Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Student number\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Assignment 3**

Derive the component form of  in the polar coordinate system. Assume that the components of stress do not depend on angle . In the polar coordinate system, the component forms of stress, external force, and gradient operator, and derivatives of the basis vectors are given by

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, .

**Solution template**

In manipulation of vector expression containing vectors and tensors, it is important to remember that tensor (), cross (), inner () products are non-commutative (order may matter). The basis vectors of a curvilinear coordinate system are not constants which should be taken into account if gradient operator is a part of expression. Otherwise, simplifying an expression or finding a specific form in a given coordinate system is a straightforward (sometimes tedious) exercise. For simplicity of presentation, outer (tensor) products like  are denoted by . Otherwise, the usual rules of algebra apply: Gradient operator  acts on everything on its right-hand side, the operator is treated like a vector etc.

The task is to simplify the vector equation



to see the component forms. Let us consider the effect of the first term of the displacement gradient to stress





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Then the same for the second term of the displacement gradient. As the stress components do not depend on  (by assumption)





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Finally combining everything



Therefore, the two equilibrium equations are given by

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