Conceptual Question C5.1

Given: A rigid body is acted upon by a set of four forces. It is desired to represent this set of forces (System I) by an equivalent force-couple system (System II) at point A on the body: $\vec{R} = R_x\hat{i} + R_y\hat{j}$ and $\vec{M} = M\hat{k}$.

Find:

Circle the correct response below regarding the x-component of the resultant $\vec{R}$:

- $R_x < 0$
- $R_x = 0$
- $R_x > 0$

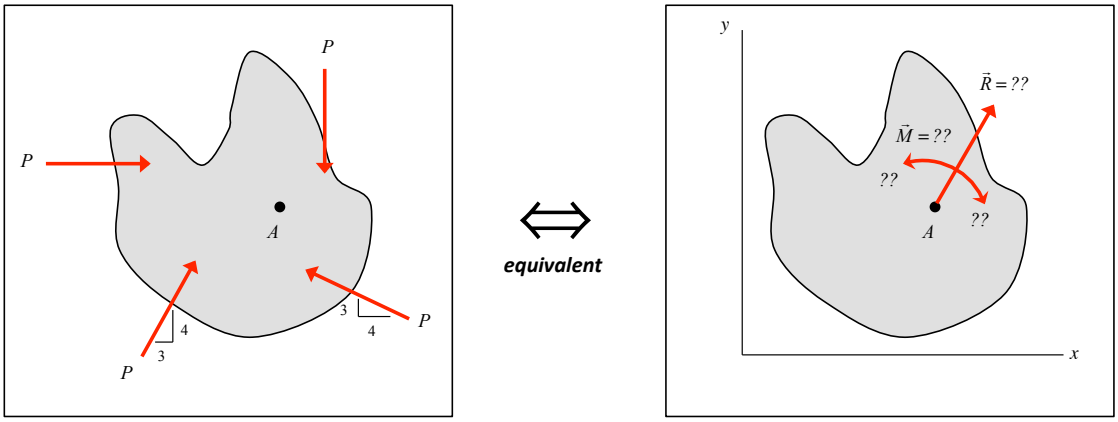
Circle the correct response below regarding the y-component of the resultant $\vec{R}$:

- $R_y < 0$
- $R_y = 0$
- $R_y > 0$

Circle the correct response below regarding the direction of the couple $\vec{M}$:

- $\vec{M}$ is counter-clockwise
- $\vec{M} = 0$
- $\vec{M}$ is clockwise

Provide explanations for your answers.



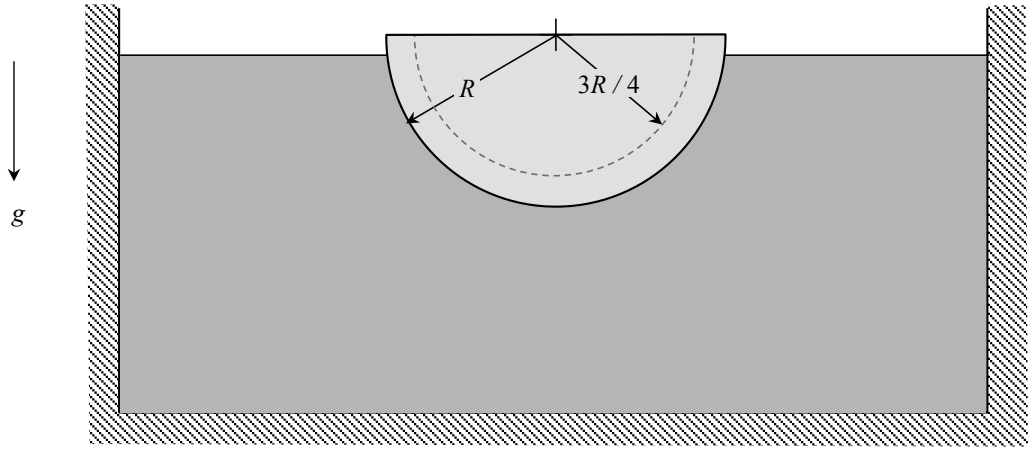
System I System II

Conceptual Question C5.2

Given: A hemispherical shell cap with an outer radius of R and inner radius of $3R/4$ is made of a material having a mass density of $\rho_c = 2\rho_w$, where ρ_w is the mass density of water.

Find: Will the cap float when placed in water in the orientation shown below?

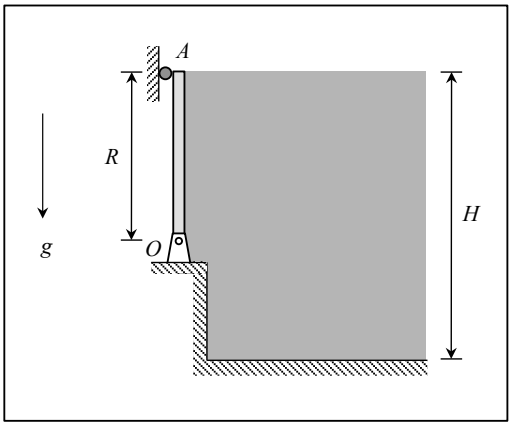
Provide an explanation for your answer.



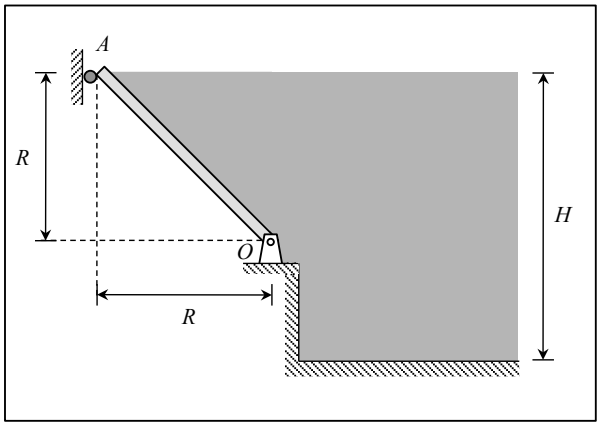
Conceptual Question C5.3

Given: Consider the vertical Gate 1 shown below that is holding back water of density ρ_w. Gate 2, also shown below, is mounted with an inclined orientation. Each gate has a dimension of b into the page. The weights of the gates are to be considered negligible compared to the weight of the water being held back by the gates. Let $(N_A)_1$ and $(N_A)_2$ represent the reaction forces acting at ends A of Gates 1 and 2, respectively.

Find: Determine the ratio of $(N_A)_2 / (N_A)_1$.



Gate 1

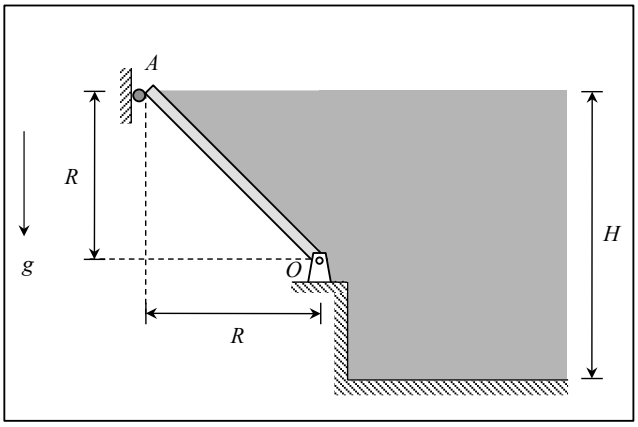


Gate 2

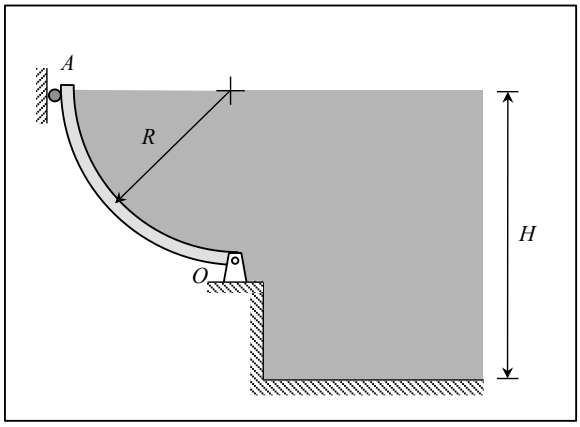
Conceptual Question C5.4

Given: Consider the straight, inclined Gate 1 shown below that is holding back water of density ρ_w. Gate 2, also shown below, is a quarter circle arc. Each gate has a dimension of b into the page. The weights of the gates are to be considered negligible compared to the weight of the water being held back by the gates. Let $(N_A)_1$ and $(N_A)_2$ represent the reaction forces acting at ends A of Gates 1 and 2, respectively.

Find: Determine the ratio of $(N_A)_2 / (N_A)_1$.



Gate 1

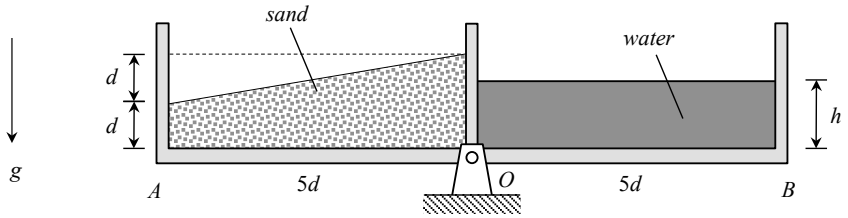


Gate 2

Conceptual Question C5.5

Given: A box containing sand is mounted on a lever between A and O. Let ρ_s represent the mass density of the sand. A second box is mounted between O and B on the same lever. This second box is to be filled with water (having a mass density of ρ_w) to a height h that will keep the lever in balance. Use $\rho_s = 2\rho_w$. Each box has a dimension of b into the page. The weights of the boxes and the lever can be considered negligible as compared to the sand and water.

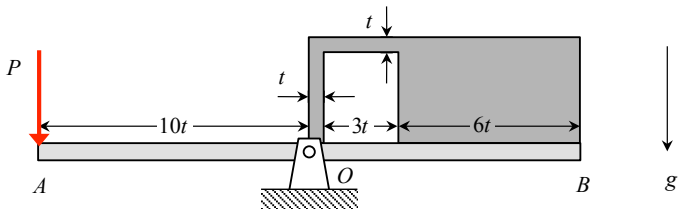
Find: Determine the height h of the water that is needed to balance the sand. Express your answer in terms of d.



Conceptual Question C5.6

Given: A body having a weight of W is placed between O and B on a lever. A vertical force P acts at end A of the lever. The weight of the lever is to be considered to be negligible compared to the weight of the body.

Find: Determine the force P required to keep the lever in balance. Express your answer in terms of W.

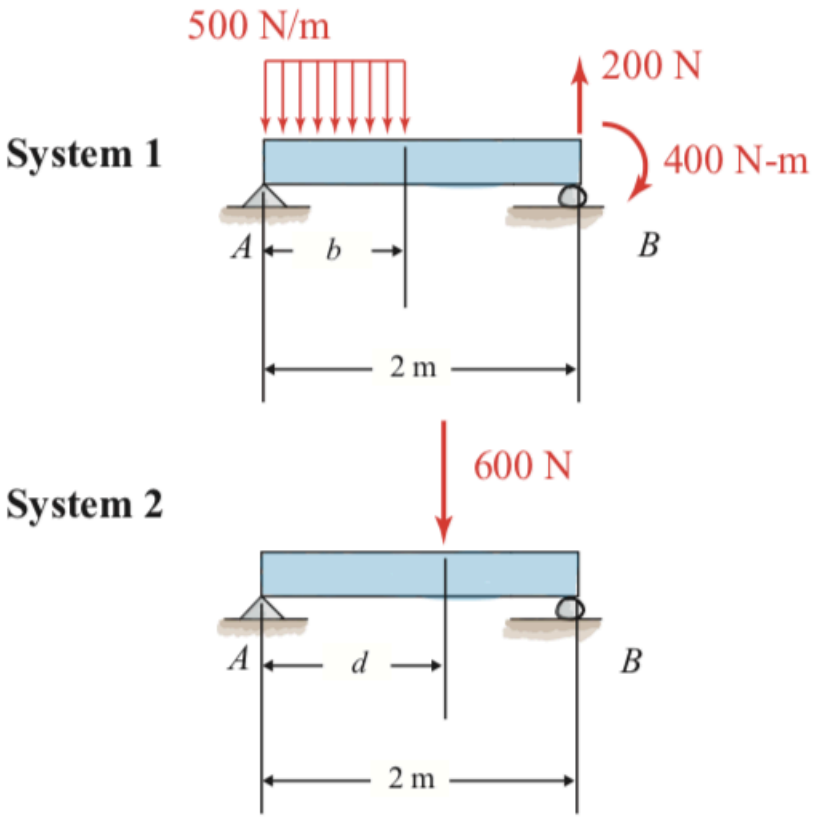


Conceptual Question C5.7

Given: Consider the two statically-equivalent force systems shown below.

Find: For this problem:

- Determine the length b over which the line load acts.
- Determine the location d of the single equivalent force.

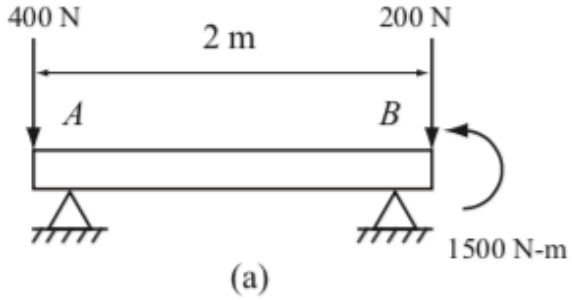


Conceptual Question C5.8

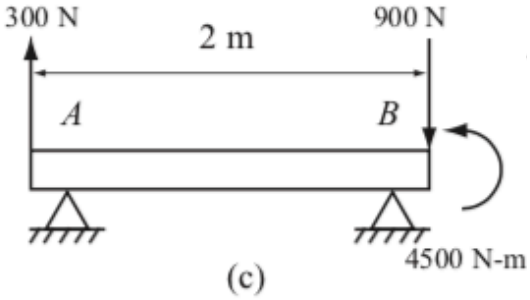
Given: Consider the four different load systems (a)-(d) shown below.

Find: For this problem:

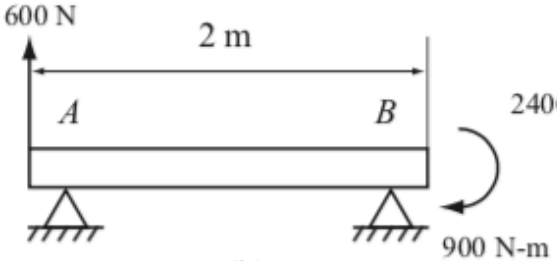
- For each loading system, determine the equivalent force-couple system at location A.
- Which of the loading systems, if any, are equivalent?



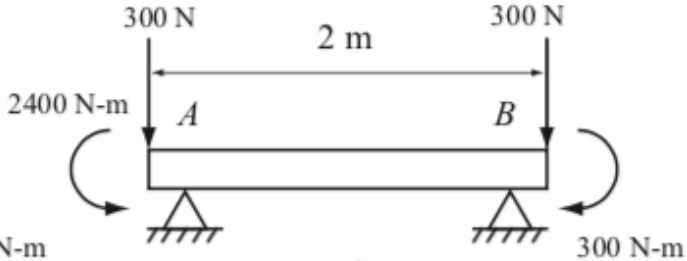
(a)



(c)



(b)



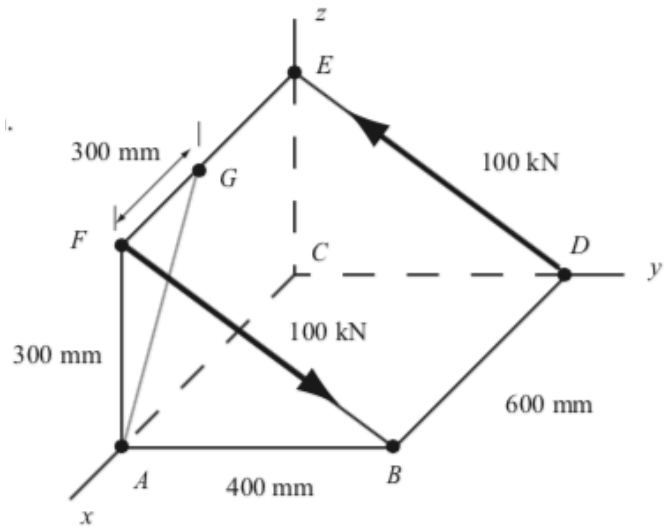
d)

Conceptual Question C5.9

Given: Consider the load pair shown below.

Find: For this problem:

- Determine the equivalent force-couple system for this load pair. Where does this equivalent system act?
- Determine the component of the couple found above along line segment AG.

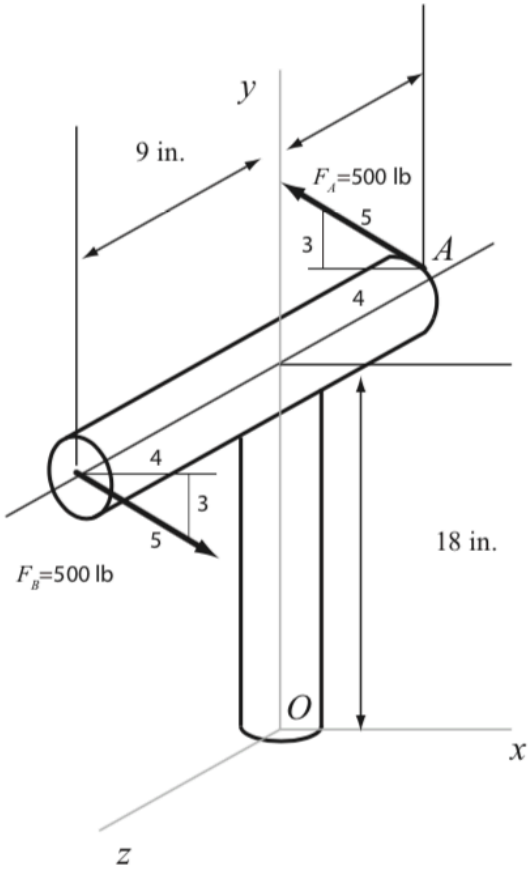


Conceptual Question C5.10

Given: Consider the load pair acting on the T-shaped bracket shown below.

Find: For this problem:

- Determine the resultant moment acting about point O due to the pair of forces F_A and F_B on the bracket.
- Determine moment of the load F_B about point A.
- Determine moment of the load F_A about point B.
- Compare your results from above.

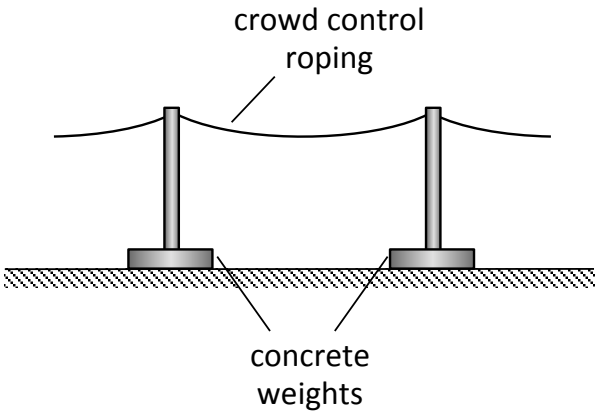


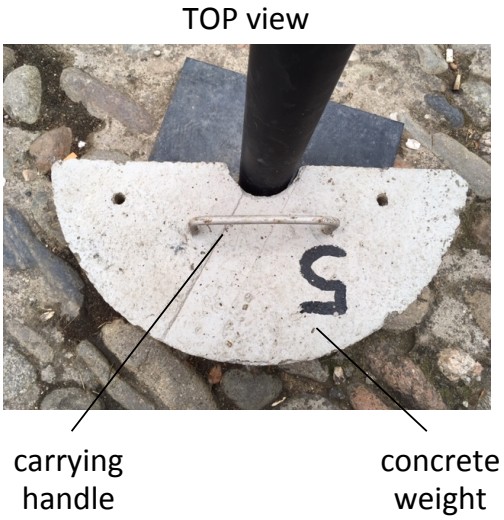
Conceptual Question C5.11

Given: Supports for crowd control roping are held in place by semi-circular concrete weights, as shown below. Built into these concrete weights are handles for transportation purposes.

Find: Consider the location of these handles on the weights.

- Where is the optimal location for these handles on the weights for balance during carrying?
- Based on the photo shown below right, how close are the handles to their optimal location?





Conceptual Question C5.12

Given: During live and video-recorded performances of the song "Criminal Minds," the late Michael Jackson and his dance team included a "45 degree lean" as part of their dance moves.

Find: Consider the approximate location of the center of mass of the human body shown below.

- What makes this dance move appear so impressive (and physics defying)?
- How did Mr. Jackson and his team perform this move?