King Saud University
College of Engineering
Department of Civil Engineering

GE201 Statics
First Semester 1430-31 H
Monday, 18th Muharram 1431
Time: 90 Min

SECOND MID TERM EXAM

Q. No.	Marks
1	
2	
3	
Total	

Name (in Arabic): ……………………………….

Student No.: ………………………………………..

Section / Instructor: ………………………………

Question # 1 (2+3+5=10 points)

Course Learning Obj. #	*Percentage*
2	100

(a) Draw free body diagrams (FBD) of the following as shown in Figure 1.

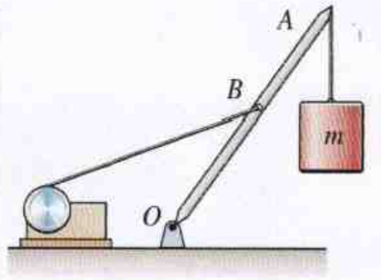
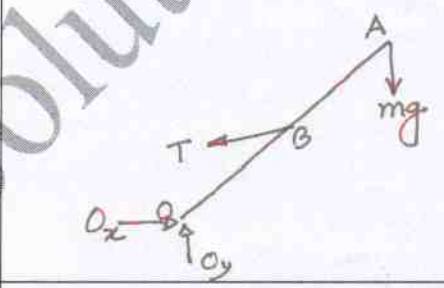
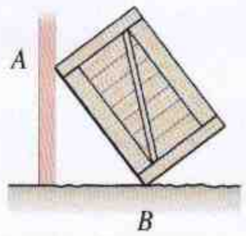
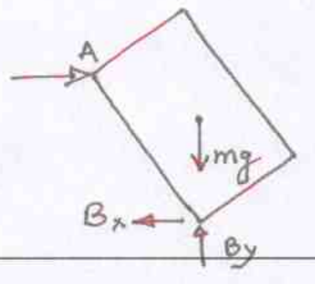
Boom *OA*, of negligible mass compared with mass *m*. Boom hinged at *O* and supported by hoisting cable at *B*.		
Uniform crate of mass *m* leaning against smooth vertical wall and supported on a rough horizontal surface.		

Figure 1

(b) Calculate the support reactions at ***A*** and ***B*** for the loaded beam shown in Figure 2. The supports at ***A*** and ***B*** are pin and roller respectively. Assume depth of the beam is negligible compared to other dimensions.

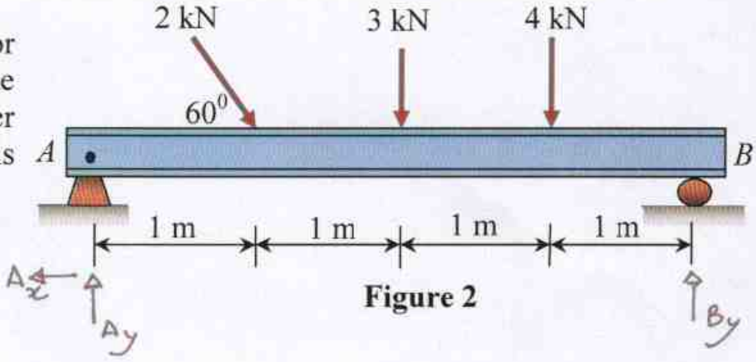


Figure 2

$\xrightarrow{+} \Sigma F_x = 0: \quad A_x = 2\cos 60^\circ = \boxed{1\,kN}$

$\circlearrowleft \Sigma M_A = 0: \quad 4B_y - 2\sin 60^\circ(1) - 3(2) - 4(3)$

$\Rightarrow \boxed{B_y = 4.93\,kN}$

$+\uparrow \Sigma F_y = 0 \quad A_y + B_y - 2\sin 60^\circ + 3 + 4$

$\Rightarrow \boxed{A_y = 3.80\,kN}$

Student name		Marks obtained for Q1	page 2/4
Student number			

(c)
Three blocks are supported using the cords and two pulleys as shown in Figure 3.

If they have weights of $\mathbf{W_A=W}$, $\mathbf{W_B=0.25W}$ and $\mathbf{W_C=W}$, determine the angle Θ for equilibrium.

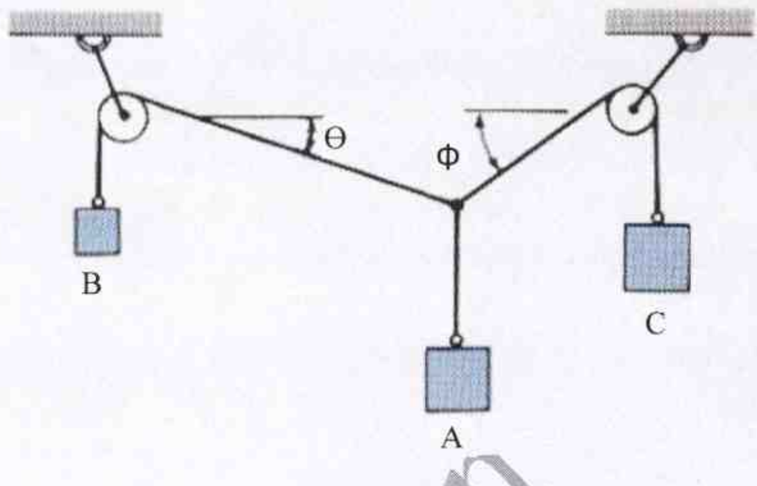
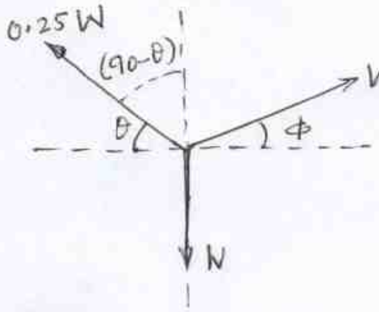
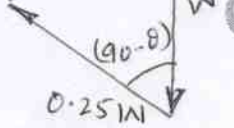


Figure 3





For equilibrium, three forces acting at a point must form three sides of a triangle (known as force triangle).

Using Law of cosine, we have

$W^2 = W^2 + (0.25W)^2 - 2W(0.25W)\cos(90-\theta)$

$\Rightarrow W^2 = 1.0625W^2 - 0.5W^2\sin\theta$

$\Rightarrow 0.5W^2\sin\theta = 0.0625W^2$

$\sin\theta = 0.125$

$\Rightarrow \boxed{\theta = 7.2^0}$

Student name		Marks obtained for Q2	page 3/4
Student number			

Question ≠ 2 (10 points)

For the loaded truss shown in Figure 4;

a) Calculate the ***support reactions*** at ***A*** and ***E***.

b) Identify the **zero force members**.

c) Determine the force in the member ***IG*** using ***Method of Joints***.

d) Calculate the force in the member ***CG*** using ***Method of Sections***.

Assume the supports at ***A*** and ***E*** as pin and roller respectively.

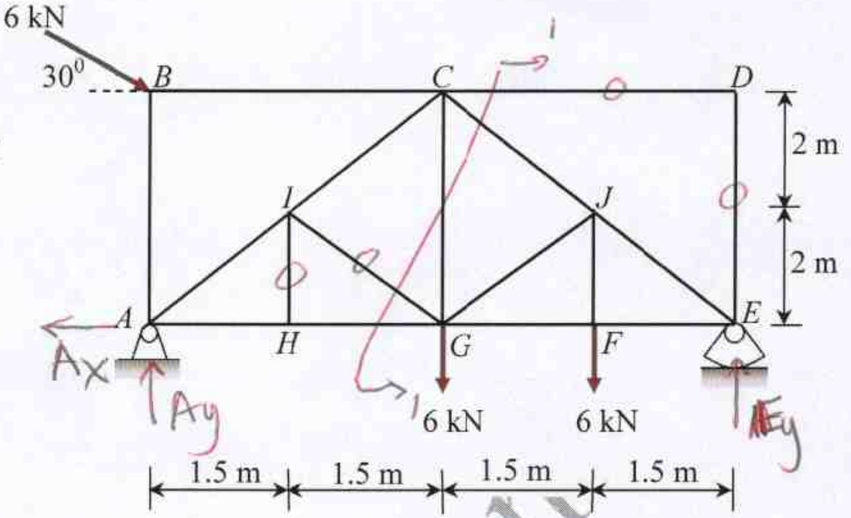


Figure 4

Course Learning Obj. #	Percentage
4	100

a) Consider the whole system

$\xrightarrow{+} \Sigma F_x = 0 \Rightarrow -A_x + 6\cos 30° = 0$

$A_x = 5.196\ kN$

$+\circlearrowleft \Sigma M_A = 0 \Rightarrow E_y \cdot 6 - 6\cos 30°(4) - 6(3) - 6(4.5) = 0$

$E_y = 10.964\ kN$

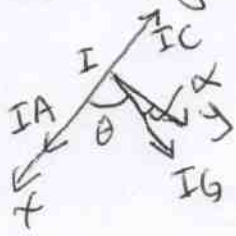
$+\uparrow \Sigma F_y = 0 \Rightarrow A_y + E_y - 6\sin 30° - 6 - 6 = 0$

$A_y = 4.036\ kN$

b) Zero-force members: CD, DE, IH (By inspection)

c) FBD at joint I

$\theta = 2\left(\tan^{-1}\left(\frac{1.5}{2}\right)\right) = 73.74° \Rightarrow \alpha = 90 - \theta = 16.26°$

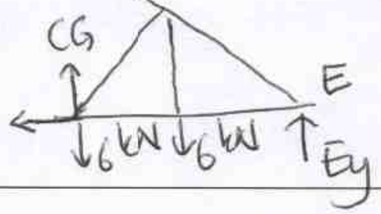


$+\downarrow \Sigma F_y = 0 \Rightarrow IG \cos\alpha = 0$

$IG = 0$

d) Section 1-1

FBD



$+\circlearrowleft \Sigma M_E = 0$

$6(1.5) + 6(3) - CG(3) = 0$

$CG = 9\ kN\ (T)$

Student name		Marks obtained for Q3		
Student number				

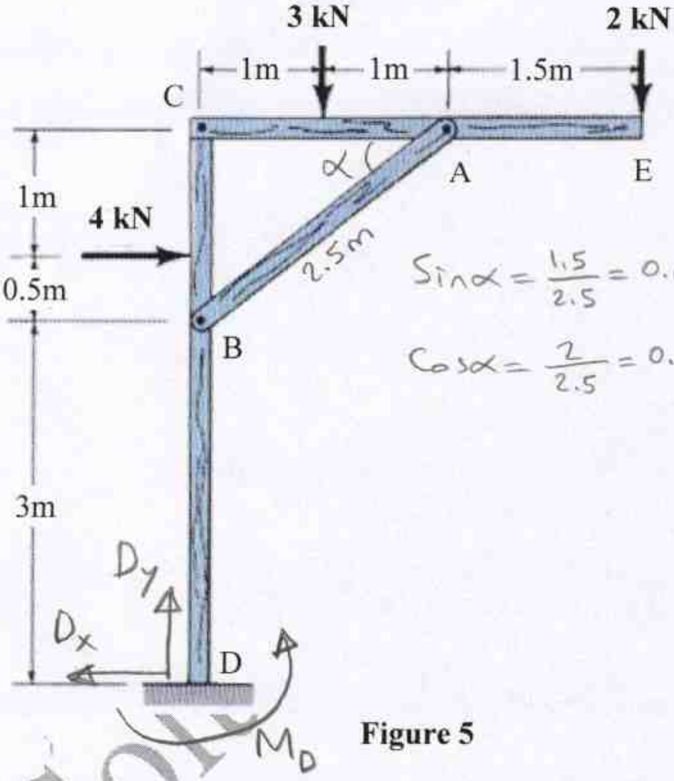
Question # 3 (10 points)

For the frame shown in Figure 5;

a) Draw the Free Body Diagrams (**FBD**) for each member,

b) Find the reaction forces at the **fixed support D**,

c) Determine the horizontal and vertical components of the forces at pins **A**, **B** and **C**.



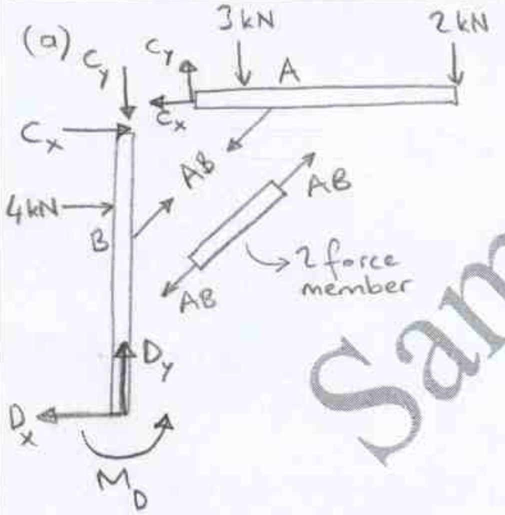
$\sin\alpha = \frac{1.5}{2.5} = 0.6$

$\cos\alpha = \frac{2}{2.5} = 0.8$

Figure 5

Course Learning Obj. #	Percentage
3	30
4	70

(a)



(b) From FBD for whole frame

$\Sigma F_x = 0: \quad 4 - D_x = 0 \quad \therefore \boxed{D_x = 4\ kN} \leftarrow$

$\Sigma F_y = 0: \quad D_y - 3 - 2 = 0 \quad \therefore \boxed{D_y = 5\ kN} \uparrow$

$\circlearrowleft + M_A = 0: \quad -M_D + 4(3.5) + 3(1) + 2(3.5) = 0$

$\therefore \boxed{M_D = 24\ kN.m} \circlearrowleft$

(c) FBD of member CE

$\circlearrowleft + \Sigma M_C = 0: \; -3(1) - 2(3.5) - 0.6AB(2) = 0$

$\therefore \boxed{AB = -8.33\ kN}$

– shows compression.

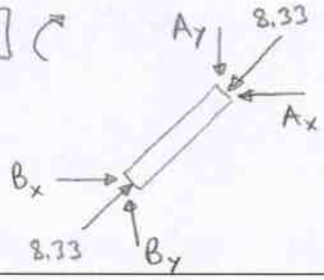
$\Sigma F_x = 0: \; -C_x - 0.8AB = 0$

$C_x = -0.8(-8.33)$

$\boxed{C_x = 6.67\ kN}$

$\Sigma F_y = 0: \; C_y - 3 - 2 - 0.6AB = 0$

$\therefore \boxed{C_y = 0}$



Recall that AB is two force member

$A_x = B_x = 0.8(8.33) = 6.67\ kN$

$A_y = B_y = 0.6(8.33) = 5\ kN$