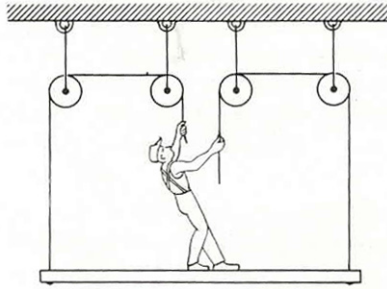


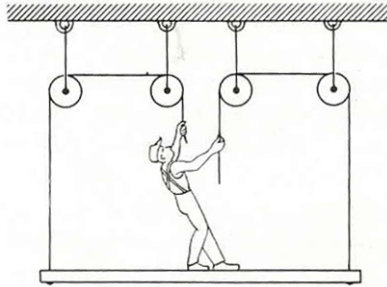
In-Class Problem 9: Painter on a Platform

A painter of mass m_1 stands on a platform of mass m_2 and pulls himself up by two ropes which hang over massless pulleys. He pulls each rope with a force F and accelerates upward with a uniform acceleration a . Find the acceleration a .



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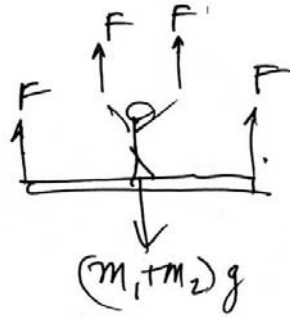
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Separate Free Body Diagrams on Plank and Painter

$$\begin{aligned}
 & a_1 = a_2 = a \\
 & \text{Free Body Diagram for Plank (mass } m_2 \text{):} \\
 & \quad \uparrow F \quad \downarrow N \quad \downarrow m_2 g \quad \uparrow F \\
 & \quad \vec{F}_2 = m_2 \vec{a} \\
 & \quad \uparrow: 2F - N - m_2 g = m_2 a \\
 & \quad 2F - N - m_2 g = m_2 a \\
 & \text{Free Body Diagram for Painter (mass } m_1 \text{):} \\
 & \quad \uparrow F \quad \downarrow m_1 g \quad \uparrow N \quad \uparrow \hat{j} \\
 & \quad \vec{F}_1 = m_1 \vec{a}_1 \\
 & \quad \uparrow: 2F - m_1 g + N = m_1 a \\
 & \quad 2F - m_1 g + N = m_1 a \\
 & \quad 4F - (m_1 + m_2)g = (m_1 + m_2)a \\
 & \quad a = \frac{4F - (m_1 + m_2)g}{m_1 + m_2} \\
 & \quad a = \frac{4F}{m_1 + m_2} - g
 \end{aligned}$$

Free Body Diagram on System consisting of Plank and Painter



$$4F - (m_1 + m_2)g = (m_1 + m_2)a$$

Lose all information about the internal normal force between painter and plank.