.

On the diagram, do the vector addition $\overrightarrow{F_A} + \overrightarrow{F_B}$, as shown in the example below.



Is the result of this addition equal but opposite to the force $\overrightarrow{F_C}$?

Note that each set of results allows you to attempt to verify the principle *three times*.

Can forces be added in the same way as displacements?