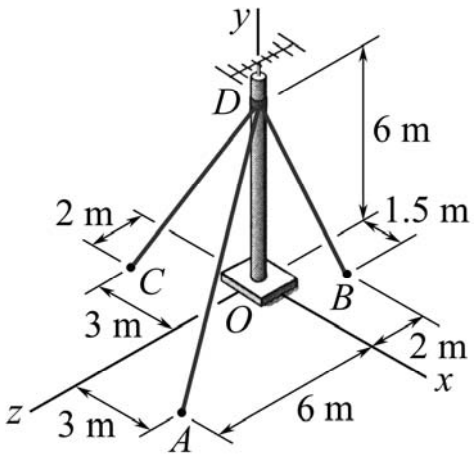
MEEG 2003 Quiz #2.m05.083

1. ③ Describe (*a*) the *parallelogram law*, (*b*) the *triangle rule*, (*c*) the *position vector* of a point *P*.

2. ⑦ The pole for an antenna is held by three guy wires as shown. If the resultant force exerted by these wires on the pole at *D* is $\mathbf{R} = -336\mathbf{j}$ N, determine the tension in each wire.



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1. (*a*) The *parallelogram law* states that the sum of two vectors is a single vector, called their *resultant*, given by the directed diagonal of a parallelogram if the two sides directed away from the tail of this diagonal are equal to these two vectors. (*b*) The *triangle rule* states that when two vectors are drawn to scale and in tip-to-tail fashion, the vector connecting, and directed from, the tail of the first vector to the tip of the second vector gives the resultant of these two vectors. (*c*) The *position vector* of a point *P* is the vector drawn from the origin *O* of the coordinate system to the point *P*. ③

2. $A(3, 0, 6)$ m, $B(1.5, 0, -2)$ m, $C(-3, 0, 2)$ m, $D(0, 6, 0)$ m

$$\overrightarrow{DA} = 3\mathbf{i} - 6\mathbf{j} + 6\mathbf{k}, \quad \overline{DA} = 9, \quad \boldsymbol{\lambda}_{DA} = \tfrac{1}{3}(\mathbf{i} - 2\mathbf{j} + 2\mathbf{k})$$

$$\overrightarrow{DB} = 1.5\mathbf{i} - 6\mathbf{j} - 2\mathbf{k}, \quad \overline{DB} = 6.5, \quad \boldsymbol{\lambda}_{DB} = \tfrac{1}{13}(3\mathbf{i} - 12\mathbf{j} - 4\mathbf{k})$$

$$\overrightarrow{DC} = -3\mathbf{i} - 6\mathbf{j} + 2\mathbf{k}, \quad \overline{DC} = 7, \quad \boldsymbol{\lambda}_{DC} = \tfrac{1}{7}(-3\mathbf{i} - 6\mathbf{j} + 2\mathbf{k})$$

$$\mathbf{F}_{DA} = \tfrac{F_{DA}}{3}(\mathbf{i} - 2\mathbf{j} + 2\mathbf{k}) \ ① \qquad \mathbf{F}_{DB} = \tfrac{F_{DB}}{13}(3\mathbf{i} - 12\mathbf{j} - 4\mathbf{k}) \ ①$$

$$\mathbf{F}_{DC} = \tfrac{F_{DC}}{7}(-3\mathbf{i} - 6\mathbf{j} + 2\mathbf{k}) \ ①$$

Since $\mathbf{F}_{DA} + \mathbf{F}_{DB} + \mathbf{F}_{DC} = -336\mathbf{j}$, ① we write

$$\mathbf{i}: \ \tfrac{1}{3}F_{DA} + \tfrac{3}{13}F_{DB} - \tfrac{3}{7}F_{DC} = 0 \quad | \quad -\tfrac{6}{13}F_{DB} - \tfrac{12}{7}F_{DC} = -336$$

$$\mathbf{j}: \ -\tfrac{2}{3}F_{DA} - \tfrac{12}{13}F_{DB} - \tfrac{6}{7}F_{DC} = -336 \quad | \quad -\tfrac{16}{13}F_{DB} - \tfrac{4}{7}F_{DC} = -336$$

$$\mathbf{k}: \ \tfrac{2}{3}F_{DA} - \tfrac{4}{13}F_{DB} + \tfrac{2}{7}F_{DC} = 0 \quad | \quad \tfrac{42}{13}F_{DB} = 672$$

Thus, we obtain

$$F_{DA} = 36 \text{ N} \qquad F_{DB} = 208 \text{ N} \qquad F_{DC} = 140 \text{ N} \ ③$$