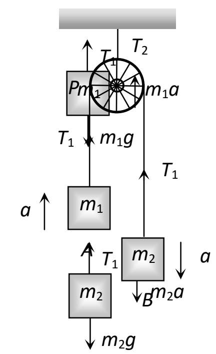
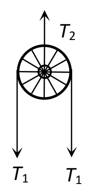
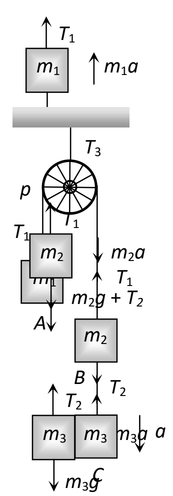
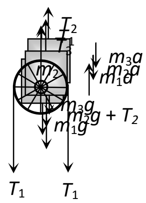
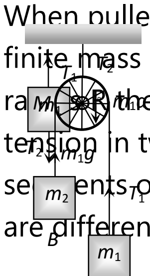
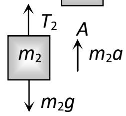
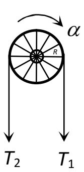
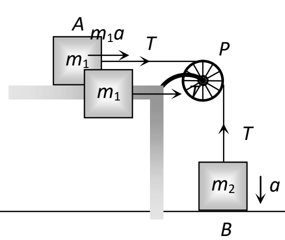
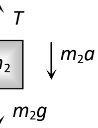
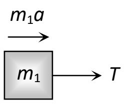
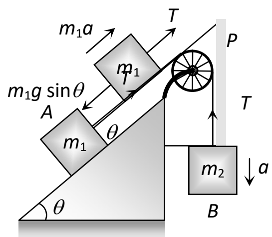
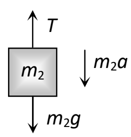
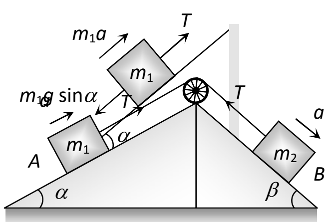
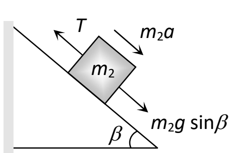
Motion of Connected Block over a Pulley.

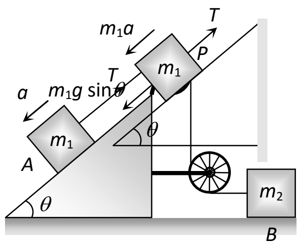
Condition	Free body diagram	Equation	Tension and acceleration
		$m_1 a = T_1 - m_1 g$	$T_1 = \frac{2m_1 m_2}{m_1 + m_2} g$
		$m_2 a = m_2 g - T_1$	$T_2 = \frac{4m_1 m_2}{m_1 + m_2} g$
		$T_2 = 2T_1$	$a = \left[\frac{m_2 - m_1}{m_1 + m_2}\right] g$
		$m_1 a = T_1 - m_1 g$	$T_1 = \frac{2m_1[m_2 + m_3]}{m_1 + m_2 + m_3} g$
		$m_2 a = m_2 g + T_2 - T_1$	$T_2 = \frac{2m_1 m_3}{m_1 + m_2 + m_3} g$
		$m_3 a = m_3 g - T_2$	$T_3 = \frac{4m_1[m_2 + m_3]}{m_1 + m_2 + m_3} g$

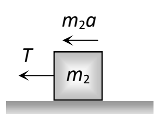
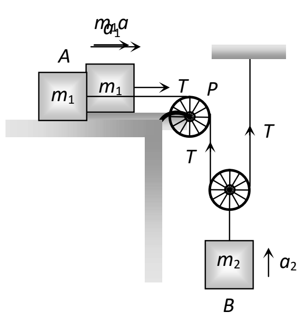
		$T_3 = 2T_1$	$a = \frac{[(m_2 + m_3) - m_1]g}{m_1 + m_2 + m_3}$

Condition	Free body diagram	Equation	Tension and acceleration
When pulley have a finite mass M and radius R then tension in two segments of string are different 		$m_1 a = m_1 g - T_1$	$a = \frac{m_1 - m_2}{m_1 + m_2 + \frac{M}{2}}$
		$m_2 a = T_2 - m_2 g$	$T_1 = \frac{m_1\left[2m_2 + \frac{M}{2}\right]}{m_1 + m_2 + \frac{M}{2}} g$
		Torque $= (T_1 - T_2)R = I\alpha$ $(T_1 - T_2)R = I\frac{a}{R}$ $(T_1 - T_2)R = \frac{1}{2}MR^2 \frac{a}{R}$ $T_1 - T_2 = \frac{Ma}{2}$	$T_2 = \frac{m_2\left[2m_1 + \frac{M}{2}\right]}{m_1 + m_2 + \frac{M}{2}} g$
		$T = m_1 a$	$a = \frac{m_2}{m_1 + m_2} g$



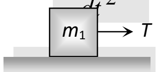
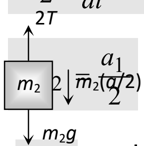
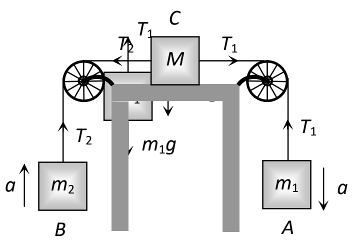
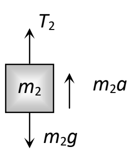
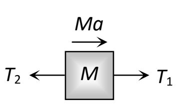
		$m_2a = m_2g - T$	$T = \frac{m_1m_2}{m_1 + m_2}g$
		$m_1a = T - m_1g\sin\theta$	$a = \left[\frac{m_2 - m_1\sin\theta}{m_1 + m_2}\right]g$
		$m_2a = m_2g - T$	$T = \frac{m_1m_2(1+\sin\theta)}{m_1 + m_2}g$
		$T - m_1g\sin\alpha = m_1a$	$a = \frac{(m_2\sin\beta - m_1\sin\alpha)}{m_1 + m_2}g$
		$m_2a = m_2g\sin\beta - T$	$T = \frac{m_1m_2(\sin\alpha + \sin\beta)}{m_1 + m_2}g$

<table>
<tr><th>Condition</th><th>Free body diagram</th><th>Equation</th><th>Tension and acceleration</th></tr>
<tr><td>
</td><td></td><td>$m_1 g \sin\theta - T = m_1 a$</td><td rowspan="2">$a = \frac{m_1 g \sin\theta}{m_1 + m_2}$

$T = \frac{2m_1 m_2}{4m_1 + m_2} g$</td></tr>
<tr><td>
</td><td></td><td>$T = m_2 a$</td></tr>
<tr><td>
</td><td></td><td>$T = m_1 a$</td><td>$a_1 = a = \frac{2m_2 g}{4m_1 + m_2}$

$a_2 = \frac{m_2 g}{4m_1 + m_2}$

$T = \frac{2m_1 m_2 g}{4m_1 + m_2}$</td></tr>
</table>

As $\frac{d^2(x_2)}{dt^2} = \frac{1}{2}\frac{d^2(x_1)}{dt^2}$   $a_2 = \frac{a_1}{2}$ a_1 = acceleration of block A a_2 = acceleration of block B		$m_2 \frac{a}{2} = m_2 g - 2T$	
 		$m_1 a = m_1 g - T_1$	$a = \frac{(m_1 - m_2)}{[m_1 + m_2 + M]} g$
 		$m_2 a = T_2 - m_2 g$	$T_1 = \frac{m_1(2m_2 + M)}{[m_1 + m_2 + M]} g$
 		$T_1 - T_2 = Ma$	$T_2 = \frac{m_2(2m_2 + M)}{[m_1 + m_2 + M]} g$