ME 205 – STATICS – FALL 2014
SECTION 04

HOMEWORK #3 SOLUTION

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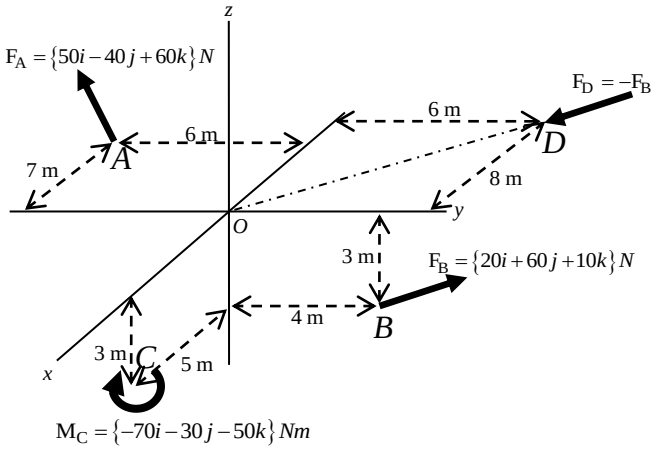
Room: C-206

Problem

For the given figure below,

a) Find the moment of the force F_A about point *C*.
b) Find the moment of the force F_A about axis *OD*.
c) Find the moment of the couple formed by forces F_B and F_D.
d) Replace all the given loading by an equivalent resultant force and a moment at point *O*.



SOLUTION

a) The moment of the force F_A about point *C*,

$$\vec{r}_{CA} = -12i - 6j + 3k$$
$$\vec{M}_A = \vec{r}_{CA} \times \vec{F}_A$$
$$\vec{M}_A = (-12i - 6j + 3k) \times (50i - 40j + 60k)$$
$$\vec{M}_A = (-240i + 870j + 780k)\,\text{N.m}$$

b) The moment of the force F_A about axis *OD*,

$$\vec{r}_{OD} = -8i + 6j$$
$$\vec{u}_{OD} = -0.8i + 0.6j$$
$$\vec{r}_{OA} = -7i - 6j$$
$$M_{OD} = \vec{u}_{OD} \cdot (\vec{r}_{OA} \times \vec{F}_A) = (-0.8i + 0.6j) \cdot \left[(-7i - 6j) \times (50i - 40j + 60k)\right]$$
$$M_{OD} = (540)\,\text{N.m} \quad \rightarrow \quad \vec{M}_{OD} = (540) \cdot (-0.8i + 0.6j) = (-432i + 324j)\,\text{N.m}$$

c) The moment of the couple formed by forces F_B and F_D,

$$\vec{r}_{DB} = 8i - 2j - 3k$$
$$\vec{M}_{\text{couple}} = \vec{r}_{DB} \times \vec{F}_B = (8i - 2j - 3k) \times (20i + 60j + 10k)$$
$$\vec{M}_{\text{couple}} = (160i - 140j + 520k)\,\text{N.m}$$

c) The equivalent resultant force and resultant moment at point *O*,

$$\vec{F}_R = \vec{F}_A + \vec{F}_B + \vec{F}_D = \vec{F}_A = (50i - 40j + 60k)\,\text{N}$$
$$\vec{M}_R = \vec{r}_{OA} \times \vec{F}_A + \vec{M}_{\text{couple}} + \vec{M}_C$$
$$\vec{M}_R = (-7i - 6j) \times (50i - 40j + 60k) + (160i - 140j + 520k) + (-70i - 30j - 50k)$$
$$\vec{M}_R = (-270i + 250j + 1050k)\,\text{N.m}$$