Question 3

The following information applies to parts A and B.

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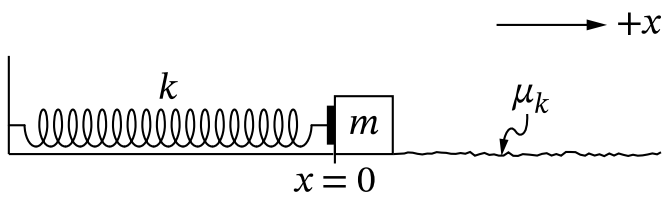
3. A horizontal spring of known spring constant k is attached to a wall. A block of known mass m is placed on a horizontal surface next to but not attached to the spring. The spring is at its relaxed length when the block is at position $x = 0$, as shown in Figure 1. There is friction between the block and the surface only for positions $x > 0$.

Figure 1



A student is asked to experimentally determine the coefficient of kinetic friction μ_k between the block and the surface using a graph. The student is permitted to use only measurements from a meterstick.

Part A

i. **Indicate** quantities that could be measured by the student that would allow them to determine μ_k using a graph.

ii. Briefly **describe** a method to reduce experimental uncertainty for the measured quantities.

Part B

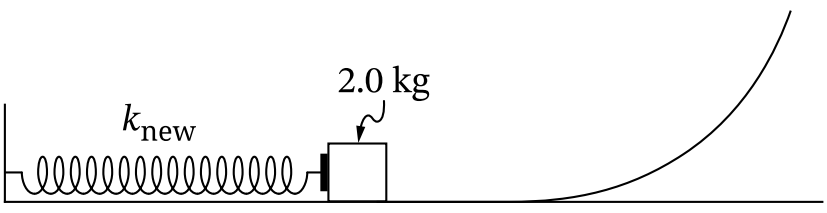
i. **Indicate** what quantities the student could graph on the horizontal and vertical axes to create a graph that can be used to determine μ_k.

ii. Briefly **describe** the relationship between μ_k and a feature of the graph from part B (i). Your answer may include an equation that relates μ_k and the chosen feature of the graph.

The following information applies to parts C and D.

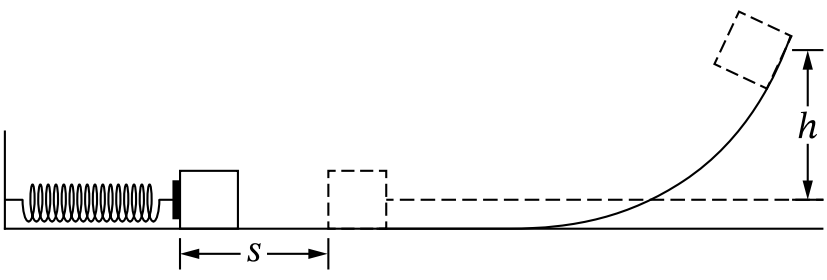
In a different experiment, the student is asked to determine the spring constant k_{new} of a new spring that is attached to a wall. A block of mass 2.0 kg is placed next to the spring on a surface where frictional forces are negligible. The surface is horizontal near the spring and slopes upward into a ramp to the right of the initial position of the block, as shown in Figure 2.

Figure 2



The student pushes the block, compressing the spring a distance s, as shown in Figure 3. The block is released from rest.

Figure 3



The student uses a meterstick to measure the maximum height h of the block on the ramp. The experiment is repeated several times with different compression distances s. The student's measurements of s and h are shown in Table 1.

Table 1

s (m)	h (m)
0.020	0.02
0.040	0.04
0.060	0.13
0.080	0.18
0.100	0.33

Part C

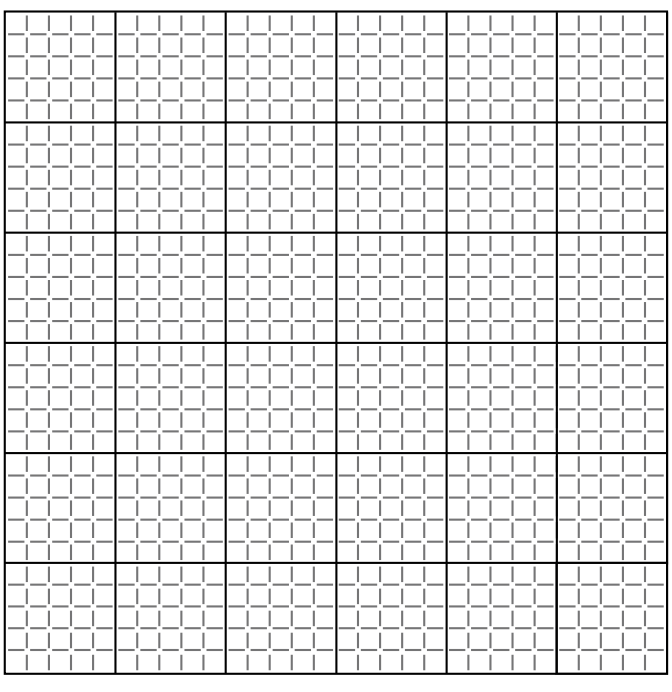
i. **Label** the axes of the grid provided with measured or calculated quantities. Include units, as appropriate. The graphed quantities should yield a linear graph that can be used to determine k_{new}.

ii. On the grid provided, create a graph of the quantities indicated in part C (i).

- Clearly **label** the vertical and horizontal axes with numerical scales.
- **Plot** the corresponding data points on the grid.
- Table 2 is provided in your booklet for scratch work and will not be scored.

Quantity (units, if appropriate)

_____ _____



Quantity (units, if appropriate)

_____ _____

iii. **Draw** a best-fit line for the data graphed in part C (ii).

Part D

Using the best-fit line that you drew in part C (iii), **calculate** an experimental value for k_{new}.