Name – Surname:

No.:

Istanbul Technical University – Faculty of Aeronautics and Astronautics   **15.11.2019**
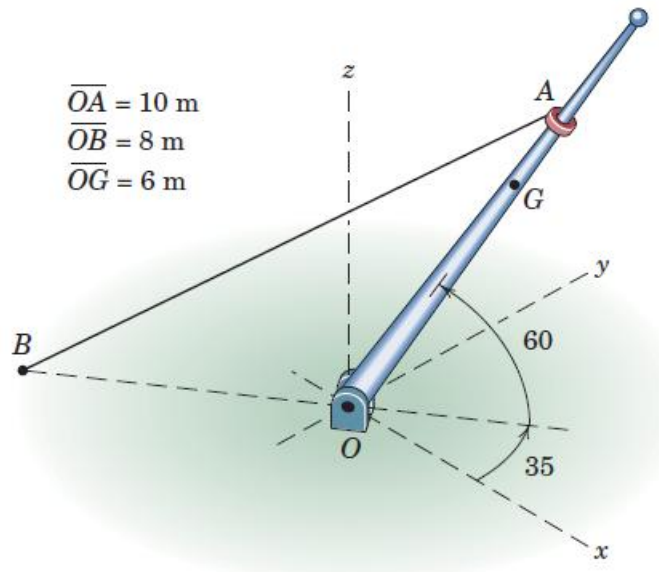**2019-2020 Fall Term**
15549 STA201E Statics

Quiz – 6 - SOLUTION

Problem: When the pole *OA* is in the position shown, the tension in cable *AB* is 3 kN. (*a*) Write the tension force exerted on the small collar at point *A* as a vector using the coordinates shown. (*b*) Determine the moment of this force about point *O* and state the moments about the *x*-, *y*-, and *z*-axes. (*c*) Determine the projection of this tension force onto line *AO*.

$\overline{OA} = 10$ m
$\overline{OB} = 8$ m
$\overline{OG} = 6$ m

Solution:

(a)

$$\vec{\lambda}_{AB} = \frac{\overrightarrow{AB}}{|\overrightarrow{AB}|} = \frac{(-8\cos 35 - 10\cos 60\cos 35)\vec{\imath} + (-8\sin 35 - 10\cos 60\sin 35)\vec{\jmath} + (-10\sin 60)\,\vec{k}}{15.62}$$

$$= -0.682\vec{\imath} - 0.478\vec{\jmath} - 0.554\vec{k}$$

$$\vec{T}_{BC} = T_{BC}\vec{\lambda}_{BC} = (3000)\left(-0.682\vec{\imath} - 0.478\vec{\jmath} - 0.554\vec{k}\right) = -2046\vec{\imath} - 1434\vec{\jmath} - 1662\vec{k} \ \ N$$

(b)

$$\vec{r}_{OA} = \vec{r}_A = 10\cos 60\cos 35\,\vec{\imath} + 10\cos 60\sin 35\,\vec{\jmath} + 10\sin 60\,\vec{k} = 4.096\vec{\imath} + 2.868\vec{\jmath} + 8.66\vec{k} \ \ m$$

$$\vec{M}_O = \vec{r}\times\vec{F} = \begin{vmatrix} \vec{\imath} & \vec{\jmath} & \vec{k} \\ 4.096 & 2.868 & 8.66 \\ -2046 & -1434 & -1662 \end{vmatrix} = 7651\vec{\imath} - 10911\vec{\jmath} - 5.736\vec{k} \ \ Nm$$

$$M_x = 7651 \ Nm$$
$$M_y = -10911 Nm$$

$M_z = -5.736 Nm$ (This small value in comparison with the other components is found nonzero due to round-off errors and must be zero.)

(c) $T_{AO} = \vec{T}_{BC}\cdot\vec{\lambda}_{A0} = \frac{[(-2046)(-4.096)+(-1434)(-2.868)+(-1662)(-8.66)]}{\sqrt{(-4.096)^2+(-2.868)^2+(-8.66)^2}} = 2688.6 \ N$