Moment Visualization Assignment

A visual understanding of moments is especially important for machine design, since this will allow one to troubleshoot and optimize a design. For this assignment review the Moment Visualization handout. Then visually represent the moments for each figure. In each problem:

1. Review the Moments Visualization handout (see Guides section of MAE3 webpage for electronic version)

2. Draw the relevant vector components, $\vec{\mathbf{r}}$, $\mathbf{r}_{\perp}$, $\mathbf{r}_{\amalg}$, $\mathbf{F}_{\perp}$, $\mathbf{F}_{\amalg}$ F_x, F_y , r_x, r_y

   Use a ruler to draw the vectors properly and measure their length. Make sure perpendicular lines are indeed drawn at 90 degrees.

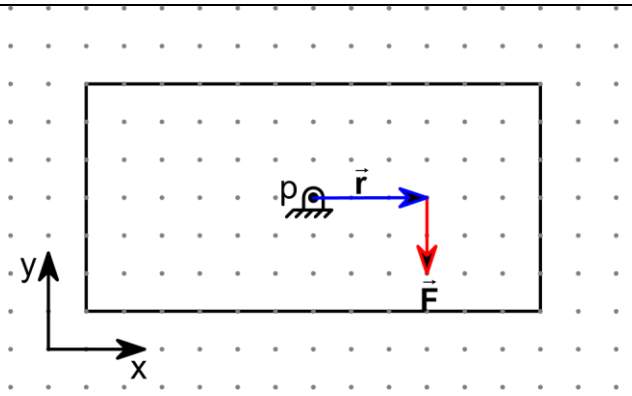
3. On the drawing measure the length of the vectors, and convert to distance and force values using the scale of:
   1 mm on drawing = Distance of 0.1m
   1 mm on drawing = Force of 2N

4. Calculate the moments about point p using the:
   - Perpendicular Force Representation
   - Moment Arm Representation
   - Cartesian (XY) Representation

For this assignment you will need:
- A ruler with millimeter markings
- An angle to draw perpendicular lines

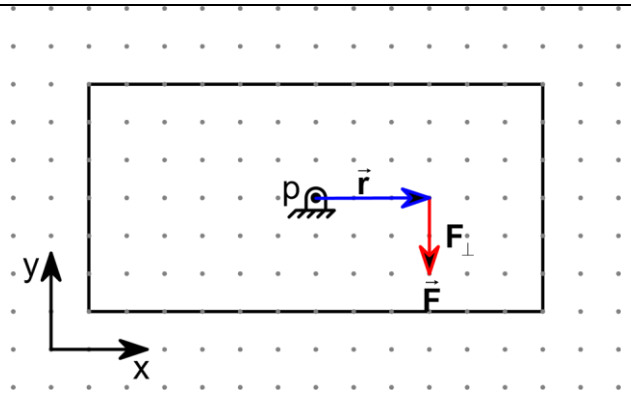
Due to errors in length measurements, one may expect up to 10% discrepancy in results from different visual methods of calculations.

Example: (This is a very easy example; for harder problems see the Moments Visualization



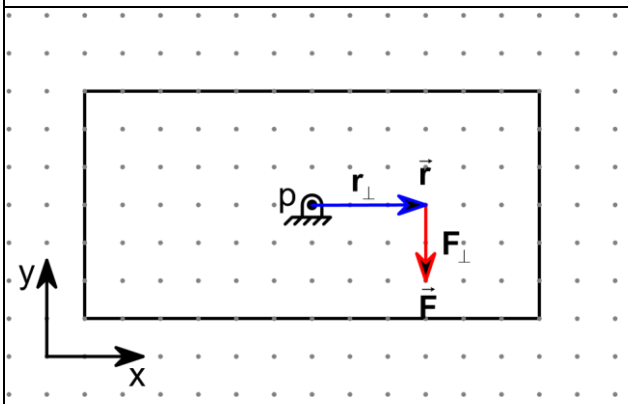
Vector magnitudes
F = 10 grid mm = 20N
r = 15 grid mm = 1.5m

Problem Definition



10 grid mm = 20N
$M_p = \mathbf{F}_\perp r$ = - 20N x 1.5m = -30Nm

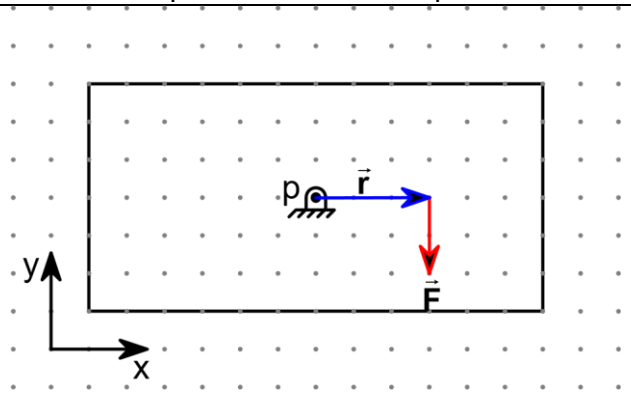
Perpendicular Force Representation



$\mathbf{r}_\perp$ = 15 grid mm = 1.5m

$M_p = F\,\mathbf{r}_\perp$ = -20N x 1.5m = -30Nm

Moment Arm Representation



grid = 0N
F_y = -10 grid mm = -20N
r_x = 15 grid mm = 1.5m
r_y = 0 grid = 0m
$M_p = F_y r_x - F_x r_y$
M_p = -20Nx1.5m – 0Nx0m = -30Nm

Cartesian (XY) Representation

handout) Scale: On the drawing, each millimeter corresponds to (the grid marks are at 5mm steps)

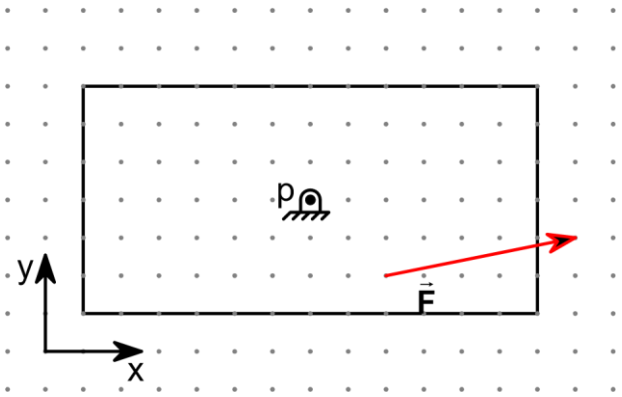
1 mm on drawing = Distance of 0.1m

1 mm on drawing = Force of 2N

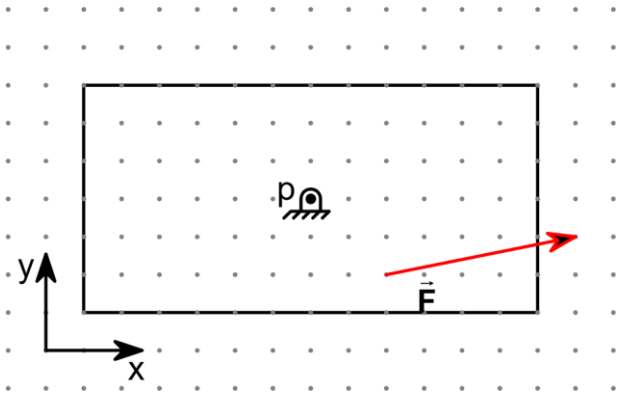
Right Hand Rule: counterclockwise moments are positive

In Cartesian representation the signs in the equations as shown are correct, as long as one represents the signs of the vectors properly.

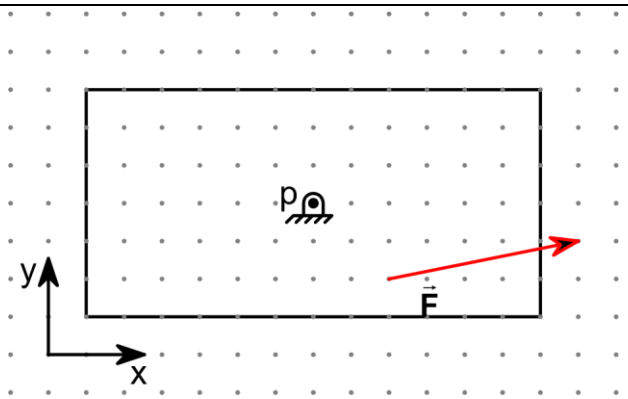
Problem 1



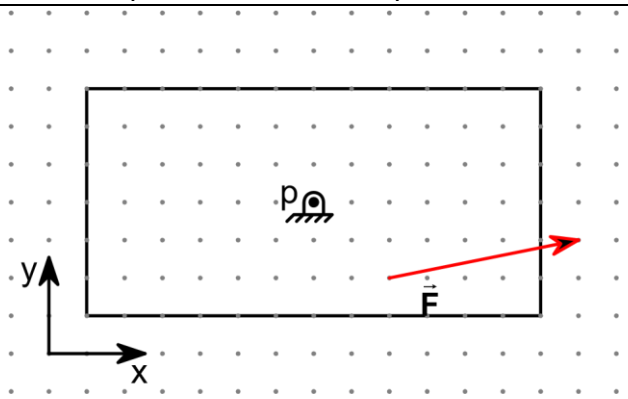
Problem Definition



Perpendicular Force Representation



Moment Arm Representation



Cartesian (XY) Representation

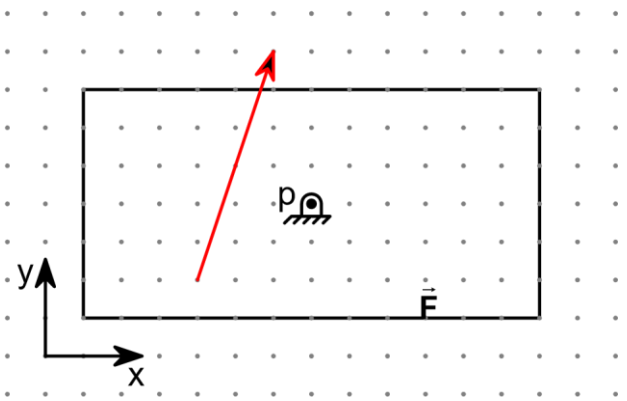
Scale: On the drawing, each millimeter corresponds to (the grid marks are at 5mm steps)

1 mm on drawing = Distance of 0.1m

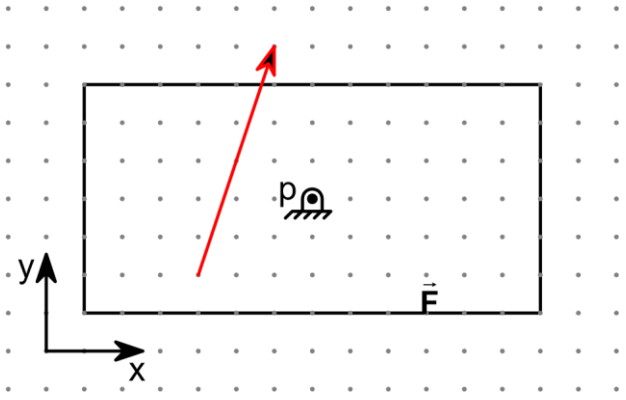
1 mm on drawing = Force of 2N

Right Hand Rule: counterclockwise moments are positive.

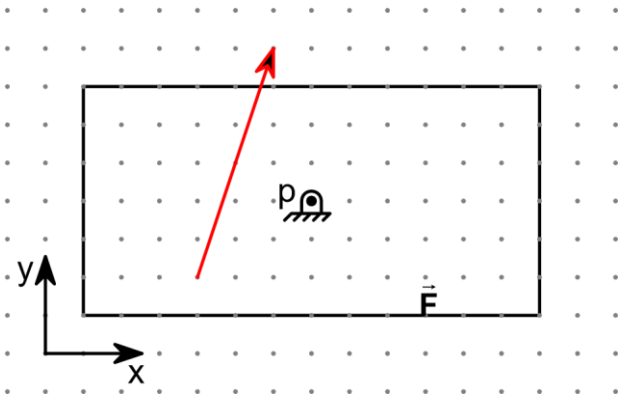
Problem 2



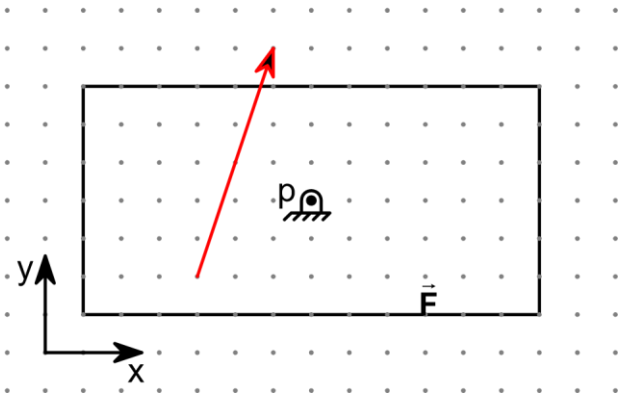
Problem Definition



Perpendicular Force Representation



Moment Arm Representation



Cartesian (XY) Representation

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