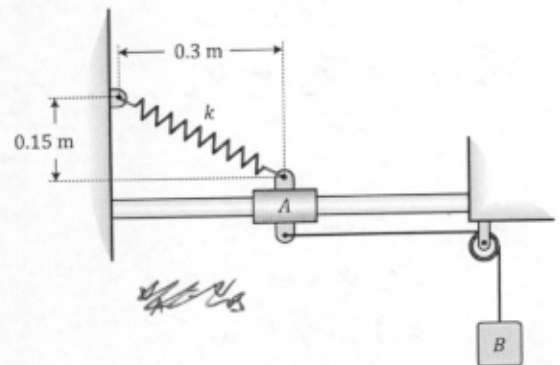## Question 3:

(2 Marks)

At the instant shown, the spring of stiffness $k = 700\,\text{N/m}$ is unstretched and the mass B is moving downward at 1 m/s. Determine the velocity (v_B) of mass B when it has moved downward 0.2 m from its present position. Note that the mass of collar A is 14 kg and $m_B = 18$ kg. The horizontal bar is smooth.

$k = 700\,\text{Nm}^{-1}$

$v_B = -1\,\text{ms}^{-1}$ ↑

$m_A = 14\,\text{kg}$

$m_B = 18\,\text{kg}$

Solution

Present your solution to Question 3, here:

$v_B = ?$ when $s_B = -0.2\,\text{m}$

unstretched length: $l = \sqrt{0.15^2 + 0.3^2} = \sqrt{0.1125}\,\text{m}$

$W_{1-2} = \Delta T_{1-2} + \Delta V_{g(1-2)} + \Delta V_{el(1-2)}$
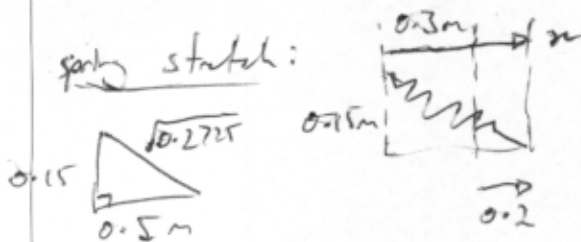
$0 = \frac{1}{2}m_B\left(v_B^2 - (-1)^2\right) + \frac{1}{2}m_A\left(v_A^2 - (-1)^2\right) + m_B g(-0.2)$

$\qquad + \frac{1}{2}k\left(x - \sqrt{0.1125}\right)^2$

length of string: $L = s_A + s_B + \text{constant}$

$\quad 0 = v_A + v_B$

$\quad \therefore v_A = -v_B$

spring stretch:

$\sqrt{0.2725}$

0.15

$0.5\,\text{m}$

$0.3\,\text{m}$ x

$0.15\,\text{m}$

0.2

if m_B moves 0.2 m ↓

then m_A moves 0.2 m →

then spring stretches (horizontally) by

0.2 m

$\left(\sqrt{0.2725} - \sqrt{0.1125}\right)^2$

$\therefore 0 = \frac{1}{2}(14+18)\left(v_B^2 - 1\right) - 18 \times 9.81(-0.2) + \frac{1}{2} \times 700$

$\quad = 16v_B^2 - 16 + 35.316 + 350(0.0348\ldots)$

$\therefore v_B = \ldots$

unstretched length: $\sqrt{0.1125}$ m
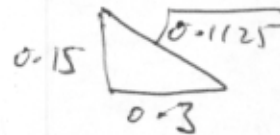
stretched length: $\sqrt{0.2725}$ m
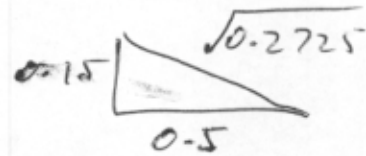
$\therefore U_{1-2} = \Delta T_{1-2} + \Delta V_{g(1-2)} + \Delta V_{e(1-2)}$

$0 = \frac{1}{2}(m_A + m_B)(v_B^2 - (-1.5^2)) + m_B g(-0.2) + \frac{1}{2}k(\sqrt{0.2725} - \sqrt{0.1125})^2$

$= \frac{1}{2}(14 + 18)(v_B^2 - 1) + 18 \times 9.81(-0.2) + \frac{1}{2} \times 700(" \quad ")^2$

$= 16v_B^2 - 16 - 35.316 + 350(0.0348...)$

$\therefore v_B = 1.56$ ms^{-1} ↓

2.1

Index of comments