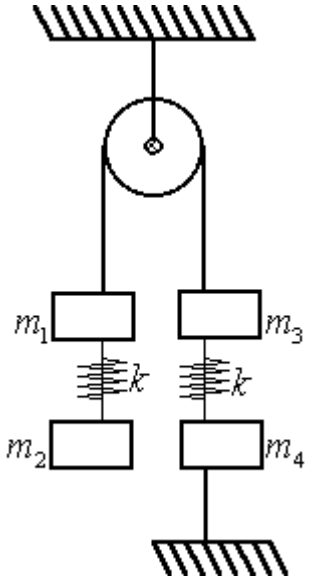
Crack Problem No:9

Solution: -

Let T_1 be the tension in the spring connecting m_1 and m_2.
Let T_2 be the tension in the string connecting the pulley and mass m_1.
Since the pulleys and strings are massless, T_2 is the tension in the string connecting the pulley and mass m_3.
Let T_3 be the tension in the spring connecting m_3 and m_4.
Let T_4 be the tension in the string connecting the mass m_4 and the ground.



Writing equations for the masses

$m_2g = T_1$ ----------(1)
$T_2 = m_1g + T_1$ ----------(2)
$T_2 = m_3g + T_3$ ----------(3)
$T_3 = m_4g + T_4$

Now when the string is cut, $T_4 = 0$
Hence mass m_4 accelerates upwards with an acceleration 'a_4'(say).
So in this case,

$m_4a_4 = T_3 - m_4g$ ----------(4)

Now eliminating T_1 and T_2 from equations (1) , (2) and (3), we get

$T_3 = (m_1 + m_2 - m_3)g$ ----------(5)

Now eliminating T_3 from Eqns.(4) and (5), we get

$m_4a_4 = (m_1 + m_2 - m_3 - m_4)g$

Hence $\mathbf{a_4 = \frac{(m_1 + m_2 - m_3 - m_4)g}{m_4}}$ upwards

Now since all other masses are connected by some springs, they are not affected immediately but take a finite time to accelerate. Hence the accelerations of all other masses at a time immediately after cutting the mentioned string is 0.

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