King Saud University
College of Engineering
Department of Civil Engineering

GE 201 Statics
First Semester 1433-34 H
Monday: 26-01-1434
Time: 90 Min

SECOND MID TERM EXAM

Name (in Arabic): ……..

Student No.: ……..

Section / Instructor: ……..

Q. No.	Max. Marks	Marks Obtained
1	10	
2	10	
3	10	
Total	30	

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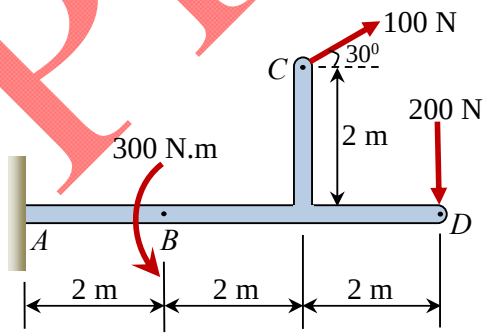
Question # 1(a) (5 Marks)

For the beam shown in the figure, calculate the reactions at the fixed support ***A***.



Solution

As the support A is a fixed support, it will offer three reactions as shown in the free body diagram. Let us assume that these three reactions are A_x, A_y and M_A respectively. We will find these three reactions with the help of three equilibrium equations as follows:

$\overset{+}{\rightarrow}\Sigma F_x = 0 \Rightarrow -A_x + 100\cos 30^\circ = 0$

$\Rightarrow \underline{A_x = 86.6\ \text{N}}$ *Ans.* **1 mark**

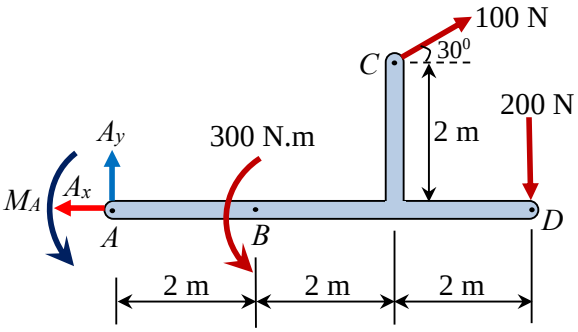
$\overset{+}{\uparrow}\Sigma F_y = 0 \Rightarrow A_y + 100\sin 30^\circ - 200 = 0$

$\Rightarrow \underline{A_y = 150\ \text{N}}$ *Ans.* **1 mark**

$CCW(+)\Sigma M_A = 0 \Rightarrow M_A + 300 + (100\sin 30^\circ)\times 4$
$- (100\cos 30^\circ)\times 2 - 200\times 6 = 0$

$\Rightarrow \underline{\underline{M_A = 873.2\ \text{N.m}}}$ *Ans.* **3 marks**

Free Body Diagram

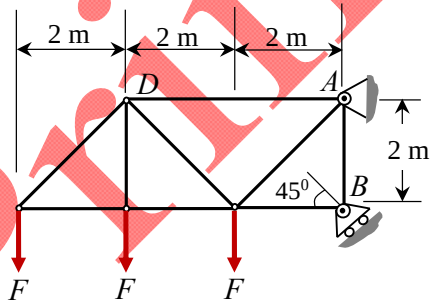


Student name		**Marks obtained for Q.1**	page 2/4
Student number			

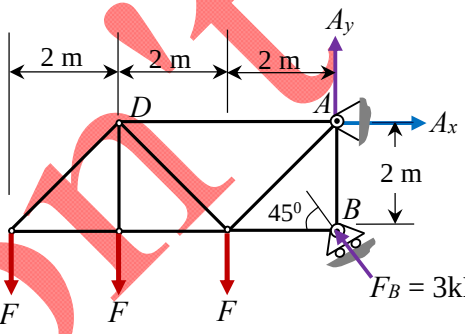
Question # 1(b) (5 Marks)

For the truss and loading shown in the figure:

If the magnitude of the reaction at the roller ***B*** is **3 kN**, determine the magnitude of each of the three forces ***F*** that can be supported by the truss.



Solution



1 mark

F_B = 3kN **1 mark**

The forces F can be obtained by applying $\Sigma M_A = 0$ (as the unknowns A_x and A_y can be eliminated by taking the moments about point A), that is:

$CCW(+)\Sigma M_A = 0 \Rightarrow F \times 6 + F \times 4 + F \times 2 - 3\cos 45^\circ \times 2 = 0 \Rightarrow F = 0.354\,\text{kN}$

$\Rightarrow \underline{\underline{F = 354\,\text{N}}}$ *Ans.*

3 marks

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Student name		**Marks obtained for Q.2**	page 3/4
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Question ≠ 2 (10 Marks)

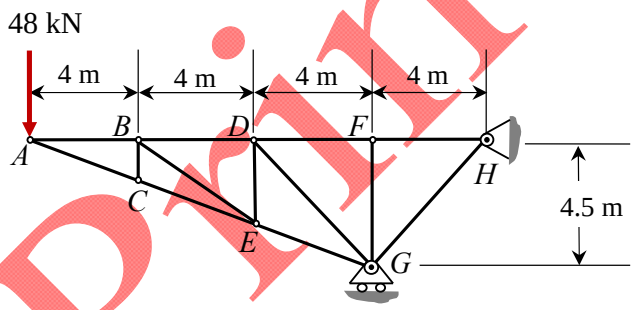
For the truss and loading shown in the figure:

a) Calculate the support reactions at roller ***G*** and pin ***H***

b) Identify the correct zero-force members

c) Calculate the forces in members ***AB*** and ***AC*** by using method of joints

d) Calculate the forces in members ***DF***, ***DG*** and ***EG*** by using method of sections



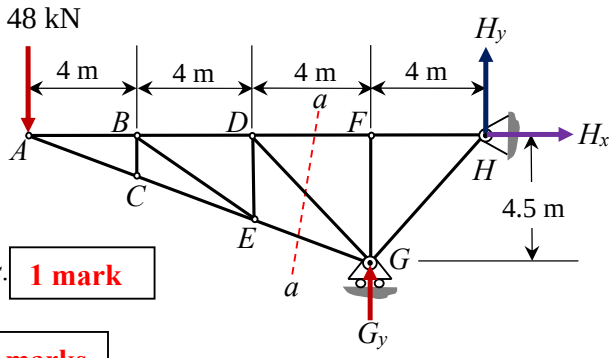
Solution:

a) *Reactions:*

$\overset{+}{\rightarrow}\Sigma F_x = 0 \Rightarrow H_x = 0$ *Ans.* **1 mark**

$CCW(+)\Sigma M_H = 0 \Rightarrow 48\times 16 - 4\times G_y = 0$ **1 mark**

$\Rightarrow G_y = 192 \text{ kN} \uparrow$ *Ans.*

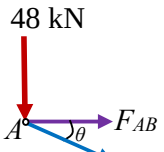


$\overset{+}{\uparrow}\Sigma F_y = 0 \Rightarrow -48 + 192 + H_y = 0 \Rightarrow H_y = -144 \text{ kN} \downarrow$ *Ans.* **1 mark**

b) *Zero force members*: *BC; BE; DE; DG* and *FG* **2 marks**

c) Forces in the members *AB* and *AC* using method of joints:

$\tan\theta = \dfrac{4.5}{12} \Rightarrow \theta = 20.556^\circ;\ \sin\theta = 0.3511 \text{ and } \cos\theta = 0.9363$

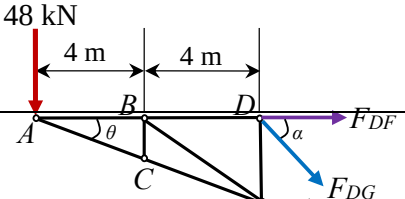


$\overset{+}{\uparrow}\Sigma F_y = 0 \Rightarrow -48 - F_{AC}\sin\theta = 0 \Rightarrow -48 - F_{AC}\times 0.3511 = 0 \Rightarrow F_{AC} = -136.7 \text{ kN (C)}$ *Ans.* **1 mark**

$\overset{+}{\rightarrow}\Sigma F_x = 0 \Rightarrow F_{AB} + F_{AC}\cos\theta = 0 \Rightarrow F_{AB} + (-136.7)\times 0.9363 = 0 \Rightarrow F_{AB} = 128 \text{ kN (T)}$ *Ans.* **1 mark**

d) Forces in the members *DF*, *DG* and *EG* using method of sections:

Cut the truss into the two parts through the section *a-a* as shown above, and then on the left side of the free body diagram (FBD) move the member forces F_{DF} and F_{DG} to the point *D* and F_{EG} to the point *E* .



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$\tan\theta = \frac{4.5}{12} \Rightarrow \theta = 20.556^{\circ}$; $\sin\theta = 0.3511$ and $\cos\theta = 0.9363$

$CCW(+)\Sigma M_A = 0 \Rightarrow F_{DG}\sin\alpha \times 8 = 0 \Rightarrow \underline{\underline{F_{DG} = 0}}$ *Ans.* **1 mark**

$\overset{+}{\uparrow}\Sigma F_y = 0 \Rightarrow -48 - F_{EG}\sin\theta - F_{DG}\sin\alpha = 0 \Rightarrow -48 - F_{EG} \times 0.3511 - 0 = 0 \Rightarrow \underline{\underline{F_{EG} = -136.7 \text{ kN (C)}}}$ *Ans.* **1 mark**

$\overset{+}{\rightarrow}\Sigma F_x = 0 \Rightarrow F_{DF} + F_{DG}\cos\alpha + F_{EG}\cos\theta = 0 \Rightarrow F_{DF} + 0 + (-136.7) \times 0.9363 = 0 \Rightarrow \underline{\underline{F_{DF} = 128 \text{ kN (T)}}}$ *Ans.* **1 mark**

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Student name		**Marks obtained for Q.3**	page 4/4
Student number			

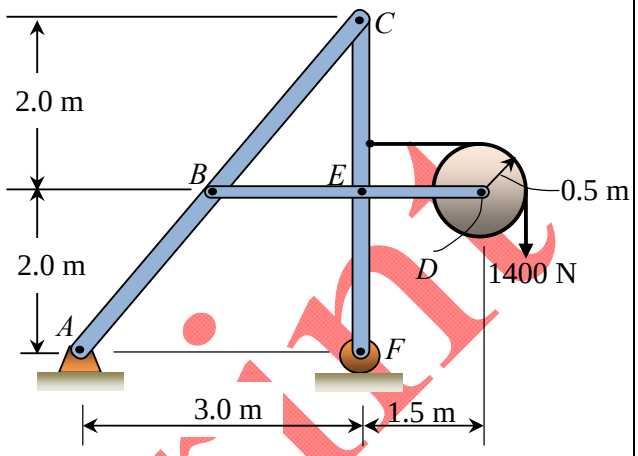
Question # 3 (10 Marks)

For the frame shown in the figure:

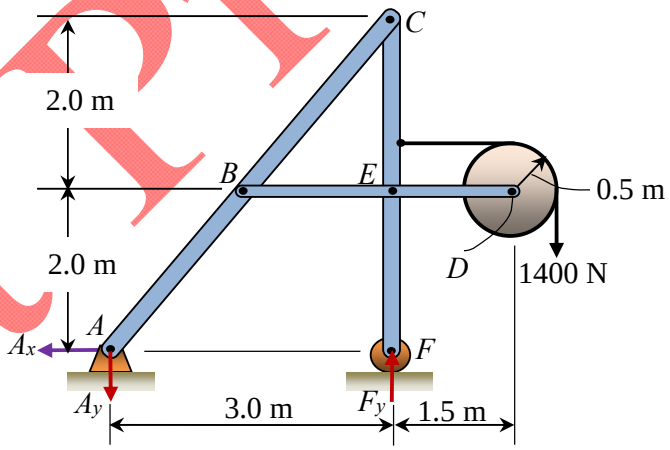
a) Find the reactions at the pin and roller supports ***A*** and ***F*** respectively.

b) Draw the free body diagrams (***FBD***) for each member.

c) Determine the horizontal and vertical components of force at ***C***.



Solution



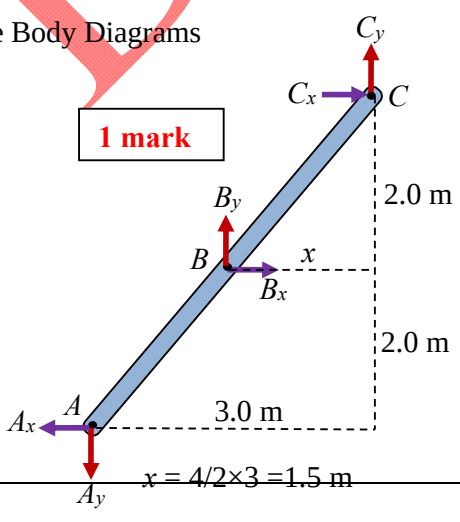
(a) Reactions

$\overset{+}{\rightarrow}\Sigma F_x = 0 \Rightarrow -A_x = 0 \Rightarrow \underline{\underline{A_x = 0}}$ *Ans.* **1 mark**

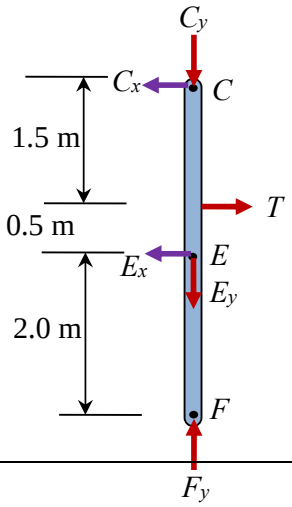
$CCW(+)\Sigma M_A = 0 \Rightarrow F_y \times 3.0 - 1400 \times 5 = 0 \Rightarrow \underline{\underline{F_y = 2333.3\ \text{N}}}$ *Ans.* **1 mark**

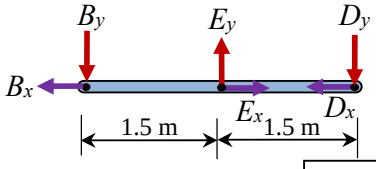
$\overset{+}{\uparrow}\Sigma F_y = 0 \Rightarrow -A_y + F_y - 1400 = 0 \Rightarrow -A_y + 2333.3 - 1400 = 0 \Rightarrow \underline{\underline{A_y = 933.3\ \text{N}}}$ *Ans.* **1 mark**

(b) Free Body Diagrams

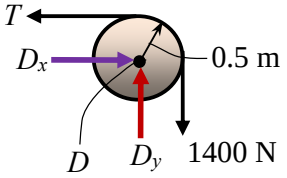


1 mark





1 mark



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1 mark

1 mark

(c) Horizontal and vertical component of forces at C

From Pulley D

$CCW(+)\Sigma M_D = 0 \Rightarrow T \times 0.5 - 1400 \times 0.5 = 0 \Rightarrow T = 1400\ \text{N}$ 1 mark

From vertical member CEF

$CCW(+)\Sigma M_E = 0 \Rightarrow C_x \times (1.5 + 0.5) - T \times 0.5 = 0 \Rightarrow C_x \times 2.0 - 1400 \times 0.5 = 0 \Rightarrow \underline{\underline{C_x = 350\ \text{N}}}$ *Ans.* 1 mark

From inclined member ABC

$CCW(+)\Sigma M_B = 0 \Rightarrow -A_x \times 2.0 + A_y \times 1.5 - C_x \times 2 + C_y \times 1.5 = 0$

$\Rightarrow 0 \times 2.0 + 933.3 \times 1.5 - 350 \times 2 + C_y \times 1.5 = 0 \Rightarrow \underline{\underline{C_y = -466.6\ \text{N}}}$ *Ans.* 1 mark

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