

Space above not to be filled in by the student

AE1103 Statics

25 January 2010

09.00h - 12.00h

Answer sheets

Last name and initials:

Student no.:

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Only hand in the answer sheets!

Other sheets will not be accepted

Write your name and study number on every page

Sheets without name or study number will not be accepted.

Write relevant calculations on the answer sheet

Use the blank sides of the answer sheets if necessary.

Answers without calculations or motivation will not be taken into account.

Use possible checks to avoid calculation errors

The order of answering the questions is free

NOTE: this exam consists of 5 problems.

The **neatness of the presentation** of the answers will be considered in the marking.

All answers must be given mentioning the correct SI units.

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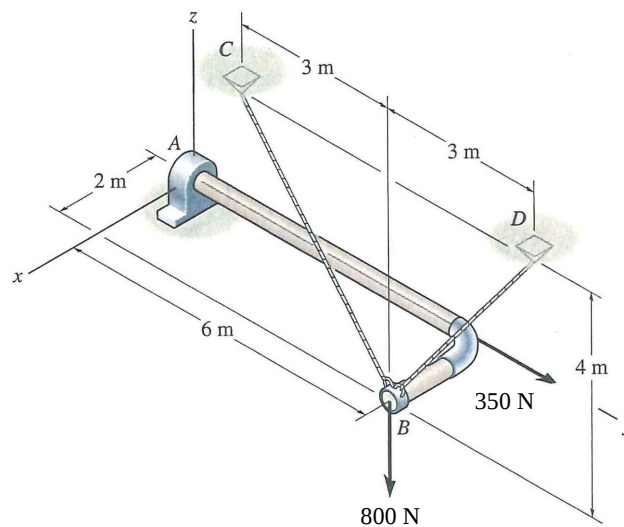
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Problem 2 (Weight 2.0 - approx. 35 minutes)

The structure in the figure below is supported by a journal bearing in A and suspended from two cables in B. All relevant information can be found in the figure.

De constructie in de onderstaande figuur wordt door een lager ondersteund in A en hangt aan twee kabels in B. Alle relevante gegevens kunnen in de figuur worden gevonden.

**Questions**

- a) Calculate the reactions at A and the cable forces in BC and BD and include these in the table on the next page. All results must be supported by calculations.

Bereken de reacties in A en de kabelkrachten in BC en BD en vermeld ze in de tabel op de volgende pagina. Alle resultaten moeten van berekeningen worden voorzien.

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(problem 2 continued)

A_x	A_z	M_{Ax}	M_{Az}	N_{BC}	N_{BD}

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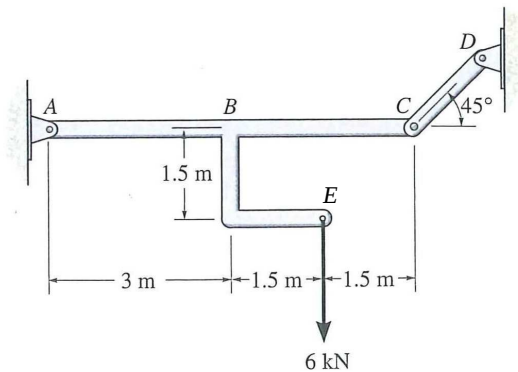
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Problem 3 (Weight 2.0 - approx. 35 minutes)

The frame structure in the figure below is attached to the wall by hinges in A and D and also has a hinge in C. In E the structure is loaded by a vertical force $F = 6 \text{ kN}$. Beam CD has length $\sqrt{2} \text{ m}$. All other relevant dimensions can be found in the figure.

De raamwerkconstructie in de onderstaande figuur is scharnierend verbonden aan de muren in A en D en heeft ook nog een scharnier in C. De constructie wordt in punt E belast door een verticale kracht $F = 6 \text{ kN}$. Balk CD heeft lengte $\sqrt{2} \text{ m}$. Alle andere relevante afmetingen staan in de figuur aangegeven.

**Questions:**

- a) Calculate the reactions in A and D and draw these in the figure in the direction in which they act on the structure in reality.

Bepaal de oplegreacties in A en in B en teken deze in de figuur zoals ze in werkelijkheid op de constructie werken.

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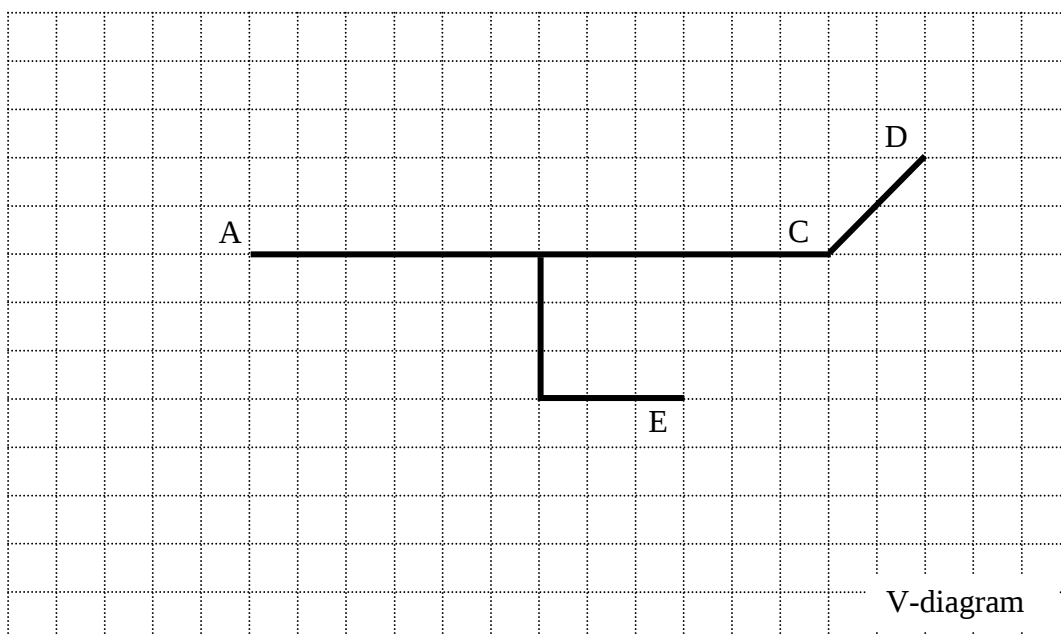
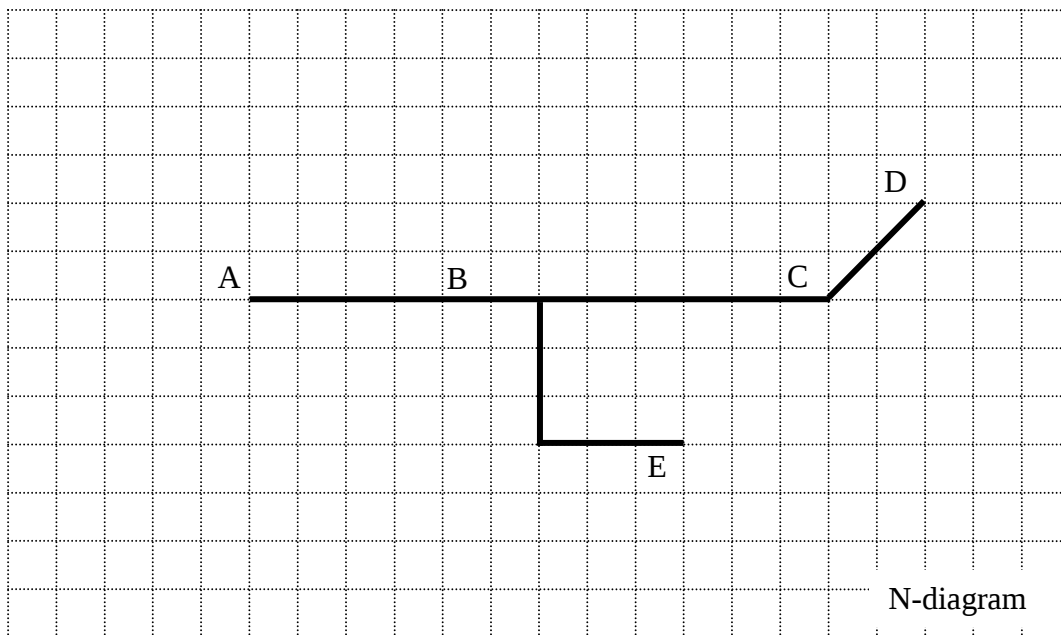
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(Problem 3 continued)

- b) Draw the normal force, shear force and moment diagrams (N, V and M-diagram) of the frame and use the correct deformation signs. Mention all relevant values including all extremes.

Teken de normaalkrachten-, dwarskrachten- en momentenlijn (N, V en M-lijnen) van het raamwerk en vermeld daarbij de juiste vervormingstekens. Vermeld alle relevante waarden inclusief de extremen.

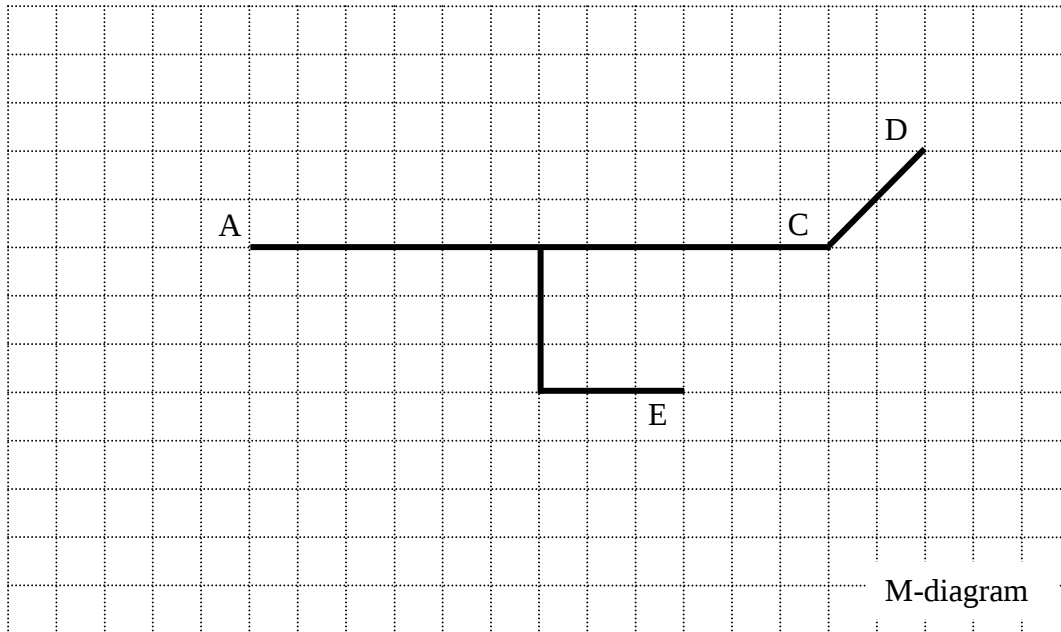


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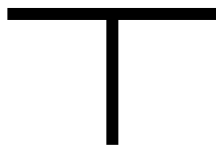
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(Problem 3 continued)

- c) Draw all the forces and moments acting on the connection in B and show that they are in equilibrium.

Teken alle krachten en momenten die op de verbinding in B werken en toon aan dat ze in evenwicht zijn.



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(Problem 4 continued)

- b) Calculate the normal forces in members DE, BE, and EC with the correct sign for tension (+) or compression (-) and include these in the table below. All results must be supported by calculations.

Bereken de krachten in de staven DE, BE en EC met het juiste teken voor trek (+) en druk (-) en vermeld ze in de onderstaande tabel. Alle resultaten moeten met berekeningen worden onderbouwd.

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N_{DE}	N_{BE}	N_{EC}

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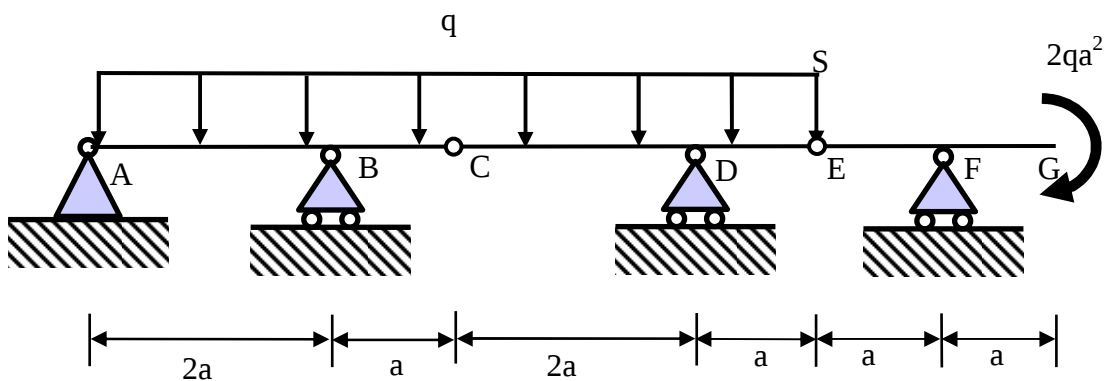
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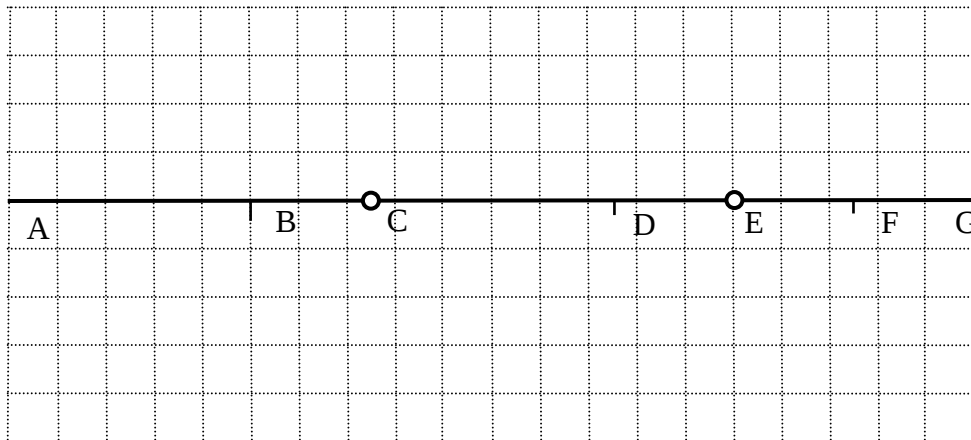
Problem 5 (Weight 1.5 - approx. 30 minutes)

Beam ABCDEFG has a hinged support in A and is supported by roller supports in B, D, and F. The beam is loaded by a uniform distributed load q acting on section AE and a couple $2qa^2$ in G. C and E are hinges. All other dimensions are indicated in the figure.

Balk ABCDEFG is scharnierend opgelegd in A en wordt door rollers ondersteund in B, D en F. De balk wordt belast door een uniform verdeelde belasting werkend op sectie AE en een koppel $2qa^2$ in G. C en E zijn scharnieren. Alle overige dimensies staan aangegeven in de figuur.

**Questions:**

- a) Use the principle of virtual work to calculate the vertical reaction force in A. Clearly indicate which virtual displacement field and which sign convention has been used.
- Gebruik het principe van virtuele arbeid om de verticale reactie kracht in A te berekenen. Geef duidelijk aan welk virtueel verplaatsingsveld en welke tekenafspraken is gebruikt.*



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(problem 5 continued)

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