King Saud University
College of Engineering
Department of Civil Engineering

GE 201 Statics
Second Semester 1436-37 H
Thursday, 7-7-1437
Time: $\mathbf{9 0}$ Min

## SECOND MID TERM EXAM

Name (in Arabic): $\qquad$
Student No.: $\qquad$
Section / Instructor: $\qquad$

## Question \# 1(a) (5 points)

Sketch free body diagrams of the mechanical systems shown below.

| Description | Mechanical System |
| :---: | :---: | :---: | :---: |
| Bell crank supporting <br> mass $m$ with pin <br> support at $A$ |  |
| Uniform horizontal <br> oar of mass <br> suspended by vertical <br> cable at $A$ and rough <br> inclined surface at $B$ |  |



## Solution



| FBDI | $\Sigma \mathrm{M}_{\mathrm{A}}=0: \uparrow 0.8 \mathrm{~N}_{\mathrm{F}}-200=0$ | $\therefore \mathrm{N}_{\mathrm{F}}=250 \mathrm{~N}$ | 1 mark |
| :---: | :---: | :---: | :---: |
| FBD II | $\Sigma \mathrm{M}_{\mathrm{B}}=0: \uparrow 0.8 \mathrm{~N}_{\mathrm{F}}-0.5 \mathrm{D}_{\mathrm{x}}=0$ | $\therefore \mathrm{D}_{\mathrm{x}}=400 \mathrm{~N}$ | 1 mark |
| FBD III | EM $\mathrm{E}_{\mathrm{E}}=0: \dagger 0.4 \mathrm{D}_{\mathrm{y}}-200=0$ | $\therefore \mathrm{D}_{\mathrm{y}}=500 \mathrm{~N}$ | 1 mark |

$$
\begin{array}{r}
\mathrm{D}=\sqrt{400^{2}+500^{2}}=640 \mathrm{~N} \\
1 \text { mark }
\end{array}
$$

FBD I $\sum F x=0: N_{F}-A x-100=0$ Then $A x=150 N$ $\square$
1 mark
$\sum \mathrm{Fy}=0$ : Then $\mathbf{A y}=\mathbf{0} 1$ mark
FBD II $\sum \mathrm{Fx}=0: \mathrm{N}_{\mathrm{F}}-\mathrm{Dx}+\mathrm{Bx}=0 \quad$ Then $\mathbf{B x}=\mathbf{1 5 0} \mathbf{N} 1$ mark
$\sum \mathrm{Fy}=0$ : Then $\mathrm{Dy}-\mathrm{By}=0 \quad$ Then $\mathbf{B y}=\mathbf{5 0 0} \mathbf{N} 1$ mark
FBD IV $\sum \mathrm{Fx}=0: \mathrm{Ex}-\mathrm{Ax}-\mathrm{Bx}-100=0$ Then $\mathbf{E x}=\mathbf{4 0 0} \mathbf{N} 1$ mark

$\sum \mathrm{Fy}=0$ : Then $\mathrm{Ay}+\mathrm{By}-\mathrm{Ey}=0 \quad$ Then $\mathrm{Ey}=500 \mathrm{~N} \quad 1$ mark


## Solution

$C C W(+) \Sigma M_{A}=0 \Rightarrow-T_{B C} \times \cos 30^{\circ} \times 0.1-$
$T_{B C} \times \sin 30^{\circ} \times 0.5+784.8 \times 0.25=0$
$T_{B C}(-0.087-0.25)+196.2=0$
$\Rightarrow T_{B C}=582.88 \mathrm{~N} \quad$ Ans. 1 marks
$\rightarrow \Sigma F_{x}=0 \Rightarrow T_{B C} \times \cos 30^{\circ}-A_{x}=0 \Rightarrow A_{x}=504.80 \mathrm{~N}$
$\stackrel{\dagger}{\uparrow} \Sigma F_{y}=0 \Rightarrow A_{y}+T_{B C} \sin 30^{\circ}-784.88=0 \quad 1$ marks
$\Rightarrow A_{y}+582.88 \times \sin 30^{\circ}-784.88=0 \Rightarrow A_{y}=493.44 \mathrm{~N}$ 1 marks

$\Rightarrow$ Total force at $\operatorname{pin} A=\sqrt{(504.80)^{2}+(493.44)^{2}}=705.9 \mathrm{~N}$ Ans.
1 marks

## Question \# 2 (a) (5 points)

Determine the force $P$ that will keep the pulley system in equilibrium. Neglect the weights of the pulleys.

## Solution

From FBD of pulley $B$ :
$\stackrel{\star}{ }{ }^{\dagger} F_{y}=0 \Rightarrow 3 T_{2}=9000 \Rightarrow T_{2}=3000 \mathrm{~N}$

From FBD of pulley $A$ :
$\stackrel{\dagger}{\uparrow} \Sigma F_{y}=0 \Rightarrow 3 T_{1}=T_{2} \Rightarrow T_{1}=\frac{T_{2}}{3} ; P=T_{1}=\frac{T_{2}}{3}=\frac{3000}{3} \Rightarrow \underline{\underline{P=1000 \mathrm{~N}}}$ Ans.

| Student name |  |
| :--- | :--- |
| Student number |  |
| Question \# 2(b) (15 points) |  |

For the loaded truss shown in the figure:
a) Identify the correct zero force members
b) Calculate the support reactions at $\operatorname{pin} A$ and roller $E$
c) Determine the force in the member $A D$ and $A C$ using the method of joints
d) Determine the forces in member $C E$ and $C D$ using the method of sections

Note: Specify whether the members are in Tension or Compression.

Marks obtained for $\mathbf{Q} .2$

