

task_5efsj705cf97jxga_with_calculation

Student Group

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lorenz force, magnetic field, exam ee2 SS2024

Exercise E1 Lorentz Force

(written test, approx. 8 % of a 120-minute written test, SS2024)

2. Describe the principle of the lift train, that is, the fact that the magnetic field of the train is repelled by the field of the fixed floor, resulting in a repulsive force that lifts the train. (see image).

Result

Path

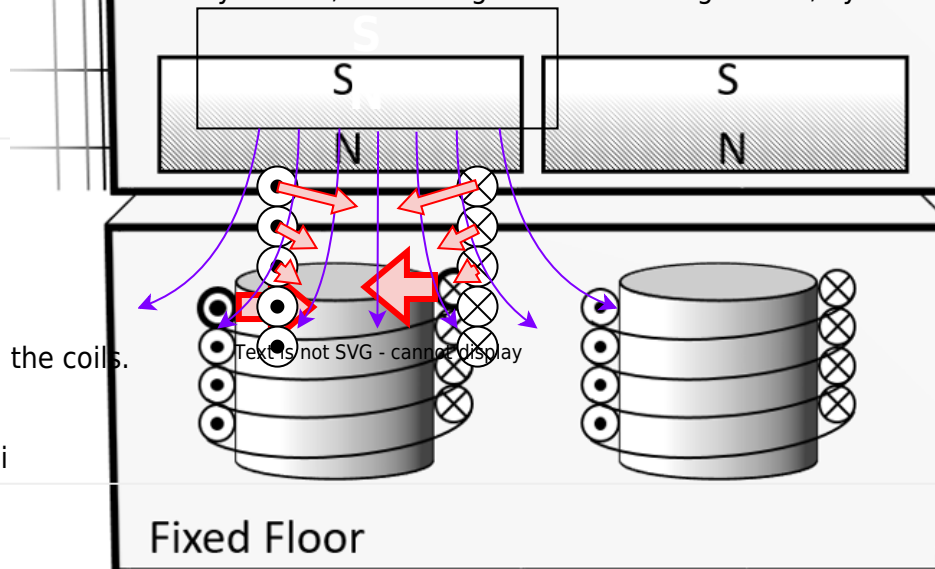
Since the resulting force has to be perpendicular to B -field and conductor, the force has to point to the left or the right.

From a homogeneous B -field ("constant magnetic field of the shuttle"), the Lorentz forces cancel each other out.

The Lorentz force can only have a lifting effect in an inhomogeneous field.

In this case, the sum of the forces results in a repulsive force, see image.

Beside boundary effects, The field gets also inhomogeneous, by the additional field of



- current $I = 1.6 \text{ A}$
- magnetic field of the shuttle is homogeneous with $B = 0.5 \text{ T}$

1. Calculate the magnitude of the resulting force on one coil!

Path

The Lorentz force on a conductor the length l and the current I in a B -field is

$$|\vec{F}_L| = I \cdot l \cdot B \cdot \cos(\angle \vec{B}, \vec{l})$$

$$= I \cdot (N \cdot 2\pi r) \cdot B \cdot \cos(\angle \vec{B}, \vec{l})$$

$$= 1.6 \text{ A} \cdot (500 \cdot 2\pi \cdot 40 \cdot 10^{-3} \text{ m}) \cdot 0.5 \text{ T} \cdot \cos 90^\circ$$

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