Using Free Body Diagrams

I In writing (not just in your mind), choose a specific object or group of objects.

II Draw an outline sketch of **just** your chosen object, without any other items near it. Do not re-orient this sketch.

III Draw a coordinate system for directions, including ±rotation and axis.

IV Draw and **name** all forces *that act on your object*, at the place and direction where they actually act. Each force must have a unique symbolic name: W_D, or N_B, etc. Correctly draw each as pushing, pulling, or scraping.

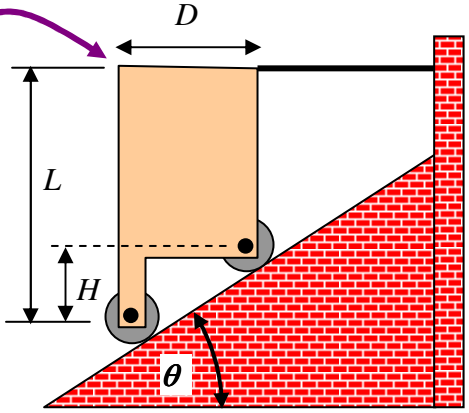
V If some of your forces are oriented diagonally with respect to your coordinate system, start over again at step III, using a new outline. Do not erase or corrupt your first version! In the new version, instead of each "diagonal" force, draw two separate forces, each of which is a component of the "diagonal" force. All the same forces should be on this diagram as were on the original, except that a few will now be there in component form.

VI Write Newton's 2nd law for each possible component direction (including rotation!), *symbolically*. If a force was drawn in the same direction as a coordinate axis, it is positive when you include it in ΣF, otherwise it is negative. Moments are positive when they are in the same direction as the coordinate axis (in the example below, $+z$ is counter clockwise). Also, write any geometric constraints as equations (e.g., $\tan\theta = H/D$)

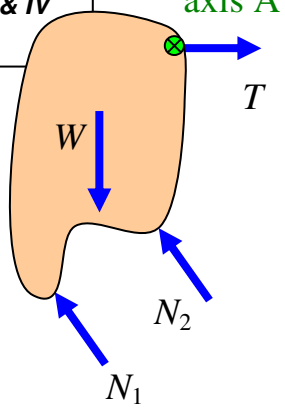
VII Do algebra until you have solved for the item you wanted to know, then box your answer.

Step I

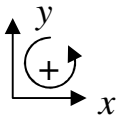
My object is this cart



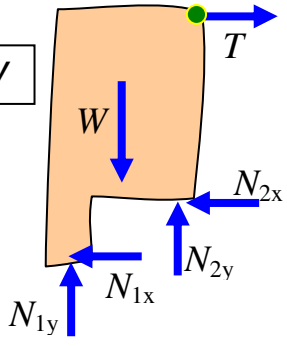
Steps II & IV & IIIc



Step III



Step V



$$\Sigma F_x = 0$$
$$-N_{1x} - N_{2x} + T = 0 \qquad [a]$$

$$\Sigma F_y = 0$$
$$-W + N_{1y} + N_{2y} = 0 \qquad [b]$$

$$\Sigma M_{Az} = 0$$
$$+(\tfrac{1}{2}D)W + (0)T + (0)(N_{2y}) - (L-H)(N_{2x}) - (L)(N_{1x}) - (D)(N_{1y}) = 0 \qquad [c]$$

Geometry:
$N_{1y}/N_{1x} = N_{2y}/N_{2x}$

Step VI