Department of Aeronautics & Astronautics, M.I.T.
16.001 - Materials & Structures

Quiz No. 3

Instructor: Raúl Radovitzky

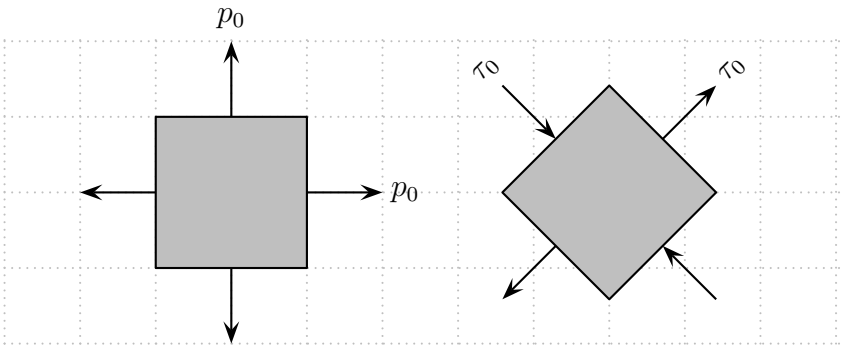
Student's name:_____

Question	Points	Score
1	30	
Total:	30	

Letter grade: _____

Question 1 [30 points]

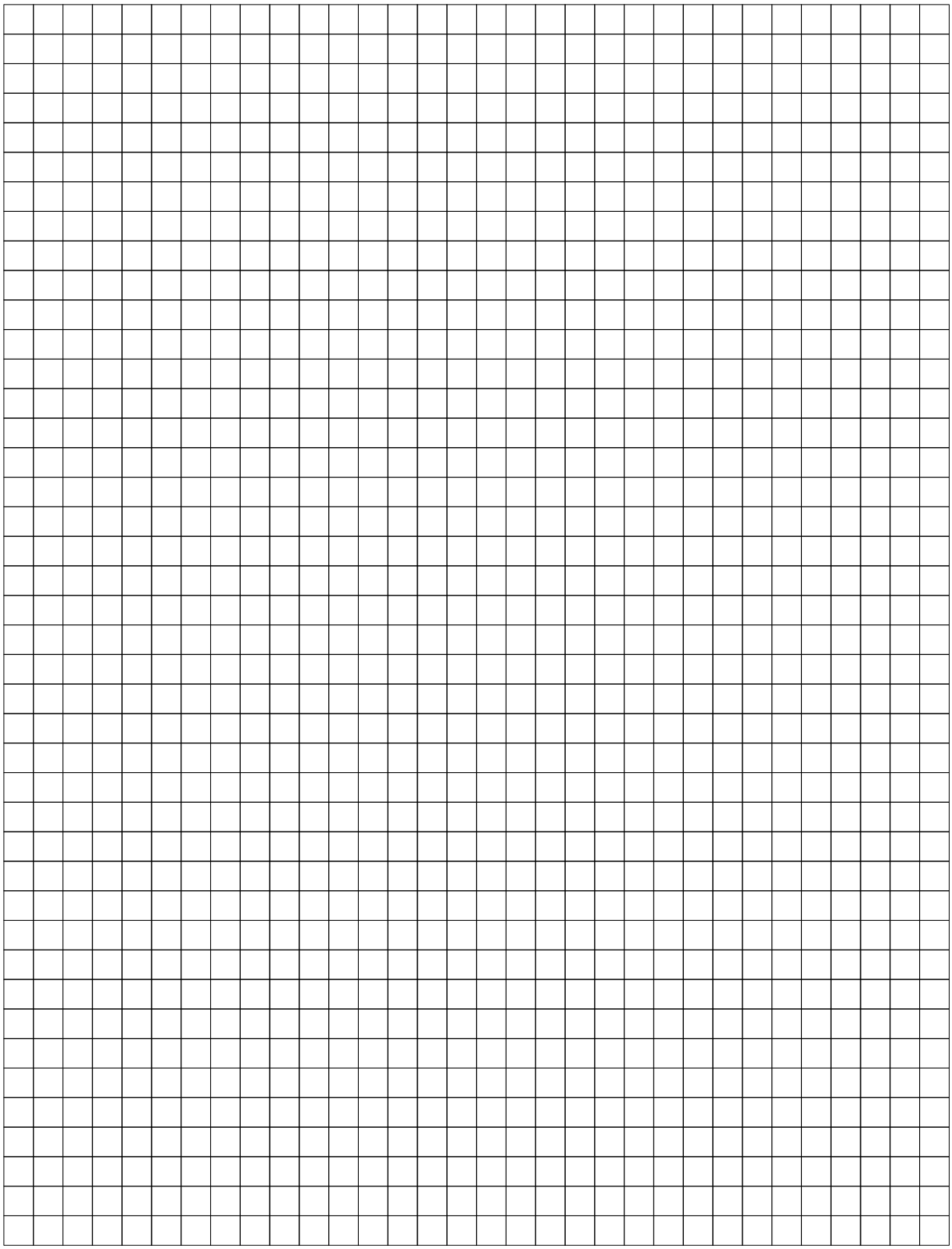
Consider the following two states of stress resulting from two different remote loads at the same point in a structure.



1.1 For each of the two states of stress:

1.1.1 (5 points) Draw your choice of cartesian unit vectors $\mathbf{e}_1, \mathbf{e}_2$ directly on the material elements above. Write down the stress components in those chosen axes in matrix form. Construct Mohr's circle qualitatively for assumed positive values of p_0, τ_0.

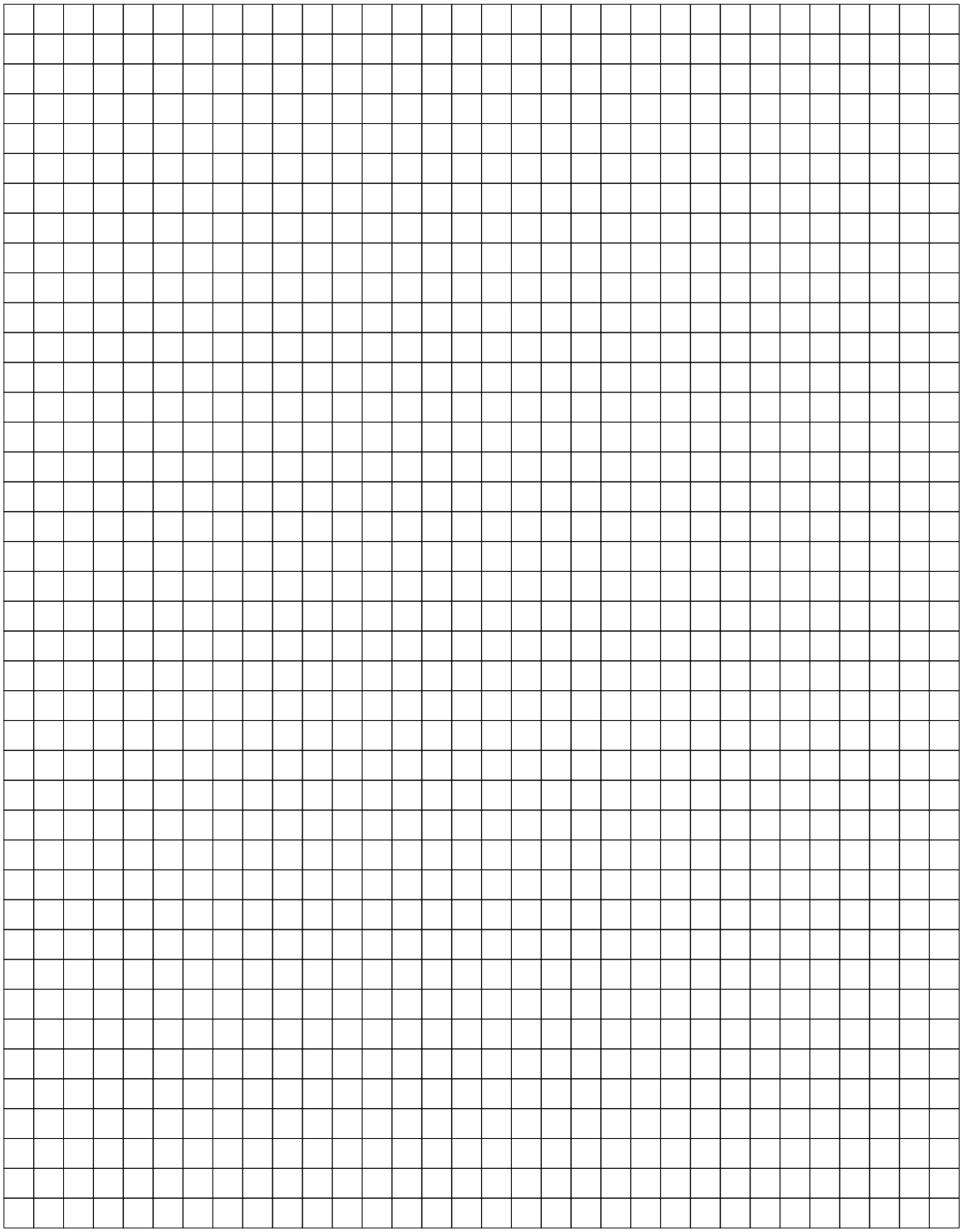
1.1.2 (5 points) Find the principal stresses σ_I, σ_{II} and direction α_p. Draw schematically the material element in the principal axes, explicitly showing the corresponding stress components.



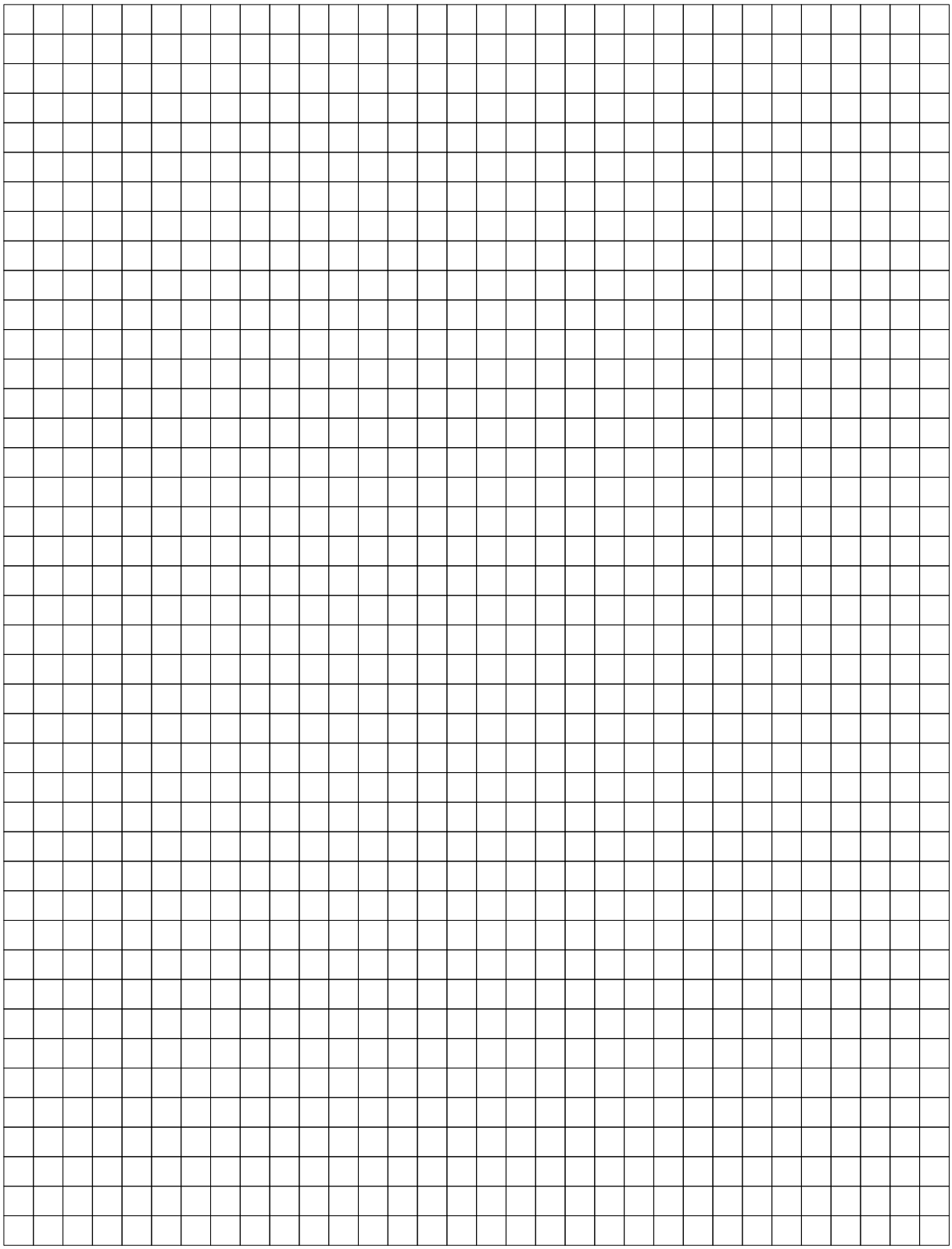
1.1.3 (5 points) Find the maximum shear stress σ_s and its corresponding direction α_s. Draw schematically the material element in these axes, explicitly showing the corresponding stress components.

1.2 Now assume that the states of stress can be superimposed.

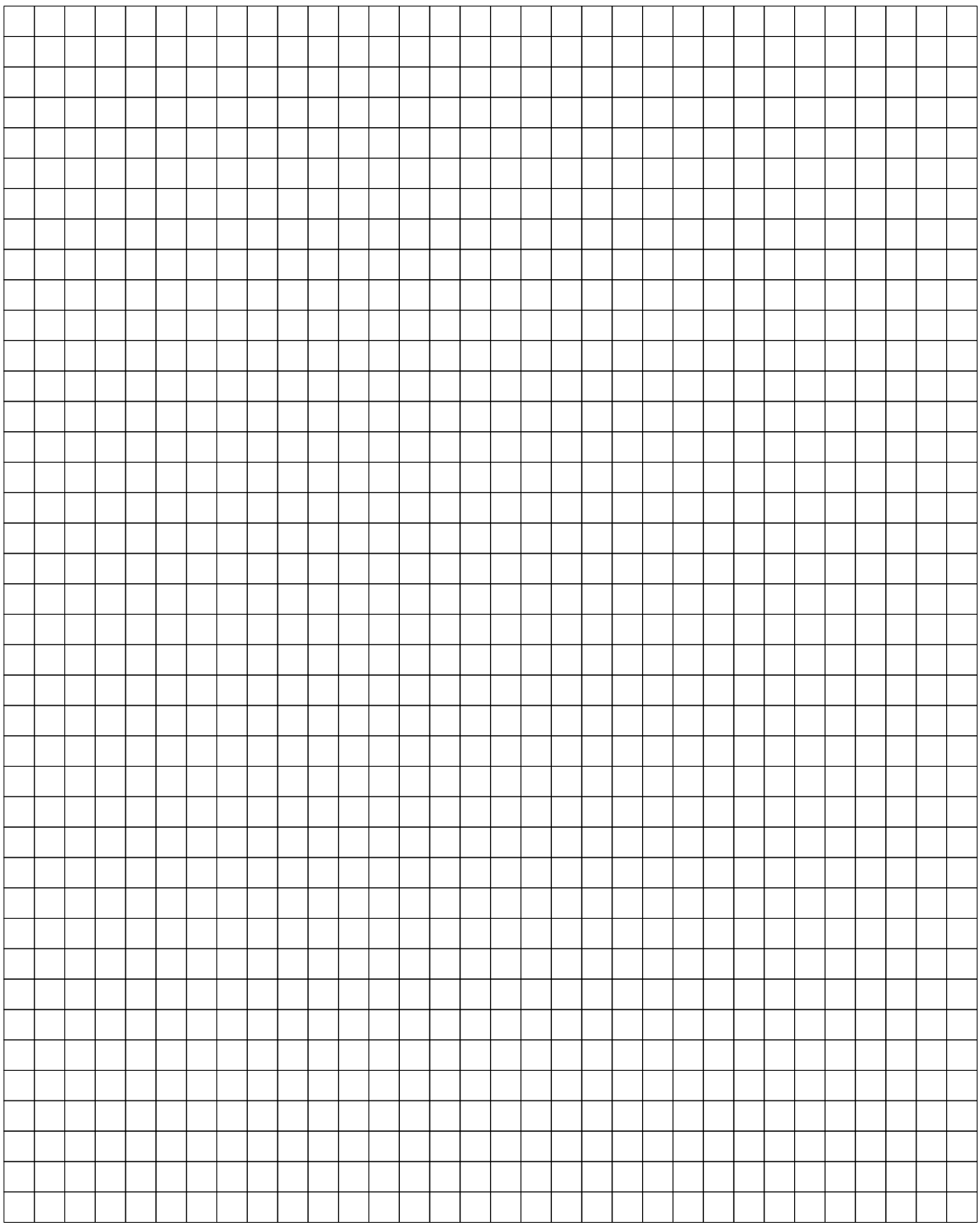
1.2.1 (5 points) Describe how one can add the stress states, and perform this superposition. Report the resulting stress components of the combined stress state in a set of axes of your choosing.



1.2.2 (5 points) For the combined state of stress, draw Mohr's circle and obtain the principal stresses and directions. Draw schematically the material element in these axes, explicitly showing the corresponding stress components.



1.2.3 (5 points) We have combined hydrostatic and pure shear stress states. Observe the resulting Mohr's circle and use a very simple geometric argument to support and conclude that any state of stress (in 2D) can be decomposed into a hydrostatic and a pure shear state of stress.



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