NATIONAL UNIVERSITY OF SCIENES & TECHNOLOGY

Engineering Mechanics (ME-100)

Assignment # 1

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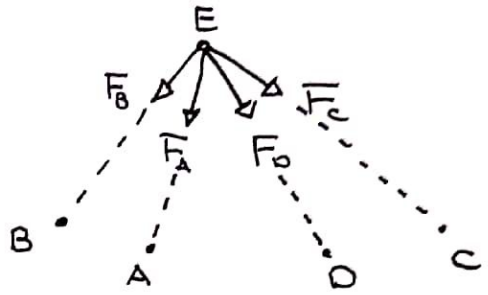
Home Assignment

2-106



Where,

A (3, 2, 0)

B (3, -2, 0)

C (-3, 2, 0)

D (-3, -2, 0)

E (0, 0, 6)

The resultant force is,

$$\vec{F}_R = -360\hat{k} = \vec{F}_A + \vec{F}_B + \vec{F}_C + \vec{F}_D$$

The four forces can be expressed as,

$$\vec{F}_A = |F_A|\,\hat{U}_A$$

$$\vec{F}_B = |F_B|\,\hat{U}_B$$

$$\vec{F}_C = |F_C|\,\hat{U}_C$$

$$\vec{F}_D = |F_D|\,\hat{U}_D$$

Since the tension in cables is same;

$$|F_A| = |F_B| = |F_C| = |F_D| = F$$

Hence, the resultant vector becomes;

$$-360\hat{k} = F_A\hat{U}_A + F_B\hat{U}_B + F_C\hat{U}_C + F_D\hat{U}_D$$

$$-360\hat{k} = F(\hat{U}_A + \hat{U}_B + \hat{U}_C + \hat{U}_D) \quad -(i)$$

Unit Vectors are;

$$\hat{U}_n = \frac{r_n}{|r_n|}$$

$$\hat{U}_A = \frac{r_A}{|r_A|} = \frac{(3-0)\hat{i} + (2-0)\hat{j} + (0-6)\hat{k}}{\sqrt{(3)^2 + (2)^2 + (6)^2}} = \frac{3}{7}\hat{i} + \frac{2}{7}\hat{j} - \frac{6}{7}\hat{k}$$

$$\hat{U}_B = \frac{r_B}{|r_A|} = \frac{(3-0)\hat{i} + (-2-0)\hat{j} + (0-6)\hat{k}}{\sqrt{(3)^2 + (-2)^2 + (-6)^2}} = \frac{3}{7}\hat{i} - \frac{2}{7}\hat{j} - \frac{6}{7}\hat{k}$$

$$\hat{U}_C = \frac{r_C}{|r_C|} = \frac{(-3-0)\hat{i} + (2-0)\hat{j} + (0-6)\hat{k}}{\sqrt{(-3)^2 + (2)^2 + (-6)^2}} = \frac{-3}{7}\hat{i} + \frac{2}{7}\hat{j} - \frac{6}{7}\hat{k}$$

$$\hat{U}_D = \frac{r_D}{|r_D|} = \frac{(-3-0)\hat{i} + (-2-0)\hat{j} + (0-6)\hat{k}}{\sqrt{(-3)^2 + (-2)^2 + (-6)^2}} = -\frac{3}{7}\hat{i} - \frac{2}{7}\hat{j} - \frac{6}{7}\hat{k}$$

$$\hat{U}_A + \hat{U}_B + \hat{U}_C + \hat{U}_D = -\frac{24}{7}\hat{k}$$

Substituting this in (i)

$$-360\hat{k} = F\left(-24/7\,\hat{k}\right)$$

$$F = +\frac{360}{+24} \cdot 7\,\cancel{k}\,\cancel{k}$$

$$\boxed{F = 105 \text{ lb}}$$

which is the tension in each string