A01-100S-Y31

Mechanics (D)

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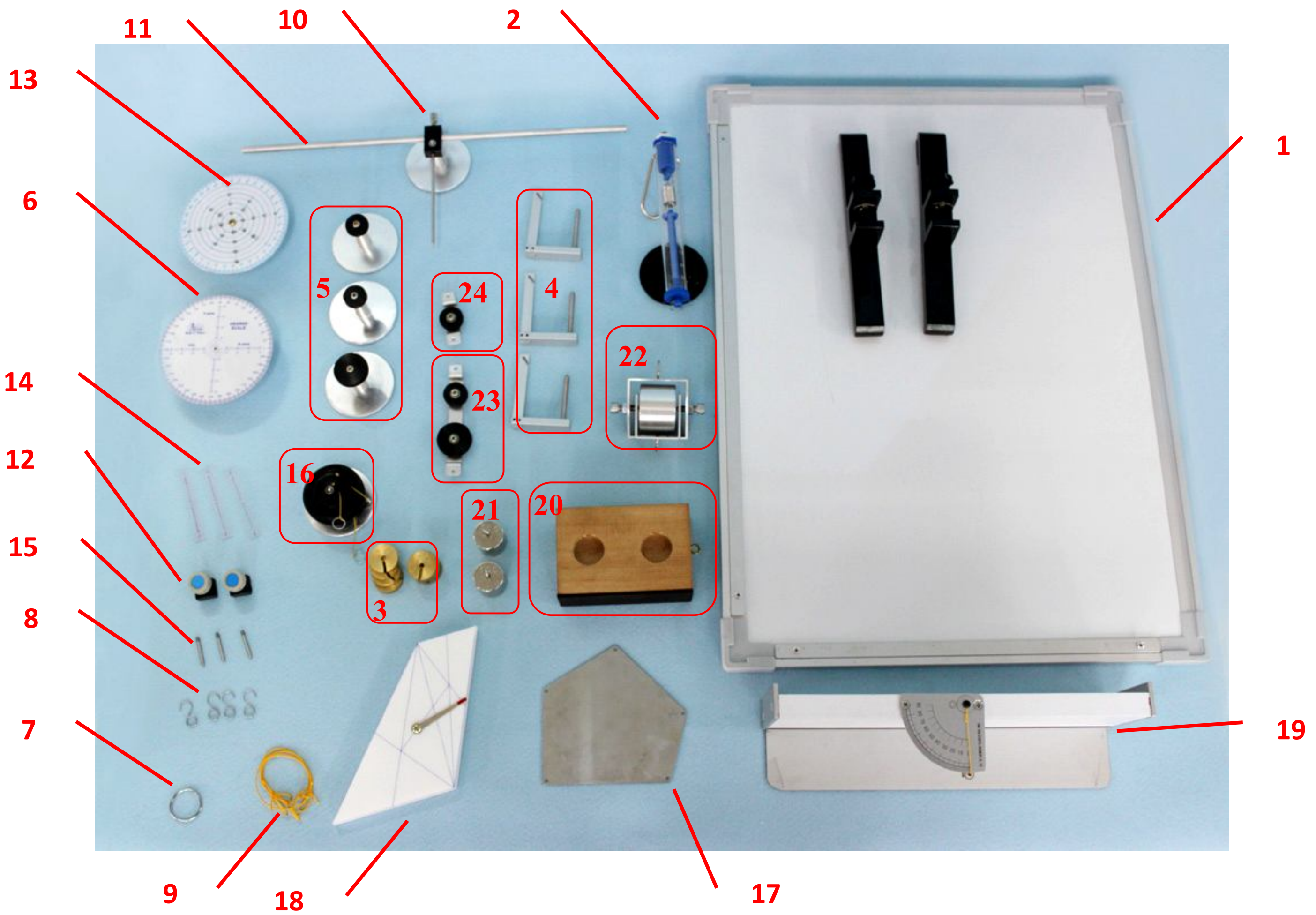
II. Experimental instrument list

Mechanics (D) instrument list					
Number	**Name**	**QTY**	**Number**	**Name**	**QTY**
1	Experimental whiteboard	1	2	Spring balance	1
3	20g weight group	1	4	Weight Block	3
5	Fixed pulley	3	6	Degree Quantity Table	1
7	O Ring	1	8	S-shaped shackle	3
9	String	3	10	Pivot	1
11	Stabilizer bar	1	12	Removable - Hook	2
13	Scale dial	1	14	Ruler Extension	3
15	Bolt	3	16	Axle	1
17	Five-sided metal plate	1	18	Four sides of the plate	1
19	Reference Plate	1	20	And attached hook - pieces of wood	1
21	100g weight	2	22	LASHING - pulley	1
23	Double pulley	1	24	Single pulley	1

(D) Instrument Control Mechanics



Experiment 1. Hooke's Law

Purpose of the experiment

According to Hooke's law, to measure the relationship between the coefficient of elasticity of the spring and the spring and the force.

Experimental principle

When the object under force, can be observed to the object deformation and the change of the state of motion, we can know, by simple one-dimensional spring deformation, given spring biasing, the deformation amount of elongation and spring force linearly-relationship.

Hooke's law:

When spring its elongation by an external force, the elongation length does not exceed the spring elastic limit and the external force proportional, which Hooke's law. According to Hooke's law can be obtained:

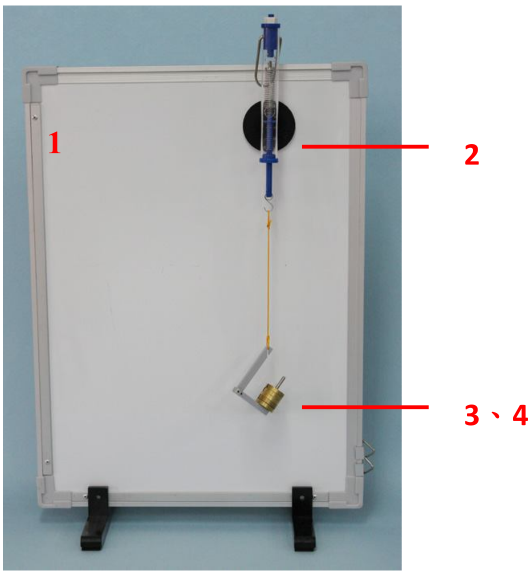
$F = -KX$, (k is the coefficient of elasticity of the spring, F representative of the restoring force, the amount of the X-table elongation.)

The negative sign in the formula representing the direction and the deformation of the elastic direction opposite. If an object of mass M is suspended from the bottom of the spring, by Newton's second law of objects in the external force $F = Mg$ (M is the mass of the object, and g is the gravitational acceleration) in the spring and its elongation X. Therefore the use of the relationship between the amount of external force and elongation measurement spring can be obtained of the modulus of elasticity of the spring k.

Experimental instrument

Hooke's law instrument list					
Item	**Name**	**Quantity**	**Item**	**Name**	**Quantity**
1	Experimental whiteboard	1	2	Spring balance	1
3	Weight Set	1	4	Weight Block	2

Hooke's law Instrumentation Diagram



Experimental procedure

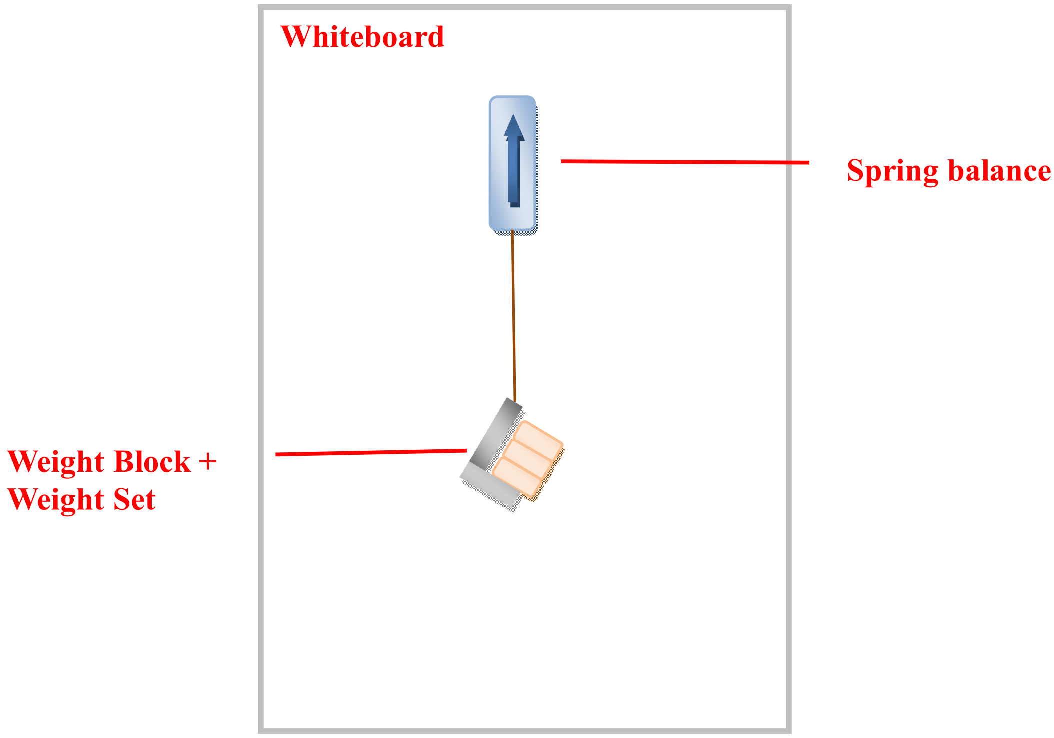
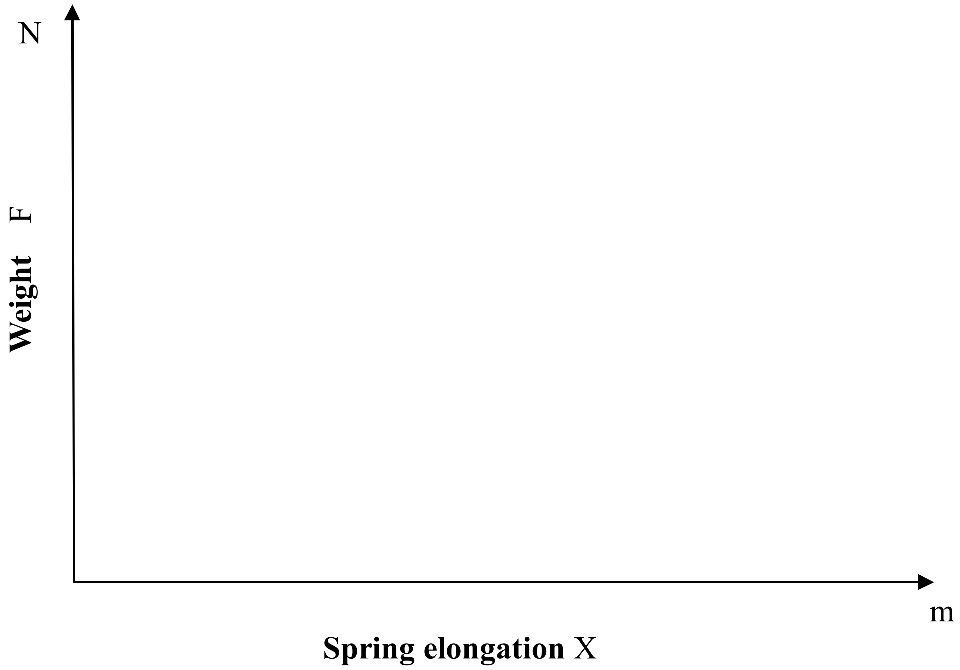


Figure 1-1 experimental setup

1. First adsorbed on the whiteboard on the spring balance, spring balance at the top of turn button, so that the initial value of the spring balance to zero.
2. According to the experimental record in Table 1-1, hanging in the hook of the spring balance weights seat sequentially increased 20g weights weight and record the results obtained Elastic Coefficient, and try to draw the spring force and spring elongation diagram.

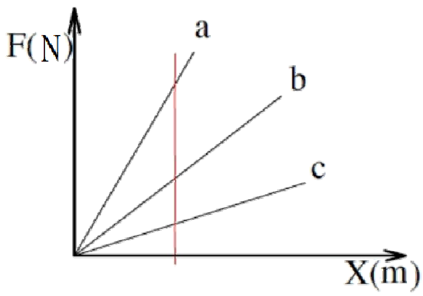
Experimental record table (1-1)								
Spring scale initial value = _______ Weights seat weight = _________ Acceleration of gravity = ________								
Weight increment (kg)		0.02	0.04	0.06	0.08	0.10	0.12	0.14
Weight(N)								
Spring elongation (m)	1							
	2							
	3							
	4							
	5							
	Average							
amount of change of the spring (m)								
Coefficient of elasticity k								
Average elastic coefficient k = ________					Average spring change = __________			



Experimental discussion

1. Describe of value of k in Hooke's law.

2. Compare elasticity coefficient size according of following figure.



Experiment 2. Static Balance - Total Points Together

Purpose of the experiment

Analysis of common point Heli relationship in of same plane by of static equilibrium mechanics

Experimental principle

In physics, of force of the physical quantities have scalar and vector representation of vector operations shown of Figure 2-1

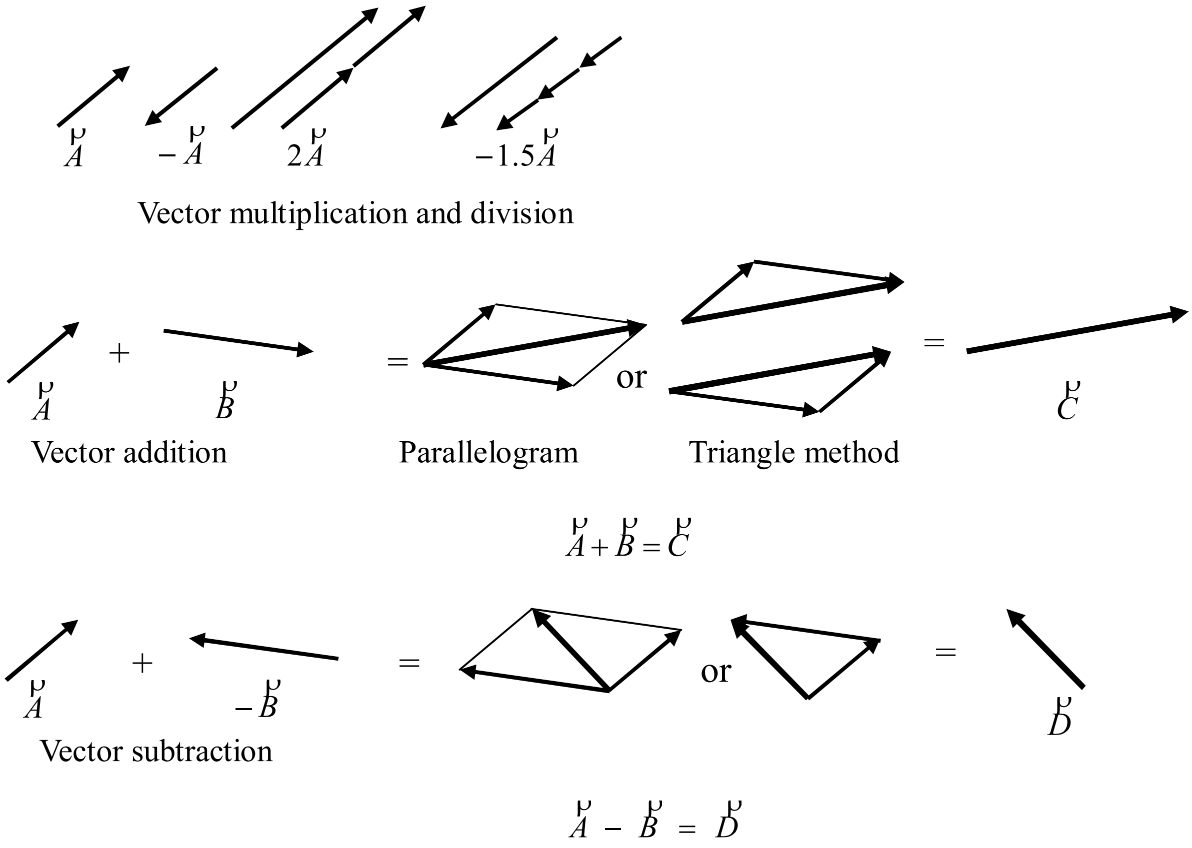


Figure 2-1 vector operations

Vector multiplication and division

Vector A mathematical representation, the size of the scalar vector A is expressed as a negative number and the direction of vector A contrary. Vector A is twice as large as can be illustrated as, where "2" represents a scalar, non-directional only the size. Scalar and vector multiplication and division, and their product is a vector rather than scalar.

Vector addition

Parallelogram: the addition of two vectors, parallelogram law of addition of vector addition, as indicated in Figure 2-1, placed in the same point of the arrow tail of two vectors of A, B, and A and B both sides of the painting. The parallelogram, through the diagonal of the tail of the arrow is the vector and the C. Triangle method: the addition of another vector, the vector of the tail of the arrow B vector A arrow head phase the above triangle method in Figure 2-1, and then by the end of the arrow of vector A to vector B arrow head a vector C, then C is the sum of the two vectors A and B. Terms of the reverse order of

addition can also get the same vector C can get certified to comply with the commutative. A + B = B + A = C.
If A, B, two vectors is collinear, the same or opposite directions, the adder are the same as the general algebraic operations. That A + B = C.

Vector subtraction
The vectors A minus vector B can be written as $\vec{A}-\vec{B}=\vec{A}+(-\vec{B})=\vec{D}$ As Figure 2-1 vector subtraction, which can be shown as the vector sum of the resulting vector A and vector B in the opposite direction vector (-B). Therefore, vector subtraction can also be used as the adder.

Mechanics static balance is in a quiescent state or uniform motion of objects. To distinguish between these two states: the case with the analysis of the object in a quiescent state by force is called static balance (static equilibrium), in uniform motion of an object by the force of circumstances analysis known as dynamic balancing (dynamic equilibrium).

Equilibrium conditions

Force balance on a plane, as in the following Figures 2-2a, a single force causes moving objects, does not reach a force equilibrium; shown in Figure 2-2b, two opposite to the direction of the force, and not in the same straight line will object rotation, did not reach force balance; Figure 2-2C, the two forces are equal in magnitude and opposite in direction, and act along the same line, to achieve a balance.

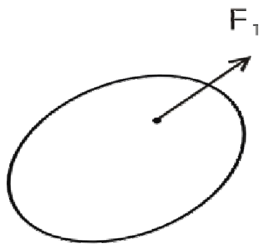


Figure 2-2a

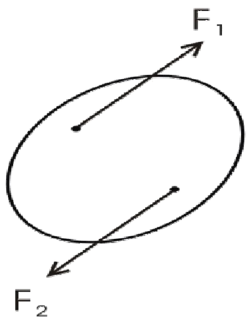


Figure2-2b

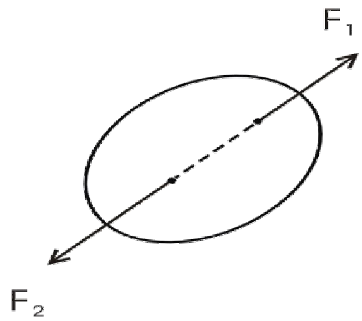


Figure2-2c

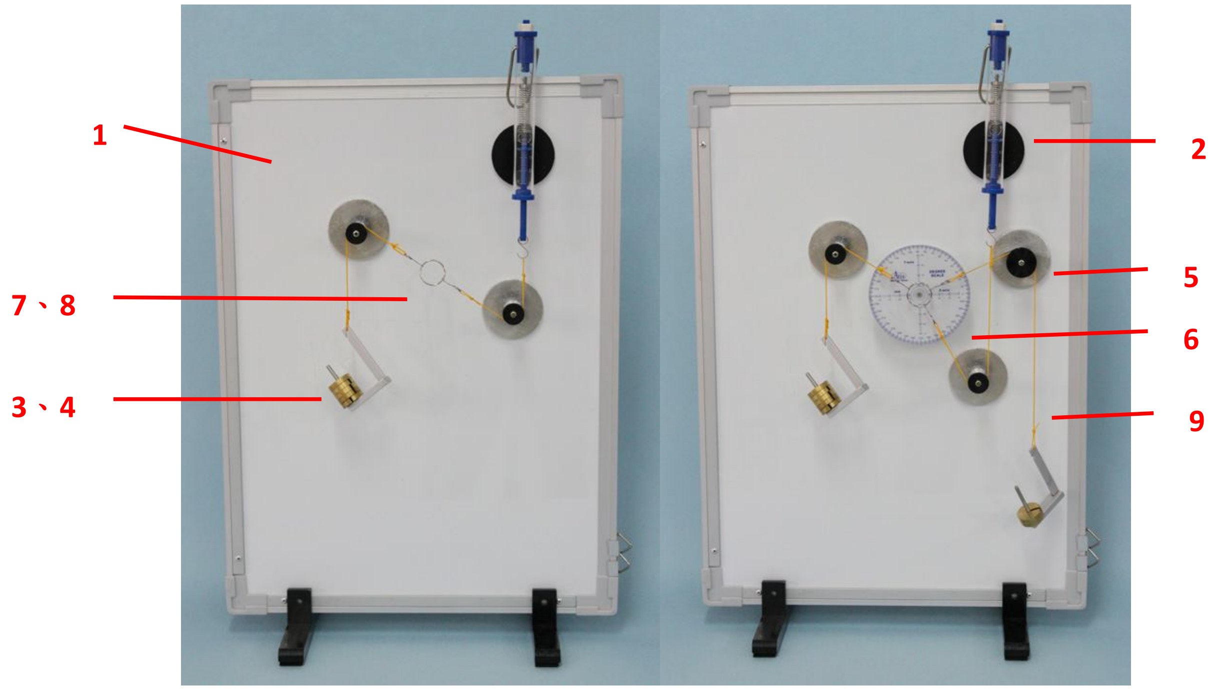
If you want to maintain a state of equilibrium, you must comply with Newton's first law of motion, that the resultant force acting on the particle on zero, this condition can be expressed as a mathematical formula to, which is active in the vector sum of all the forces on the particle.

Formula is not only the balance necessary conditions sufficient condition is balanced, which can be learned from Newton's second law of motion. If the force system satisfies the formula, can be obtained, this particle acceleration a = 0, so that the particle will remain uniform motion or stationary.

Experimental instrument

Hooke's law instrument list					
Item	Name	QTY	Item	Name	QTY
1	Experimental whiteboard	1	2	Attached magnetic - spring balance	1
3	Weight Set	1	4	The attached hook - weight Block	2
5	The attached magnetic - fixed pulley	3	6	The attached magnetic - degree Quantity Table	1
7	O-ring	1	8	S-shaped shackle	3
9	Thread	3			

Static equilibrium total points resultant force instrument



Laboratory procedures

1. Spring balance adsorbed on whiteboards, spring scale zero initial value, use two pieces of thin wire connected to one end of the s-hook-loop, and then hook the o-rings, bypass the two pulleys, hanging spring scale and weights, respectively, as in Figure 2-2. And application of weights on the replay m g

2. According to the record of experiments (2-1), captured spring balance size and direction of the Fe application.

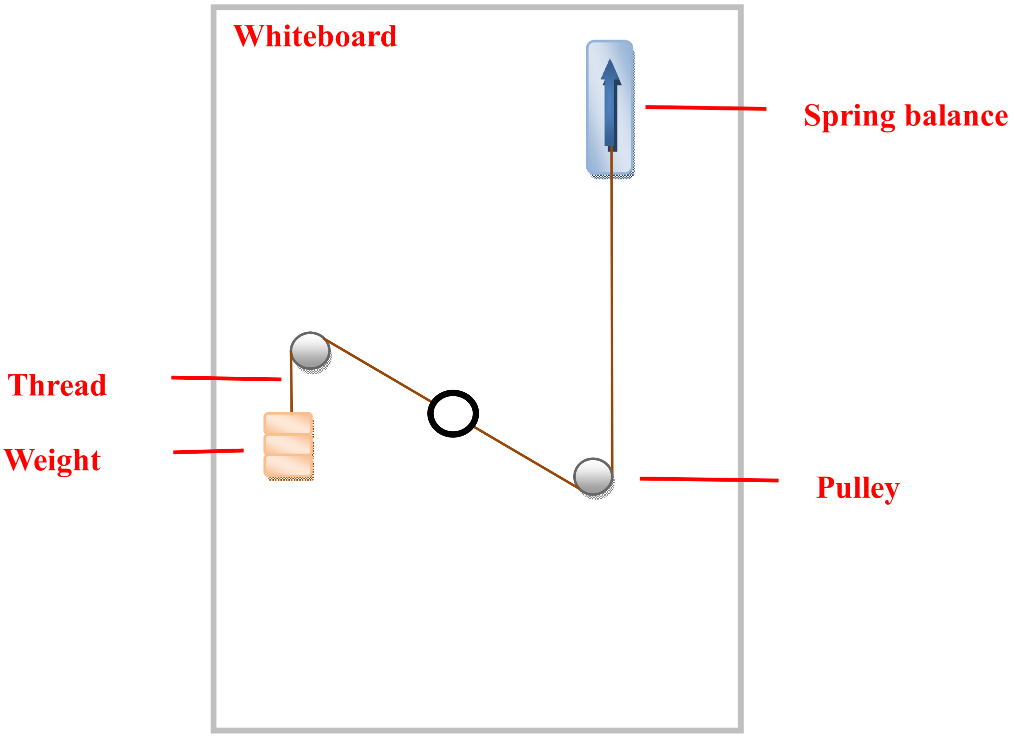


Figure 2-2 Experimental device

3. On the third string end with s-shaped hook with O-rings, bypass pulley at the other end, hung up the weights. For co-O-rings, three spring balance Fe, respectively on the other side of the thin line, weights of F1 and F2 of weights of three force to balance, as shown in Figure 2-3

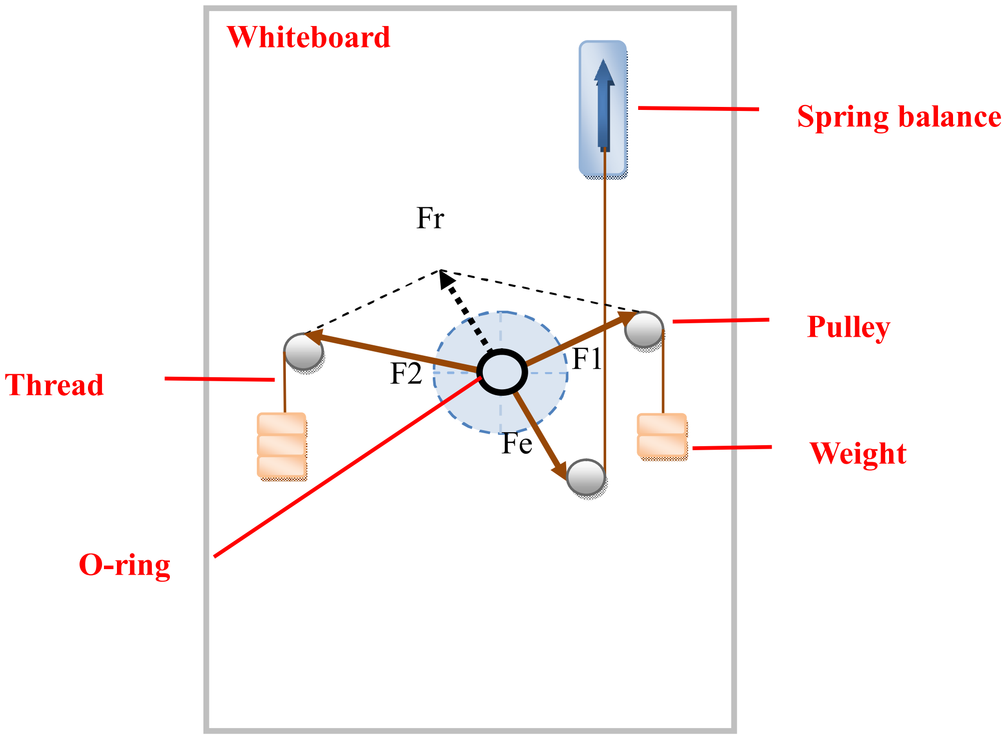


Figure 2-3

4. Increased weight, F1, and F2 force size and angle, and Fe balance Fe recorded in size is equal to the above steps. Remember green in experimental record form (2-1).

5. According to records (2-1), and angle in the data values to the vector expressed in the experimental diagram, select approximately 50 per cent of them mm/N. And in a table, using parallelogram theorem paint the size of forces in F1 and F2 Fr, Fe.

6. With the same size Fe, change the direction of F1 force size, resize the F2 force direction, repeat the steps above ~. Record in the experimental list (2-2)

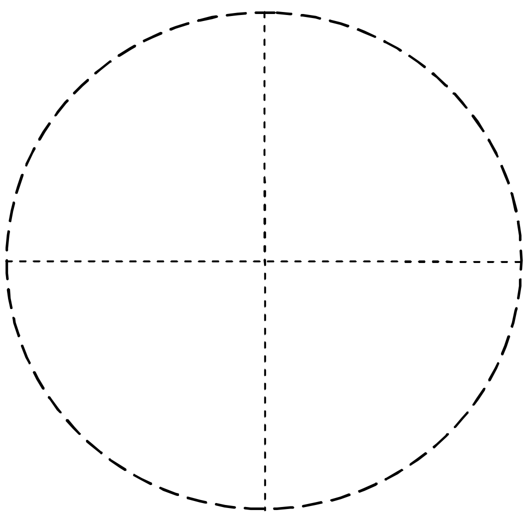
Experimental record

Experiment sheet (2-1)

Force scale spring balance to zero =______N
Acceleration =______m/S2
Force =______mm/N

	Weight (g)	**Force (n)**	**Angle (°)**	**The force-length (cm)**
Fe				
F1				
F2				
Fr				

Common point of the a joint force vector chart

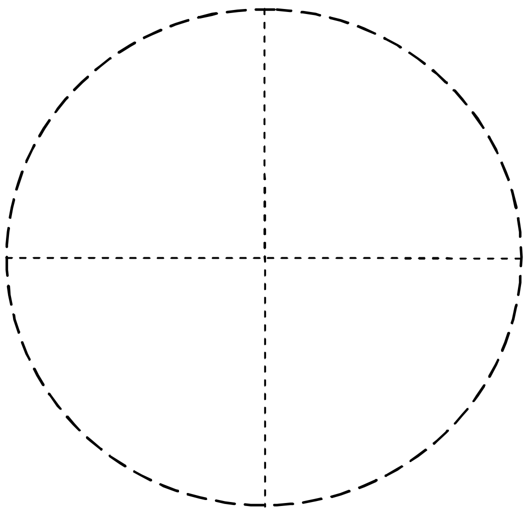


Experiment sheet (2-1)

Force scale spring balance to zero =______N
Acceleration =______m/S2
Force =______mm/N

	Weight (g)	Force (n)	Angle (°)	The force-length (cm)
Fe				
F1				
F2				
Fr				

Common point of the a joint force vector chart



Experimental discussion

1. According to the experimental vector chart, using the law of cosines proof the vector parallel's law as well as the triangle method.

Experiment 3. Static Balance - The Resolution of Forces

Experimental purposes

Static experimental analysis on the Whiteboard total points balance, using the x-y plane rectangular coordinates to represent the component.

Experimental principle

From previous experiments that, force vectors, with magnitude and direction, can make use of the parallelogram law for addition. Statics of commonly encountered in two issues: A is known to contribute to two, requiring them to; the other is known to be a force, calling its two part. These two problems can be solved using parallelogram law If two or more together using parallelogram law, requires the use of geometry and trigonometry calculations to get Heli size and direction. However such problems using Cartesian way, easily find their solution.

Vector decomposition (resolution of a vector)

In a two-dimensional plane, using parallelogram law of one vector can be decomposed into two components of known direction. 3-1 in the following illustration (a) as shown in the vector f broken down into two components of x, y axis, By the arrow head made of two parallel lines parallel to the x and y axes, respectively, and given over to y, x axis from the origin o to the intersection of the axis, you can make two components Fx and Fy, as shown in Figure 3-1 (b).

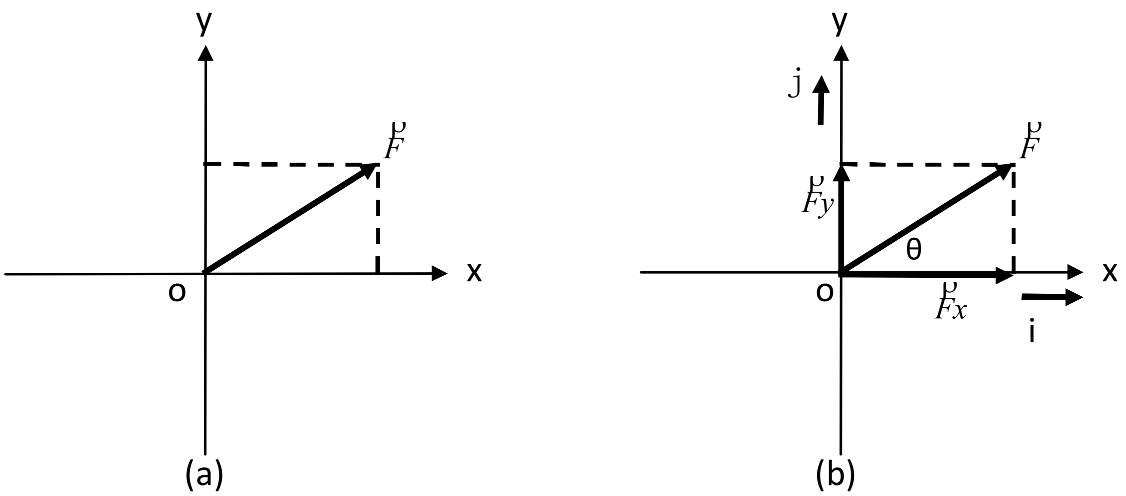


Figure 3-1 Cartesian vector decomposition

Unit vector

The vector whose size is 1, it shall be a unit vector. If the size of the vector F is not zero, The veneered panels-stub in the direction of the vector is the same $\vec{u}_F = \frac{\vec{F}}{|\vec{F}|} = \frac{\vec{F}}{F}$ or $\vec{F} = \vec{u}_F F$

Components of a vector

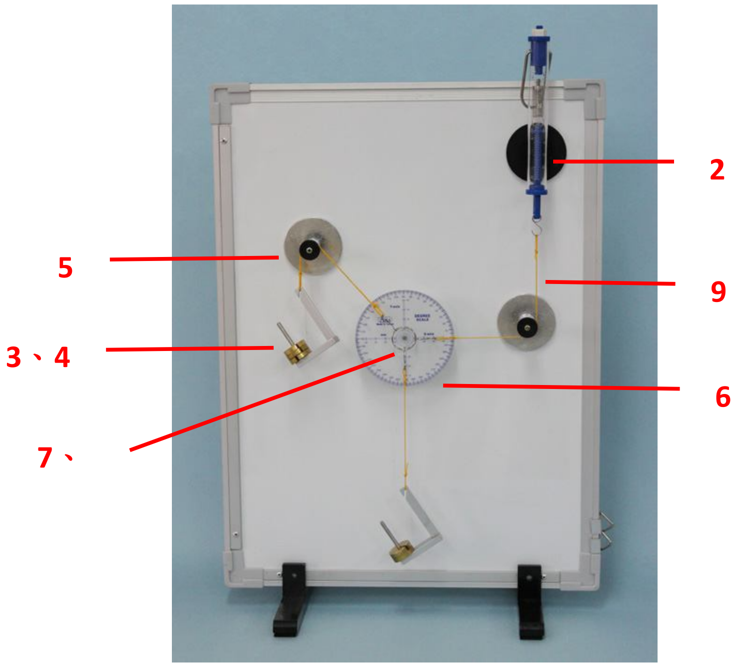
A unit vector in a two-dimensional plane of i and j represent the x and y axes, respectively, as indicated in Figure 3-1 (b) as shown. These vector is a unit of size, with a plus or minus sign to indicate its direction, if forward along the x or y axis, expressed in symbols.

$$\vec{F} = F_x \vec{i} + F_y \vec{j}$$

$$F_x = F\cos\theta \text{ ， } F_y = F\sin\theta \text{ ， } |\vec{F}| = \sqrt{F_x^2 + F_y^2} = F\sqrt{\cos^2\theta + \sin^2\theta} = F \text{ ， } \theta = \tan^{-1}(\frac{F_y}{F_x}) \text{ 。}$$

Experimental instruments

Hooke's law instrument list					
Item	**Name**	**QTY**	**Item**	**Name**	**QTY**
1	**Experimental whiteboard**	**1**	**2**	**Attached magnetic - spring balance**	**1**
3	**Weight Set**	**1**	**4**	**The attached hook - weight Block**	**2**
5	**The attached magnetic - fixed pulley**	**3**	**6**	**The attached magnetic - degree Quantity Table**	**1**
7	**O-ring**	**1**	**8**	**S-shaped shackle**	**3**
9	**Thread**	**3**			



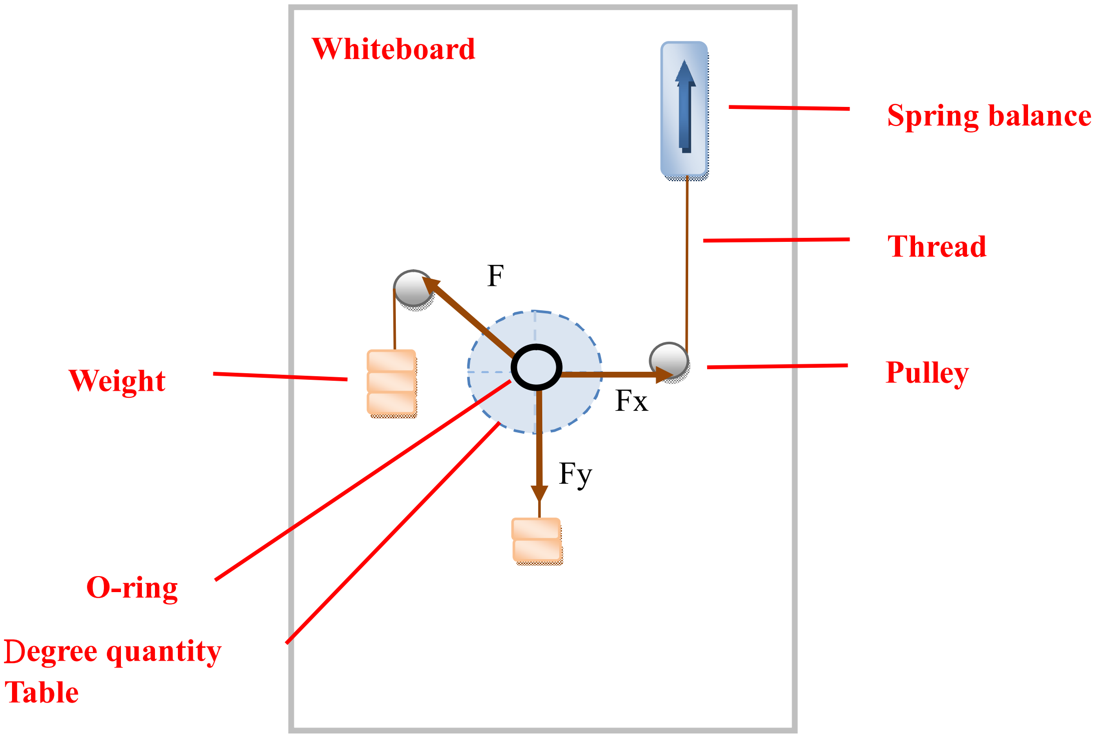


Figure 3-2 sketch of total points balance

1. Direction of the appliance as indicated in Figure 3-2,Fx for the Cartesian x axis horizontal, Fx for the Cartesian y axis vertical direction, f for Fx and Fy Heli, Fx and Fy f component.

2. According to the experiments in mind the table (3-1), an increase of weight sets f and Fy force size, Fx spring scale measurement value read

3. About 50 mm/N, draw a force analysis on the Cartesian diagram. Theoretical calculation and compare the measured value with error.

4. Change weight, heavy with the steps above, and recorded in a record of experiments (3-2)

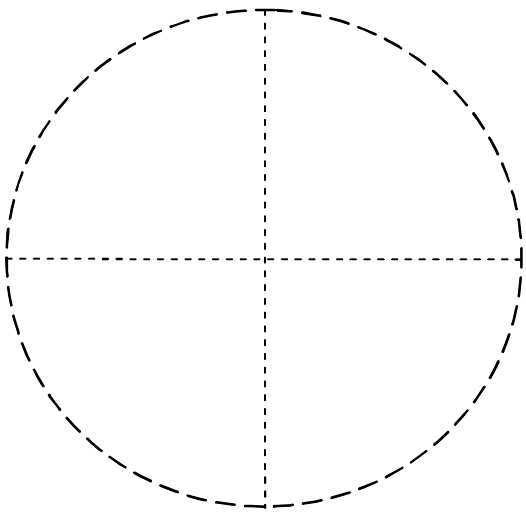
Experimental record

Experiment sheet (3-1)

Force scale spring balance to zero =______N
Acceleration =_______m/S2
Force =_______mm/N

	Weight (kg)	Force (n)	Force size Measurement (n)	Force angle (°)	Applying pressure angle Measuring (°)	The force-length (cm)
F						
Fy						
Fx						
Error%		Fx:		F：		$F^2=F_x^2+F_y^2$

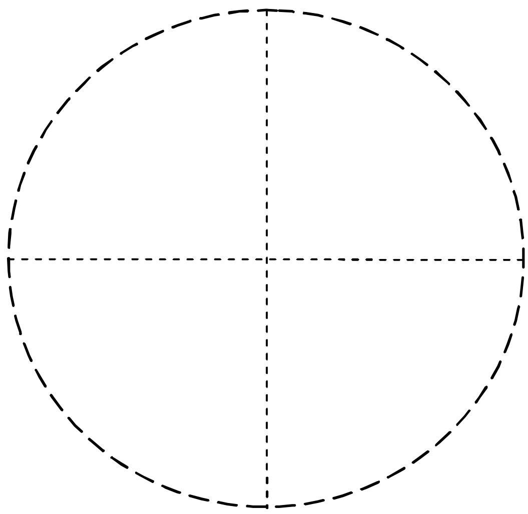
Force decomposition of vector map table



Force scale spring balance to zero =______N
Acceleration =_______m/S2
Force =_______mm/N

	Weight (kg)	**Force (n)**	**Force size Measurement (n)**	**Force angle (°)**	**Applying pressure angle Measuring (°)**	**The force-length (cm)**
F						
Fy						
Fx						
Error%		**Fx:**		**F：**		**$F^2=F_x^2+F_y^2$**

Force decomposition of vector map table



Experimental discussion

1. Try to discuss the relation between f, Fx and Fy.
2. F angle change, observed changes in Fx and Fy.
3. When rotated 45 degrees if x-y axes at right angles, to observe changes in Fx and Fy

Experiment 4. The Torque Balance - Plummet Parallel Force

Experimental purposes

In static non concurrent to use both sides respectively of the stabilizing effect in the vertical forces, the moment arm of analysis and size of the force.

Experimental principle

Torque:

Torque, moment or moment of force, is the tendency of a force to rotate an object about an axis, fulcrum, or pivot. Just as a force is a push or a pull, a torque can be thought of as a twist to an object. Mathematically, torque is defined as the cross product of the lever-arm distance and force, which tends to produce rotation.

Loosely speaking, torque is a measure of the turning force on an object such as a bolt or a flywheel. For example, pushing or pulling the handle of a wrench connected to a nut or bolt produces a torque (turning force) that loosens or tightens the nut or bolt.

The symbol for torque is typically τ, the Greek letter tau. When it is called moment, it is commonly denoted *M*.

The magnitude of torque depends on three quantities: the force applied, the length of the *lever arm* connecting the axis to the point of force application, and the angle between the force vector and the lever arm. In symbols:

$$\tau = (r)(F\sin\phi) \text{ or } \tau = (r\sin\phi)(F),$$

$$\vec{\tau} = \vec{r} \times \vec{F}$$

τ is the torque vector and τ is the magnitude of the torque,
r is the displacement vector (a vector from the point from which torque is measured to the point where force is applied), and *r* is the length (or magnitude) of the lever arm vector,
F s the force vector, an *F* is the magnitude of the force,
× denotes the cross product,
θ is the angle between the force vector and the lever arm vector.

The length of the lever arm is particularly important; choosing this length appropriately lies behind the operation of levers, pulleys, gears, and most other simple machines involving a mechanical advantage.

The SI units for torque is the Newton Meter (N·m).

For more on the units of torque, see below.

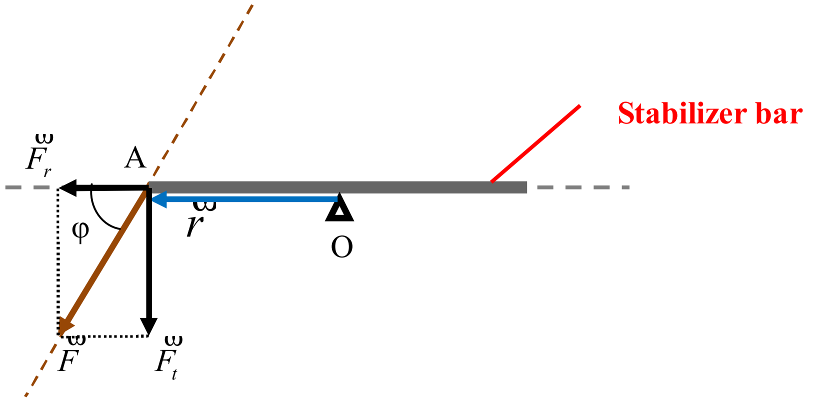


Figure 4-1

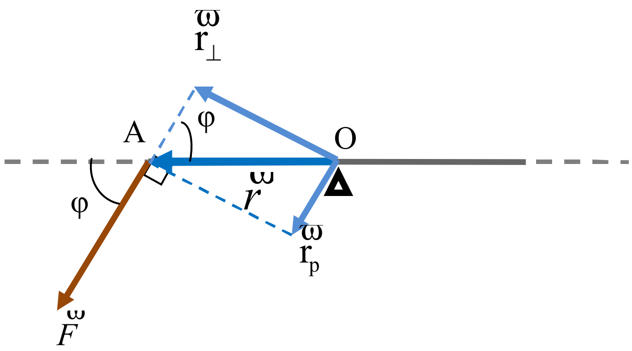


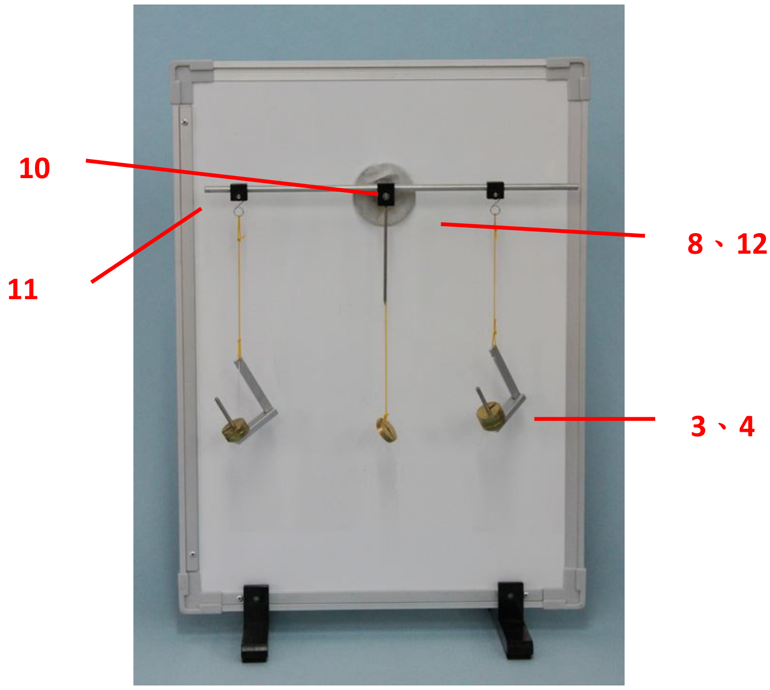
Figure 4-2

Total torque:

Match Synthesis of force, joint force torque and total torque. Total torque equal to zero, then the object will not be rotated; otherwise there will be rotation of the phenomenon

Laboratory instruments

Hooke's law instrument list					
Item	**Name**	**QTY**	**Item**	**Name**	**QTY**
1	**Experimental whiteboard**	**1**	**2**	**Attached magnetic - spring balance**	**1**
3	**Weight Set**	**1**	**4**	**The attached hook - weight Block**	**2**
5	**The attached magnetic - fixed pulley**	**3**	**6**	**The attached magnetic - degree Quantity Table**	**1**
7	**O-ring**	**1**	**8**	**S-shaped shackle**	**3**
9	**Thread**	**3**	**10**	**Attached magnetic – pivot**	**1**
11	**Stabilizer bar**	**1**	**12**	**Removable – Hook**	**2**



Laboratory procedures

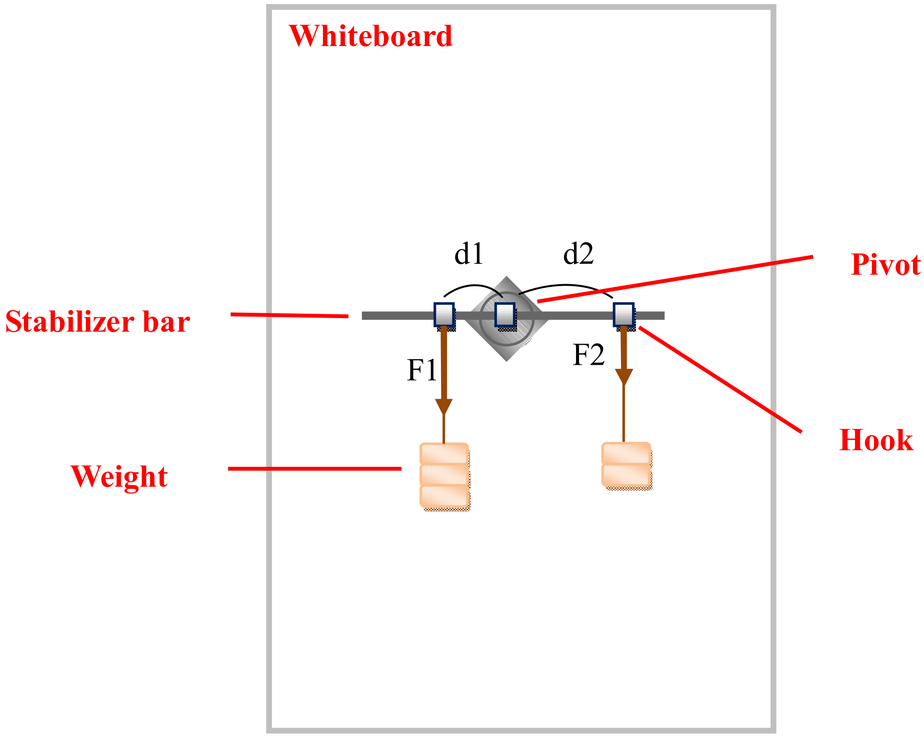


Figure 4-3 sketch of experimental device

1. Experimental device as indicated in Figure 4-3, the balance Rod insert the pivots and adjusts the horizontal balance and hang the hook Use two pieces of thin rope, one end with s-shaped loop, weights go on the other end.

Note: weights with a thin line connection and vertical hung on pivots, left and right balance adjustment