ME 205 – STATICS – FALL 2014
SECTION 04

HOMEWORK #2 SOLUTION

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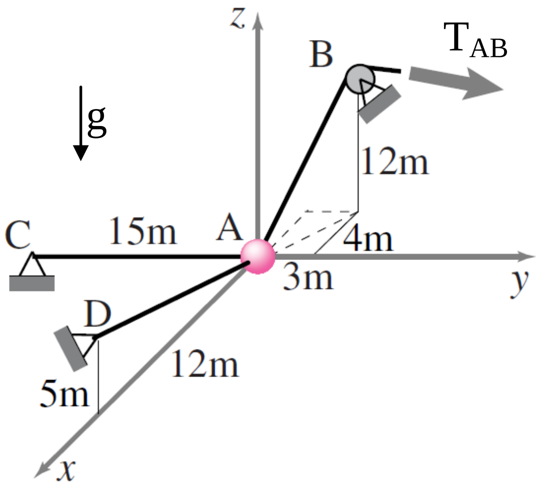
Problem

A particle of mass 1 kg located at point A is attached to two strings tied at points C and D shown in the figure. Another string, AB, attached to the particle, passes over a pulley and is used to hold the particle in equilibrium under gravity such that it loses contact with the ground at point A. Find the tension in string AB,T_{AB}.

Hint: Point D is on the *xz* plane and Point C is on the -*y* axis.



SOLUTION

a) The condition of equilibrium;

$$\vec{T}_{AB}+\vec{T}_{AC}+\vec{T}_{AD}+\vec{W}=0$$
$$T_{AB}\vec{u}_{AB}+T_{AC}\vec{u}_{AC}+T_{AD}\vec{u}_{AD}-m_A g k=0$$

From the given figure,

$$\vec{u}_{AB}=\frac{-4i+3j+12k}{\sqrt{4^2+3^2+12^2}}=-\frac{4}{13}i+\frac{3}{13}j+\frac{12}{13}k$$
$$\vec{u}_{AC}=\frac{-4i+3j+12k}{\sqrt{4^2+3^2+12^2}}=-j$$
$$\vec{u}_{AD}=\frac{12i+5k}{\sqrt{5^2+12^2}}=\frac{12}{13}i+\frac{5}{13}k$$

So,

$$T_{AB}\left(-\frac{4}{13}i+\frac{3}{13}j+\frac{12}{13}k\right)+T_{AC}(-j)+T_{AD}\left(\frac{12}{13}i+\frac{5}{13}k\right)-m_A g k=0$$

Equating the *x*, *y* and *z* components of the equation to zero separately,

$$-\frac{4}{13}T_{AB}+\frac{12}{13}T_{AD}=0$$
$$\frac{3}{13}T_{AB}-T_{AC}=0$$
$$\frac{12}{13}T_{AB}+\frac{5}{13}T_{AD}=m_A g$$

These equations can be solved to get,

$$T_{AB}=\frac{39}{41}m_A g=9.33\text{ N},\quad T_{AC}=\frac{9}{41}m_A g=2.15\text{ N},\quad T_{AD}=\frac{13}{41}m_A g=3.11\text{ N}$$