PROBLEM SHEET 1

Electromagnetic induction

1. Two metal rings are attached to a bar that can freely rotate on a support, see Fig. 1. Ring A is cut, while the ring B is unbroken. If a permanent magnet is moved into the ring A, nothing happens. However, if the magnet is moved into the ring B, it is repelled from the magnet, and the bar rotates. Explain the effect.

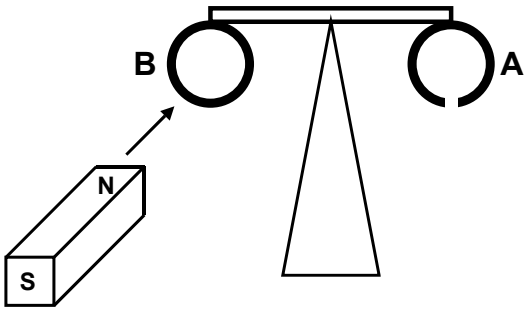

Fig. 1

2. A wire ring of area $S = 1$ cm^2 and resistance $R = 1$ mΩ is in the uniform magnetic field which is perpendicular to the plane of the turn. The magnetic field induction B varies at a rate $\Delta B/\Delta t = 0.01$ T/sec. Determine the power which is dissipated in the wire.

3. A coil, which has $N = 1000$ turns of area $S = 5$ cm^2, is connected to a resistor $R = 1$ kΩ. The coil was placed in magnetic field of induction $B = 10$ mT which was parallel to the axis of the coil. After that, the direction of magnetic field was slowly changed to the opposite one. Determine the charge which passed through the resistor.

4. (*) A circuit shown in Fig. 2 is made of the wire of the same diameter, and ABCD is a square with a side a. The resistance of each side of the square is R. The circuit is in magnetic field, the induction of which is perpendicular to the circuit plane and varies as $B = k \cdot t$, where t is time. Determine: 1) current I ; 2) voltage U_{AB} between the points A and C. Hint: apply Kirchhoff's laws and the law of the electromagnetic induction to the loops ABC and ACD.

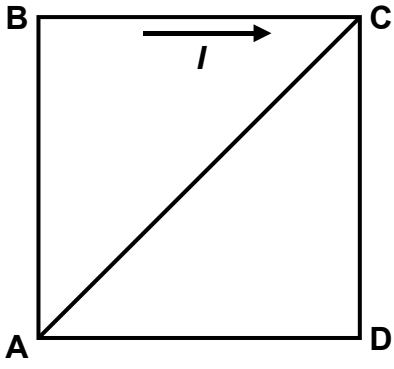

Fig. 2

See also an (*) example on p. 4.