Answer on Question #70696, Physics / Mechanics | Relativity

The 0.732x 1.2 m lid ABCD of a storage bin is hinged alongside AB and is held open by looping cord DEC over a frictionless hook at E. If the tension in the cord is 54N, determine the moment about each of the co-ordinate axes of the force exerted by the cord at D.

Mx=-30.7 N.m My=12.96 N.m Mz=-2.38 N.m.

Solution:

$$z = \sqrt{0.732^2 + 0.132^2} = 0.720\ m$$

$$d_{DE} = \sqrt{0.360^2 + 0.720^2 + 0.720^2} = 1.08\ m$$

$$\boldsymbol{T_{DE}} = \frac{\boldsymbol{T_{DE}}}{d_{DE}} r_{E/D}$$

Where $r_{E/D}$ is the vector drawn from D to E

$$r_{E/D} = (0.360\ m)\boldsymbol{i} + (0.720\ m)\boldsymbol{j} + (0.720\ m)\boldsymbol{k}$$

$$\boldsymbol{T_{DE}} = \frac{\boldsymbol{54\ N}}{1.08\ m}(0.360\ m)\boldsymbol{i} + (0.720\ m)\boldsymbol{j} + (0.720\ m)\boldsymbol{k}$$

$$\boldsymbol{T_{DE}} = (18\ N)\boldsymbol{i} + (36\ N)\boldsymbol{j} - (36\ N)\boldsymbol{k}$$

The moment M_A of the force $\boldsymbol{T_{DE}}$ about A is obtained by forming the vector product

$$M_A = r_{D/A} \times \boldsymbol{T_{DE}}$$

Where $r_{D/A}$ is the vector drawn from A to D

$$r_{D/A} = (0.132\ m)\boldsymbol{j} + (0.720\ m)\boldsymbol{k}$$

The moment M_A can be expressed in the form of a determinant:

$$M_A = \begin{vmatrix} i & j & k \\ 0 & 0.132 & 0.720 \\ 18 & 36 & -36 \end{vmatrix} = -(30.7\ Nm)\boldsymbol{i} - (12.96\ Nm)\boldsymbol{j} - (2.38\ Nm)\boldsymbol{k}$$

Answer: M_x=-30.7 Nm; M_y=12.96 Nm; M_z=-2.38 Nm.