

3.Magntic arrows

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Problem

Place two suspended magnetic arrows close to each other .after a short time they will reach the equilibrium where the opposite poles are aligned together. .deflect one of the arrows by some small angle and release it. Both arrows will start oscillations . Investigate and explain the character of the coupled oscillations of magnetic arrows.



Main approach

Theory and experiment:

- Physics view

Magnetic field

Magnetic arrows field

- Earth magnet

Conclusion:

- Theory vs experiment
- Answering the questions

Physics view

1.Magnet

2.Magnetic arrows

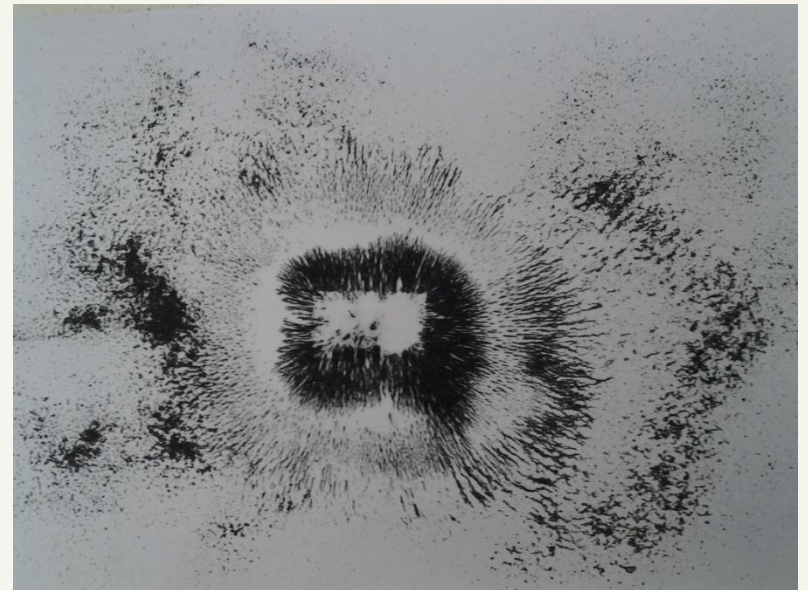
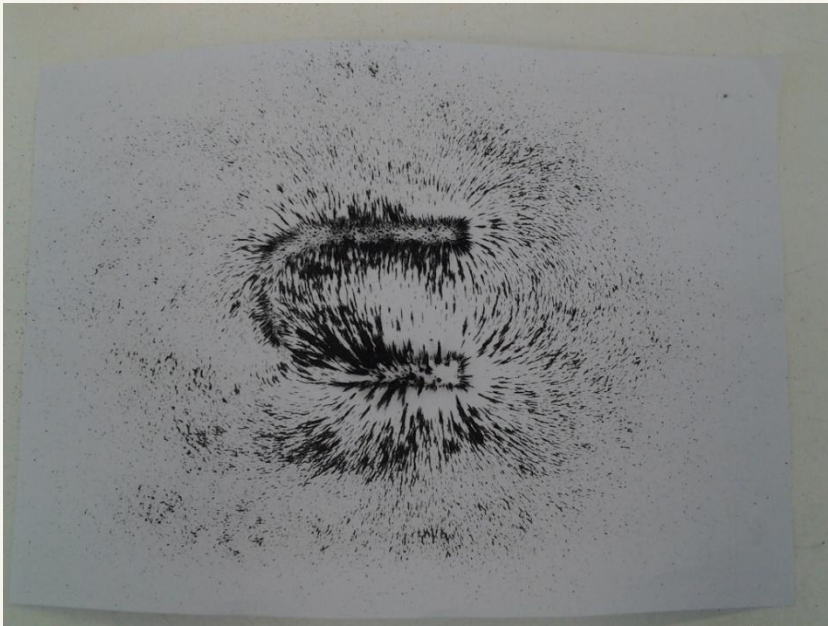
3.Magnetic field

4.Earth magnet

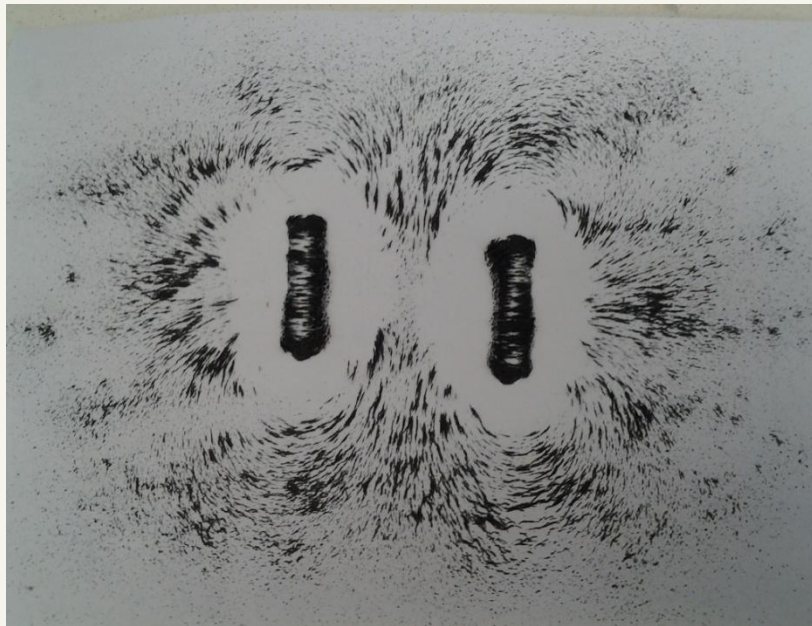
5.Rotational pendulien

Magnetic field

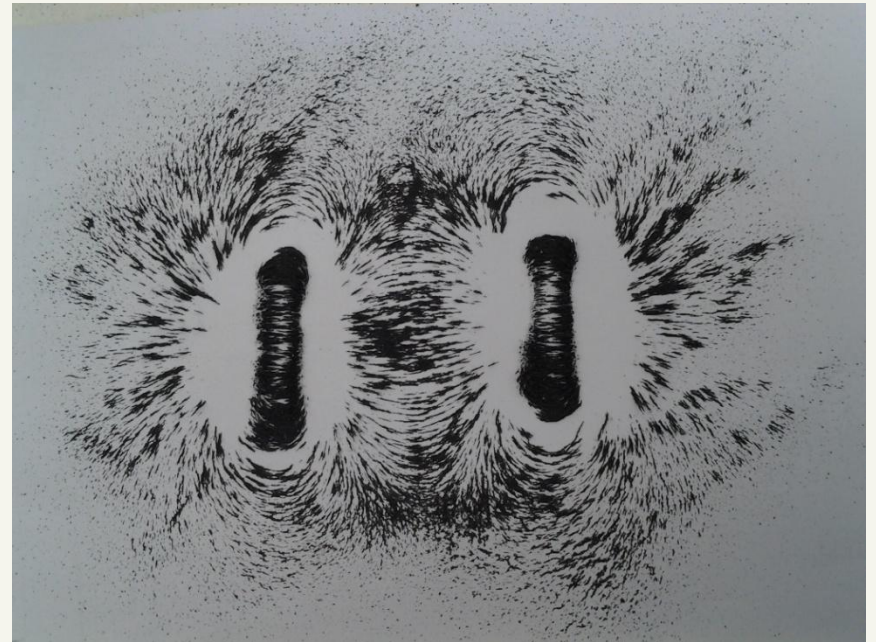
1. Normal magnet



2. Opposite poles



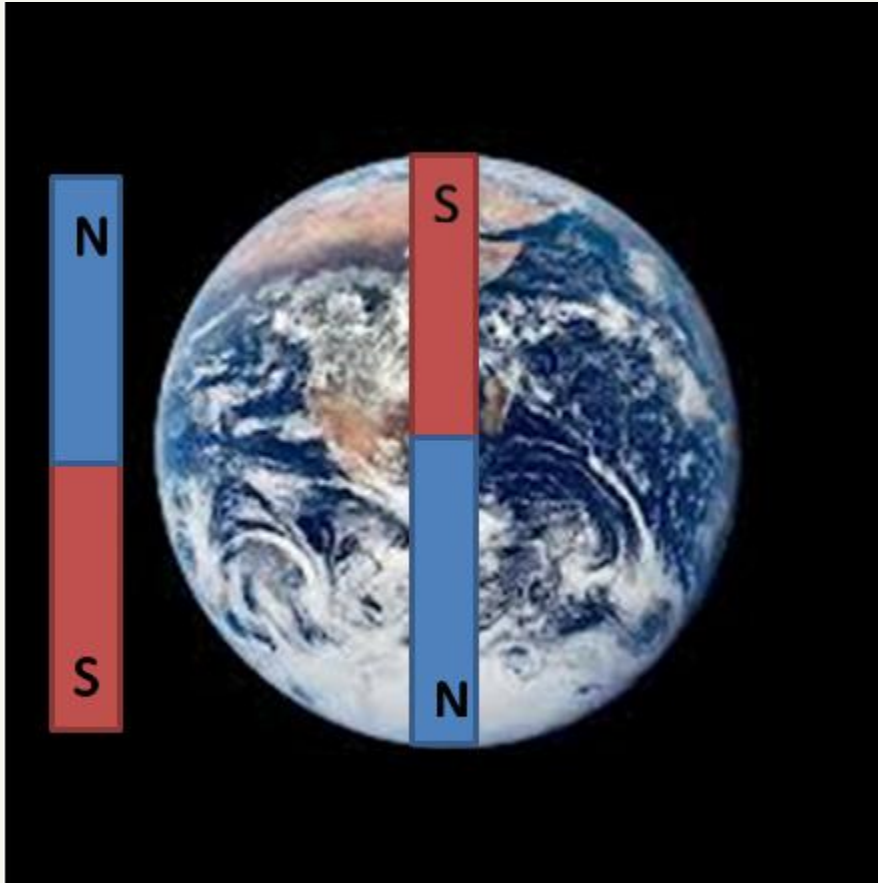
3. Same poles



Magnet arrows field

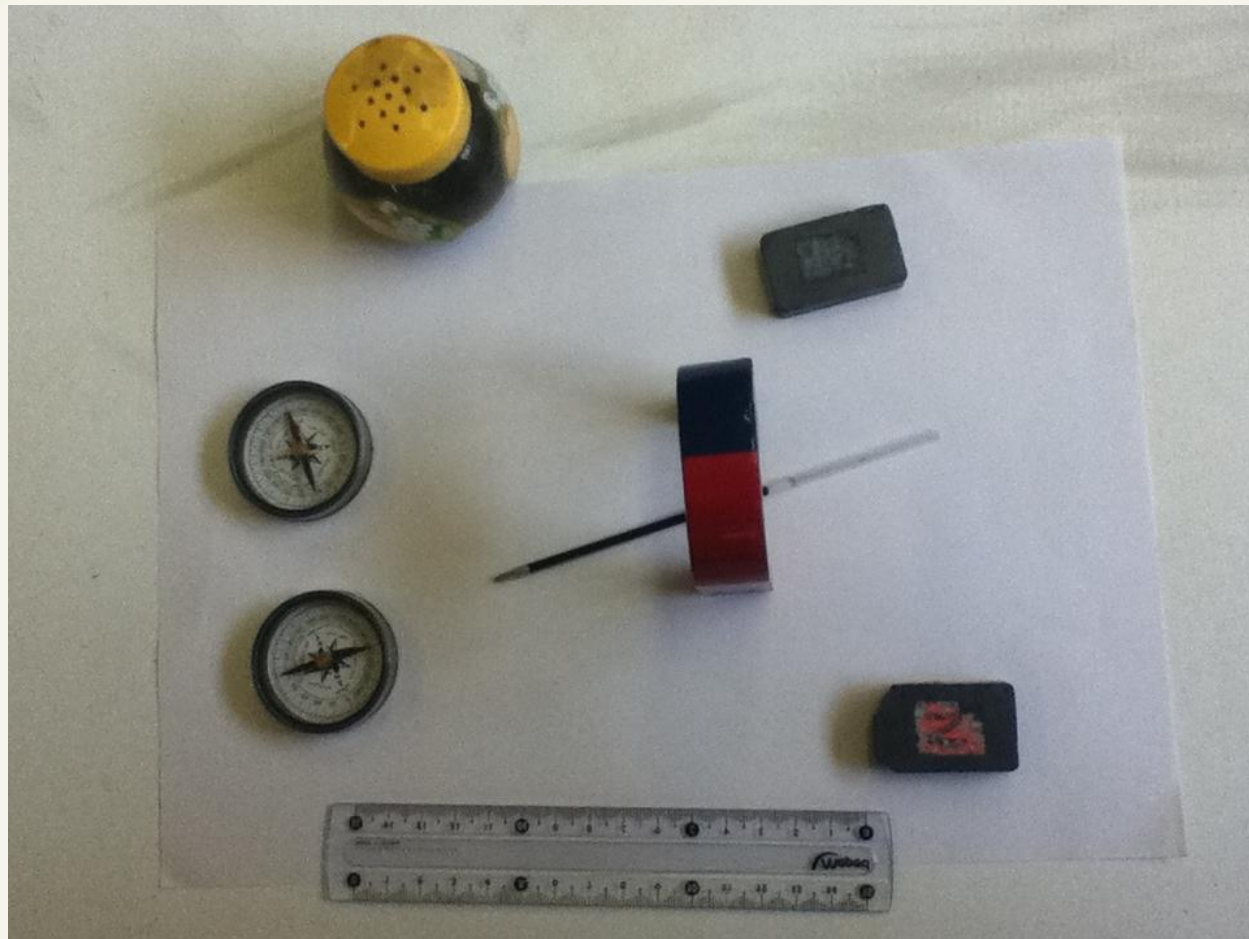


Earth magnet



According to attraction of two opposite pole to each other earth magnet is unfavorable.

My design



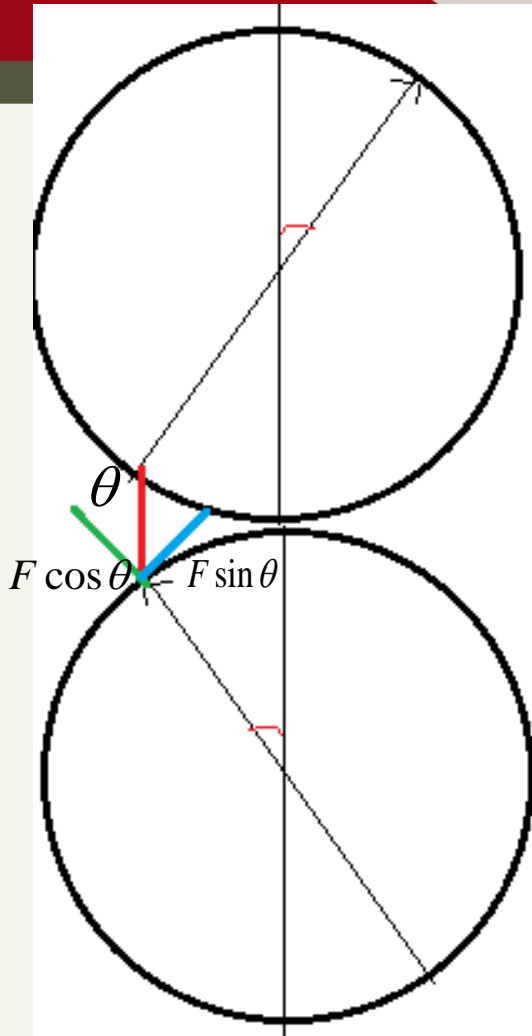
The phenomenon

Two opposite pole will seat near each other so the magnetic force will absorb them together. Movement of a single arrow will transfer the force to another one so the next arrow will move too. This transmitted force is depended to distance Of the arrows

The respect between the force and the distance is :

$$F_B \approx \frac{1}{r^2}$$





The magnetic force will divide to two vertical component .one of them is tangential to the circle and the other one is in the arrows direction the tangential component is affective force.

The tangential force will cause to rotate the arrow but it will decrease by decreasing the angle of arrow.

At 0 degree it will be equal to zero. But the arrow will keep the rotation. Then by increasing the angle is other side the force will increase and the speed will decrease till it stop. and then the force will make arrow to come back and the oscillation will continue.

Main approach

Theory and experiment:

- Physics view
- Magnetic field
- Magnetic arrows field
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Conclusion

- Theory vs experiment
- Answering the questions

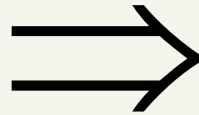
Conclusion

So two opposite poles will reach each other and two same poles will repel each other. when we have two magnetic arrows next to each other the magnetic Field of one of them will transfer its oscillation to the other magnetic arrow. The oscillation force is the tangential force . The tangential is depended on the Angle.

More about this oscillation

According to:

$$F_B \approx \frac{1}{r^2}$$



$$F \sin(\theta) = I\alpha = I\ddot{\theta}$$

$$F\theta = I\ddot{\theta}$$

$$F\theta - I\ddot{\theta} = 0$$

$$\omega = \sqrt{\frac{I}{F}}$$

$$T = \frac{1}{2\Pi} \sqrt{\frac{ml^2}{F}}$$

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References

1. Fundamental physics (*David Heston*)
2. www.wikipedia.com
3. My science school book



Thanks for your attention