



**POLITÉCNICA**

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**EXERCISE 9:  
IDEMPOTENCE OF THE CLOSING-OPENING**

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# 1 Idempotence of the ‘closing-opening’

In this document, it is going to be explained the idempotence of the ‘closing-opening’ morphological operations.

The assumptions we have are:

1.  $\gamma(I) = \gamma\gamma(I)$
2.  $\varphi(I) = \varphi\varphi(I)$
3.  $\gamma$  is antiextensive and  $\varphi$  is extensive. Hence,  $\varphi_B(I) \leq \gamma_B(I)$ .

Hence, if we apply the closing-opening operation ( $\varphi\gamma(I)$ ), as the opening operation is idempotent, it would be equal to ( $\varphi\varphi\gamma(I)$ ). Now, if we change a closing operation by an opening one, it would result in:

$$\varphi\varphi\varphi\gamma(I) \leq \varphi\gamma\varphi\gamma(I)$$

On the other hand, if we expand the opening operation ( $\varphi\gamma\gamma\gamma(I)$ ) and change a opening operation by a closing one, it would result in:

$$\varphi\gamma\gamma\gamma(I) \geq \varphi\gamma\varphi\gamma(I)$$

Using this two operations, we can conclude that:

$$\varphi\gamma(I) = \varphi\gamma\varphi\gamma(I)$$