Instruction manual

C15-1631-W0

Dynamic cart set of large-size wooden cart and two metallic carts DYB

&

C15-1631-W1

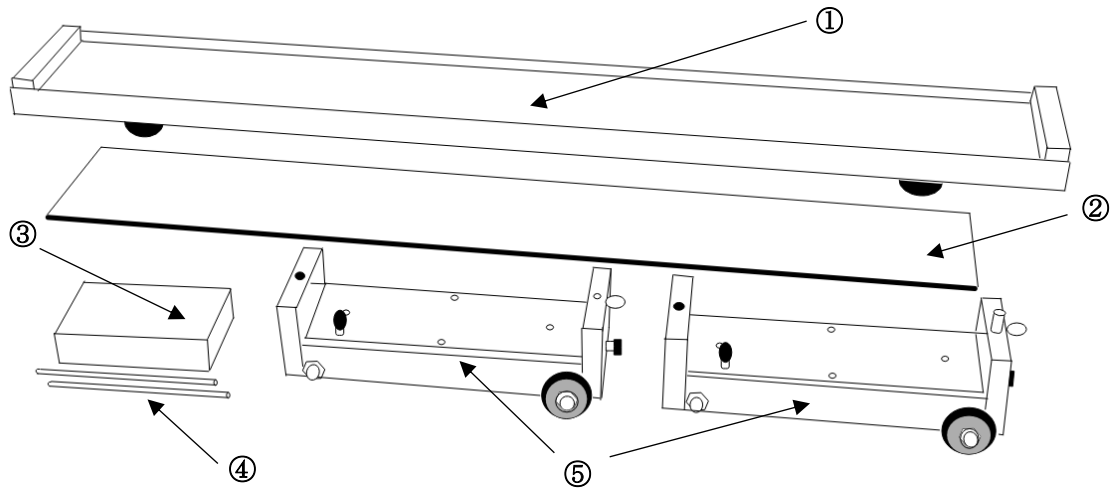
Large-size wooden dynamic cart DYB-1

Apr 2021

⚠ Safety Precaution

- Do not disassemble, repair and remodel this product. This product might stop working and warranty will be void.
- Teacher or trainer must instruct students about the safe ways of conducting experiments with this product before actually conducting experiments.
- When you find that something is broken, please do not repair the product by yourself and contact your distributor.
- Do not get on the product or do not use the product as a skate.
- Make sure to take measures against the product falling down from the table during experiments. It might cause damage to the product.

Name of each part



① Large-size wooden dynamic cart
② A wooden board for making a slope
③ A wooden block for making a slope
④ A wooden stick
⑤ Metallic dynamic cart DY-5 (one pair) (C15-1622-W0)

* There are 2 removable wooden barriers at both ends of the large-size cart (when they are attached the weight of the large-size cart is 1kg)

Specification

① **Large-size wooden dynamic cart:** Size: 1,100 × 160 × 78mm, Mass: 1 kg (±0.05 kg)

② **A wooden board for making a slope:** Size: 1,000 × 150 × 4mm,

③ **A wooden block for making a slope:** Size: 90 × 35 × 150mm,

④ **A wooden stick:** Size: φ6mm × 170mm, 2 pcs

⑤ **Metallic dynamic cart DY-5 (one pair) (C15-1622-W0)**

***** This set (C15-1631-W0) includes these 2 metallic dynamic carts.

Size: (L) 303 x (W) 102 x (H) 95 mm

Weight: 1kg (±0.002 kg)

Material: Body: Steel, Wheels: ABS with a ball bearing

Accessories: force sensor anchoring rod x 1pc, spring balance holding metal bracket x 1pc

Description of Large-size wooden dynamic cart

Large-size wooden dynamic cart (C15-1631-W1) is designed to be used in combination with metallic dynamic cart DY-5 (C15-1622-W0) for a variety of dynamics experiments. Additionally, the top of the large-size wooden dynamic cart is spacious enough to load up to two metallic dynamic carts for a variety of motion experiments.

Furthermore, it is easy to calculate and then analyze results of experiments because each cart of the set (one wooden and two metallic carts) weighs 1kg. That enables simple calculation when substituting the mass (m=1) to motion equation.

Experiment Guide

1. The law of inertia (Newton's first law)

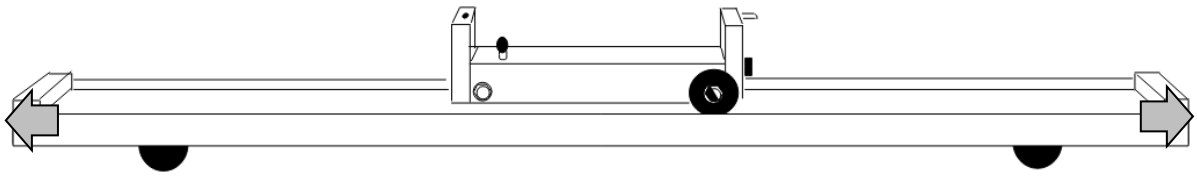


Fig. 1

This is a simple experiment to demonstrate the inertia motion (Newton's first law) using the large wooden cart and a metallic cart. Place a metallic cart on top of the large wooden cart and move the large wooden cart to left and right swiftly by your hands. Learners will observe a metallic cart not mowing while the large wooden cart is moving.

2. The law of conservation of momentum in collisions (Newton's third law)

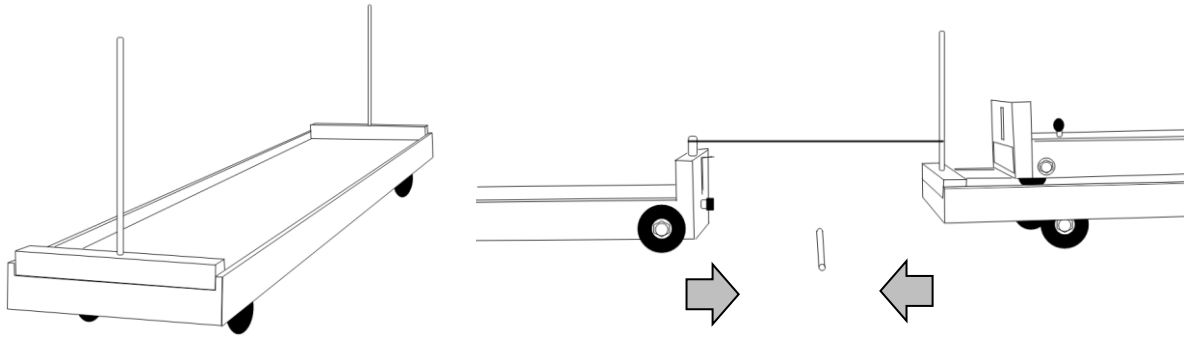


Fig. 2

A. Experiment of normal collision between two carts which have the same mass.

1) Set a stick on one end of the large wooden dynamic cart and set an anchoring rod of force sensor to the metallic dynamic cart. Note: Mass of each cart is 1 kg.
2) Tie the stick of wooden cart to the anchoring rod of metallic cart with a rubber band (see Fig. 2).
3) Place a stick in the middle between the two carts (see Fig. 2).
4) Move the carts apart around the same distance from where the stick is placed in the middle (the recommended distance between them is less than 30cm).
5) If you release them at the same time, the two carts are going to collide in the middle, and then each cart is going to move back to its original position.

B. Experiment of collision between two carts with different masses

1) Set a stick on one end of the large wooden dynamic cart and set an anchoring rod of force sensor to the metallic dynamic cart. Note: Mass of each cart is 1 kg.
2) Place the other metallic dynamic cart on the wooden dynamic cart (see Fig. 2) to double its mass. Therefore, the mass ratio of metallic cart and wooden cart unit (with a metallic cart on top) is 1 : 2.
3) Tie the stick of wooden cart to the anchoring rod of metallic cart with a rubber band (see Fig. 2).
4) Place a stick in the middle between two carts (see Fig. 2).
5) Move the carts apart around the same distance from where the stick is placed in the middle (the recommended distance between them is less than 30cm).
6) If you release them at the same time, the two carts are going to collide in the middle, and then each cart is going to move back to its original position even though their masses are different.

Additional information: because the metallic cart on top of the wooden cart can move freely without almost any friction, its mass does not play any role in the collision due to the law of inertia. On the other hand, if we would fix the metallic cart (for example placed it upside down) onto the wooden cart, its mass does play a role in the collision and then the collision does not occur in the middle where the stick is placed.

3. The motion of an object going down a slope (Newton's second and third law)

Make an inclined plane (slope) using a wooden block and a wooden board on the large-size wooden dynamic cart (a) and put the metallic dynamic cart (b) on the inclined plane (see Fig. 3). While the metallic cart (b) is going down the inclined plane, the motions of the wooden cart (a) and the metallic cart (b) can be demonstrated to learners. Consequently, the wooden cart (a) will move backward when the metallic cart (b) will move forward in Fig. 4.

The purpose of the demonstration using two carts (a and b) is that learners analyze what forces drive the carts movement in the demonstration.

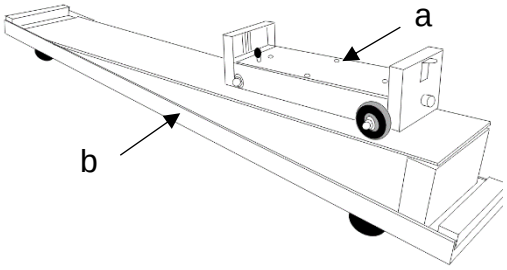


Fig. 3

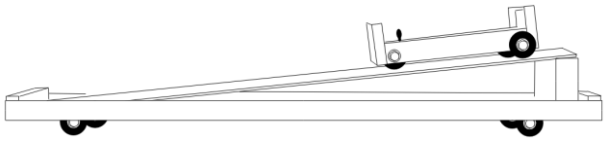
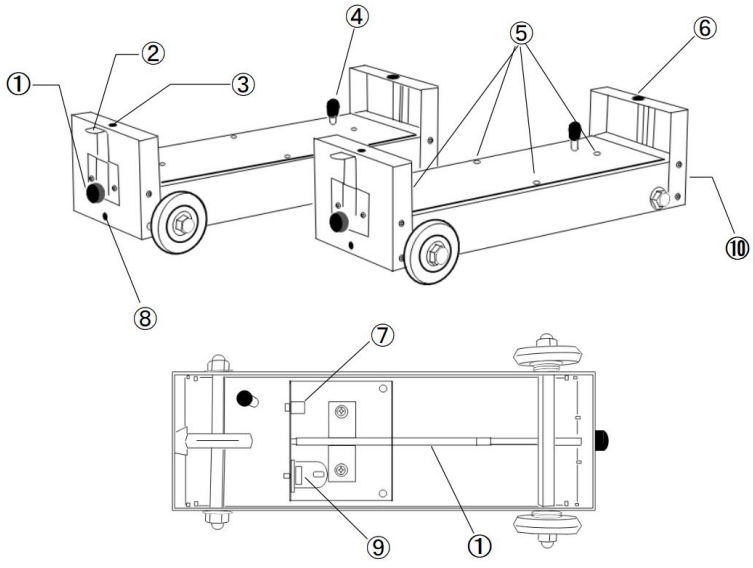


Fig. 4

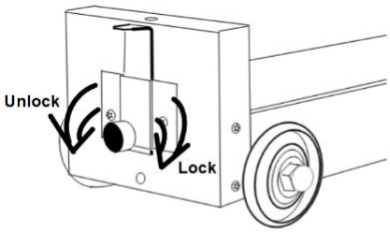
Description of Metallic dynamic cart DY-5 (C15-1622-W0)



① **Plunger and its shaft**
② **Plunger Launcher**
③ **Screw hole for a force sensor anchoring rod**
④ **Knob of anti-moving stopper**
⑤ **M4 screw holes (**⌀ 4mm)
⑥ **Button for holding a recording paper**
⑦ **Force sensor anchoring rod**
⑧ **Hole for a spring balance hook**
⑨ **Bracket for holding a spring balance**
⑩ **Velcro Tape**

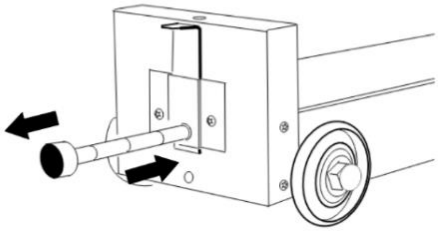
[Plunger]

Turning the head of the plunger anticlockwise unlocks it and it pops out from the body a little bit. When storing the repulsion bar, insert the repulsion bar into the body and turn it clockwise to tighten.



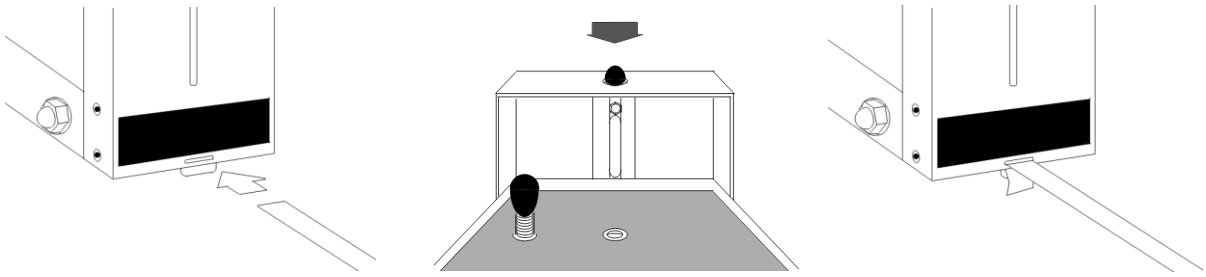
[Releasing the plunger]

The plunger has three indentation on itself. The pushing strength out depends on the position of the indentation. Pulling the plunger launcher up at an indentation position will place the plunger at the requested position. If you press the plunger launcher the plunger will be released at once.



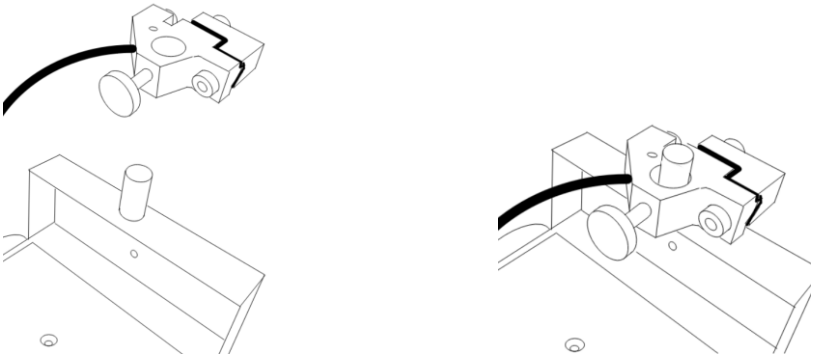
[Setting a recording paper]

When using a spark timer with the dynamic cart, set a recording paper of the timer up the body. At first, insert the recording paper into a hole at the lower part on the opposite side of the plunger side (Velcro Tape side). And pressing the button will fix the paper to the cart. The maximum width of the recording paper is 15 mm.



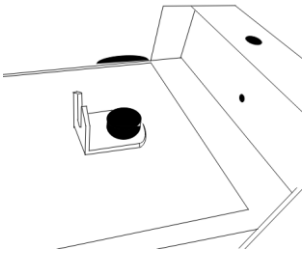
[Use a force sensor]

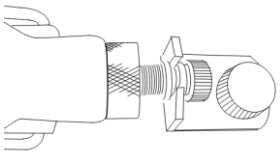
In the case of using a force sensor of a data logger or computer with this dynamic cart, at first, remove the force sensor anchoring rod (part No. 7) from beneath the bottom. Set it at the screw hole (part No. 3). Then set the force sensor on the rod. Narika recommends the Data Harvest force sensor.

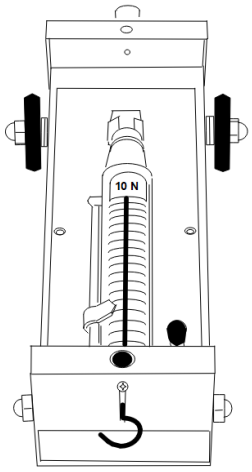


[Mount a spring balance]

Narika's spring balance SO series (Catalog number: A05-4053-W1, W2, W3, A05-4054-W1) can be mounted on the ’s top of the cart to measure the force strengths in experiments. A bracket (part No. 9) holding a spring balance on the top is beneath the body. Remove the bracket from beneath the body and set it on the top with a knurled screw. Then place and fit the spring balance into the bracket on the top.

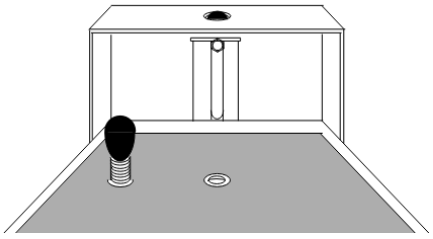


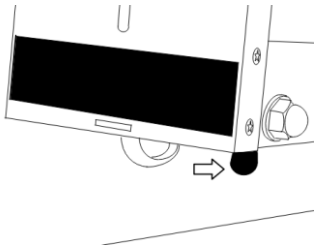




[Use of an anti-moving stopper]

The dynamic cart is equipped with an anti-moving stopper (part No. 4) to keep it from rolling down on an inclined plane or on a table during experiments. Rotating clockwise the knob on the top of the cart until the stopper touching to the surface can stop the cart on the inclined plane or the table during the preparation of experiments. If turning the knob anticlockwise, it will return to its original position and the cart will freely move.





[Attaching a Camera]

If you screw the force sensor anchoring rod (part No. 7) to the screw hole (part no. 3) the other way, then when you were using it with force sensor then you can attach a camera to the body. Size of the screw is 1/4-20 UNC.

[Velcro Tape]

This dynamic cart has a Velcro tape (part No. 10) to joint another cart. For example, when a slowly moving cart contacts a standing cart, these two carts are jointed like a train and keep moving. This Velcro tape is useful for experiments of the momentum conservation law or inelastic collision studies and others.