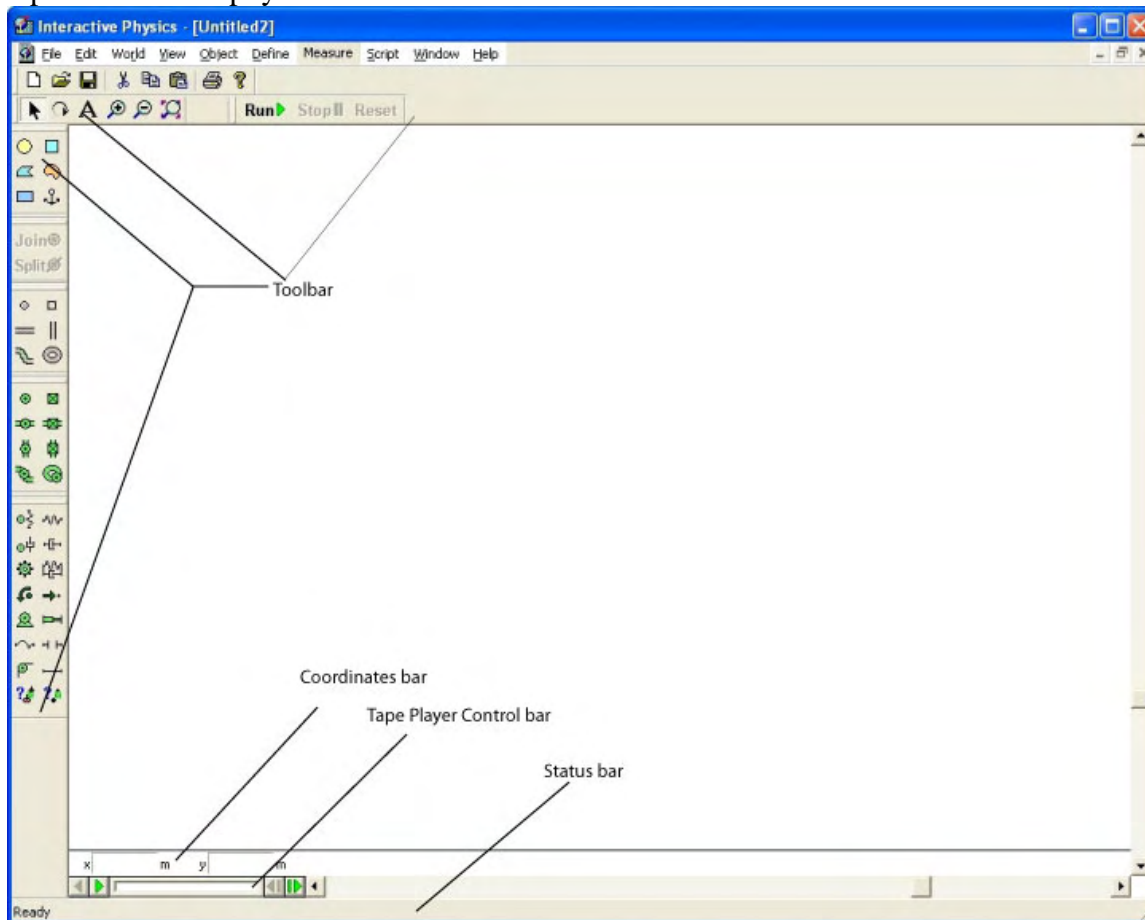# Interactive Physics Lab

PART A (FREELY FALLING BODY)

Open Interactive physics 2005
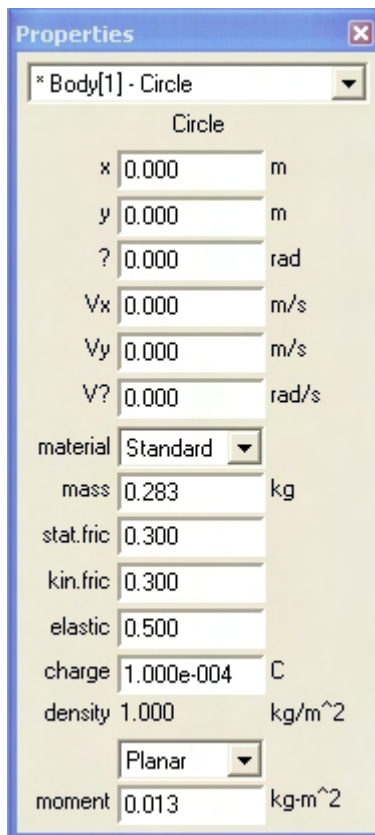

Note the terminolgy used

Save this file as say "calIP"

Click once (select) the "circle tool" in the "tool bar" and draw a circle in the drawing (white) area.

If the circle is selected (click once on the circle) you will observe that the coordinate bar showing the x-cordinate, y coordinate, radius (r) and angle (?) orientation of the reference line in the circle.
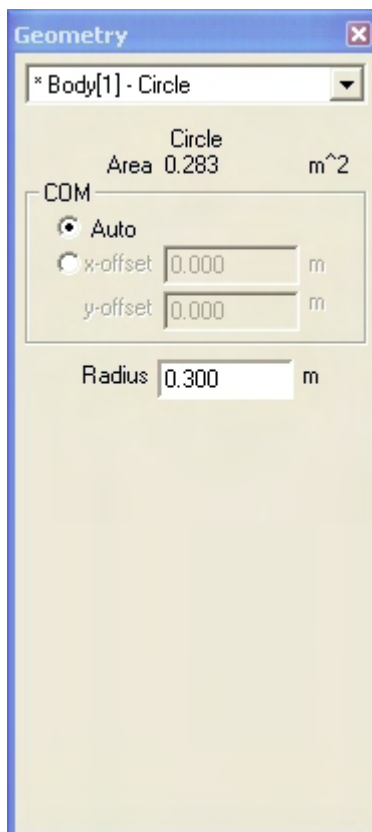
Double click on the circle (Or select the circle, pull down the menu Window → Properties. This will bring up the properties window.

Set x=0 and y= 0 for this object (Body[1])

Properties ✕

| * Body[1] - Circle | ▼ |

Circle

| x | 0.000 | m |
y	0.000	m
?	0.000	rad
Vx	0.000	m/s
Vy	0.000	m/s
V?	0.000	rad/s
material	Standard ▼	
mass	0.283	kg
stat.fric	0.300	
kin.fric	0.300	
elastic	0.500	
charge	1.000e-004	C
density	1.000	kg/m^2
	Planar ▼	
moment	0.013	kg-m^2

Move the vertical and horizontal scroll bars so that the circle appears approximately in the middle of the drawing region.

With the circle selected, go to menu "Window" → Geometery. You will get the geometery window opened up. Set the radius to 0.300 m.

Geometry ✕

| * Body[1] - Circle | ▼ |

Circle

Area 0.283 m^2

COM
- ⦿ Auto
- ◯ x-offset 0.000 m
-   y-offset 0.000 m

Radius 0.300 m

Close both the geometry and the properties window, and now open the Appearance window. Set the fill color to red. You can simply type in 1 for R, 0 for G and 0 for B.
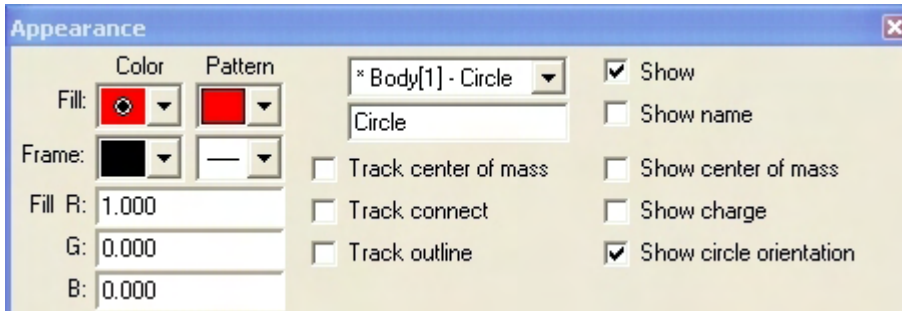
With the object circle selected, click the menu "Measure" → Position -→ y-graph. This will bring the Graph Window "Y-position of Circle 1". Double click on the graph and it will bring you the property window for this graph object.

Unclick the tick marks under "Auto" and set the minimum and maximum values as (0, 1) for x-axis and (-2, 1) for y-axis.
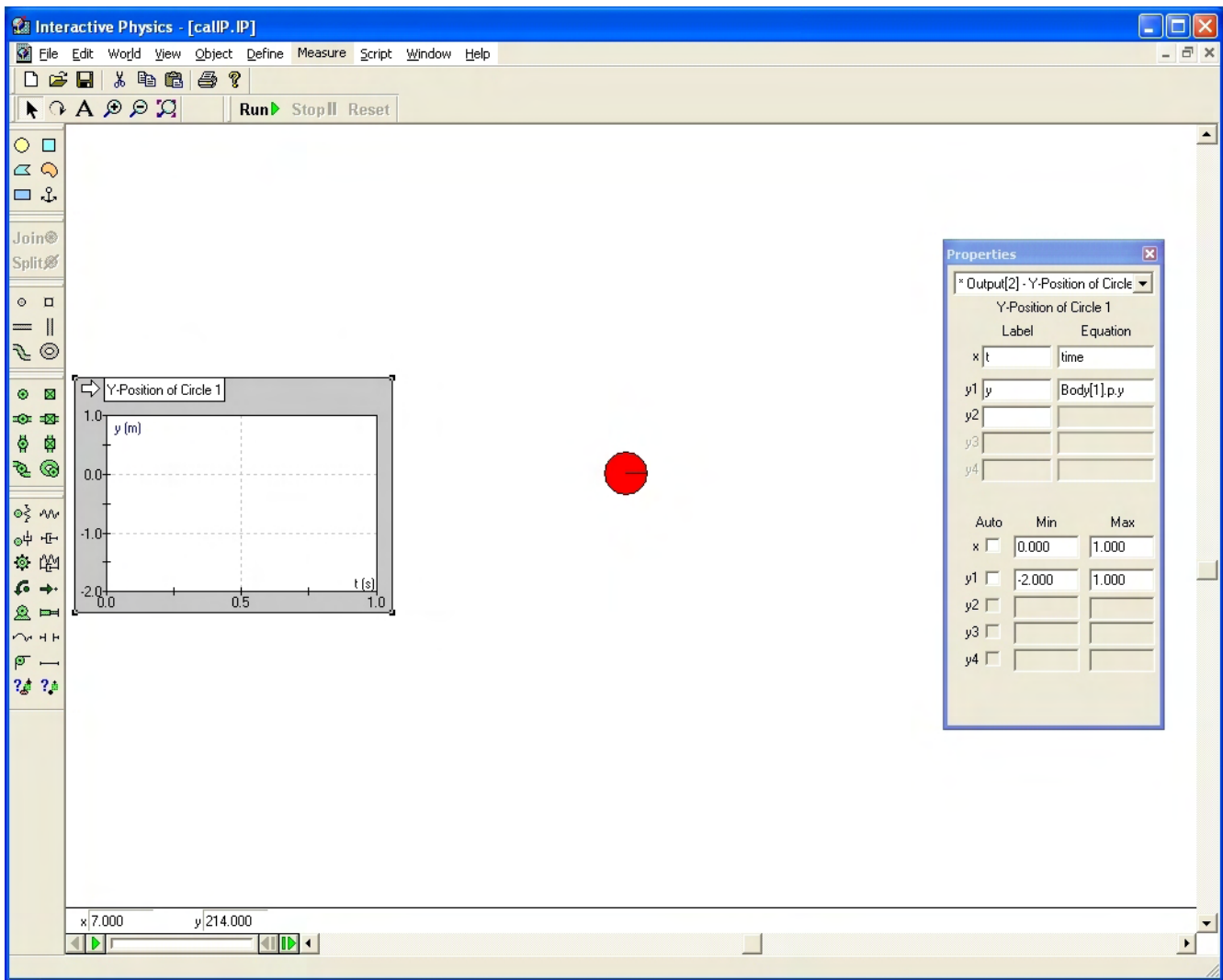
Close the properties window.
Go to Menu "Measure" → Time. (To bring up the time meter you don't have to select any object). And place this "meter" somewhere at the top.

Press the "Run" button at the top (or alternatively you can use the short cut key Ctrl+R) and observe. The ball falls in the virtual enviorenment of earth's gravity. The ball is still falling when it is out of the view at the bottom. You can stop the play at any time by clicking anywhere in the drawing area or by pressing the "Stop" button at the top. After stopping press the "Reset" button to come back to the editing mode.

For the instructors: Explain to the student about the y versus t graph. This is not the trajectory (y versus x) of the ball but y-position versus time (y-position curve). The velocity (slope of the curve) seems to decrease steadily with time. There will be few students who won't understand the "decrease", obviously the speed (magnitude of the velocity or the magnitude of the slope) is increasing. Explain. The default positive direction of the y-axis is upward – numbers increases upward and decreased downward.

With the object circle selected, go to Menu "Measure" → Velocity → Y-grahp. This will bring up the velcoity curve. Double click on the velocity graph; the property window pops up. Unclick the tick marks under "Auto" and set the minimum and maximum values as (0, 1) for x-axis and (-20, 10) for y-axis. Close the properties window.

Run this model and observe. As suspected you see that the velocity is decreasing steadily (straight line), meaning the acceleration is negative and constant. Stop and Reset to return to edit mode.

Go to Menu "Define" → Vectors → and click on "Velcoity. This will make the velocity vector to be displayed on the ball as it falls. Run and observe.

You can make the simulation to stop after a given time as follows: Go to Menu "World" → Pause Contrlol → click on "new condition" and in the "Pause when" type in "time > 2.5". Run the simulation again and wait until it stops on its own at t =2.55 s.

Use the "Tape Player Control" slider to move the model frame by frame at will, forward and backward. You can stop at any time and get the time from the "time" meter. Click on the white arrow on the y-position graph, until the display changes to show just the y-coordinate.
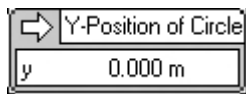

Switch it back to display the graph.

Place two more circles (one blue and other green; use the appearance window) to the left and right of this red disk. Make the coordinate of the blue circle (-2, 0) and green circle (+2, 0).

Double click on the blue circle to bring out the properties window. Set the initial y-velocity (Vy) to +4.00 m/s. From the Define menu make the velocity vector to be displayed. Do the same with the green circle but set the initial y-velocity to -4.00 m/s.

Also display the y-position curve and velocity curve for the blue and green circles.

Run the simulation until it stops and reset. You will now have something like this:
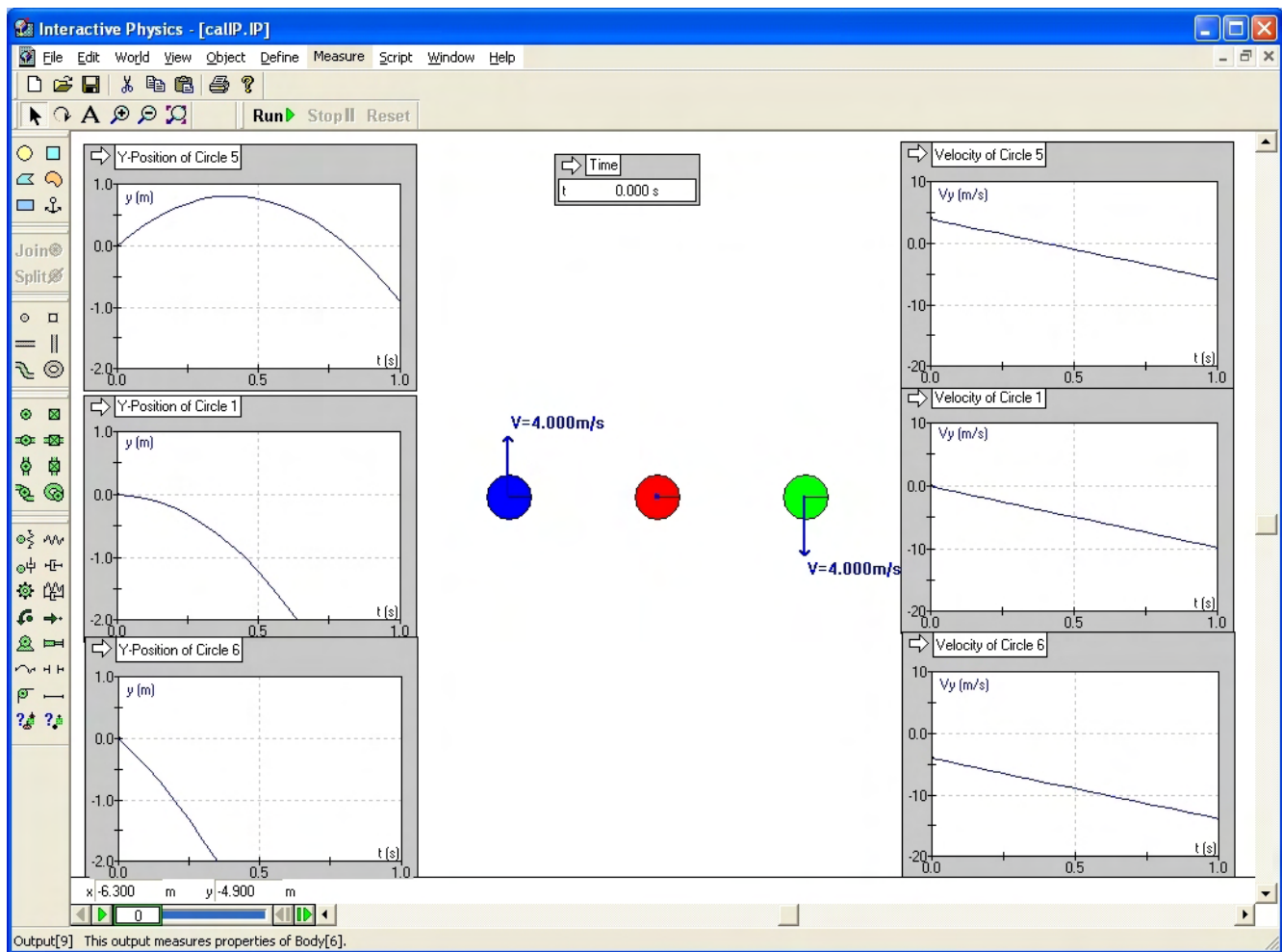
For Instructors: Direct the students' attention to the position curve of blue circle and show them that the rate of change of y-position is steadily decreasing always: on its way up, at the top and on the way down. Velocity curve on the right proves it. And whatever the initial velocity is all three balls have the same rate of change of velocity (the same negative, constant slope for the velocity curve - acceleration) throughout its journey. The acceleration of a freely falling body is the same and is downward (negative if we choose positive direction to be upward, as it is in IP) whether it is going up, down or at the top.

PART B: (Acceleration on a smooth incline).

Choose the rectangle tool, and draw a rectangle in the drawing area.
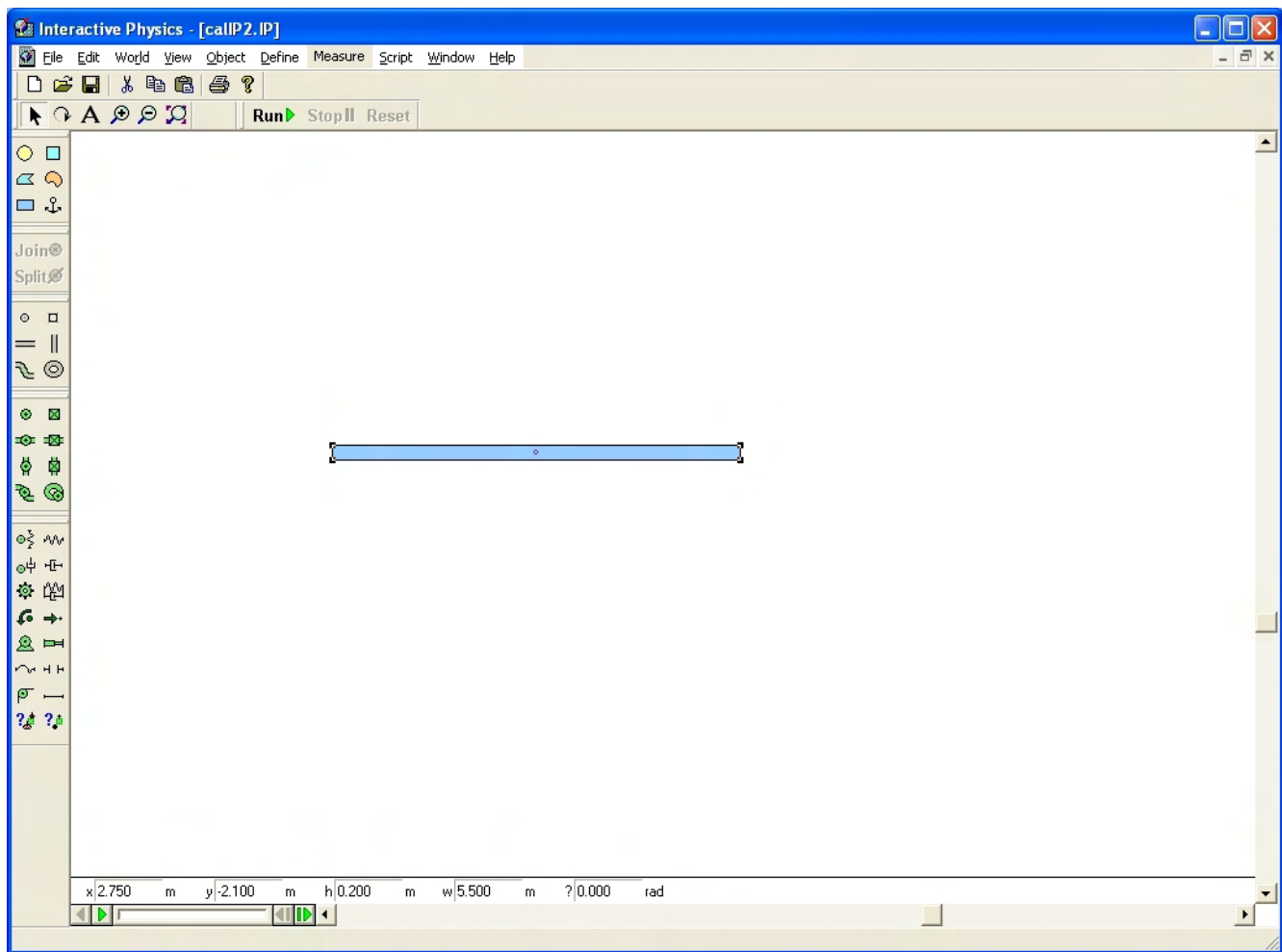
Go to menu "View" and make sure that Oject Snap (and Grid Snap) are enable (ticked).

Click the anchor tool ⚓ , and click preferably on the center point of the rectangular block. The anchor tool has the effect of fixing the object to whatever is behind it, in this case the background. So when the simulation starts, the block will not fall.

Now draw a square block using the square tool and move it to place exactly on the rectangular block somewhere on the right side. This is possible only if the "Object Snap" is ticked.
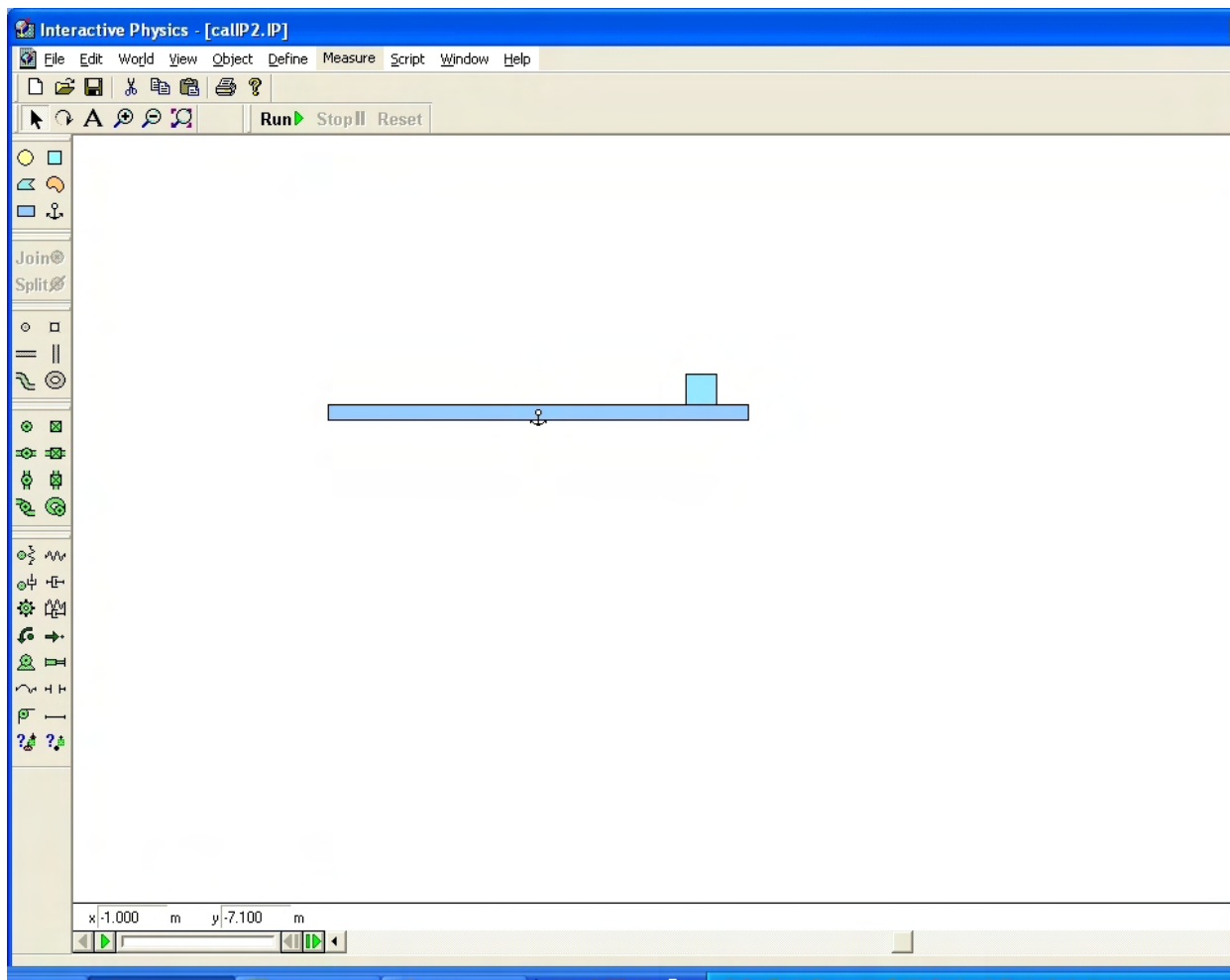
Double click on the rectangular block to bring up the properties window and make both the kinetic and static friction of the block zero. It is not necessary to make the friction of the square block to be zero, as IP will take the friction to be the friction of the one with the smaller value.

Select both the rectangle and the square together. Go to Window menu → Properties. In the properties window set both the kinetic and static friction to zero.

With both blocks still selected, click the rotate tool ↻. Rotate by picking the center of the rectangle block by about 10 degrees (0.175 rad) counterclockwise.
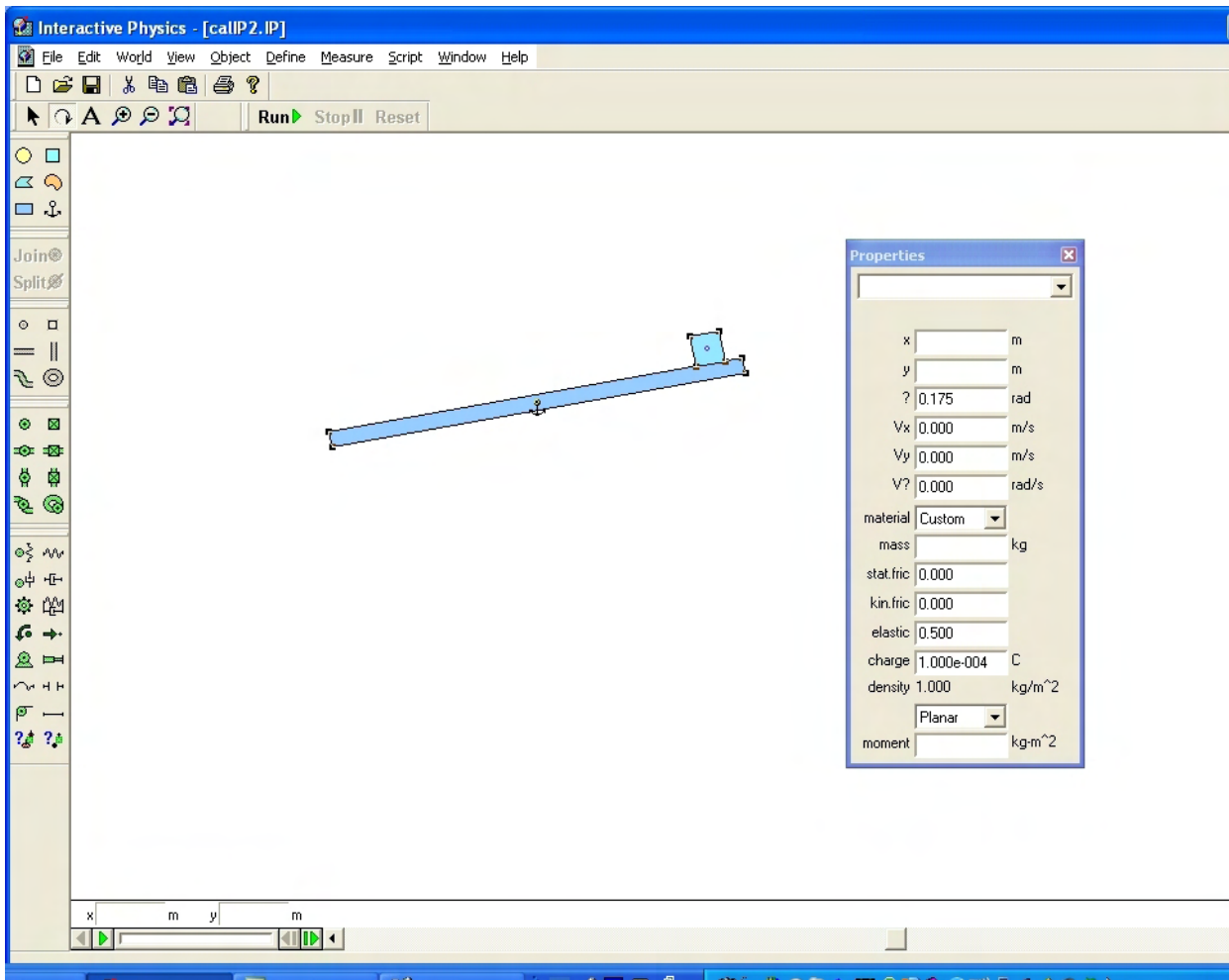
Click the arrow tool. Click on an empty white space, so none of the objects is selected. Close the properties window.

Draw a marquee over the square block so only the square block is selected. Go to the menu "Measure" → Acceleration → All.

Run the simulation and record the total acceleration (|A|), which is the acceleration of the block along the rectangle block.

Repeat this with different angle of the smooth incline and each time record the acceleration.

Plot a graph of acceleration versus angle in EXCEL and see if you can figure out the relationship between them from the experimental data.