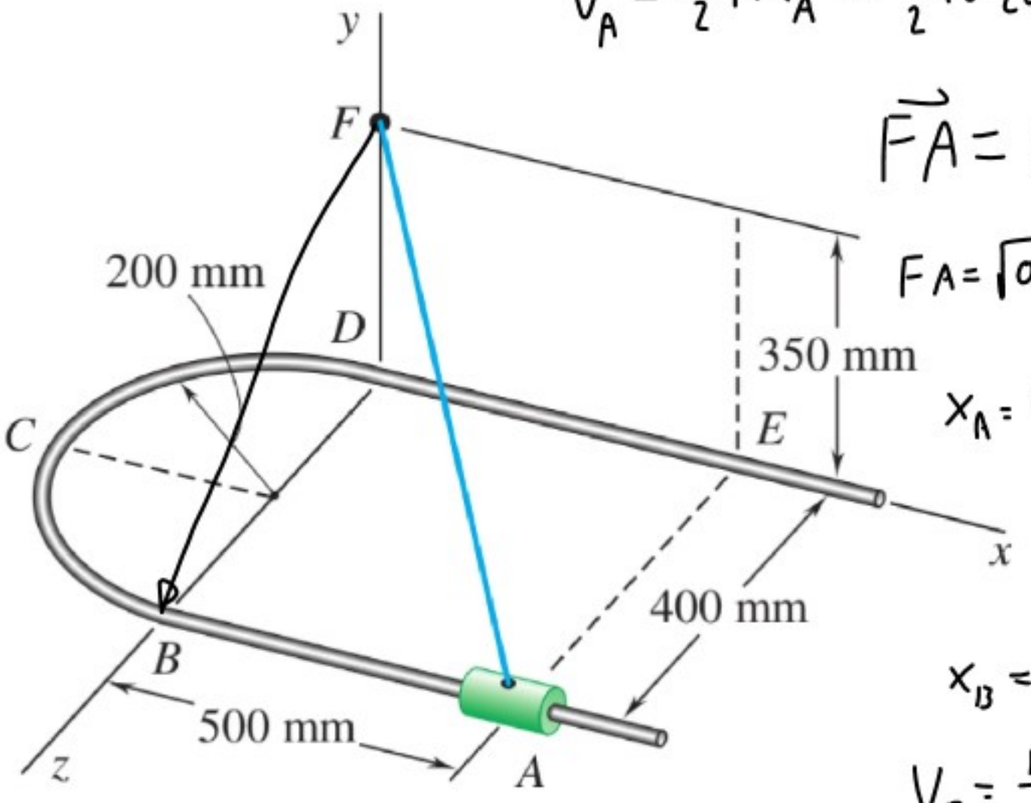
A 750-g collar can slide along the horizontal rod shown. It is attached to an elastic cord with an undeformed length of 300 mm and a spring constant of 150 N/m. Knowing that the collar is released from rest at A and neglecting friction, determine the speed of the collar (a) at B, (b) at E.



$V_A = \frac{1}{2} K x_A^2 = \frac{1}{2} 150 (0.43)^2 = 13.85$

$\vec{FA} = 0.5\,i - 0.35\,j + 0.4\,k$ m

$FA = \sqrt{0.5^2 + 0.35^2 + 0.4^2} = 0.73$ m

$x_A = FA - 0.3 = 0.43$

$\vec{FB} = -0.35\,j + 0.4\,k$ m

$FB = \sqrt{0.35^2 + 0.4^2} = 0.53$ m

$x_B = FB - 0.3 = 0.23$ m

$V_B = \frac{1}{2} K x_B^2 = \frac{1}{2} 150 (0.23)^2 = 9.02$

$T_A + V_A = T_B + V_B$

$13.85 = T_B + 9.02$

$13.85 - 9.02 = T_B = 9.83$

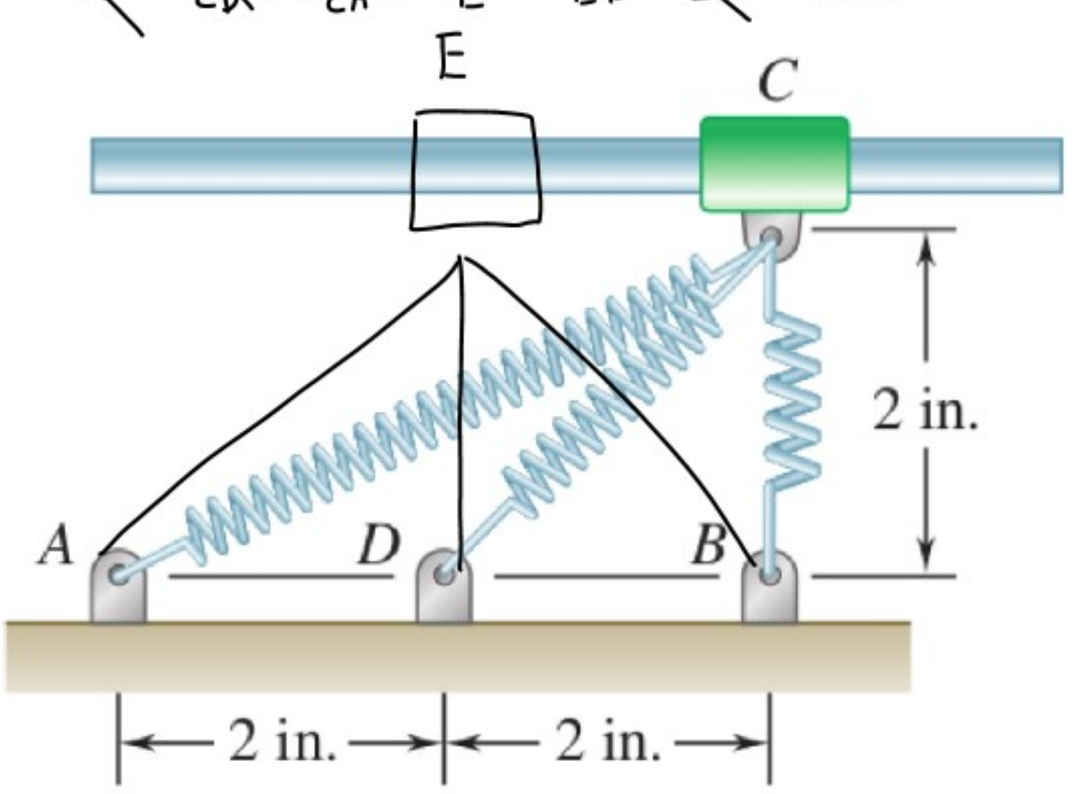
$T_B = \frac{1}{2} m v_B^2$

$9.83 = \frac{1}{2} 0.75 v_B^2$

$\frac{2 \cdot 9.83}{0.75} = v_B^2 = 26.21$

$v_B = 5.12$ m/s

A 2-lb collar C may slide without friction along a horizontal rod. It is attached to three springs, each of constant 30 lb/ft and 2-in. undeformed length. Knowing that the collar is released from rest in the position shown, determine the maximum speed it will reach in the ensuing motion.



$T_C + V_C = T_E + V_E$

$V_{CB} + V_{CD} + V_{CA} = T_{IE} + V_{EB} + V_{ED} + V_{EA}$

$30 \frac{lb}{ft} \frac{1ft}{12 in} = 2.5 \frac{lb}{in}$

$V_{CA} = \frac{1}{2} k x_{CA}^2 = \frac{1}{2} 2.5 \frac{lb}{in} (2.47 in)^2$

$= 7.69 \text{ lb-in}$

$x_{CA} = CA - 2 = 4.47 - 2 = 2.47 \text{ in}$

$CA = \sqrt{2^2 + 4^2} = 4.47 \text{ in}$

$V_{EB} = \frac{1}{2} K x_{EB}^2 = \frac{1}{2} 2.5 (0.83)^2 = 0.86 \text{ lb-in}$

$x_{EB} = EB - 2 = 2.83 - 2 = 0.83 \text{ in}$

$EB = \sqrt{2^2 + 2^2} = 2.83 \text{ in}$

$7.69 = T_E + 0.86$

$T_E = 7.69 - 0.86 = 6.73 \text{ lb-in}$

$6.73 = T_E = \frac{1}{2} m v^2$

6.78 $\text{lb}\cdot\text{in} = \frac{1}{2} m v^2$

$$m = \frac{w}{g} = \frac{2\ \text{lb}}{32.2\ \text{ft/s}^2} = 0.062\ \frac{\text{lb s}^2}{\text{ft}}\ \frac{1\ \text{ft}}{12\ \text{in}} = 5.17\times10^{-3}\ \frac{\text{lb s}^2}{\text{in}}$$

$$\frac{2(6.78\ \text{lb in})}{5.17\times10^{-3}\ \frac{\text{lb s}^2}{\text{in}}} = V^2$$

$$V = \frac{1}{2}Kx_1^2 + \frac{1}{2}Kx_2^2 = \frac{1}{2}K(x_1^2 + x_2^2)$$

$$2620\ \frac{\text{in}^2}{\text{s}^2} = V^2$$

$$51\ \frac{\text{in}}{\text{s}} = V$$