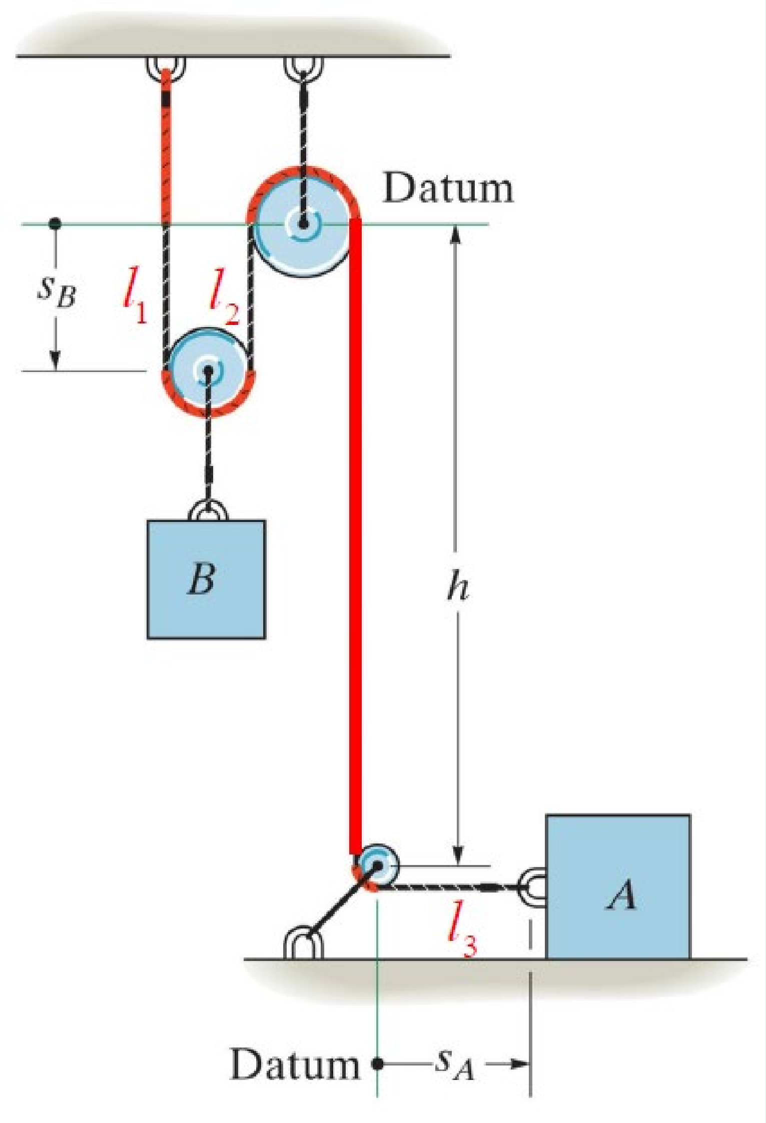
Q: What do you think about the midterm?

A. Too easy
B. Easy
C. About right
D. Difficult
E. Too difficult

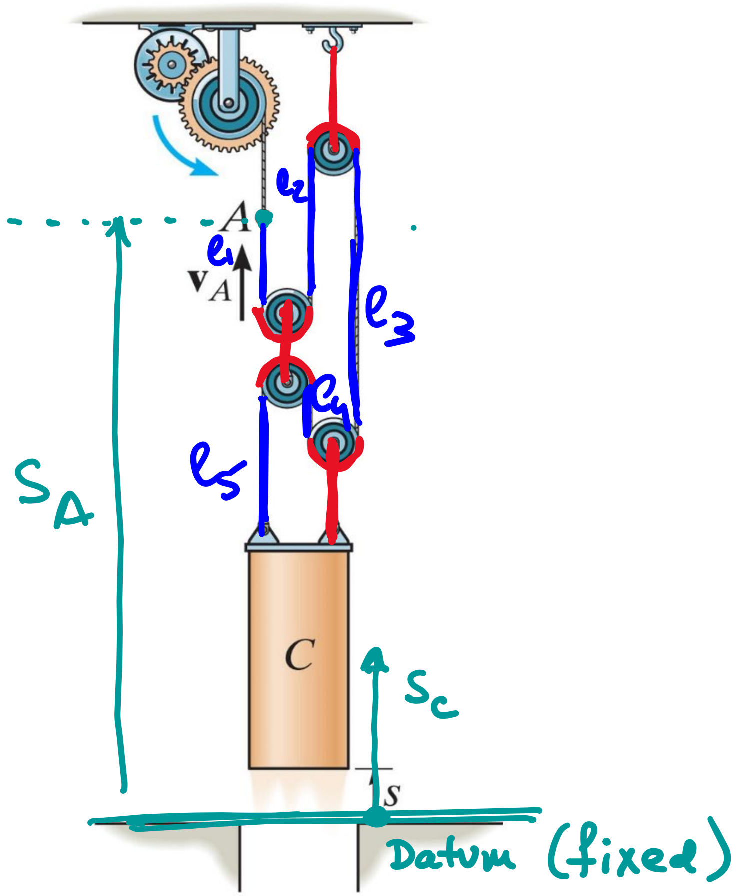
ROPE EQUATION & PATH EQUATION

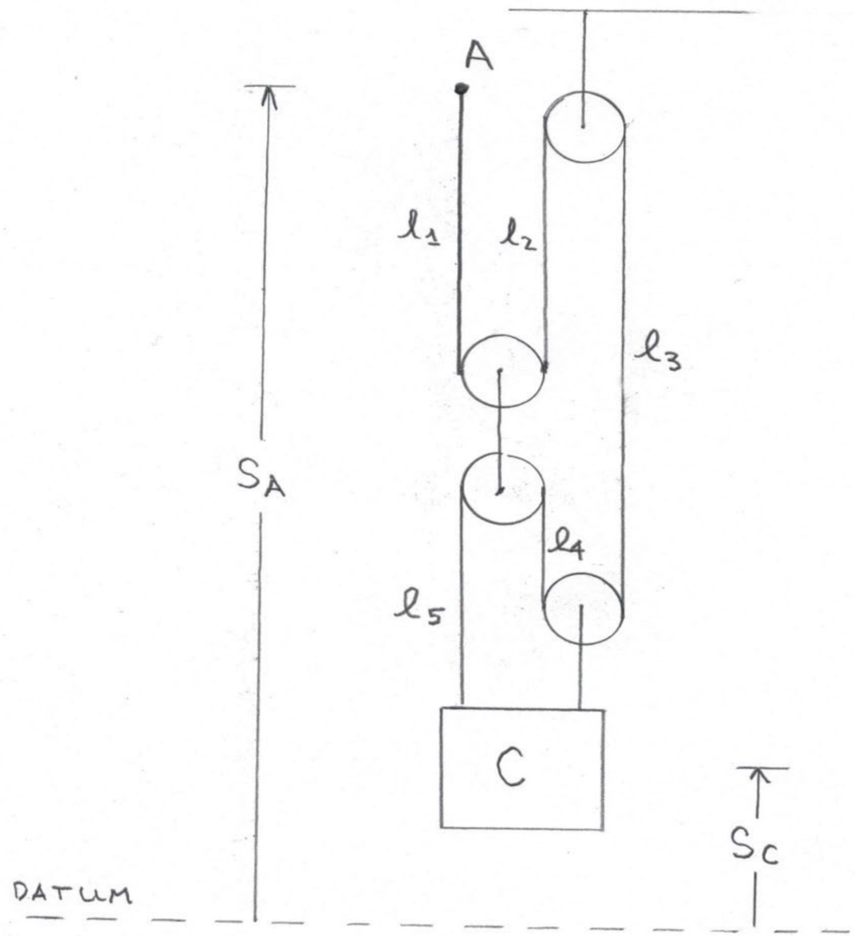
Last Time



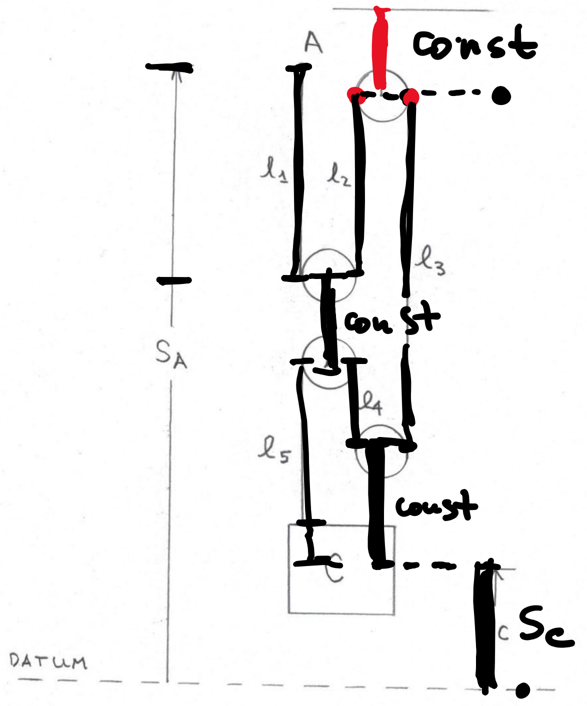
- Setting problem up:
  - Datum/data, paths, rope segments (all non-constant pieces of the rope)
- Rope equation(s):
  - $L_{rope} = l_1 + l_2 + l_3 + const$ => $l_1 + l_2 + l_3 = const'$
- Path equation(s):
  - $l_1 = s_B$
  - $l_2 = s_B$
  - $l_3 = s_A$
- Eliminate the rope(s)
  - Replacing the sum of the rope segments with a const
- Take time derivative
  - Connection between the velocities

W8-3. The cylinder is lifted by a motor and pulley system. The motor draws in cable at 30 cm/s. Determine the speed of the cylinder.





W8-3. The cylinder is lifted by a motor and pulley system. The motor draws in cable at 30 cm/s. Determine the speed of the cylinder.



Rope equation:

(1) $\boxed{l_1 + l_2 + l_3 + l_4 + l_5 = \text{const}}$

Path equation:

(a) $l_1 + \text{const} + l_5 + \text{const} + s_c = s_A$

(b) $l_2 + l_4 + \text{const} + s_c = \text{const}$

(c) $l_3 + \text{const} + s_c = \text{const}$

(a) + (b) + (c):

$$\underbrace{(l_1 + l_2 + l_3 + l_4 + l_5) + \text{const}} + 3 s_c = s_A + \underline{\text{const}}$$

$$\frac{d}{dt}\left[3 s_c = s_A + \cancel{\text{const}}\right] \rightarrow 3\dot{s}_c = \dot{s}_A \qquad \dot{s}_c = \frac{\dot{s}_A}{3}$$

$\frac{30}{3}$

$\dot{s}_c = 10\ \text{cm/s}$

UP

Q: v_C is:

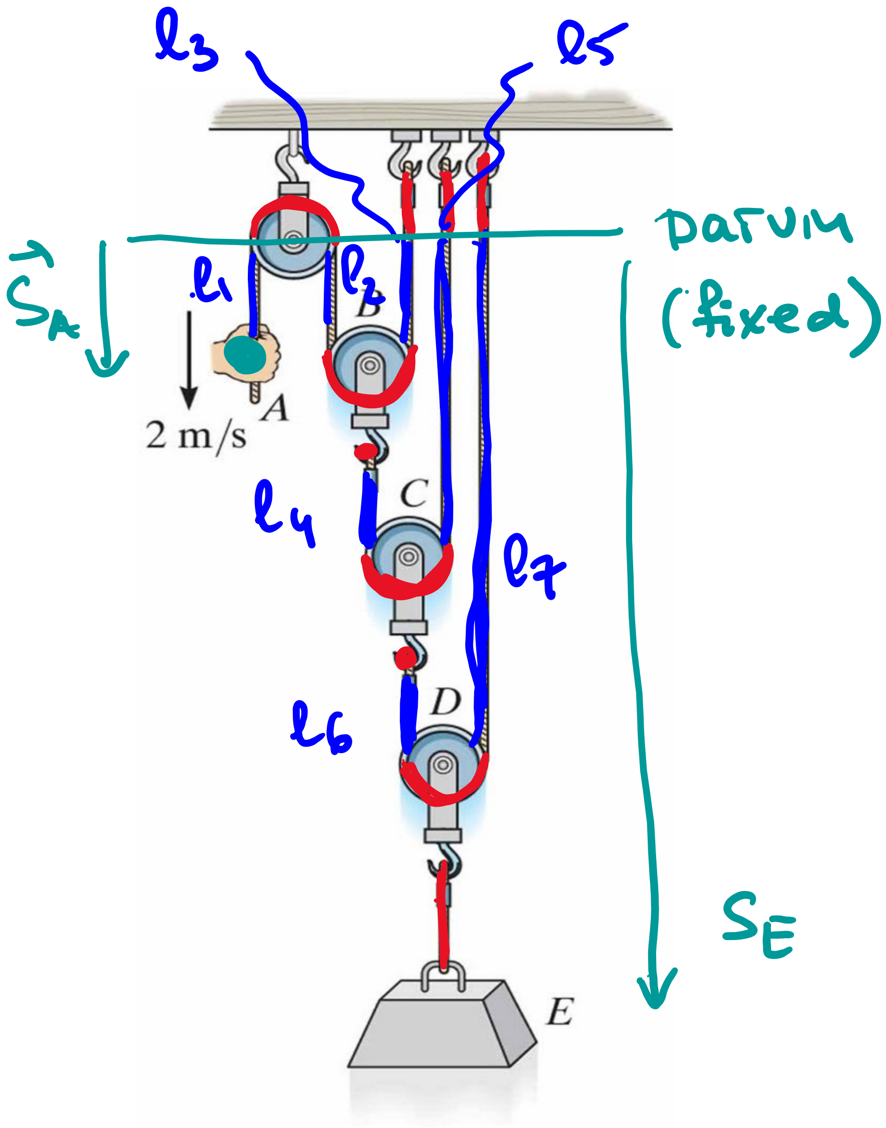
A. 90 cm/s

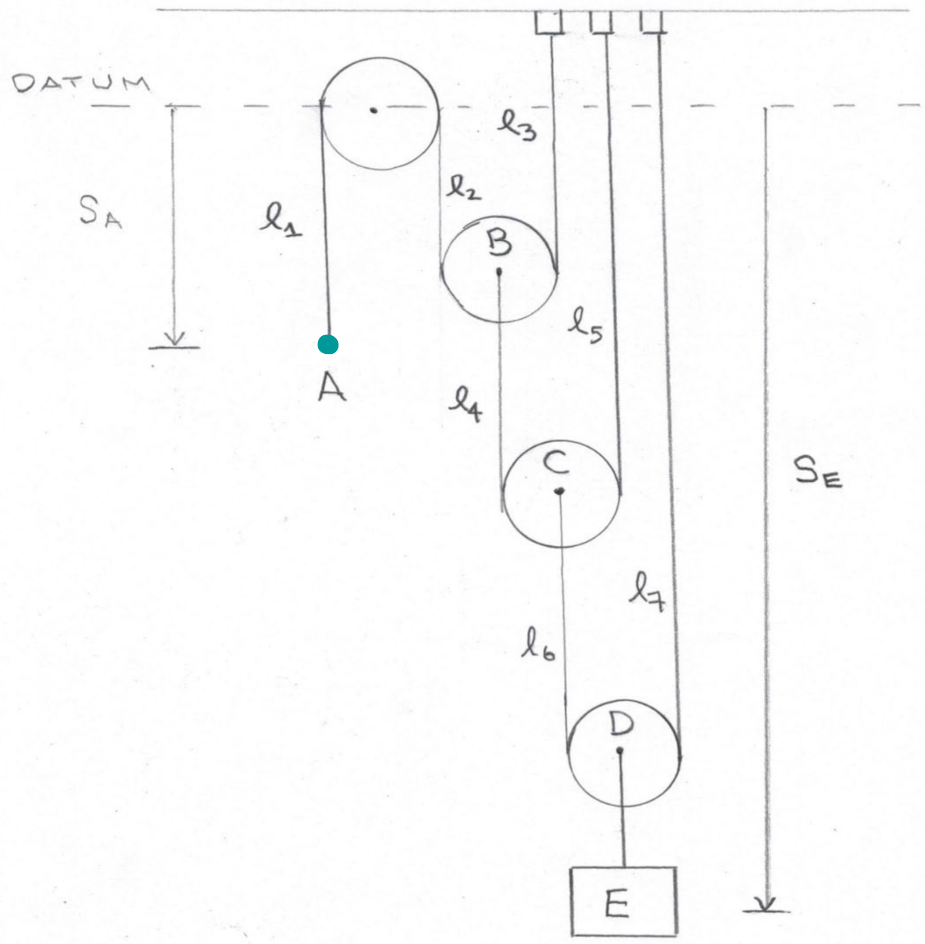
B. 15 cm/s

C. 10 cm/s

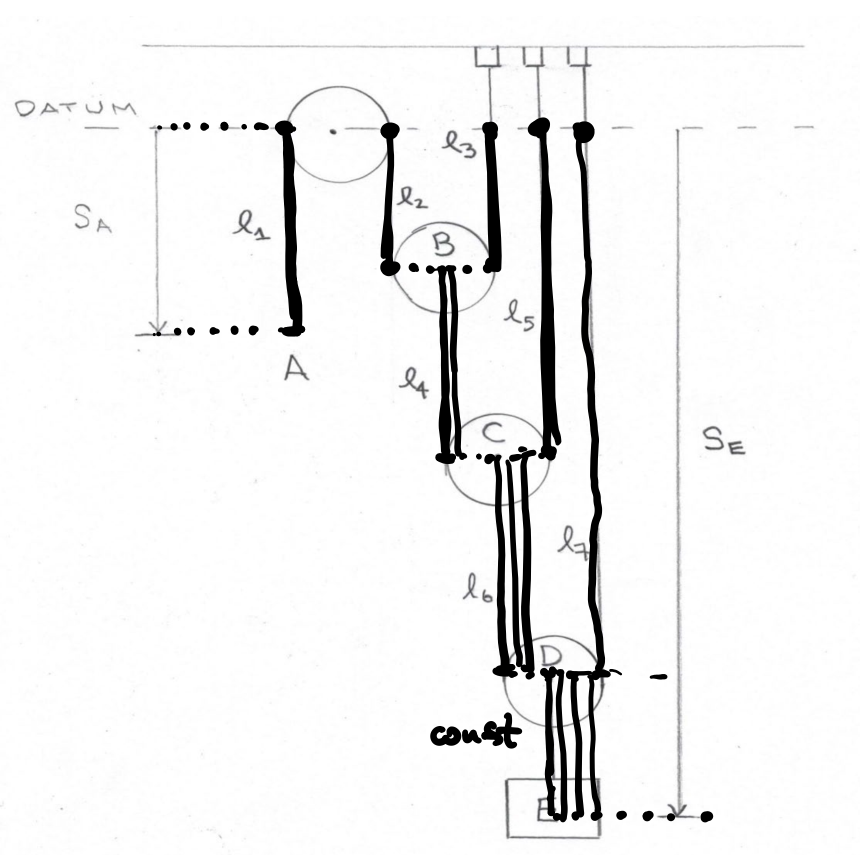
D. Other

W8-4. The end of the cable at A is pulled down with speed 2 m/s. Determine the speed at which block E rises.





W8-4. The end of the cable at A is pulled down with speed 2 m/s. Determine the speed at which block E rises.



- Rope equations:

(1) $\ell_1 + \ell_2 + \ell_3 = \text{const}$ (2) $\ell_4 + \ell_5 = \text{const}$

(3) $\ell_6 + \ell_7 = \text{const}$

- Path equations:

(a) $\ell_1 = S_A$

(b) $\ell_2 + \ell_4 + \ell_6 + \text{const} = S_E$

(c) $\ell_3 + \ell_4 + \ell_6 + \text{const} = S_E$

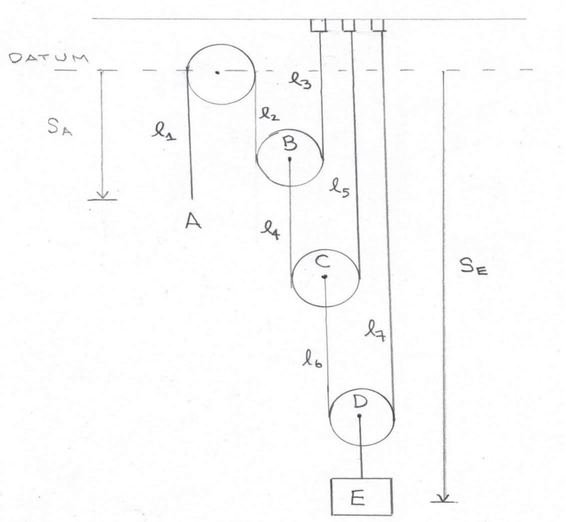
(d) $\ell_5 + \ell_6 + \text{const} = S_E$

(e) $\ell_7 + \text{const} = S_E$

$$(a)+(b)+(c)+(d)+(e) = (\ell_1) + (\ell_2 + \ell_4 + \ell_6) + (\ell_3 + \ell_4 + \ell_6) + (\ell_5 + \ell_6) + (\ell_7)$$

W8-4. The end of the cable at A is pulled down with speed 2 m/s. Determine the speed at which block E rises.

$2\ell_4 + 2\ell_5 = 2R_2$



Path equations :

(a) $\ell_1 = S_A$

(b) $\ell_2 + \ell_4 + \ell_6 + \text{const} = S_E$

(c) $\ell_3 + \ell_4 + \ell_6 + \text{const} = \text{const} + S_E$

(d) $\ell_5 + \ell_6 + \text{const} = \text{const} + S_E$

(e) $\ell_7 + \text{const} = \text{const} + S_E$

Rope equations :

$\ell_1 + \ell_2 + \ell_3 = \text{const} = R_1$ (rope 1) (1)

$(\ell_4 + \ell_5) = \text{const} = R_2$ (rope 2) (2)

$\ell_6 + \ell_7 = \text{const} = R_3$ (rope 3) (3)

$4\ell_6 + 4\ell_7 = 4R_3$

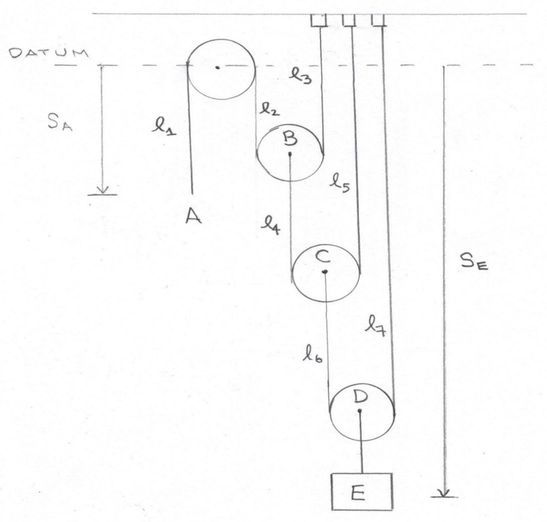
(a) + (b) + (c) $\rightarrow (\ell_1) + (\ell_2 + \ell_4 + \ell_6) + (\ell_3 + \ell_4 + \ell_6) = \overbrace{(\ell_1 + \ell_2 + \ell_3)}^{R_1} + 2\ell_4 + 2\ell_6$

+ 2(d) $\rightarrow (\ell_1 + \ell_2 + \ell_3) + 2\ell_4 + 2\ell_6 + 2\ell_5 + 2\ell_6 =$

$= \overbrace{(\ell_1 + \ell_2 + \ell_3)}^{R_1} + 2\overbrace{(\ell_4 + \ell_5)}^{R_2} + 4\ell_6$

+ 4(d) $\rightarrow (R_1) + 2(R_2) + 4\ell_6 + 4\ell_7 = R_1 + 2R_2 + 4R_3 = \text{const}$

W8-4. The end of the cable at A is pulled down with speed 2 m/s. Determine the speed at which block E rises.



Path equations :

(a) $\ell_1 = s_A$

(b) $\ell_2 + \ell_4 + \ell_6 + \text{const} = s_E$

(c) $\ell_3 + \ell_4 + \ell_6 + \text{const} = \text{const} + s_E$

(d) $\ell_5 + \ell_6 + \text{const} = \text{const} + s_E$

(e) $\ell_7 + \text{const} = \text{const} + s_E$

Rope equations :

$\ell_1 + \ell_2 + \ell_3 = \text{const}$ (rope 1) (1)

$\ell_4 + \ell_5 = \text{const}$ (rope 2) (2)

$\ell_6 + \ell_7 = \text{const}$ (rope 3) (3)

$$\boxed{(a) + (b) + (c) + 2(d) + 4(e)}$$

$$\underbrace{(\ell_1+\ell_2+\ell_3) + 2(\ell_4+\ell_5) + 4(\ell_6+\ell_7) + \text{const}}_{\text{const} = R_1 + 2R_2 + 4R_3} = s_A + s_E + s_E$$

$$= 2s_E + 4 \cdot s_E + \text{const}$$

$$\frac{d}{dt}\left[\cancel{\text{const}} = s_A + 8s_E\right]$$

$$\dot{s}_A + 8\dot{s}_E = 0$$

$$\dot{s}_E = -\dot{s}_A/8 = -0.250 \text{ m/s}$$

against $\vec{s}_E$

$$\boxed{\dot{s}_E = 0.250 \tfrac{m}{s} \text{ up}}$$