$$\left.\begin{aligned} \Rightarrow\ m_A g - 2T &= m_A a_A \\ T - m_B g &= 2 m_B a_A \quad \times 2 \\ \hline \Rightarrow\ 2T - 2m_B g &= 4 m_B a_A \end{aligned}\right\} \text{Adding}$$

$$\Rightarrow g(m_A - 2m_B) = (4m_B + m_A)\, a_A$$

$$\Rightarrow a_A = \frac{(m_A - 2m_B)g}{4m_B + m_A}$$

Now for acceleration for block A to be downwards $\Rightarrow a_A > 0$

$$\Rightarrow m_A - 2m_B > 0 \Rightarrow \boxed{m_A > 2m_B}$$

[Applicable Only in Pulley Systems] Trick for finding Constraint Relations in Pulley Problems

We define virtual work for any system (usually block) (attached to a pulley system (usually string)) as follows:

Hint:- $\cos(0^\circ) = 1$
$\cos(180^\circ) = -1$

$$\boxed{W_V := T_{sys} \cdot a_{sys} \cdot \cos\theta}$$

where T_{sys} = Tension in the string attached to the system

a_{sys} = acceleration of the system.

of

Theorem :- Th

S

where

Ex

In the

concept of

constraint

System - A :-

θ :- Angle which the direction of tension makes with direction of acceleration of the system

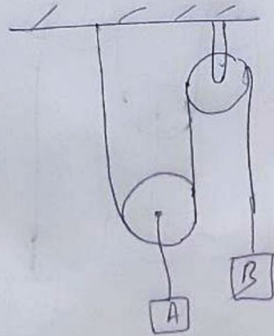
Theorem :- The sum total of virtual work of individual systems = 0 i.e,

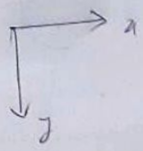
$$\boxed{\sum_i T_{sys_i} \cdot a_{sys_i} \cdot \cos\theta_i = 0}$$

where i runs over all the systems.

Example :-

In the above problem we used the concept of virtual work to find the constraint relation.





System - A :-

$T' = 2T$ (Described in above example)

a_A

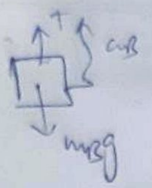
$m_B g$

$T_{sys} = 2T$

$a_{sys} = a_A$

$\theta = 180°$

System - B :-



$T_{sys} = T$

$a_{sys} = a_B$

$\theta = 0°$

applying the theorem :-

$$\sum_{i \in \{A,B\}} T_{sys_i} \cdot a_{sys_i} \cdot \cos\theta_i = 0$$ where A, B are systems.

$\Rightarrow (2T a_A \cos 180) + (T a_B \cos 0) = 0$

$\Rightarrow -2T a_A + T a_B = 0$

$\Rightarrow \boxed{2a_A = a_B} \longrightarrow$ Same as earlier.

---

(4) (easy)