

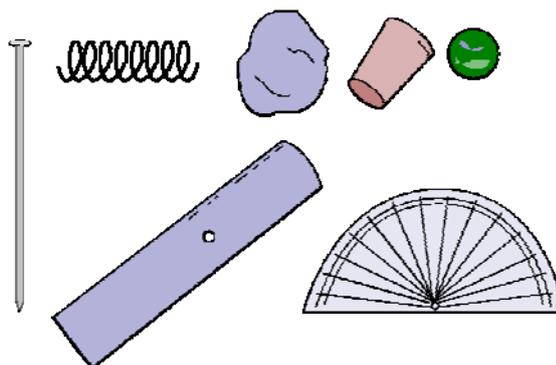
## TAP 207- 5: Build and test a marble launcher

### Parabolas, projectiles and gravity

Start with the construction of a simple marble launcher. Then analyse its performance via a series of investigations. Building confidence in the use of the kinematic equations is the main objective, although many measurement and design skills can be developed.

#### You will need

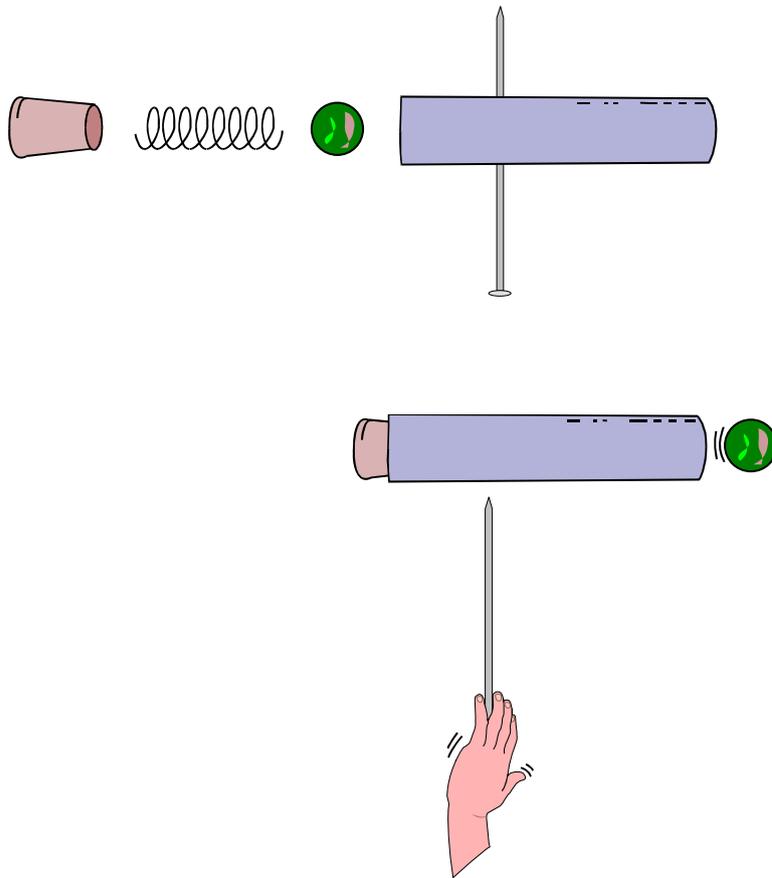
- ✓ a protractor
- ✓ a metre rule
- ✓ a small sand pit
- ✓ a means of measuring speed
- ✓ safety spectacles
- ✓ a compression spring
- ✓ 1 cm diameter plastic conduit with rubber bung to fit
- ✓ marble and / or ball bearing to fit tube
- ✓ drill and large nail



#### Wear safety spectacles

The projectiles are likely to be smaller than the eye socket, and may not always be very well aimed!

### Building and evaluating the performance of a launcher



You may be given the launcher to assemble or be asked to construct one from drawings. Removing the nail smartly will result in a clean launch. You will want to measure the angle of launch and the range and maximum height of the flight.

1. Design and carry out an experiment to measure the exit speed of the marble for a given spring compression setting.
2. Now use the kinematic equations for a given angle of launch, ignoring air resistance, to see if you can land the marble in the sand pit. Is it reasonable to ignore air resistance here? Is the marble flight adequately described by the kinematic equations, used in two dimensions?

### **All very predictable?**

1. The equations allow you to predict, perhaps surprisingly well, where the marble will land.
2. At the end of this activity you should be confident in using the equations.
3. There are some limitations to be careful of when applying the equations to a real projectile launcher.

### **Practical advice**

The launcher activity will allow your students to get some practical work done while studying motion in a gravitational field. You may want them to build the launcher themselves or provide

a kit for assembly.

The launcher design described in this activity was based on the beautiful but expensive Pasco device. Students like to use the equations to get the marble into the sand-pit. Competition soon sets in.

In trying to measure the muzzle velocity some students might try an indirect approach and you might revise some energy ideas in the first part of the activity, although this is not strictly necessary. Most students will be happy with simple conservation arguments from pre-16 course.

### **Alternative approaches**

A more controlled version might be to organise an activity around one pre-made launcher.

### **Be safe**

Students should wear eye protection, at least bearing the 'F' impact code (although 'B' would be better) during this activity. The projectiles are small and may well transfer significant amounts of kinetic energy on impact. For the same reasons you may want to limit the materials and construction techniques used. Considering the disposition of the firing ranges before live firing commences may also limit the collateral damage to fixtures and fittings.

	<p style="text-align: center;"><b>Wear safety spectacles</b></p> <p>The projectiles are likely to be smaller than the eye socket, and may not always be very well aimed!</p>
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### **External references**

This activity is taken from Advancing Physics Chapter 9, 172E