Simulation experiment on circular motion

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AIM: Find the relation between square of angular velocity (ω^2) and acceleration in circular motion.
EQUIPMENTS:

1. Lap top
2. https://phet.colorado.edu/en/simulations/legacy/rotation

REQUIREMENTS:

Data Collecting

1. Open the link and try phet lab simulation on your lap top;
2. Go over the webpage and set different initial conditions of the movement.
3. Select dependent and independent variables.
4. Collect data needed and record them on the data table.

Data processing

1. Draw square of angular velocity (ω^2) v.s. centripetal acceleration (a) graph.
2. Determine the gradient and intercept of the graph

ARRANGEMENT

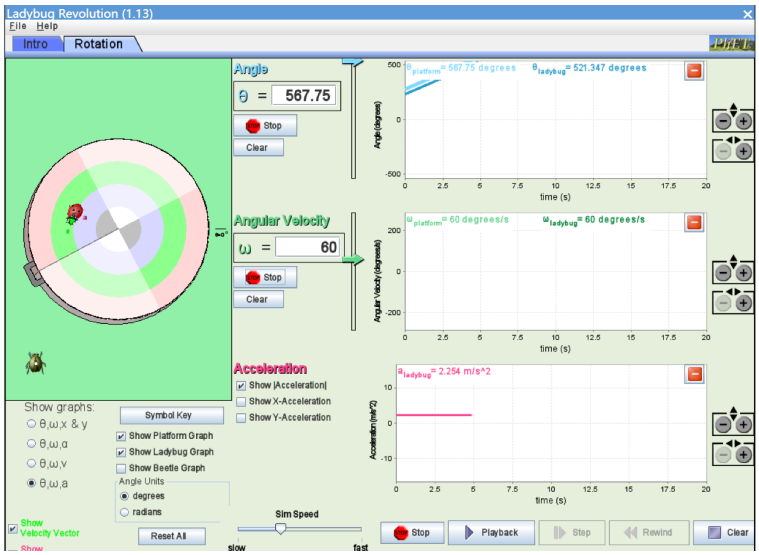

Figure 1: The screen capture of the Phet lab.

Because we need to investigate the relationship between ω^2 and a, the independent variable should be ω and the dependent variable should be a. The distance from the ladybug to the center of the circle should remained constant. So can we examine whether

$$a = \omega^2 r$$

is correct or not.

#Number	Angular velocity (ω) (rad/s)	Centripetal Acceleration (a) (m/s^2)
#1	10	0.063 ± 0.001
#2	20	0.250 ± 0.001
#3	30	0.564 ± 0.001
#4	40	1.002 ± 0.001
#5	50	1.565 ± 0.001
#6	60	2.254 ± 0.001
#7	70	3.068 ± 0.001
#8	80	4.007 ± 0.001

Table 1: Raw data table containing angular velocity and centripetal acceleration.

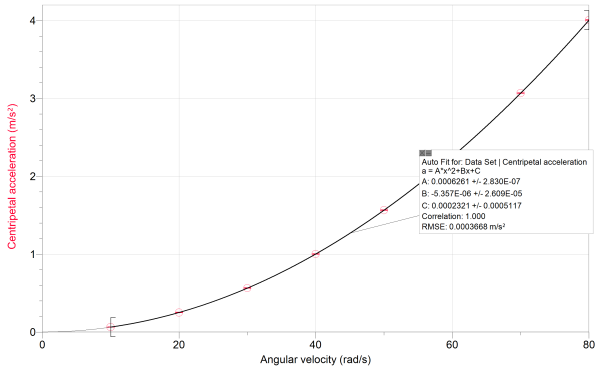

Figure 2: The relationship between angular velocity and centripetal acceleration

After setting angular velocity with data 10, 20, 30, 40, 50, 60, 70, 80, we can get Tab.1.

Fig.3 shows that the best fit line is a straight line passing through the origin. So the centripetal acceleration is proportional to square of angular velocity,

$$a \propto \omega^2$$

CONCLUSION:

The centripetal acceleration a is proportional to ω^2.

Because this is a simulation experiment, there is no error.

#Number	Angular velocity (ω) (rad/s)	Centripetal Acceleration (a) (m/s^2)
#1	100	0.063 ± 0.001
#2	400	0.250 ± 0.001
#3	900	0.564 ± 0.001
#4	1600	1.002 ± 0.001
#5	2500	1.565 ± 0.001
#6	3600	2.254 ± 0.001
#7	4900	3.068 ± 0.001
#8	6400	4.007 ± 0.001

Table 2: This is the processed data table containing square of angular velocity (ω^2) and centripetal acceleration.

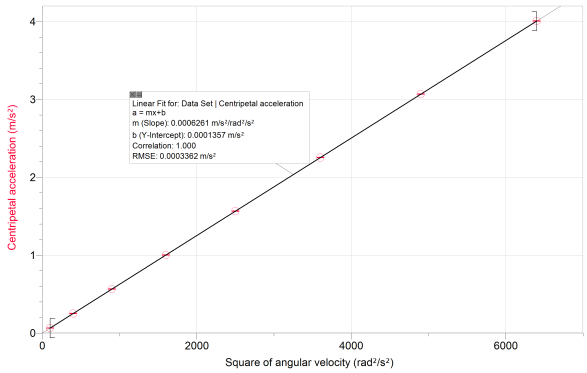

Figure 3: The graph showing the relationship between square of angular velocity and centripetal acceleration