

Example 1:

Establish the relationship between velocity and acceleration of A and B

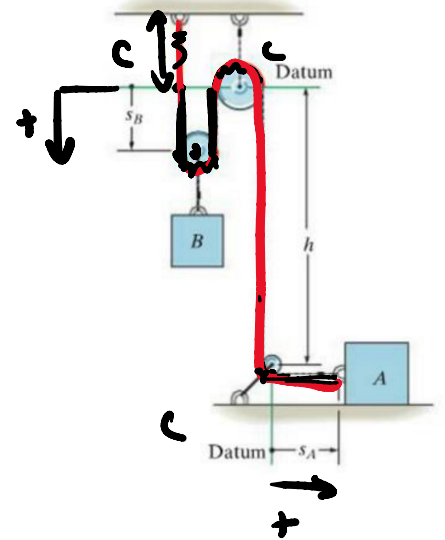
$$l_T = s_B + s_B + h + s_A$$

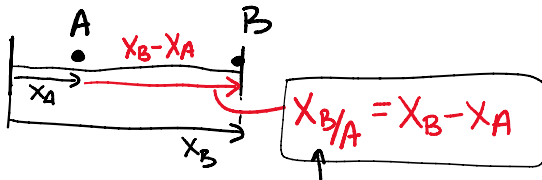
$$0 = v_B + v_B + 0 + v_A \quad \text{d.r.t}$$

$$0 = 2v_B + v_A$$

$$v_A = -2v_B$$

$$A_A = -2A_B$$

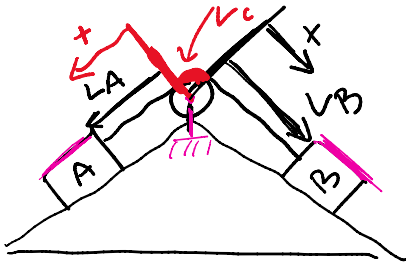




Position of B with respect to A
d.r.t

$$v_{B/A} = v_B - v_A$$

$$a_{B/A} = a_B - a_A$$



Assumptions: ① Neglect the mass of pulleys
② Ropes do not extend

Steps to solve

$$L_A + L_B + L_C = L_T$$

↑
constant

$$L_A + L_B = L_T' \quad L_T' = L_T - L_C$$

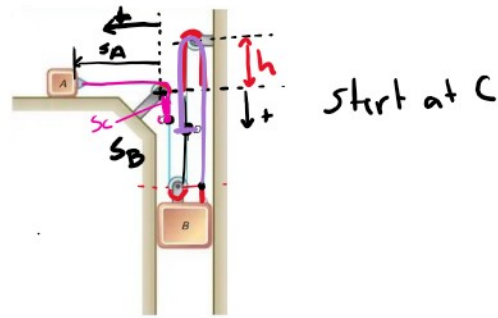
$$v_A + v_B = 0$$

$$a_A + a_B = 0$$

- ① Establish position coordinates w/origin at fixed point
- ② Coordinates are extended along path of motion
- ③ Origins do not need to be the same for each direction, However it is important it is along the path of motion
- ④ Obtain total length of rope
- ⑤ If a problem has multiple ropes EACH ROPE needs its own equation

Example 2:

B starts from rest and moves downward with constant acceleration and knowing A has moved 9 inches and A moves to the left with a constant velocity of 6 ft/s. Determine



- The velocity of block B
- The velocity of portion D of the cable
- The relative velocity of portion C with respect to portion D
- What is the acceleration of A and B
- What is the velocity and change in position of B after 2s.

$$l = s_A + s_B + s_B + h + h + s_B$$

$$l = s_A + 3s_B + 2h$$

$$0 = v_A + 3v_B \leftarrow$$

$$0 = \underline{v_A} + 3\underline{v_B} \leftarrow$$

$$a) 0 = 6 + 3v_B$$

$$v_B = -2 \text{ ft/s} = 2 \text{ ft/s} \uparrow$$

$$b) \underline{l_D} = s_B + h + h + s_D$$

$$0 = v_B + v_D$$

$$v_D = -v_B = -(-2) = 2 \text{ ft/s} \downarrow$$

$$c) v_{C/D} = v_C - v_D$$

$$= (-6) - (2)$$

$$= -8 \text{ ft/s} = 8 \text{ ft/s} \uparrow$$

$$l_C = s_C + s_A$$

$$0 = v_C + v_A$$

$$v_C = -v_A = -(-6) \text{ ft/s}$$

$$d) v_f^2 = v_0^2 + 2a(x_f - x_0)$$

$$6^2 = 0^2 + 2A_A(9/12)$$

$$A_A = -24 \text{ ft/s}^2$$

$$A_B = -\frac{A_A}{3} = -\frac{-24}{3} = +8 \text{ ft/s}^2$$

Example 3:

2 ropes: The elevator shown starts from rest and moves upward with a constant acceleration. If the counterweight W moves through 30 ft in 5s, determine

- a) The acceleration of the elevator and the cable C
- b) The velocity of the elevator after 5s.

