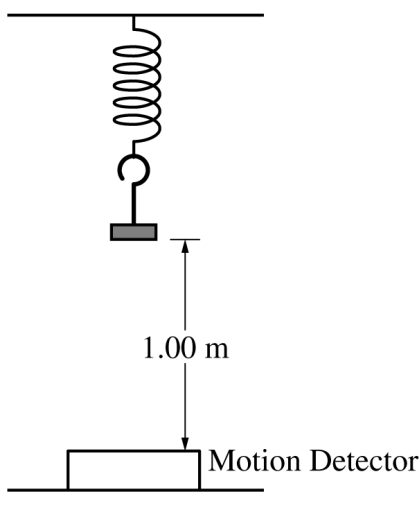




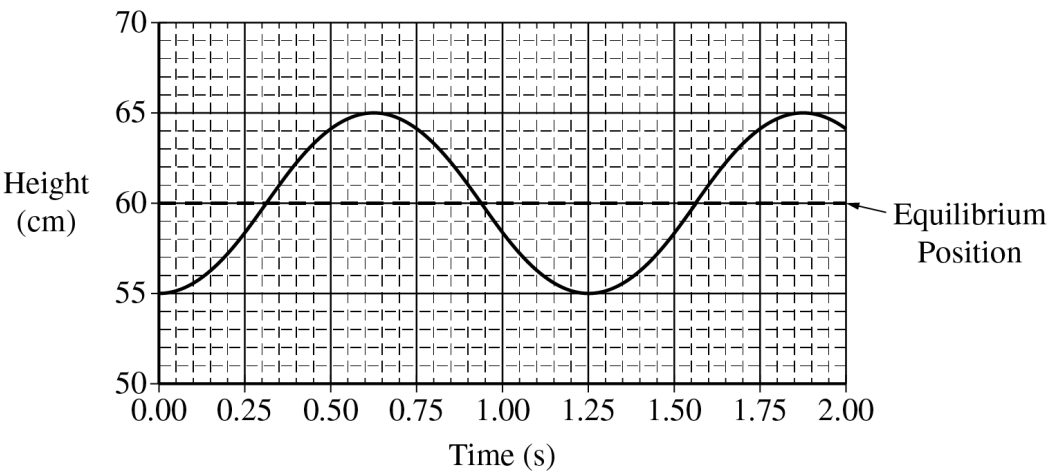
(7 points, suggested time 13 minutes)

A spring of unknown spring constant k_0 is attached to a ceiling. A lightweight hanger is attached to the lower end of the spring, and a motion detector is placed on the floor facing upward directly under the hanger, as shown in the figure above. The bottom of the hanger is 1.00 m above the motion detector.

A 0.50 kg object is placed on the hanger and allowed to come to rest at the equilibrium position. The spring is then stretched downward a distance d_0 from equilibrium and released at time $t = 0$. The motion detector records the height of the bottom of the hanger as a function of time. The output from the motion detector is shown in the graph on the following page.

GO ON TO THE NEXT PAGE.

Continue your response to **QUESTION 5** on this page.

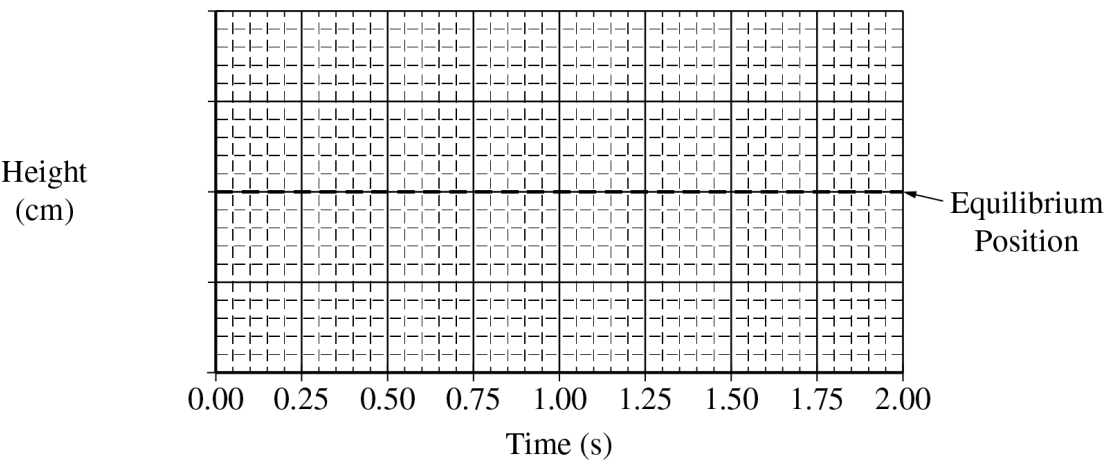


- (a) Using the information given and information taken from the graph, calculate the spring constant.
- (b) At time 0.75 s, the object-spring-Earth system has a total kinetic energy K_0 and a total potential energy U_0 . At 1.13 s, the object-spring-Earth system again has a total kinetic energy K_0 and a total potential energy U_0 .
- i. Explain how a feature of the graph indicates that the total kinetic energy of the system is the same at these two times.
- ii. Briefly explain why the total potential energy of the system is the same at these two times.

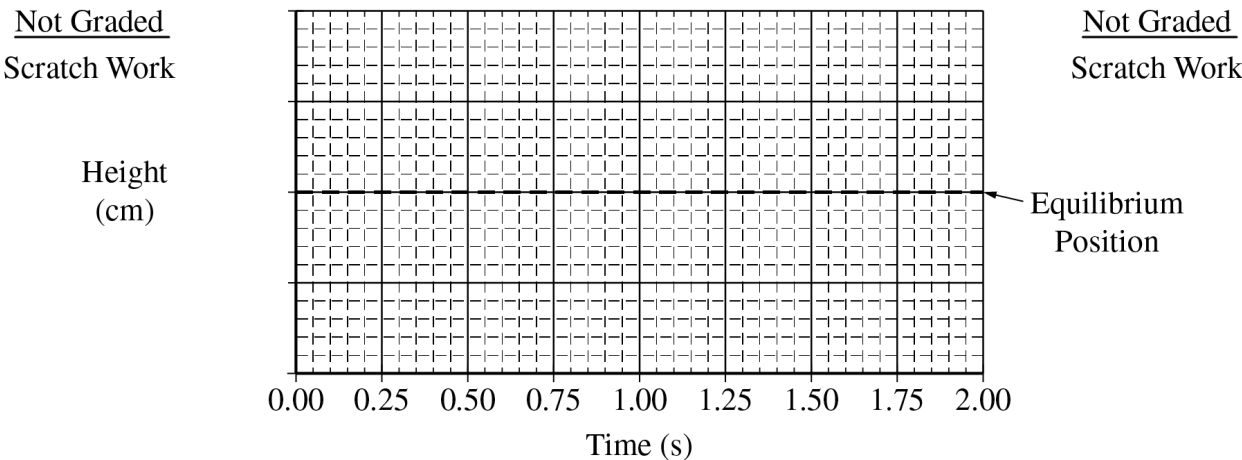
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Continue your response to **QUESTION 5** on this page.

- (c) The experiment is repeated with a spring of spring constant $4k_0$ and that has the same length as the original spring. The 0.50 kg object is hung from the new spring and allowed to come to rest at a new equilibrium position.
- i. Determine the new equilibrium position above the motion detector.
- ii. The object is again pulled down the same distance d_0 from the equilibrium position and released. On the following graph, draw a curve representing the motion of the object after it is released. Label the vertical axis with an appropriate numerical scale. A grid for scratch (practice) work is also provided.



The following graph is provided for scratch work only and will not be graded.



GO ON TO THE NEXT PAGE.

STOP

END OF EXAM