

# task\_unkkahm3u0v9azny\_with\_calculation

## Student Group

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### Exercise E1 Self Induction

(written test, approx. 8 % of a 120-minute written test, SS2022)

2. A motor is in a motion with a magnitude of  $i(t) = 63 \text{ A}$ , which the circuit breaker has a DC voltage source  $U_s = 3150 \text{ V}$  and which is fused with a circuit breaker.

Sketch the diagram  $i(t)$  and  $u_{\text{ind}}(t)$  with the circuit breaker  $U_s = 3150 \text{ V}$  and the induced voltage  $u_{\text{ind}}(t)$  linearly down to  $0 \text{ A}$  within  $1 \text{ ms}$ .

(The inner resistance of the motor shall be neglected.)

$$u_{\text{ind}}(t) = 3150 \text{ V}$$

Path

.. Draw the circuit (the circuit breaker can be drawn as a switch), with all voltage and current arrows.

For the maximum voltage on the circuit breaker one has to consider the following:

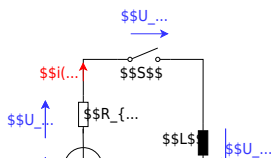
Result

- external voltage of the voltage source  $U_s$
- voltage  $u_{\text{ind}}(t)$  induced by the change of the current

The first one is not given in the exercise, and therefore not considered here.

The induced voltage can be calculated by linearizing the following: 
$$u_{\text{ind}}(t) = -L \frac{di(t)}{dt} \rightarrow u_{\text{ind}}(t) = -L \frac{\Delta i}{\Delta t}$$

With the given details: 
$$u_{\text{ind}}(t) = -L \frac{0 - 63 \text{ A}}{1 \cdot 10^{-6} \text{ s}} = 3150 \frac{\text{Vs}}{\text{A}} \cdot 63 \frac{\text{A}}{\text{s}} = 200 \text{ kV}$$



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