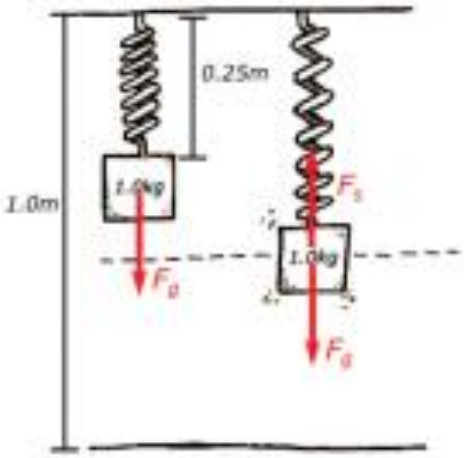
NAME _____ DATE _____

Scenario

An ideal spring of an unstretched length of $\ell_0 = 0.25\ m$ and spring constant $k = 50\ N/m$ is hung vertically above a level floor as shown in the figure. A 1.0 kg block is attached to the spring when it is at its natural length, released, and allowed to move freely.



Using Representations

PART A: Draw and label the forces exerted on each block in the diagram. Qualitatively consider relative magnitudes of the forces. The equilibrium point of the block-spring system is shown as a dotted line.

Quantitative Analysis

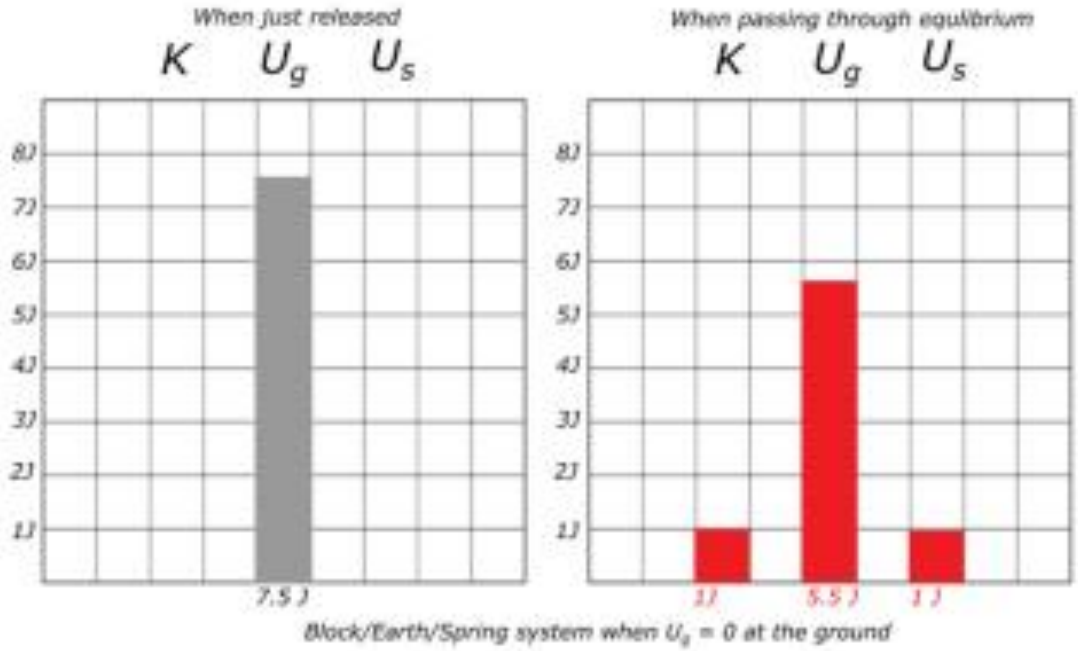
PART B: i. Calculate how much the spring has stretched when the block is at equilibrium.

$$F_{net} = 0,\ F_s - mg = 0,\ kx = mg,\ x = \frac{mg}{k} = \frac{(1\ kg)\left(10\ \frac{N}{kg}\right)}{50\ \frac{N}{m}} = 0.2\ m$$

ii. Calculate the height of the equilibrium position of the spring, with respect to the floor.

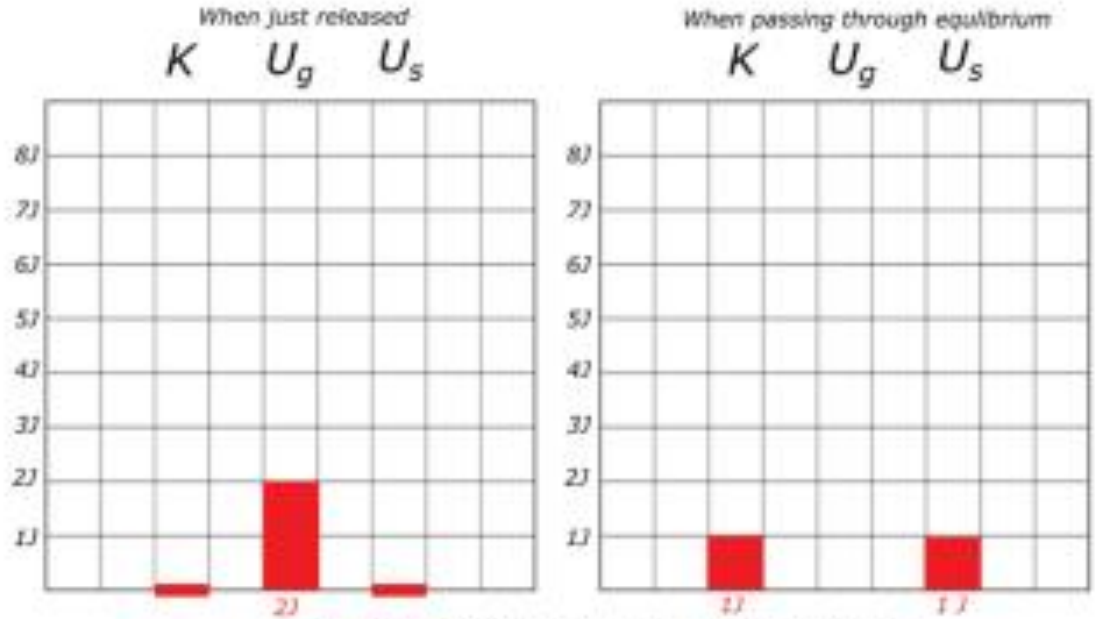
$1.0\ m - 0.25\ m - 0.2\ m = 0.55\ m$

PART C: Angela is tasked with completing energy bar charts for the scenario described above and creates the chart (below and left) for the time just as the block is released. Complete the energy bar chart below and right that would depict the energy of the block-Earth-spring system as the block passes through equilibrium.



Block/Earth/Spring system when $U_g = 0$ at the ground

Dominique says that the height above the ground doesn't matter; only the change in height is relevant. She considers the equilibrium position to be zero gravitational potential energy. Complete the energy bar charts for the block-Earth-spring system when the block is initially released.



Block/Earth/Spring system when $U_g = 0$ at equilibrium

Argumentation

PART D: Use the results of your bar charts to support Dominique's claim that the zero point of gravitational potential energy does not affect the behavior of the block-Earth-spring system. Reference specific details of the students' energy bar charts in your answer.

Looking at the final bar chart in each case, the motion of the system remains the same regardless of the zero location of the gravitational potential energy. In both charts, the values for the block-spring potential energy and the kinetic energy of the block are unaltered by the definition of the zero point for the gravitational potential energy.