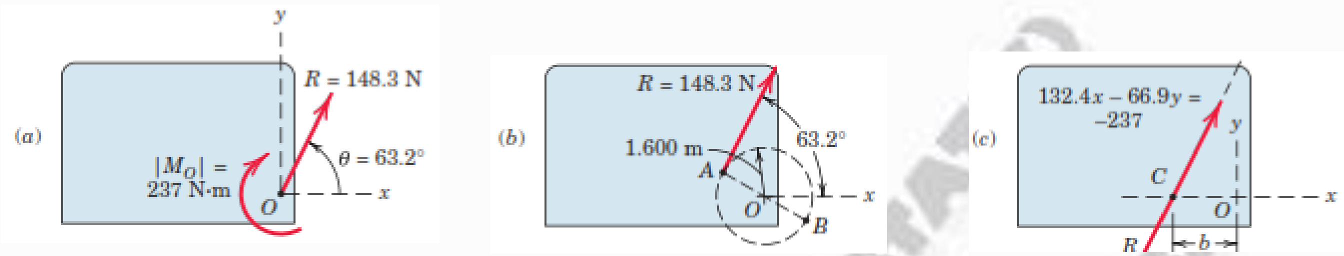

The force–couple system consisting of **R** and M_O is shown in Fig. *a*. We now determine the final line of action of **R** such that **R** alone represents the original system.

$[Rd = |M_O|]$ $\quad 148.3d = 237 \quad d = 1.600\ m$

Hence, the resultant **R** may be applied at any point on the line which makes a 63.2 angle with the *x-axis and is tangent at point A to a circle of 1.600-m radius* with center *O, as shown in part b of the figure. We apply the equation Rd =M* in an absolute-value sense (ignoring any sign of *M*) and let the physics of the situation, as depicted in Fig. *a*, dictate the final placement of **R.** Had M_O been counterclockwise, the correct line of action of **R** would have been the tangent at point *B.*

The resultant **R** may also be located by determining its intercept distance *b* to point *C on the x-axis, Fig. c. With Rx* and *Ry* acting through point *C, only Ry* exerts a moment about *O so that*

$$R_y b = |M_o| \quad and \quad b = \frac{237}{132.4} = 1.792\ m$$

Alternatively, the *y-intercept could have been obtained by noting that the moment* about *O* would be due to *Rx* only. A more formal approach in determining the final line of action of **R is to use** the vector expression

$$\mathbf{r} \times \mathbf{R} = \mathbf{M}_O$$

where $\mathbf{r} = x\mathbf{i} + y\mathbf{j}$ is a position vector running from point O to any point on the line of action of **R.** Substituting the vector expressions for **r, R**, and $\mathbf{M}_O$ and carrying out the cross product result in

$(x\mathbf{i} + y\mathbf{j}) \times (66.9\mathbf{i} + 132.4\mathbf{j}) = -237\mathbf{k}$

$(132.4x - 66.9y)\mathbf{k} = -237\mathbf{k}$

Thus, the desired line of action, Fig. *c, is given by*

$132.4x - 66.9y = -237$

By setting *y = 0, we obtain x = 1.792 m, which agrees with our earlier calculation* of the distance *b.*

Helpful Hints

1. We note that the choice of point *O* as a moment center eliminates any moments due to the two forces which pass through *O*. Had the clockwise sign convention been adopted, M_O would have been +237 N·m, with the plus sign indicating a sense which agrees with the sign convention. Either sign convention, of course, leads to the conclusion of a clockwise moment M_O.
2. Note that the vector approach yields sign information automatically, whereas the scalar approach is more physically oriented. You should master both methods.

2