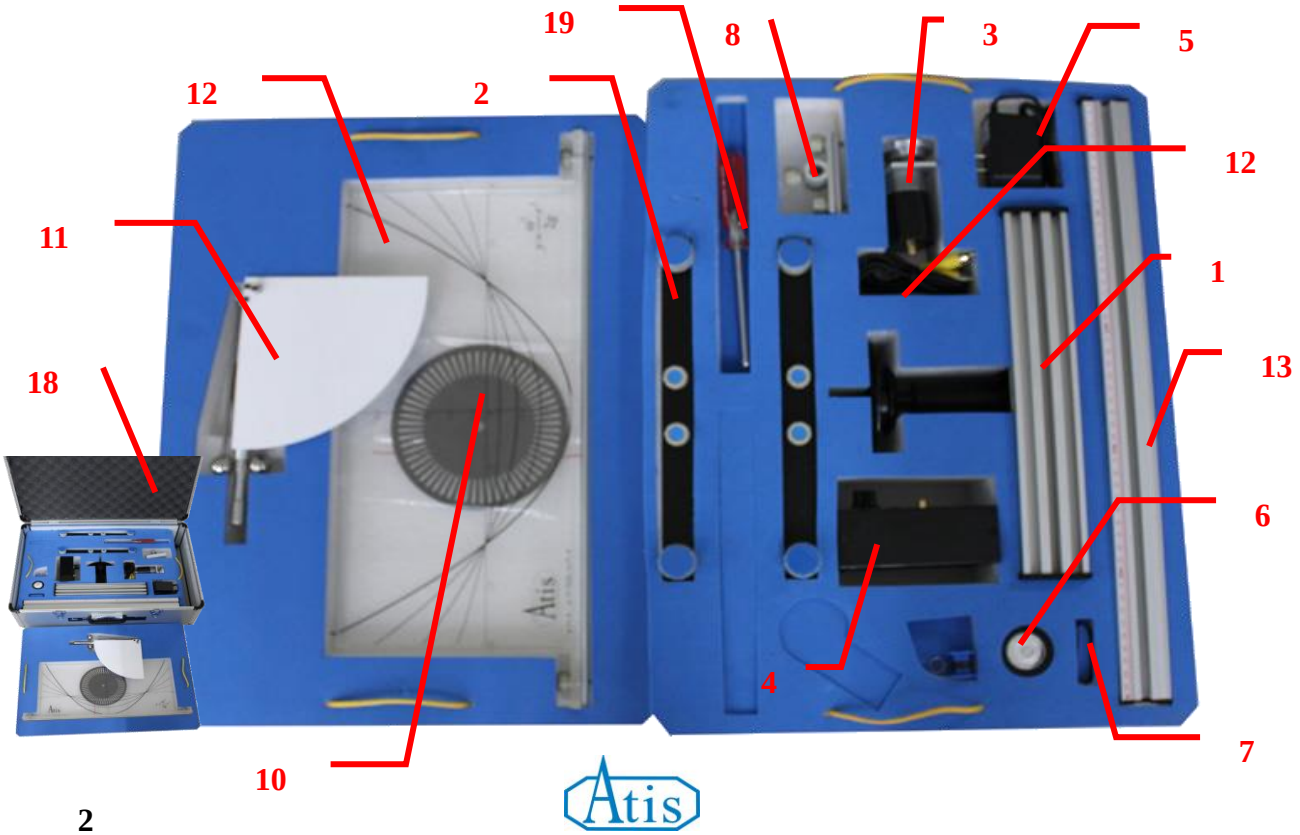
Centripetal Force System Kit

Project

1. A01-423P-Y01 Centripetal Force Experiment (Ball)
2. A01-424P-Y01 Horizontal Centripetal Force Experiment

Instrument

Instrument list					
No.	**Accessory**	**Qty**	**No.**	**Accessory**	**Qty**
1	Base	1	2	Adjustable feet	2
3	DC motor	1	4	Rotational motor drive	1
5	DC power supply	1	6	Level	1
7	Belt	1	8	Connector	1
9	Connecting wire	1	10	Fence (60 grids)	1
11	Angle bracket	1	12	Centripetal sink	1
13	Aluminum platform	1	14	Photogate electronic timer	1
15	Photogate sensor	1	16	DC Power Supply (12V)	1
17	Iron rod	1	18	Aluminum storage case	1
19	Phillips screwdriver (not included)	1			



Experiment I. Centripetal Force Experiment (Ball)

Purpose

Discuss the relationship between the circumferential angular velocity of a rotating ball and the angle in a rotation experiment.

Theory

The rotating velocity of a vertical axis is **ω** (rad/s) which drives the ball (mass m) to perform a horizontal circular motion in radius r(m). The tangential velocity of the motion is v(m/s). The influence of horizontal centrifugal force F'_c (N), gravity and tension T(N) caused by arm length L(m) results in an angle **θ** between the ball and the axis, as shown in **Figure 1-1**.

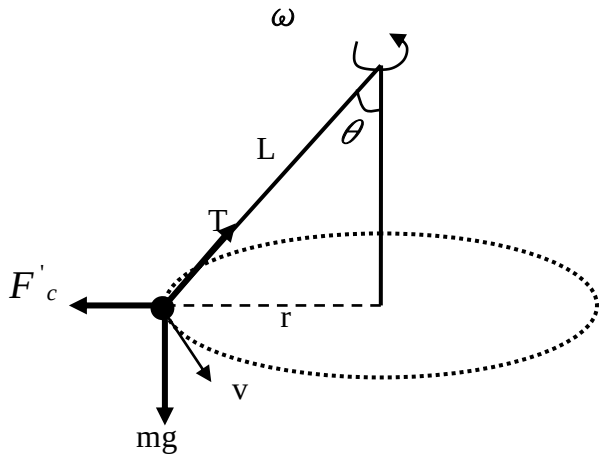


Figure 1-1

The relationship between the horizontal force of tension and the centrifugal force can be expressed as:

$$TSin\theta = F'_c = ma'_c \quad (1)$$

The centrifugal acceleration is

$$a'_c = \frac{v^2}{r} = \omega^2 r \tag{2}$$

We can acquire the following formula by bring formula (2) to (1)

$$T\sin\theta = m\omega^2 r \tag{3}$$

The relationship between the radius of the circle and the length of arm can be written as:

$$r = L\sin\theta \tag{4}$$

The relationship between vertical force of tension and the gravity is:

$$T\cos\theta = mg \tag{5}$$

The angle θ can be calculated by the following formula.

$$\theta = \cos^{-1}\left(\frac{g}{\omega^2 L}\right) \tag{6}$$

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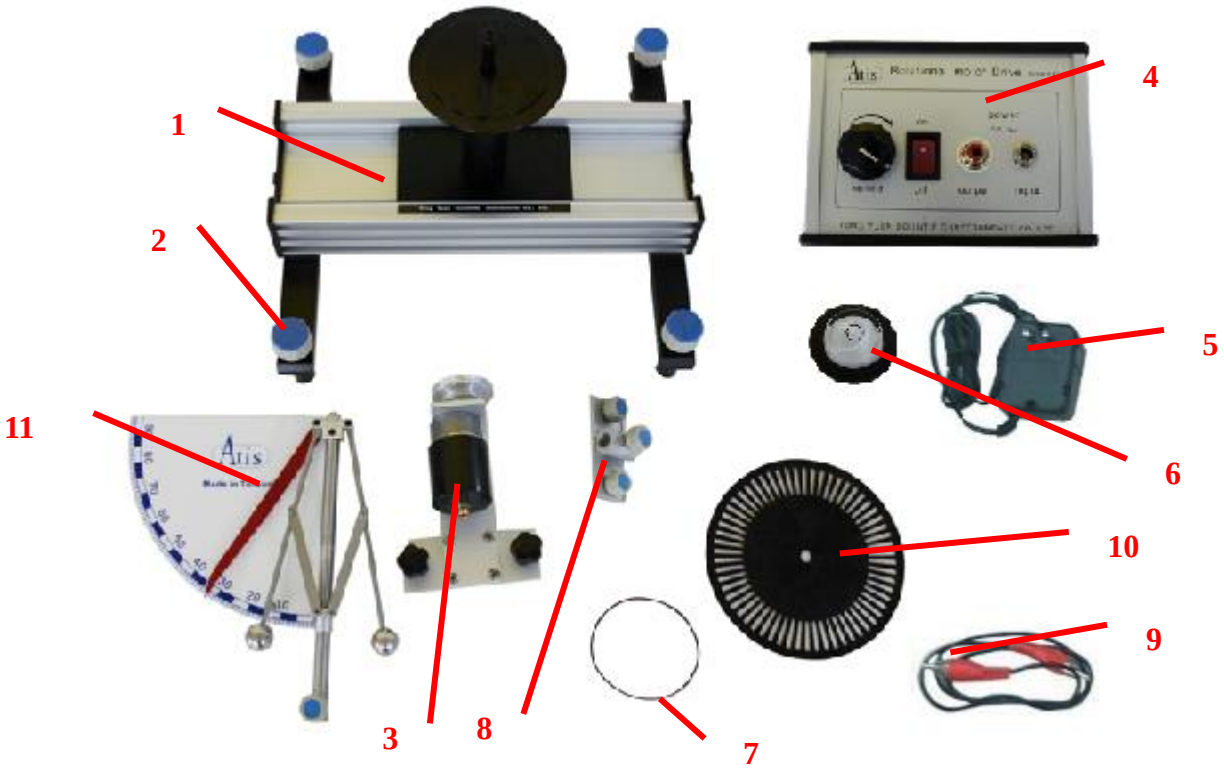
Pictures of accessories



Instrument setup

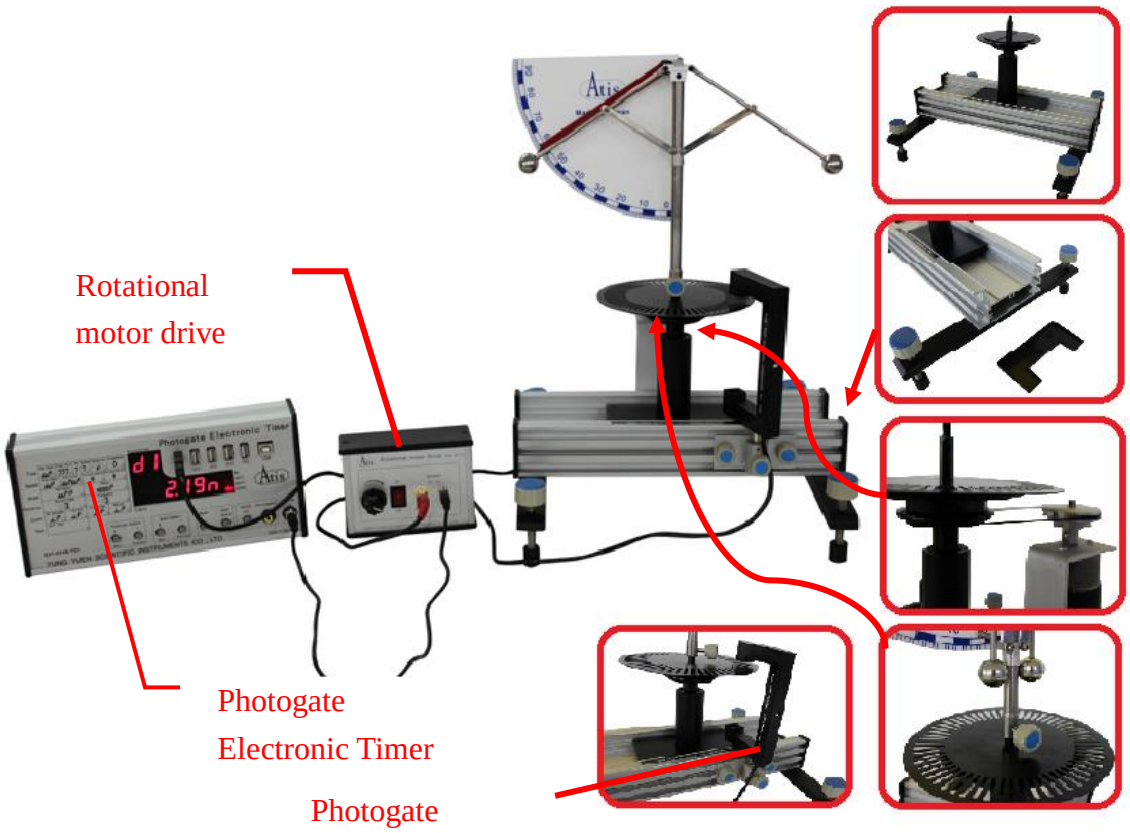


Figure1-2 Experimental setup

1. Experimental setup is shown in **Figure 1-2**. Connect the experimental base to the feet and lock screws on the base.

2. Open side lids on the base and put on the connector and DC motor. Put back the side lids.

3. Connect one end of the belt to the groove under the base and another end to the axis groove on the DC motor. The belt will be horizontal when the setup is complete. Carefully put on the fence.

4. Put on the angle bracket and lock the screws at the bottom.

5. Connect the photogate to the connector and connect the photogate electronic timer to the wire.

Note: The kit does not include photogate and photogate electronic timer (E01-631E-Y01). For better experiment results, we strongly recommend you to purchase photogate and photogate electronic timer. Please contact for details.

6. Use wires to connect DC motor, rotational motor drive and DC power supply.

Note:

1. The intensity of belt will affect the start of motor. Please adjust the connector properly. Do not pull the belt tight.

2. Make sure the instruments do not hit objects during the experiment. Do not force to stop or slow the experiment.

Experimental method

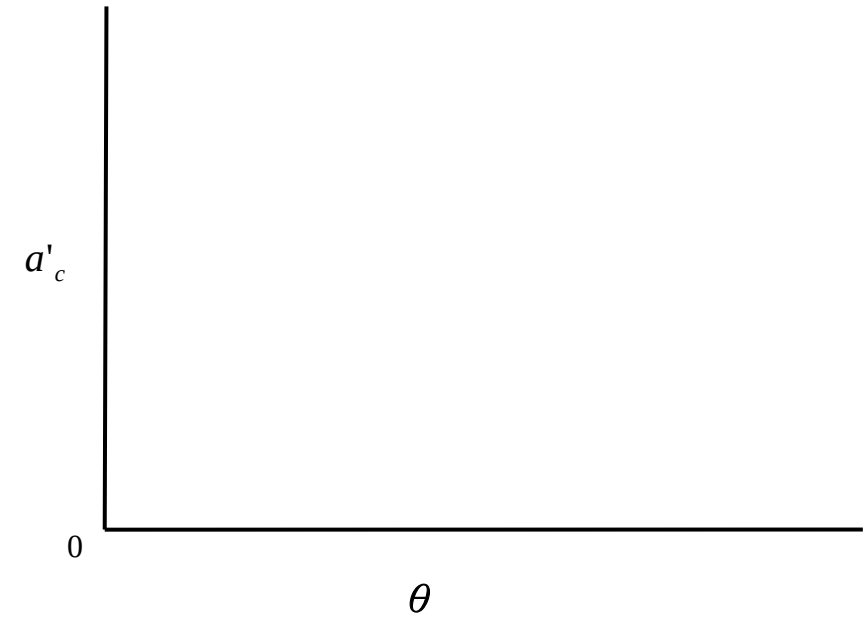
1. The experimental setup is shown in **Figure 1-2**. Start the rotational motor drive to operate the motor for 2-5 minutes. Observe the rotation of motor. Stop and adjust the motor when there is a problem.

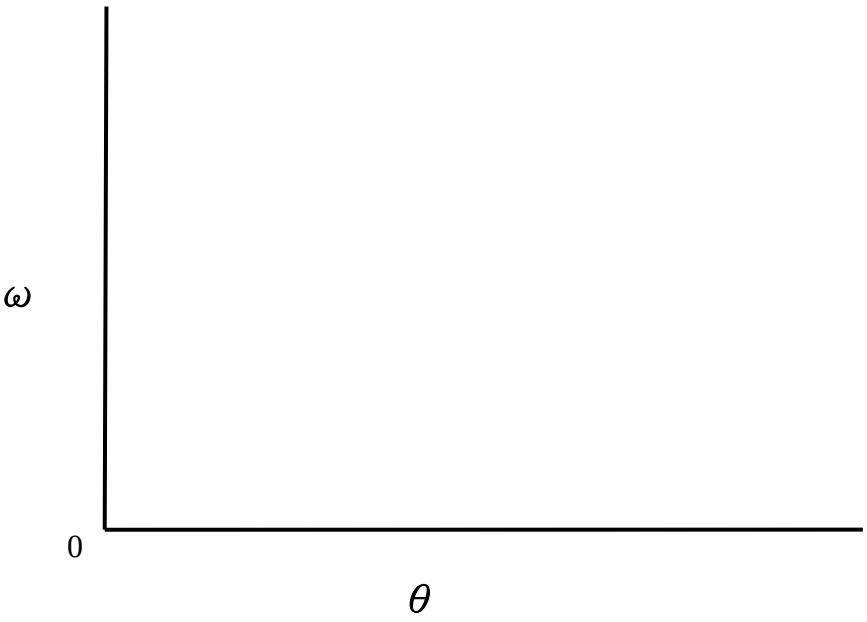
2. Record the experiment results based on the experiment recording sheet. Record the experiment results when the rotation velocity is 2.6~3.6πrad/s. Calculate experimental errors.

3. Draw the figure of ω, a'_c and θ.

Experiment results

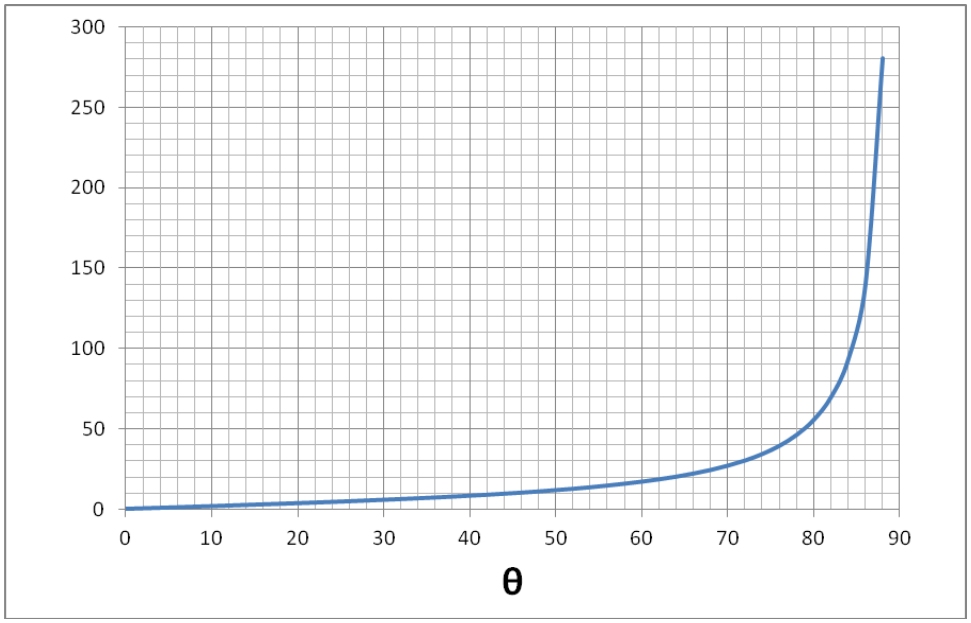
Experiment recording sheet						
Acceleration of gravity g = _____(m/s^2 **)** **Length L = _____(m)**						
Rotation velocity of axis ω	ω^2	**r**	**Centrifugal acceleration** a'_c	**Angle θ**	**Calculated Angle θ**	**Experimental errors %**


a'_c
0
θ

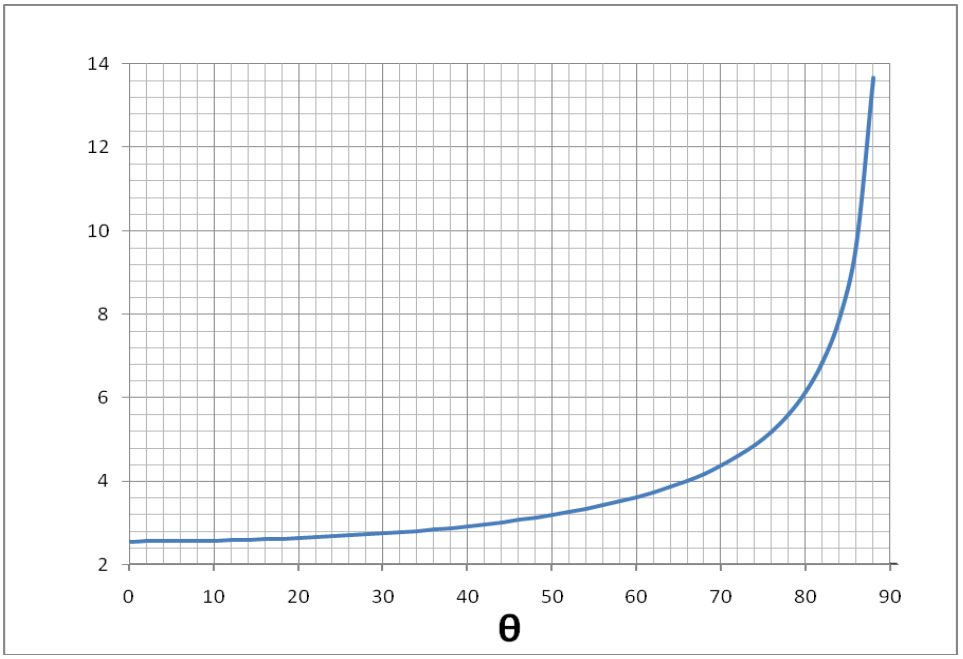

ω
0
θ

Questions and discussion

1. What is the relationship between angle, axis angular velocity and centrifugal force?



Centrifugal acceleration and angle



Rotational speed and angle.

2. What is the result if we increase the length?

3. Will the angle be influenced if we change the mass of ball?