

21-S-4-8-AG-071

A force of F Newtons is acting D degrees below the horizontal axis at coordinates (X, Y) meters. What is the equivalent force and couple moment at the origin? Further simplify the force and couple moment system and determine the magnitude and distance of the resulting force from the origin.

ANSWER:

First simplification:

The force simply moves down to the origin.

The moment is calculated via:

$$M = r \times F = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ X & Y & 0 \\ F \cos(D) & F \sin(D) & 0 \end{vmatrix} = X \cdot F \sin(D) - Y \cdot F \cos(D) \hat{k}$$

Further simplification:

The force remains the same, again simply moving to the new location.

The location is d via:

$$M = F \cdot d \rightarrow d = \frac{M}{F} = \frac{X \cdot F \sin(D) - Y \cdot F \cos(D)}{F} = X \sin(D) - Y \cos(D)$$