Application No. 68: The Launching Pad

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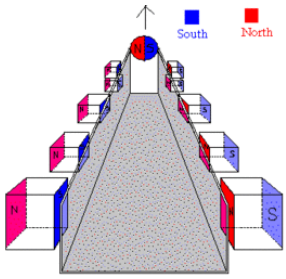
This can catapult a marble for meters!

Gilles Charles works at the University of Orléans and publisizes many of his experiments without our magnets on YouTube. Here he shows a cool lauching pad for marbles...

Video

The device is made up of a trench, for instance made from aluminum with magnets mounted upon it.

The most important thing is the positioning of the magnets: they must be positioned so that the magnetic poles are all facing the same direction on each side of the trench, e.g. on the left, all magnets are mounted with the south pole facing inward; on the right, all magnets are mounted with the north pole facing inward.

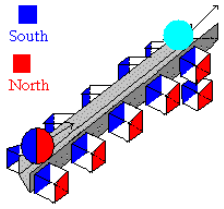


Configuration of the channel and positioning of the magnetic poles

In the experiment shown in the video, small cube magnets (www.supermagnete.fr/eng/W-05-G) were used, but one could also use discs. On the assumption that the discs are magnetized axially, they would have to be placed vertically, like small wheels. The distance between the magnets doesn't make a big difference, but in order to achieve a decent acceleration, they have to be close enough to each other. The distance depends upon the strength of the magnets: in our experiment, the magnets were placed approximately 5 mm apart.

At the end of the ramp two magnets rather than just one are place on top of each other on each side. This creates a magnetic trap: a strong magnetic field, which stops the sphere in place.

The magnetic sphere is now placed approximately 2 cm from the start of the ramp. You don't need to get the sphere rolling because the magnetic field within the channel will pull the sphere toward the opening. The strong magnetic field at the bottom of the channel will stop the sphere.

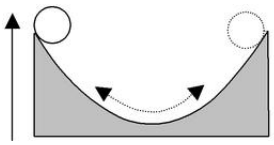


The magnetic sphere below on the left, the glass marble to be launched above on the right

The glass marble is placed on the ramp just in front of the last magnet so that the magnetic sphere will strike at maximum speed. The magnetic sphere will be stopped by the magnet trap, but the glass marble will be shot from the ramp.

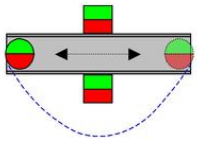
Explanation:

A sphere that rolls into a depression is drawn to the deepest point. This depression is also called "potential well". This term can also be used to explain the magnetic launching pad.



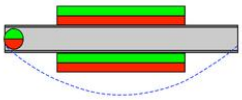
"Gravitational potential well". On the Y axis the height of the sphere or rather the potential energy.

At first, let's look at a simplified platform with only one magnetic pair. This magnetic pair builds, together with the walls of the trench that guides the sphere, a potential well. The sphere is drawn to its "deepest" point, which is located between the two platform magnets. If we let the sphere roll into this "well", it will roll back and forth until it comes to a standstill in the middle (due to friction loss and very little radiation of electromagnetic energy).

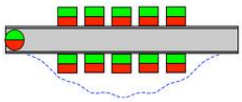


Potential well of the magnets and the track (schematic).

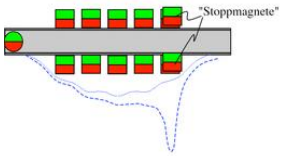
If we now use two long cross-polarised magnetic bars instead of two magnetic cubes, we get a long drawn-out potential well.



You can also picture the long magnet pair sawed up into short pairs put together (lengthwise) without gaps. This doesn't change anything in relation to the not sawed up bars. But if you pull the sawed up magnet pairs apart (lengthwise), they still form a symmetric potential well together with the trench, but the gaps between the magnet pairs make it wavy. If the distances between the waves (the distances between the magnet pairs) are not too big, the sphere still rolls back and forth until it comes to a standstill.



The launching pad does not have this symmetry.



Due to the "stopping magnets" at the end of the pad, the whole potential well is deformed asymmetrically. The deepest point of the well is now located between the stopping magnets. The sphere falls into this point, meaning it swings back and forth in the "ending dell" until its speed energy converts into heat due to friction. The swinging can be heard in the video as a buzzing.

The experiment can be viewed in more detail on YouTube (www.youtube.com/watch?v=yMoIExJEaBU).

Articles used
W-05-G: Cube magnet 5 mm (www.supermagnete.fr/eng/W-05-G)
K-13-C: Sphere magnet Ø 12,7 mm (www.supermagnete.fr/eng/K-13-C)

Online since: 11/03/2008