SI Physics - Full Discipline Demo

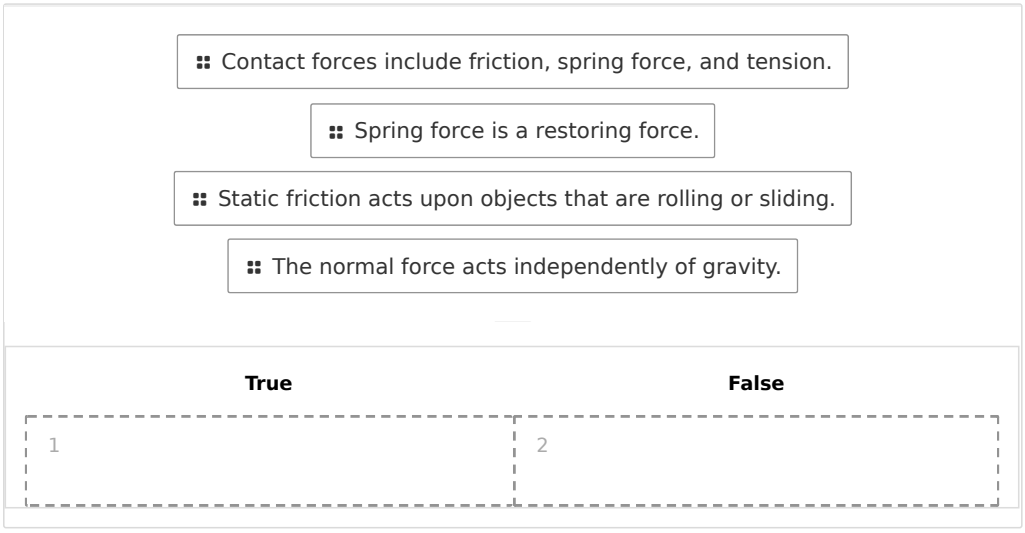
Contact Forces

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Physics - Full Discipline Demo
Course	SI Physics - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Identify each statement as true or false.



Correct answers:

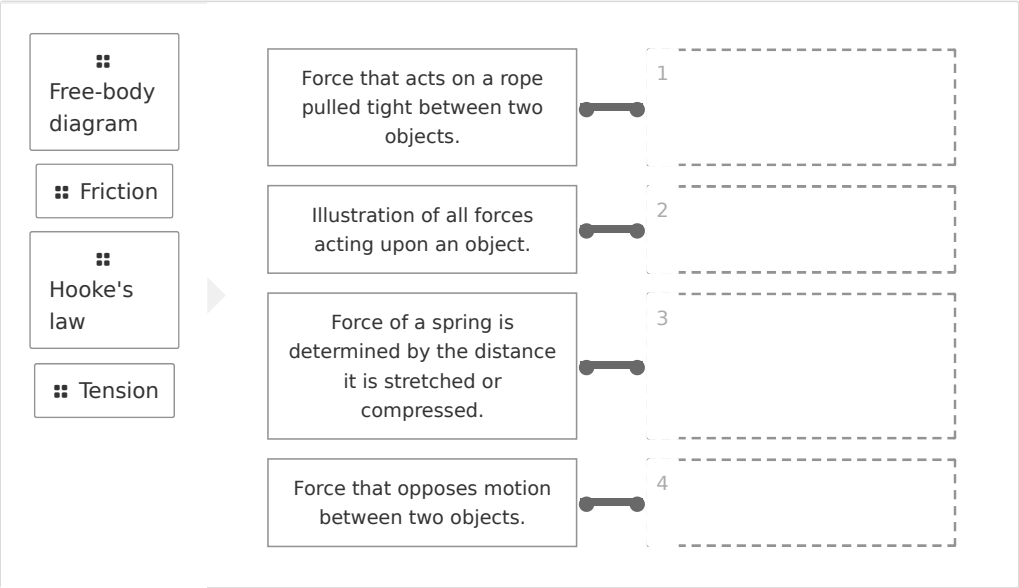
1 Contact forces include friction, spring force, and tension.

Spring force is a restoring force.

2 The normal force acts independently of gravity.

Static friction acts upon objects that are rolling or sliding.

Match each term with the best description.



Correct answers:

1 Tension 2 Free-body diagram 3 Hooke's law 4 Friction

Exploration

____ is an example of a contact force.

- Friction
- Spring force
- Tension
- All of the above ✔

Static friction must be overcome before objects will move.

- True ✔
- False

Hooke’s Law states that the spring force is _____ the amount of stretch or compression of the spring.

- directly proportional to ✔
- independent of
- inversely proportional to
- multiplied by

The normal force acts parallel to the point of contact between two objects.

- True
- False ✔

_____ is a force that is always a pulling force, never a pushing force.

- Normal force
- Spring force
- Tension ✔
- All of the above

Free-body diagrams illustrate the magnitude and direction of _____ acting upon an object.

- friction
- gravity
- normal forces
- All of the above ✔

Exercise 1

In Part 1, how would the force of friction change if the mass of the box was doubled? If the area of the box was doubled? In each case, justify your answer.

If the mass is doubled, the force of friction will also double because it depends on the normal force, which is equal to the force of gravity in this scenario, and gravity is proportional to mass. There is no change with area; friction is independent of the area of the object because the normal force and the force of gravity are also independent of area.

In Part 2, which spring is stiffer (more resistant to stretching and compression)? Explain your answer using the spring coefficients and the graphs in Photo 2 and 3.

Spring 1 has a k value of 4.9; spring 2 has a k value of 28.35. A higher value of k means a stiffer spring, so spring 2 is stiffer. As shown in the graphs, moving Spring 1 a distance of 1.15 m required -5.635 N of force, while moving Spring 2 the same distance required -32.6025 N of force.

In Part 3, how would tension on the chain change if the mass of the bucket were doubled? Explain your answer.

The tension would double. In this example, the tension of the chain is offsetting the force of gravity. The force of gravity is directly proportional to the mass of the bucket and will double. Therefore, the tension on the chain must also double.

Data Table 1: Force Required to Move Box
(SAMPLE ANSWER BELOW)

Force of Friction	5.9 N
Type of Friction	Static

Photo 1: Forces Acting on Box
(SAMPLE ANSWER BELOW)

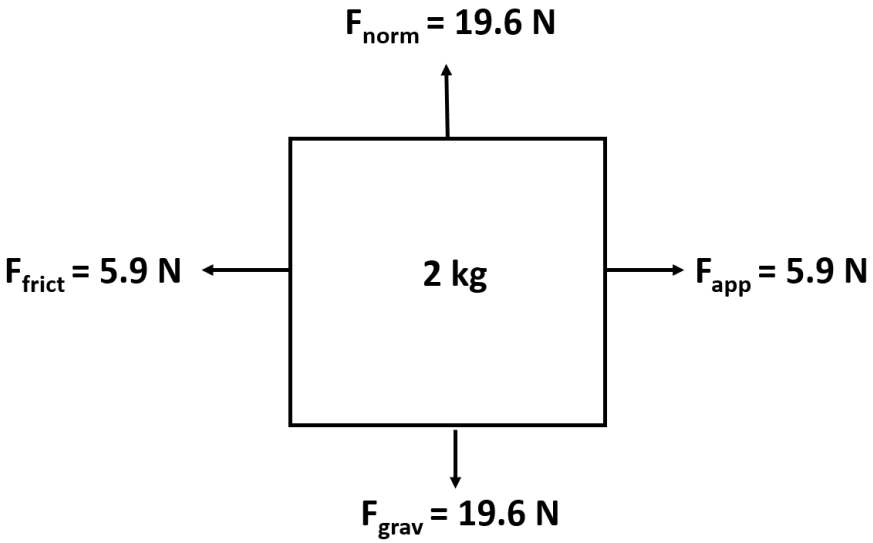
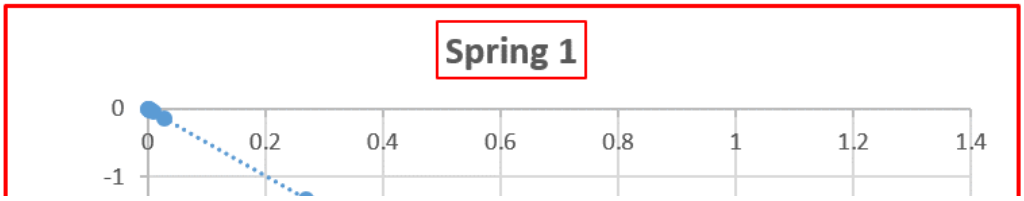
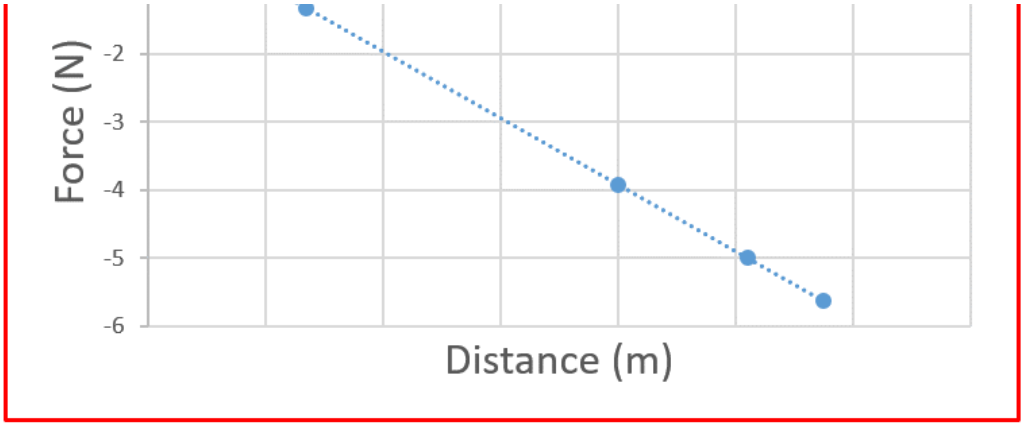


Photo 2: Spring 1 Force and Distance
(SAMPLE ANSWER BELOW)

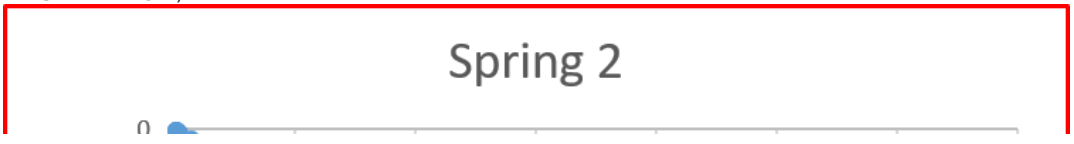


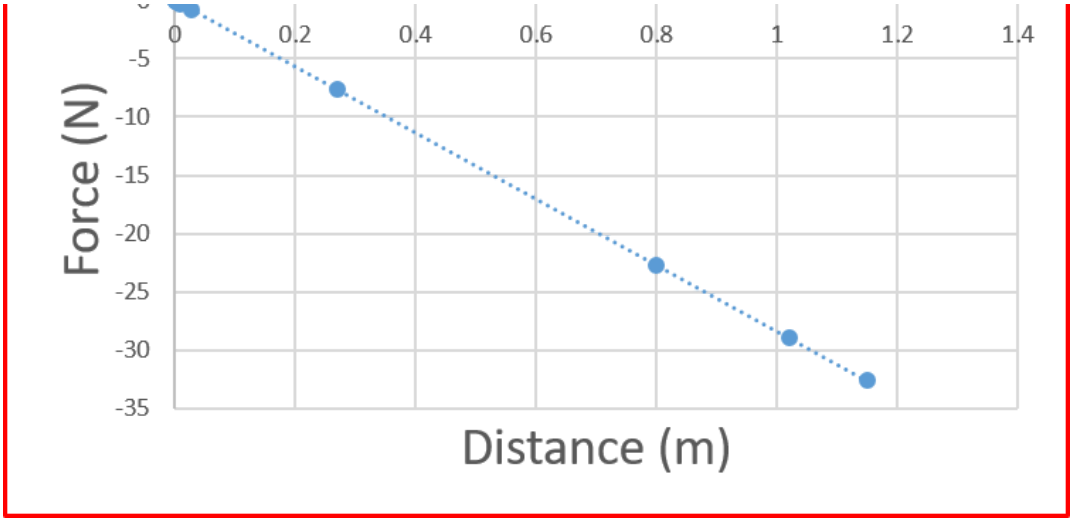


Data Table 2: Spring Force Coefficients
(SAMPLE ANSWER BELOW)

Spring 1 Coefficient	4.9 N/m
Spring 2 Coefficient	28.4 N/m

Photo 3: Spring 2 Force and Distance
(SAMPLE ANSWER BELOW)





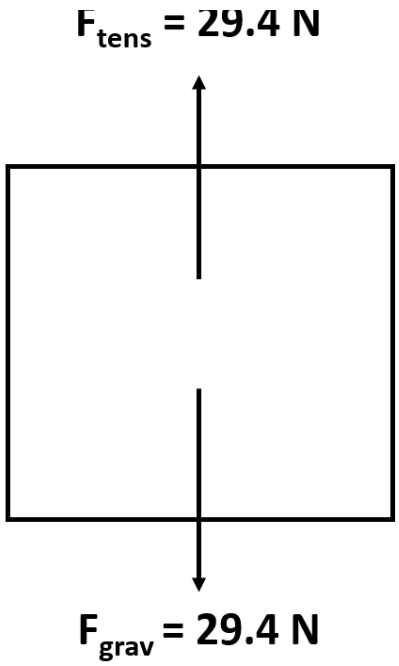
Data Table 3: Chain Tension

(SAMPLE ANSWER BELOW)

Tension in Rope	29.4 N

Photo 4: Forces Acting on Bucket

(SAMPLE ANSWER BELOW)



Competency Review

Both friction and gravity are examples of contact forces.

- True
- False ✔

The coefficient of static friction is typically _____ the coefficient of kinetic friction.

- greater than ✔
- less than
- equal to

The spring constant is a measure of the _____ of the spring.

- diameter
- length
- stiffness ✔
- All of the above

The _____ force supports resting objects and is counter to gravity.

- normal ✔
- spring
- tension
- All of the above

Free-body diagrams are only used to illustrate contact forces acting upon an object.

- True
- False ✔

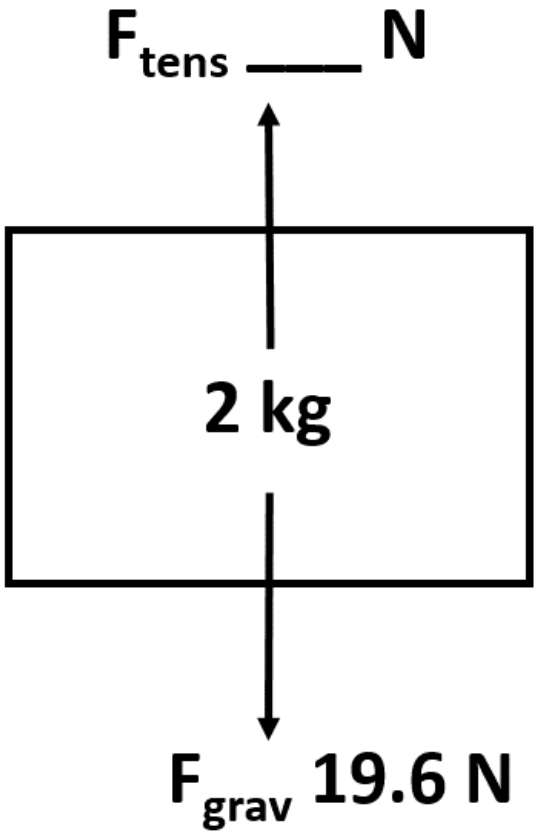
The force of static friction acting upon a resting 1.0 kg box under 9.8 N/kg gravity with a 0.5 coefficient of friction is _____ N.

- 0.5
- 1.0
- 4.9 ✔
- 9.8

The normal force acting upon a 4.0 kg resting box under 9.8 N/kg gravity with a 0.6 coefficient of friction is _____ N.

- 0.6
- 2.4
- 9.8
- 39.2 ✔

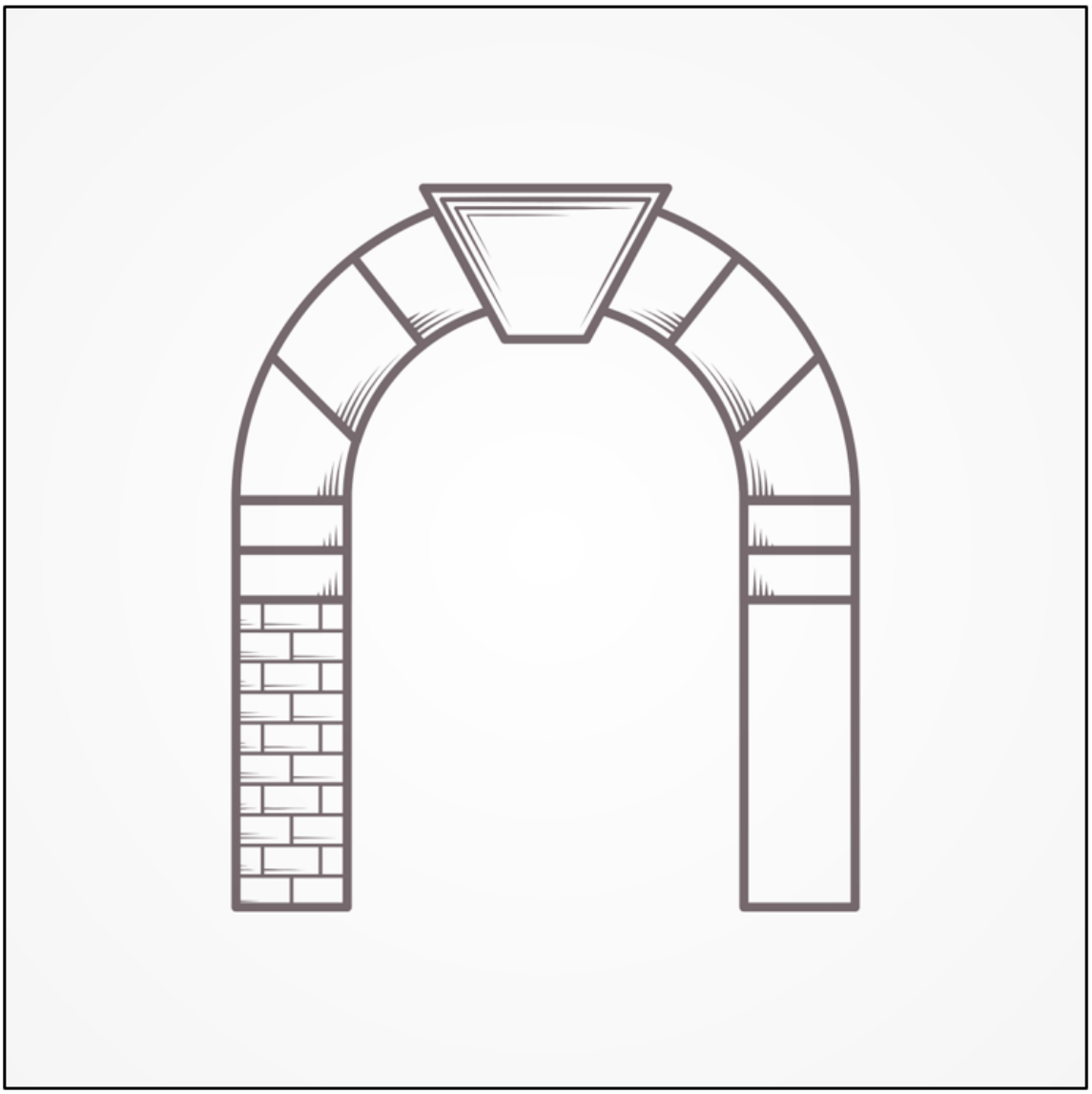
The diagram represents an object suspended by a rope. The tension force is _____ N.



- 2
- 9.8
- 19.6 ✔
- 39.2

Extension Questions

Keystones are load-bearing, often trapezoidal shaped, stones at the top of archways as illustrated below. Apply what you have learned about the normal force and the force of friction to explain how a keystone supports an arch.



(SAMPLE ANSWER BELOW)

The purpose of a keystone is to at least partially change the downward force of a load on the bridge to a horizontal force, that is absorbed by the sides of the arch. The trapezoidal shape of the keystone is designed for just this purpose. The force is transferred to the sides of the arch by means of contact forces, specifically, the normal force and the force of friction (static). The normal force acts on the sides of the keystone, where it comes into contact with the adjacent stones. This force keeps the stones from passing through each other. It pushes back on the stones and keeps them from collapsing inward. This force increases as the downward force on the bridge increases, keeping the bridge in balance. The force of friction also plays a role here. Static friction opposes the slippage of the stones. It helps to keep them from moving past each other.