Delft Applied Mechanics:
Statics

AE1-914-I

January 27, 2006, 9:00–12:00

ANSWER FORM

Student number: | | | | | | | |

Name:

Section below is not to be filled in by the student

Marks:

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Exam AE1-914-I **Student number:** | | | | | | | |

January 27, 2006 **Name:**

Problem 1 (Weight 1.0, approx. 20 min.)

Question a

What is the essential difference between a kinematically determinate and a kinematically indeterminate structure?

Question b

What is the essential difference between a statically determinate and a statically indeterminate structure?

For 2-dimensional trusses a fast method can be used to determine the degree of determinacy of a structure:

$$s = 2k - 3$$

Question c

Explain what this formula means and also explain how it can be used to determine the degree of kinematical and statical (in)determinacy for trusses in general.

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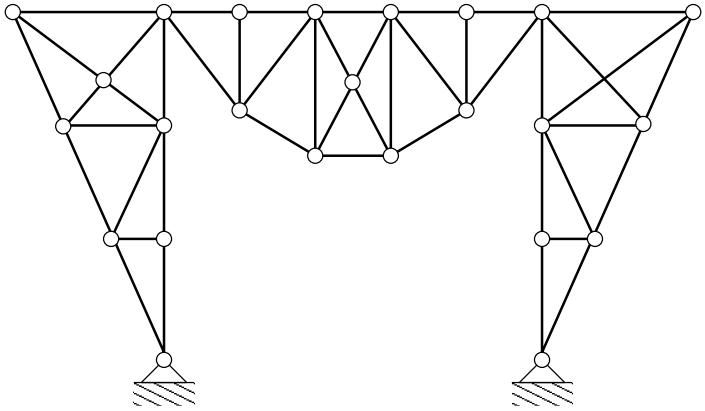
Question d

Evaluate the degree of kinematical and statical (in)determinacy of the truss below.



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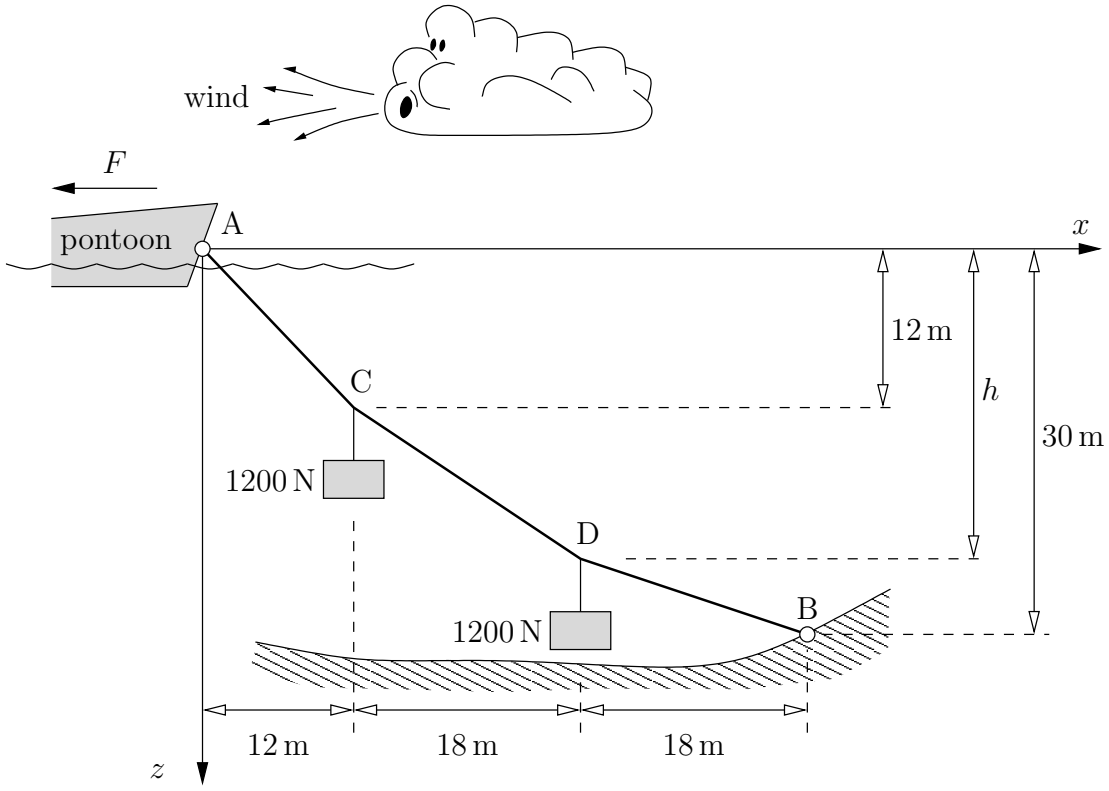
Problem 2 (Weight 2.0, approx. 35 min.)

A pontoon is anchored by a cable in a fjord which is 30 m deep. The cable is being weighted down by two concrete blocks of 1200 N each. It is assumed that the cable will not stretch under the given loads. In the situation below a horizontal force F due to the wind load is acting on the pontoon.

NOTE: The vertical position h of point D is unknown!



Question a

Calculate the magnitude of the force F due to the wind load acting on the pontoon. Draw the force that the cable exercises on the pontoon in the correct direction.

Question b

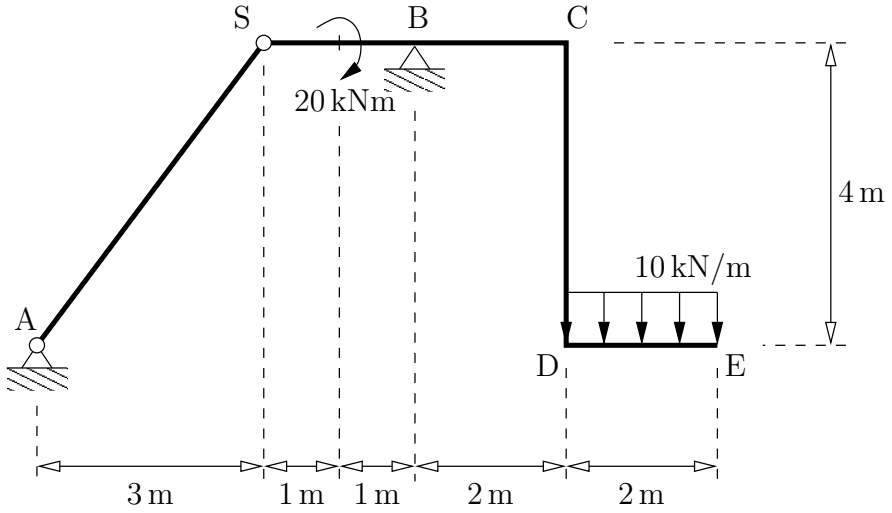
Determine the vertical position h of point D.

Question c

Determine the maximum force in the cable and indicate where this occurs.

Problem 3 (Weight 2.5, approx. 45 min.)

The structure below consists of parts AS and SBCDE which are connected by a hinge in S. The structure is loaded by a couple of 20 kNm halfway between S and B and a uniform distributed load of 10 kN/m on part DE. The structure is simply supported in A and in B.



Question a

Calculate the reactions and draw them in the figure as they act on the structure in reality.

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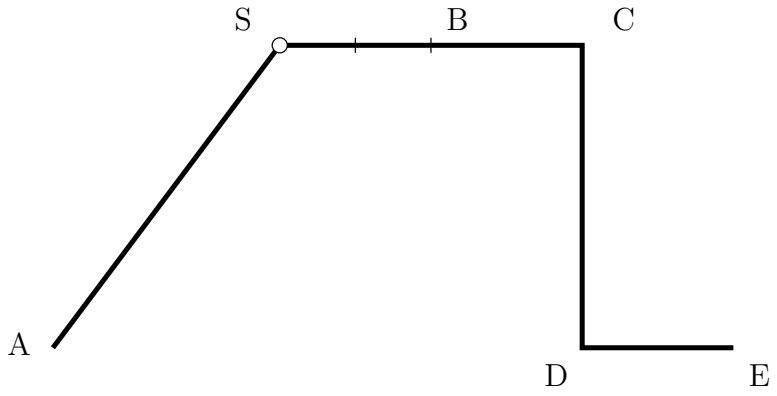
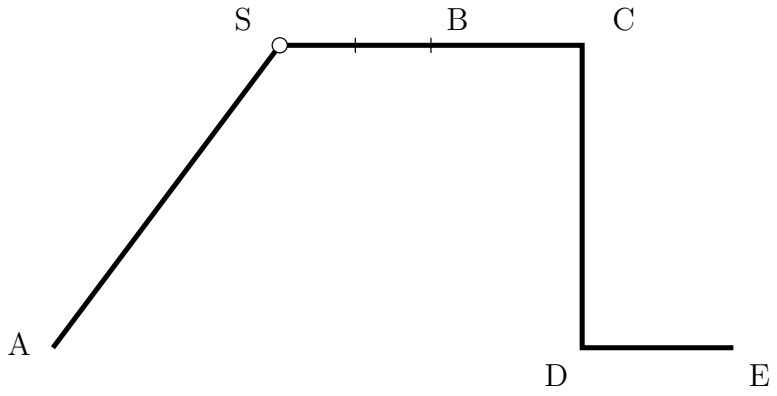
Question b

Draw the moment diagram (M-diagram) of the entire structure with the appropriate deformation signs. Mention all relevant values and draw the tangents when necessary.



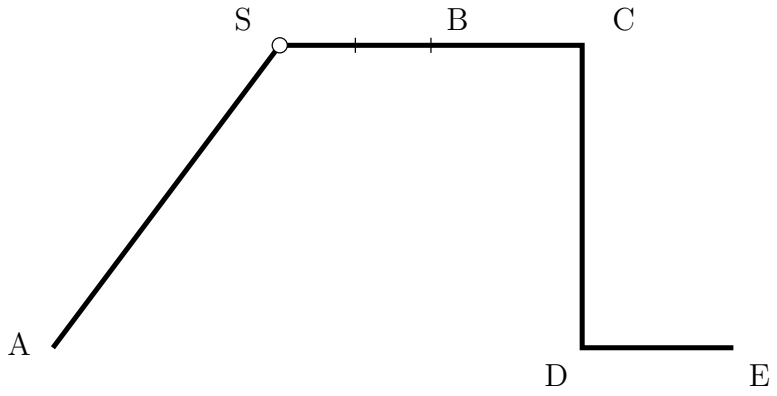
Question c

Draw the shear force diagram (V-diagram) of the entire structure with the appropriate deformation signs. Mention all relevant values.



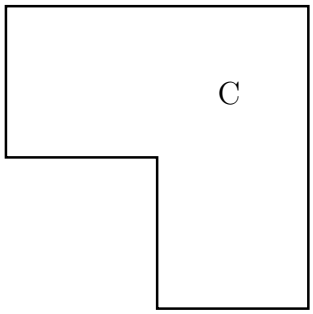
Question d

Draw the normal force diagram (N-diagram) of the entire structure with the appropriate signs for tension and compression. Mention all relevant values.



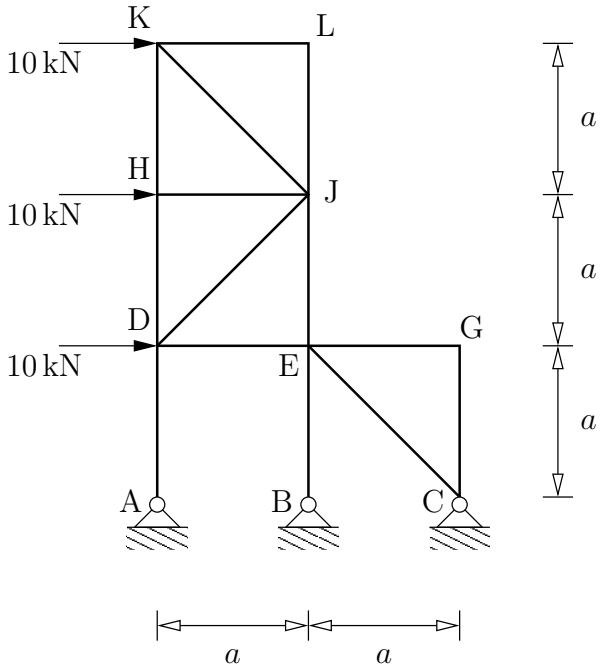
Question e

Isolate joint C and draw all forces (and moments) as they act on the joint.



Problem 4 (Weight 2.5, approx. 45 min.)

As indicated in the figure, the truss is loaded by three forces of 10 kN each.



Question a

Identify the zero-force members and indicate them in the figure.

Question b

Calculate the reactions in A, B, and C and draw them in the figure as they act on the structure in reality.

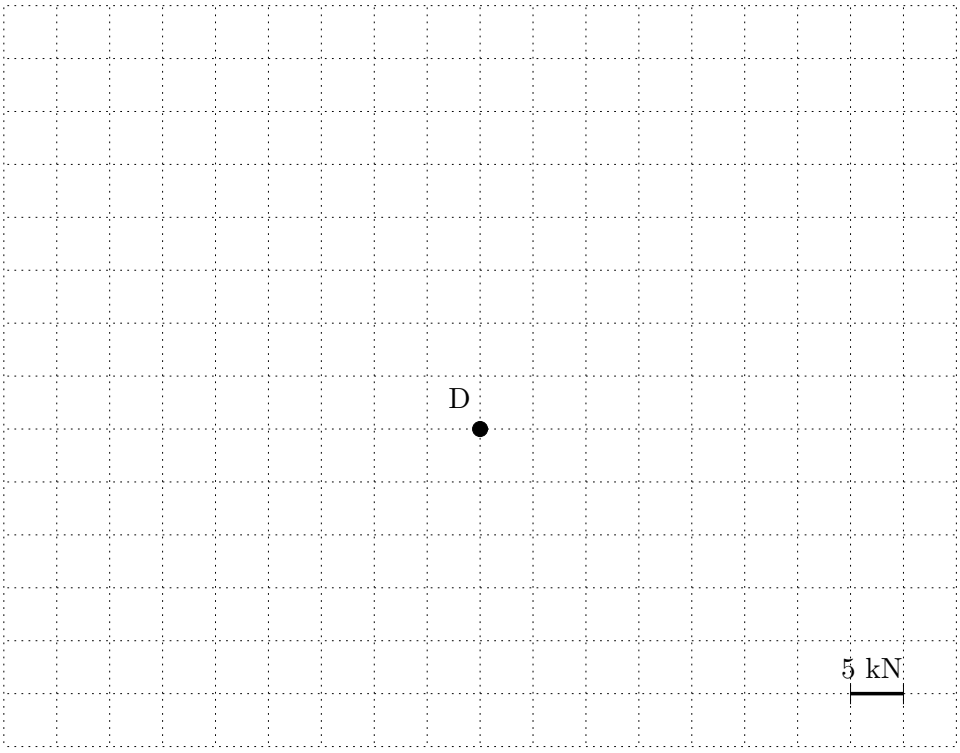
Question c

Calculate all the forces in the members with the correct sign for tension and compression. Write all answers in the table at the end of this question.

F_{AD}	F_{BE}	F_{CE}	F_{CG}	F_{DE}	F_{DJ}	F_{DH}
F_{EG}	F_{EJ}	F_{HJ}	F_{HK}	F_{JK}	F_{JL}	F_{KL}

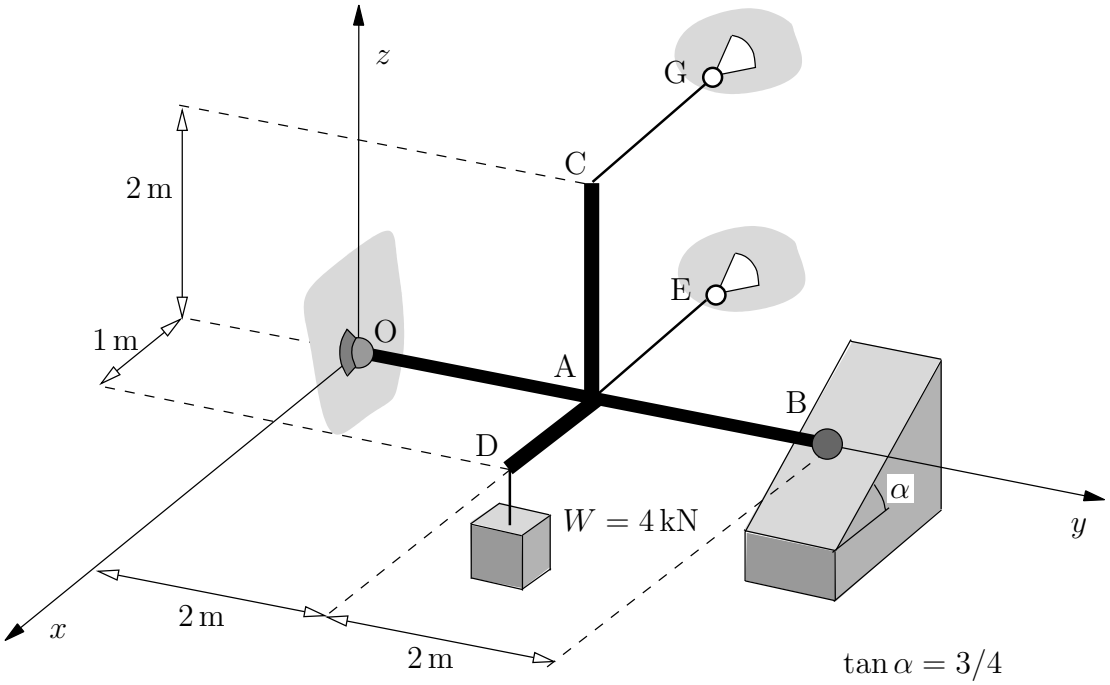
Question d

Draw the force polygon for the equilibrium of point D.



Problem 5 (Weight 2.0, approx. 35 min.)

The structure below consists of beam OAB with arms AC and AD attached perpendicularly. The weight of the structure may be neglected. Point O is a ball- and socket joint. The ball that is attached to point B slides over a frictionless slope. The angle α of the slope with respect to the x-axis is equal to $\tan\alpha = 3/4$. The structure is kept in equilibrium by means of the cables AE and CG which are parallel to the x-axis. A mass with a weight of $W = 4\,\text{kN}$ is attached to point D.



Question a

Calculate the reaction(s) in B. Draw them in the figure as they act on the structure in reality.

Question b

Calculate the forces in cables AE and CG.

Question c

Calculate the reaction(s) in the ball- and socket joint O. Draw them in the figure as they act on the structure in reality.