C15-2455-W1

Collision Apparatus for Kinetic Energy with BeeSpi v

Instruction Manual

Thank you very much for purchasing Collision Apparatus for Kinetic Energy.
Read all these instructions before use.
The Collision Apparatus for Kinetic Energy is specialy designed for student experiments in school.

Narika Corporation
2014 Edition

Introduction

This apparatus includes a "Horizontal Ball Launcher" and BeeSpi v for measuring velocity of the launched ball. Kinetic energy change depending on the velocity of the ball can be quantitatively obtained by measuring moving distance of sliding wood block when getting collision of horizontal launched ball on the guide rail.

Safety Precautions (Read before use.)

⚠ Notice

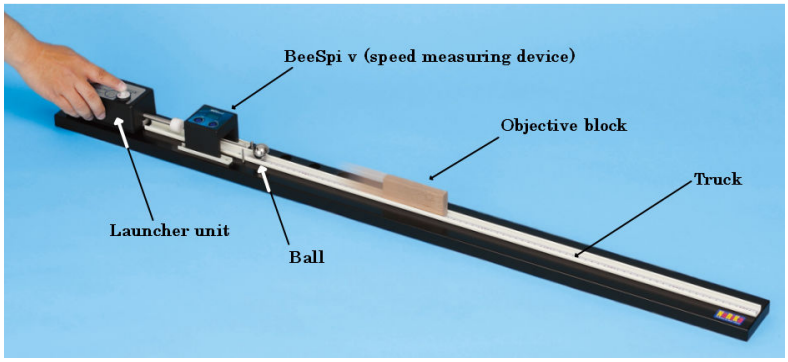
* Keep dry, please do not expose it to water, it may cause failure of the apparatus.
* Do not leave it under direct sunlight and in high temperature places. It may cause problems and damage of apparatus.
* Do not experiment on uneven or unlevel table.

Features of the apparatus

* Launcher unit has function to adjust initial velocity of the ball. Using a speed measuring device, such as "BeeSpi v" together, initial velocity of the ball can be measured.
* On the main body next to the truck there are 3 holes where can be balls placed during the experiment.
* The wooden block moving distance after the collision is given by its scale at once during the experiment.

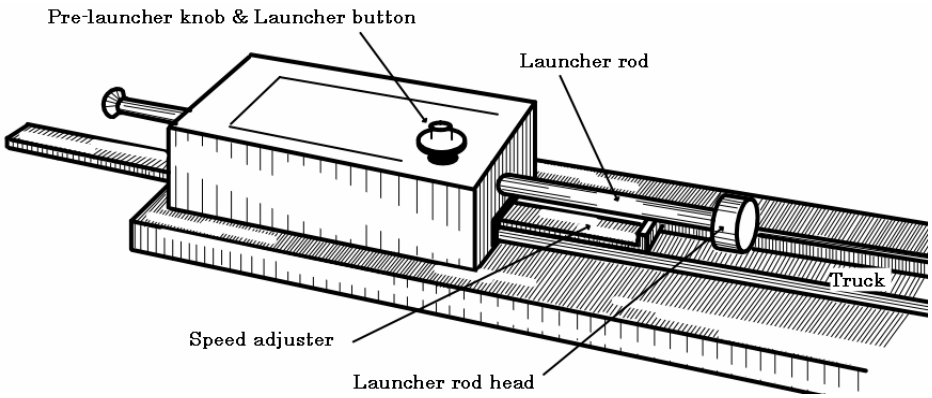
Contents and Specification

Main Body	:	Approx. 1,150 x 80 x 70 mm (included launcher unit)
Launcher unit	:	Continuously and non-continuously knob for control the initial velocity.
Balls	:	Steel ball (diameter 25mm, 67g) x 1, Ceramic ball (diameter 24mm, 19g) x 1, Plastic ball (diameter 25mm, 9.5g) x 1.
Truck	:	Plastic truck (length 1,000mm) with a scale (length: 820mm, 1mm graduation)
Wooden block	:	Objective block (approx. 14 x 100 x 40 mm, approx. 28g) x 1
BeeSpi v	:	A speed measuring device (Narika item number : S77-1321-W0) x 1



Instruction

1. Description of Launcher unit



*Pre-launcher knob (= PL knob)	:	This is a knob to set the launcher rod at the position of launcher as a preparation.
*Launcher button (= L button)	:	Launcher button is for launching a ball. When pushed after setting the launcher rod by "PL knob", the launcher rod will launch a ball.
*Speed adjuster (= S adjuster)	:	Launch speed will be controlled by the launch adjuster. Launch speed can be adjusted at three steps and as well continuously between the steps.
*Launcher rod head (= LR head)	:	There is a plastic block on top of launcher rod called launcher rod head. It pushes the ball out.
*Launcher rod	:	Launcher rod is like a cue stick.

2. Operating Launcher unit

1. Push and slide "L adjuster" to any position of three levels to set the launcher power (see Fig.1).
2. Turn "PL knob" up clockwise to 180 degrees where is an upper position of the knob (see Fig.1).
3. Move pushing "LR head" to the point of "S adjuster" and set the launcher rod (see Fig.2).
4. Set the ball at the launch position (see Fig.3).
5. Push "L button" for launching the ball with hold the launcher unit by your hand (see Fig.4).

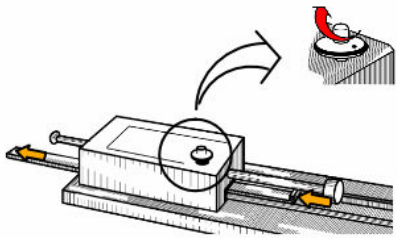


Fig.1

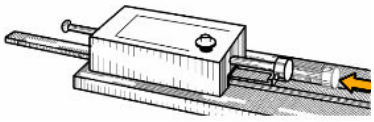


Fig.2

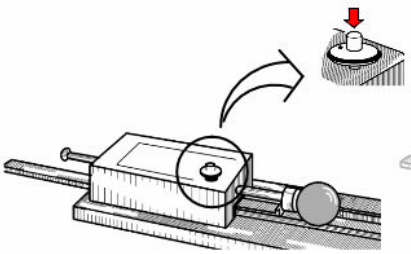


Fig.3

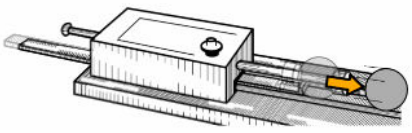


Fig.4

3. Operating Collision Apparatus with BeeSpi v

1. Set BeeSpi v (A speed measuring device) on BeeSpi v holder (see Fig.5 and 6), after setting the launcher unit (see Operating launcher unit).

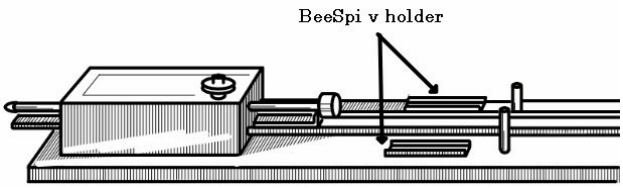


Fig.5

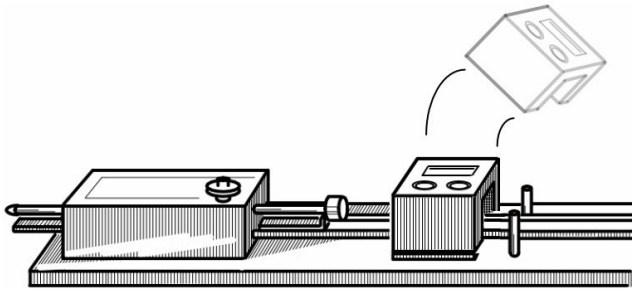


Fig.6

2. Put the ball in front of LR head (see Fig.7).
3. Put the wooden block (a target) correctly at the position of launch. The correct position is "0" on the scale tape on the truck (see Fig.8).
4. Push the start button of BeeSpi v for the measuring speed (see the instruction manual of BeeSpi v attached).
5. Push L button for launching the ball with hold the launcher unit by your hand.

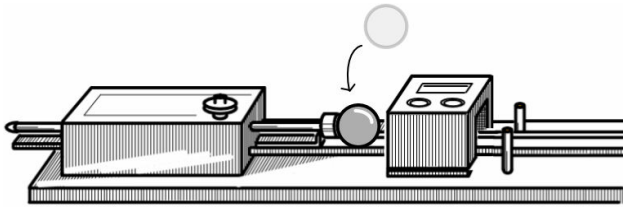


Fig.7

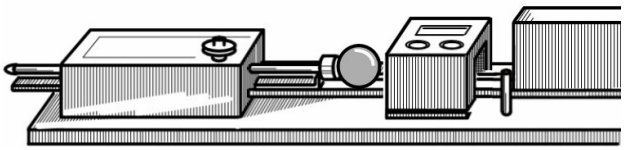


Fig.8

[Caution!]

*The launch position of the ball and position of the wooden block is extremely important for the experiment. If the ball and wooden block is put in wrong position, it may cause bigger dispersion in measurement.

* Hold the launcher unit at the launch by hand to get a better data.

Sample experiment

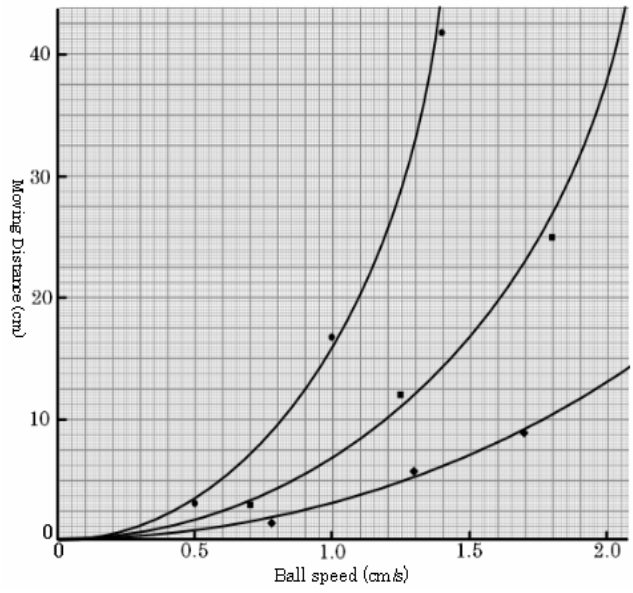
Confirmation of Kinetic Energy

You may confirm that the kinetic energy (E) is proportional to the square of the velocity using this apparatus.

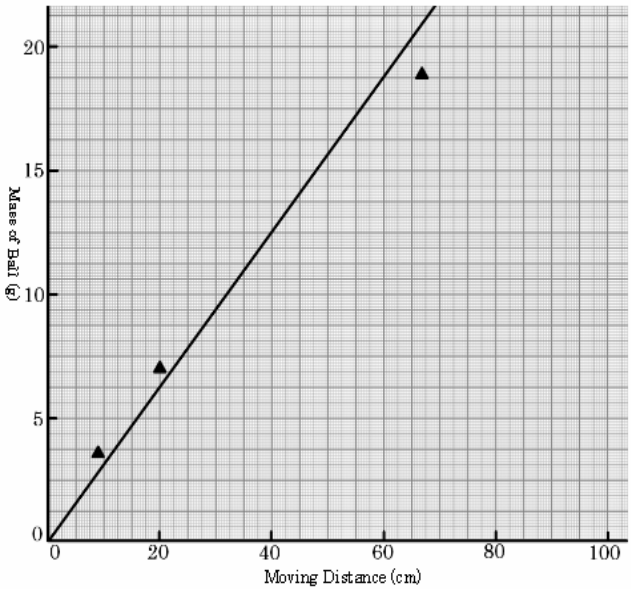
$$E = \frac{1}{2} m v^2$$

In the collision experiment of balls which are the same diameter, different weight (steel, ceramic, and plastic) with a wooden block, you may obtain the moving distance and speed of ball and make Graph 1 of the distance and speed. In the experiment, the moving distance of the ball is proportional to the kinetic energy. The kinetic energy formula is confirmed by the graph (Quadratic curve).

And when speeds of balls are controlled at 1.0 m/s by "Speed adjuster", the relation between the moving distance and the mass may be obtained Graph 2 (Primary curve).



Graph 1



Graph 2

Data of Graph 1

Steel Ball: Mass = 67g

Moving distance of Wooden block(cm)	Speed of Ball (m/s)
3.2	0.5
19.4	1.0
41.9	1.4

Ceramic Ball: Mass = 20g

Moving distance of Wooden block(cm)	Speed of Ball (m/s)
2.91	0.697
12.01	1.251
24.8	1.759

Plastic Ball: Mass = 9.5g

Moving distance of Wooden block(cm)	Speed of Ball (m/s)
1.62	0.782
5.88	1.308
8.86	1.657

Data of Graph 2

Steel Ball			Ceramic Ball			Plastic Ball		
66.7g	Moving distance of Wooden block (cm)	Speed of Ball (m/s)	20.0g	Moving distance of Wooden block (cm)	Speed of Ball (m/s)	9.5g	Moving distance of Wooden block (cm)	Speed of Ball (m/s)
1	19.2	0.98	1	6.6	0.97	1	3.5	1.01
2	19.1	0.98	2	6.0	0.94	2	3.6	1.02
3	18.5	0.99	3	7.4	1.01	3	3.4	1.02
4	18.2	0.99	4	8.2	1.04	4	3.5	1.01
5	17.9	0.98	5	6.8	0.97	5	3.5	1.01
6	19.5	0.98	6	6.8	0.98	6	3.2	0.97
7	19.0	0.99	7	7.0	0.97	7	3.6	1.02
8	18.9	0.98	8	7.5	0.99	8	3.5	1.02
9	19.3	0.98	9	7.5	0.99	9	3.5	1.03
10	19.3	0.99	10	7.4	0.99	10	3.7	1.03
av.	18.9	0.98	av.	7.1	0.99	av.	3.5	1.01

Table1-1. Experiment result of relationship between the moving distance and the speed of Steel ball.

Steel Ball	Speed adjuster level 1 (Low Intensity)		Speed adjuster level 2 (Medium Intensity)		Speed adjuster level 3 (High Intensity)	
Mass: 67g	Moving distance of Wooden block(cm)	Speed of Ball (m/s)	Moving distance of Wooden block(cm)	Speed of Ball (m/s)	Moving distance of Wooden block(cm)	Speed of Ball (m/s)
1	3.2	0.51	19.2	0.97	44.7	1.43
2	2.9	0.46	19.1	0.96	44.2	1.41
3	3.4	0.52	18.7	0.99	40.8	1.45
4	3.1	0.52	19.7	0.98	42.2	1.44
5	3.1	0.52	18.0	0.95	42.4	1.42
6	3.5	0.50	20.0	0.97	44.8	1.45
7	3.3	0.52	19.1	0.96	43.1	1.41
8	3.1	0.50	20.3	0.99	40.4	1.41
9	2.9	0.49	19.1	0.91	38.0	1.37
10	3.3	0.51	21.1	0.99	38.4	1.43
Average	3.2	0.51	19.4	0.97	41.9	1.42

Table1-2. Experiment result of relationship between the moving distance and the speed of Ceramic ball.

Ceramic Ball	Speed adjuster level 1 (Low Intensity)		Speed adjuster level 2 (Medium Intensity)		Speed adjuster level 3 (High Intensity)	
Mass: 20g	Moving distance of Wooden block(cm)	Speed of Ball (m/s)	Moving distance of Wooden block(cm)	Speed of Ball (m/s)	Moving distance of Wooden block(cm)	Speed of Ball (m/s)
1	2.6	0.68	11.8	1.24	26.0	1.78
2	2.5	0.68	12.3	1.25	25.7	1.78
3	3.0	0.70	11.7	1.25	24.9	1.78
4	2.7	0.70	12.1	1.24	23.7	1.74
5	2.8	0.69	11.5	1.26	26.6	1.76
6	3.2	0.71	11.7	1.25	23.7	1.74
7	3.0	0.70	12.2	1.26	23.0	1.75
8	3.3	0.70	12.4	1.26	24.2	1.73
9	2.9	0.70	12.1	1.27	26.3	1.78
10	3.1	0.71	12.3	1.23	23.9	1.75
Average	2.9	0.70	12.0	1.25	24.8	1.76

Table1-3. Experiment result of relationship between the moving distance and the speed of Plastic ball.

Plastic Ball	Speed adjuster level 1 (Low Intensity)		Speed adjuster level 2 (Medium Intensity)		Speed adjuster level 3 (High Intensity)	
Mass: 9.5g	Moving distance of Wooden block(cm)	Speed of Ball (m/s)	Moving distance of Wooden block(cm)	Speed of Ball (m/s)	Moving distance of Wooden block(cm)	Speed of Ball (m/s)
1	1.4	0.75	6.0	1.31	9.2	1.69
2	1.5	0.77	6.0	1.31	7.6	1.68
3	1.5	0.77	5.9	1.29	10.2	1.68
4	1.6	0.78	5.9	1.33	9.0	1.61
5	1.7	0.78	6.0	1.31	9.0	1.63
6	1.7	0.79	6.3	1.31	9.3	1.65
7	1.6	0.79	5.0	1.27	10.4	1.69
8	1.7	0.79	5.7	1.31	7.8	1.77
9	1.8	0.80	6.0	1.31	8.2	1.58
10	1.7	0.80	6.0	1.33	7.9	1.59
Average	1.6	0.78	5.9	1.31	8.9	1.66

Memo

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