## FREE-RESPONSE QUESTION: PARAGRAPH ARGUMENT SHORT ANSWER



- 2. A spring with unstretched length  $L_1$  is hung vertically, with the top end fixed in place, as shown in Figure 1 above. A block of mass *M* is attached to the bottom of the spring, as shown in Figure 2, and the spring has length  $L_2 > L_1$  when the block hangs at rest. The block is then pulled downward and held in place so that the spring is stretched to a length  $L_3 > L_2$ , as shown in Figure 3.
  - (A) On the dot below, which represents the block in Figure 3, draw and label the forces (not components) exerted on the block. Each force must be represented by a distinct arrow starting on, and pointing away from, the dot.



(B) The student releases the block. Consider the time during which the block is moving upward toward its equilibrium position and the spring length is still longer than  $L_2$ .

In a clear, coherent paragraph-length response that may also contain diagrams and/or equations, indicate why the total mechanical energy is increasing, decreasing, or constant for each of the systems listed below.

- System 1: The block
- System 2: The block and the spring
- System 3: The block, the spring, and Earth

Use  $E_{p}$ ,  $E_{2}$ , and  $E_{3}$  to denote the total mechanical energy of systems 1, 2, and 3, respectively.