Delft Applied Mechanics: Statics

AE1-914-I

ANSWER FORM



Name:

Please do not write below this line.

Grades:



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Problem 1 (Weight 2.0, approx. 35 min.)

The truss below is supported by a horizontal roller support in A and a pin connection in N. The structure is loaded by a vertical force of $60 \,\mathrm{kN}$ in joint G and a horizontal force of $80 \,\mathrm{kN}$ in C.



Question a

Calculate the reactions in A and N. Draw these forces in the figure as they act on the structure in reality.

Answer

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Which of these members can be immediately identified as zero-force-members? Indicate these members in the figure.

Answer



$\mathbf{Question}\ \mathbf{c}$

Calculate the forces in members HK, GK, JK, MK, NK. Use the correct sign for tension and compression.

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Collect all results in the table below.

$F_{ m HK}$	$F_{ m GK}$	$F_{ m JK}$	$F_{\rm MK}$	$F_{\rm NK}$

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

The 3-dimensional truss in the figure below is loaded in joint E by a force of 25 kN in the positive *y*-direction and a force of 50 kN in the negative *z*-direction.



Question a

Calculate all reactions.

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Draw all support reactions in the figure as they act on the structure in reality.



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Problem 3 (Weight 2.0, approx. 35 min.)

The structure in the figure consists of two parts (ABCS and SDE) which are hinged together in S.



Question a

Graphically determine the direction of the reaction force in A.

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				D					Е		
				S			С				
	 			Α			В			 $1\mathrm{m}$	

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Calculate the reactions in A and E. It is permitted to use the solution from the previous question.

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$\mathbf{Question}\ \mathbf{c}$

Draw the moment-diagram (M-diagram) of part ABCS using the correct deformation signs. Mention all relevant values and draw the tangents when necessary.

Answer



Question d

Draw the shear force diagram (V-diagram) of part ABCS using the correct deformation signs. Mention all relevant values.



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Question e

Isolate the corner at C and draw all forces and moments as they act on it in reality. State all values of these forces and moments.



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

The crane in the figure is used to load sea containers onto trucks. The beam ABCDE is supported by a hinge in A and the two-force member CH. The container is suspended from a cable which in turn is connected to point E and leads to the engine at M via the frictionless pulleys K, J, D and B. All pulleys have the same radius and the dimensions of the pulleys are negligible in comparison to the other dimensions of the crane. The weight of the container is 60 kN and its line of action goes through the centre of mass G of the container. The mass of the crane itself may be neglected.



Calculate the force in the cable.

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Calculate the reactions in A and H and draw them in the figure on the previous page as they act on the structure in reality. (*Hint: When drawing the free-body diagram, do not forget the force in the cable!*)

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$\mathbf{Question}\ \mathbf{c}$

Draw the free-body diagram of pulleys B and D and calculate the reactions.





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Question d

Isolate beam ABCDE and draw all forces which act on it. Also draw the N-, V-, and M-diagrams.



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Problem 5 (Weight 1.5, approx. 30 min.)

Beam ABSCD in the figure has a fixed support in A and a roller support in B. The beam is loaded by a uniform distributed load q kN/m in section BS and a moment M with magnitude qa^2 kNm in D. S is a hinge.



Question a

Use the principle of virtual work to calculate the moment reaction in A. Clearly indicate which virtual field of displacement and which sign conventions have been used.

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Use the principle of virtual work to calculate the shear force in B. Clearly indicate which virtual field of displacement and which sign conventions have been used.

Answer			
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