

Objectives:

Using the **Collisions** applet, the student will investigate collisions between two particles ("ships") given the initial position vectors and the velocity vectors of the two particles. Paths can be plotted as absolute or relative vectors.

Functionality:

When the student presses **START** they will see the **VEWS** menu shown right.

The **VEWS** option of **Setup vectors** allows the student to supply the initial position vectors of the two vessels. These vectors should be input in Cartesian form. For example, a position vector of $100\mathbf{i} + 200\mathbf{j}$ should be typed in as (100,200).

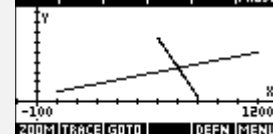
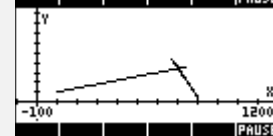
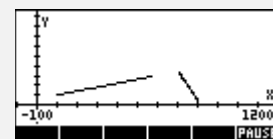
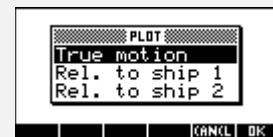
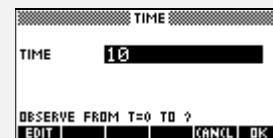
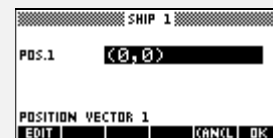
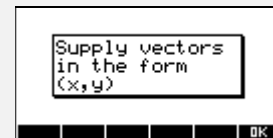
The student must also specify the time interval, starting with $t = 0$, which is to be displayed. The default value is the first 10 seconds. **Tstep** is set to 0.1 seconds by default, usually resulting in a **PLOT** which is slow enough to show clearly the sequence of events. This can of course be adjusted in **PLOT SETUP**.

The second option of **Plot paths** will plot the paths of the two ships.

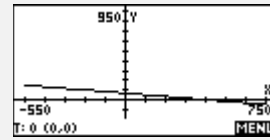
This can be done either using the absolute vectors as entered, or with Ship 1 held stationary and Ship 2's position plotted relative to Ship 1, or vice versa.

Settings for both axes are automatically calculated but can be adjusted in **PLOT SETUP** if desired (press **PLOT** to redisplay).

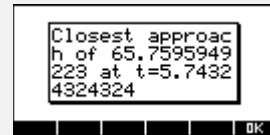
The successive images shown right show two ships coming very close to a collision.



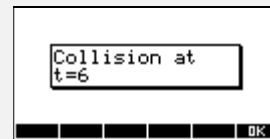
It is also possible to plot the motion of Ship 2 relative to Ship 1. In this case Ship 1 is modelled as being stationary at the origin (0,0) while Ship 2 moves relative to it. This is shown opposite. The converse case of Ship 1 moving relative to Ship 2 is the third option.



The third **VIEWS** option of **Report** will give the time of closest approach or of collision. If the ships do not collide then the separation at this time is given.



The final option of **Start** will re-initialise all the position and velocity values back to their defaults.



Additional Exploration:

The distance between the ships can be shown graphically using the function applet. Simply change to the **Function** applet in the **APLET** view and enter the function $F1(X) = \sqrt{((X2(X)-X1(X))^2 + (Y2(X)-Y1(X))^2)}$

Set suitable axes in **PLOT SETUP**, bearing in mind that **X** is now serving as the time variable and **Y** as the separation. My experience is that the **FCN Extremum** facility in the **Function** applet will not usually give the minimum of this function, reporting instead either "Bad Guess" or "Can't find Extremum". I'm not sure why.

Ideas can be applied to:
Vectors

Programs associated with this applet:
.COLL.INIT, .COLL.PLOT, .COLL.RPT, .COLL.S

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