

## Friday 10<sup>th</sup> March - Tools for Materials Science - Challenge n°7 - 40'


### EDDY CURRENT BRAKES

On the desk you have two pipes: one is made of copper, the other is clear plastic. Their dimensions are almost identical (both length and diameter). You also have two metal cylinders: one of them is aluminium, the other actually is a magnet.

1. Drop the **aluminium** disk through the plastic tube first and then the copper one.

**WARNING:** Catch it with your hand as soon as it comes out !!!


**Q1.** Measure the falling time: you can repeat one or two more times. Do you see any difference? Write down the (mean) **Falling Time** for the two tubes on the answer sheet.

 Make a video of the fall through the clear (plastic) tube and save it as "mag\_video\_1". [See general instruction to save or share files]

2. Now repeat the experiment with the **magnet**.


**WARNING:** Catch it with your hand. It may break !!!

**Q2.** Measure the falling time: you can repeat one or two more times. Do you see any difference? Write down the (mean) **Falling Time** for the two pipes on the answer sheet. What do you think is actually happening?

 Make a video of the fall through the clear (plastic) tube and save it as "mag\_video\_2". [See general instruction to save or share files]

Unfortunately you can't see (and make a video of) the magnet falling because the copper pipe is opaque. However you have a very powerful tool to "see" what's happening inside the tube: the magnetic field viewing film that you already used last Wednesday [CH6].

3. Fix with sellotape a strip of this green film along the full length of the copper pipe. Then repeat the experiment of the falling magnet. What do you observe now?

 Make a video of the fall through the copper tube and save it as "mag\_video\_3". [See general instruction to save or share files]

4. Analyse the videos with Tracker. [Suggestion: do it manually, do not use the automatic tracking.] In particular produce and save the 3 plots of "**Distance Versus Time**" from the three videos and paste them in a Word file together with a short comment.

**Q3.** Can you say the magnet inside the copper is in free fall? Justify your answer.

5. **Magnetic Shielding alloy** - Put the magnetic shielding alloy slate in between the copper pipe and the strip of magnetic view film. Then drop the magnet as usual.

**Q4.** What do you notice? Does it happen with other metal slates ?

 **OUTPUT WANTED: answers to Q1-Q4 + 3 videos + Word file with the 3 graph s-t and comment.**

-> **PLEASE REMEMBER:** Give ALL the files (video, tracker elaboration, Word) to the teacher in charge at the end of the lab. [See general instruction to save or share files]

Answer sheet

GROUP N° \_\_\_\_\_

## Ch.7 --- EDDY CURRENT BRAKES

Q1: ALLUMINIUM:

Falling Time: (Plastic tube) \_\_\_\_\_ (Copper tube) \_\_\_\_\_

Comments:

Q2: MAGNET:

Falling Time: (Plastic tube) \_\_\_\_\_ (Copper tube) \_\_\_\_\_

Comments:

Q3Q4

**-> PLEASE REMEMBER:** Give ALL the files (video, tracker elaboration, Word) to the teacher in charge at the end of the lab. [See general instruction to save or share files]

### Teacher's Notes

#### Technical notes:

- ???

#### Organizational notes:

- Each student will keep a copy of the students' sheet but the group will collectively fill in the answer sheet and give it over to the teacher in charge at the end of the lab.

#### Correction grid

Question or Request	Note	Max. score
Q1	1 point for measurements; 1 point for answer/comment	2
Q2	1 point for measurements; 1 point for answer/comment	2
Q3	Evaluate if answer is motivated on data elaboration or graph	2
Q4		2
Graph	3 points for each graph well done (Clear, readable, without evident mistakes); 3 point for comments (well motivated on data collected)	3*3+3=12

### Key to Answer

**Q1.** No difference. NB: Falling time is hardly measurable using manual chronometer (It's lower than 1/10 sec.)

**Q2.** Big difference. NB: Falling time in plastic tube only is hardly measurable using manual chronometer (It's lower than 1/10 sec.)

**Q3.** The motion is almost uniform.

MoM Resources <http://www.mattersofmatter.eu/mom-materials/>

- Ch6\_TEACH\_EN\_Seeing Magnetic Field

#### Equipment needed and where to buy

- Strip of magnetic viewing film <https://www.materialsampleshop.com/>
- Copper pipe
- Clear plastic pipe
- Neodimium cylindrical magnet fitting the pipe size
- Aluminium cylinder

N.B. **Educational Innovations** sells a kit <https://www.teachersource.com/product/eddy-current-tubes-super-large/electricity-magnetism>, but actually you can do it from scratch



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