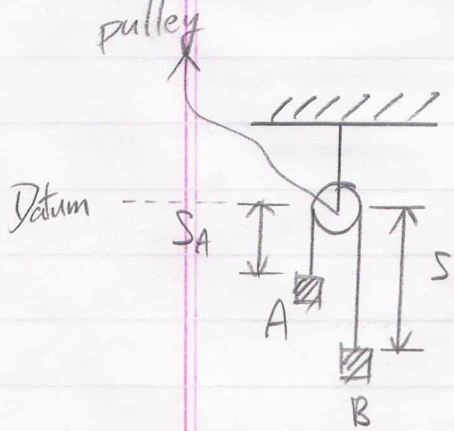
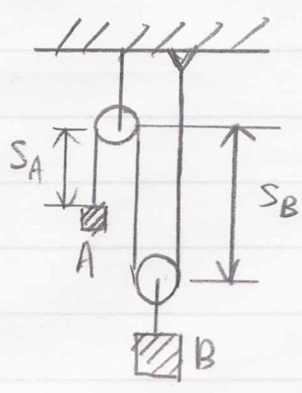
Absolute Dependent Motion

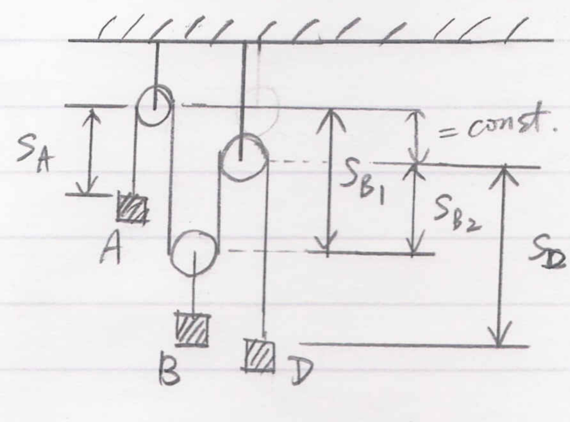
* Assumptions:
  1. Two blocks are perfectly connected to each other by a cord.
  2. The cord does NOT change its length.

* Concept: The motion of two blocks can be evaluated by the relation changes of the cord sections.

* Procedure:
  1. Define the relations of cord sections by the total length of the cord. ⇒ Displacement
  2. Take time derivative of the total length.
     ⇒ $\underbrace{\text{Constant}}_{\text{cord}}$ sections → 0 ⇒ Velocity
  3. Take time derivative of the velocity representation.
     ⇒ Acceleration.







$S_A + S_B + C = l$

$v_A + v_B = 0$

$\Rightarrow v_A = -v_B$

$\Rightarrow a_A = -a_B$

$S_A + 2S_B + C = l$

$v_A + 2v_B = 0$

$\Rightarrow v_A = -2v_B$

$\Rightarrow a_A = -2a_B$

$(\because F_A = F_B$

$\therefore m_A = \frac{1}{2} m_B)$

$S_A + S_{B_1} + S_{B_2} + S_D + C = l$

$S_A + 2S_{B_2} + S_D + C = l$

$\Rightarrow v_A + 2v_B + v_D = 0$

$\Rightarrow v_A + v_D = 2v_B$

$\Rightarrow a_A + a_D = -2a_B$

* **Remarks:** ① The sign of v & a suggests the relative change of cord sections. e.g. $\begin{cases} v_A = v_B \Rightarrow S_A \uparrow \text{ when } S_B \uparrow \\ v_A = -v_B \Rightarrow S_A \uparrow \text{ when } S_B \downarrow \end{cases}$

② Notice that the sign depends on the relative definition of datums in the problem #

Relative Motion of Two Particles

* Relative position:

$$\vec{r}_B = \vec{r}_A + \vec{r}_{\underline{\underline{B/A}}}$$

→ Motion of B observed by point A.

or $\vec{r}_A = \vec{r}_B + \vec{r}_{A/B}$

Relative velocity:

$$\vec{v}_B = \vec{v}_A + \vec{v}_{B/A} \quad \text{or} \quad \vec{v}_A = \vec{v}_B + \vec{v}_{A/B}$$

Relative acceleration:

$$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A} \quad \text{or} \quad \vec{a}_A = \vec{a}_B + \vec{a}_{A/B}$$