

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 system for the lift and the force of the magnetic coils. The field of the coils is homogeneous, the field of the shuttle is inhomogeneous. The resulting force repels the shuttle in the image for all sides of the shuttle (see image).

Result

Path

Since the result of the force has to be perpendicular to the magnetic field and conductor, the force has to point to the left or the right.

For a homogeneous magnetic 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 the coils.

- 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 magnetic field is

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

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

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

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