

Comparing Magnitudes of Common Forces

Purpose and Expected Outcome

In this activity you will explore several common forces in more detail. After completing this activity, you should be able to decide what factors determine the magnitude of a particular force.

Prior Experience / Knowledge Needed

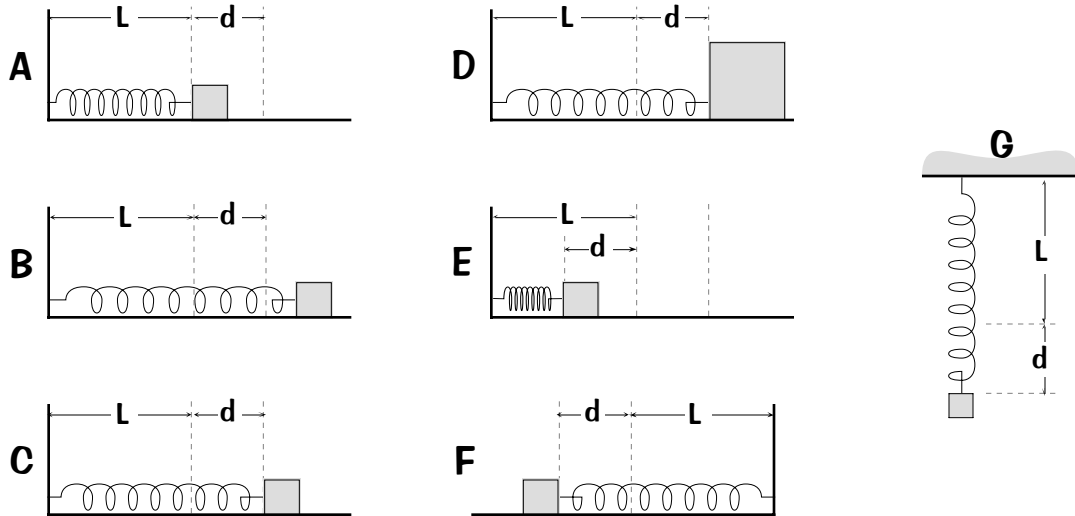
You should be familiar with the following three forces: Gravitational, Spring, and Tension.

Explanation of Activity and Example

This activity consists of three parts, one part for each of three common forces. For each force, a variety of situations is presented, and you are asked to compare selected pairs of situations. For each pair, select the situation in which the force has the larger magnitude. If the force has the same magnitude in both situations, say so. If you do not have enough information to determine which force has the larger magnitude, say so. In each case, briefly explain your answer.

PART A: Comparing Magnitudes of the Spring Force

In each situation, consider the force that the spring exerts on the block attached to it. All the springs are identical. L is the natural (relaxed) length of the spring; d is some particular distance (the same in each situation). The blocks in A, B, C, E, and F all have the same mass, while the block in D has a larger mass, and the block in G has a smaller mass (than the blocks in A, B, C, E and F).



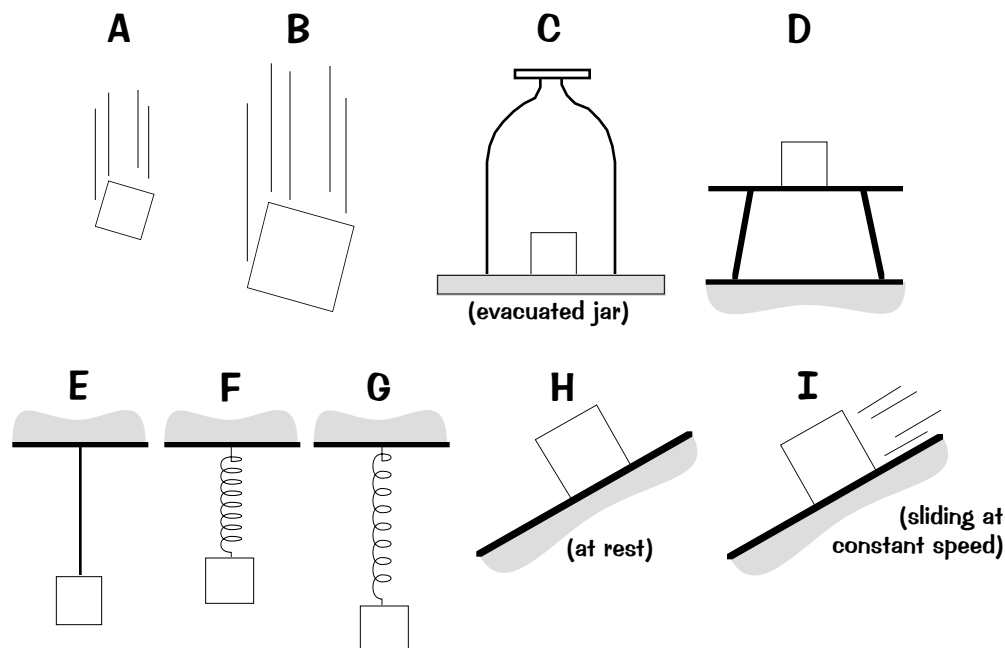
Example. In which situation is the magnitude of the spring force larger, A or C? Explain.

Answer: *The spring force is greater in C. The greater the distance a spring is stretched or compressed from its relaxed state, the greater the magnitude of the spring force. In situation A, the spring force is zero, because the spring is neither compressed nor stretched.*

- A1. In which situation is the magnitude of the spring force larger, B or C? Explain.
- A2. C or D? Explain.
- A3. C or E? Explain.
- A4. C or F? Explain.
- A5. C or G? Explain.

PART B: Comparing Magnitudes of the Gravitational Force

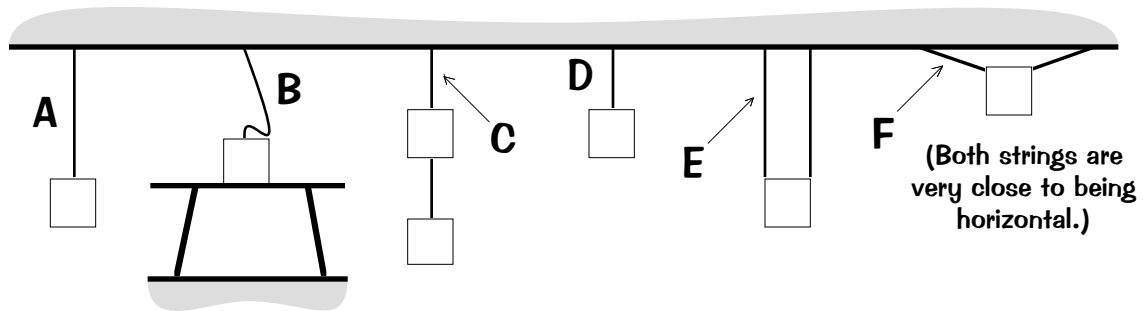
In each situation, consider the gravitational force that the earth exerts on the block. The masses of the blocks in situations A, C, D, E, F and G are the same. The mass of the block in situation B is four times that of the block in situation A, and the masses of the blocks in situations H and I are each twice the mass of the block in situation A.



- B1.** In which situation is the magnitude of the gravitational force larger, A or B? Explain.
- B2.** A or C? Explain.
- B3.** A or D? Explain.
- B4.** A or E? Explain.
- B5.** E or F? Explain.
- B6.** F or G? Explain.
- B7.** A or H? Explain.
- B8.** E or H? Explain.
- B9.** H or I? Explain.

PART C: Comparing Magnitudes of the Tension Force

In each situation, consider the tension force that the string exerts on the block. If there is more than one string attached to the block, consider the one indicated by the arrow. All the blocks have the same mass.



- C1. In which situation is the magnitude of the tension force larger, A or B? Explain.
- C2. A or C? Explain.
- C3. A or D? Explain.
- C4. A or E? Explain.
- C5. A or F? Explain.
- C6. E or F? Explain.

Reflection

- R1. What factors determine the magnitude of the gravitational force?
- R2. What factors determine the magnitude of the spring force?
- R3. What factors determine the magnitude of the tension force? How is the tension force different from the gravitational and spring forces?
- R4. (a) Imagine hanging an object from a rope, and then hanging it from a spring. Is there any difference between a very stiff spring and a rope? Comment on the similarities.
(b) Is there any difference between a moderately stiff spring and a very stretchy rope? Comment on the similarities.