Answer on Question 59417, Physics, Mechanics, Relativity

Question:

A uniform plank AB 30 m long, weighing 100 N is pivoted at points P, Q which are 5 m from the ends A and B respectively. A boy of weight 250 N stands at point D on the plank, 1 m away from Q and the arrangement is in equilibrium. Determine the reaction R_1 and R_2 at the supports?

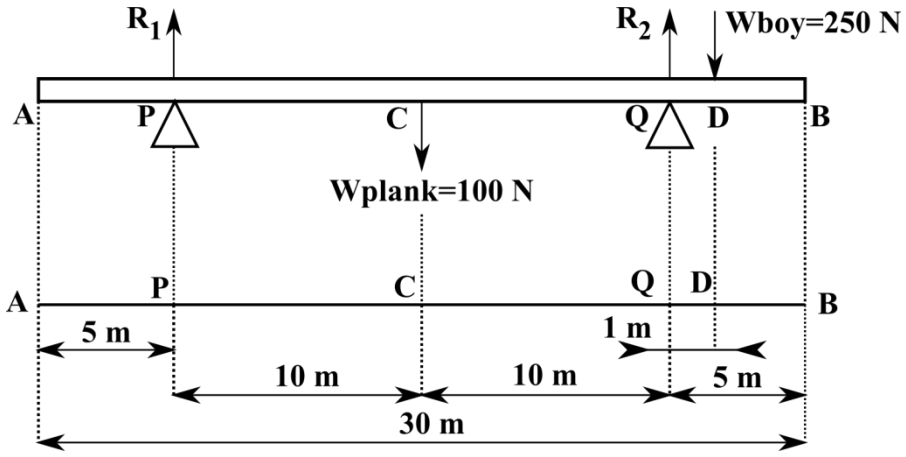
a) $R_1 = 77.5\ N$, $R_2 = 245.5\ N$.

b) $R_1 = 105.5\ N$, $R_2 = 33.5\ N$.

c) $R_1 = 37.5\ N$, $R_2 = 312.5\ N$.

d) $R_1 = 27.5\ N$, $R_2 = 232.5\ N$.

Solution:



a) To find the reaction force at the left support, R_1, we should consider the sum of moments of forces around the point Q. From the condition of the question we know that the arrangement is in equilibrium, thus the sum of all moments is equal to zero:

$$\sum M_Q = 0,$$

$$R_1 l_{PQ} - W_{plank} l_{CQ} + W_{boy} l_{QD} = 0.$$

From this equation, we can find R_1:

$$R_1 = \frac{W_{plank} l_{CQ} - W_{boy} l_{QD}}{l_{PQ}} = \frac{100\ N \cdot 10\ m - 250\ N \cdot 1\ m}{20\ m} = \frac{750\ N \cdot m}{20\ m} = 37.5\ N.$$

b) To find the reaction force at the right support, R_2, we should consider the sum of moments of forces around the point P. Again, since the arrangement is in equilibrium the sum of all moments is equal to zero:

$$\sum M_P = 0,$$

$$W_{plank} l_{PC} + W_{boy} l_{PD} - R_2 l_{PQ} = 0.$$

From this equation, we can find R_2:

$$R_2 = \frac{W_{plank} l_{PC} + W_{boy} l_{PD}}{l_{PQ}} = \frac{100\ N \cdot 10\ m + 250\ N \cdot 21\ m}{20\ m} = \frac{6250\ N \cdot m}{20\ m} = 312.5\ N.$$

Answer:

c) $R_1 = 37.5\ N$, $R_2 = 312.5\ N$.