

SI Physics - Full Discipline Demo

Non-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.

⚡ Electromagnetic force acts on two uncharged objects.	
⚡ Gravitational force acts on all objects with mass.	
⚡ Inverse square forces influence objects no matter how great the distance between them.	
⚡ Non-contact forces cause acceleration, rotation, and shear.	

True	False
1	2

Correct answers:

1

Inverse square forces influence objects no matter how great the distance between them.

Gravitational force acts on all objects with mass.

2 Non-contact forces cause acceleration, rotation, and shear.

Electromagnetic force acts on two uncharged objects.

Match each term with the best description.

⚡ Attractive force	A pull between two objects	1
⚡ Coulomb's law	A measure of the pull of gravity that varies by location	2
⚡ Magnetic force	A pull or push between electrically charged particles based on their motion in a magnetic field	3
⚡ Right hand rule	A method of predicting the deflections of charged objects in a magnetic field	4
⚡ Weight	Force is directly proportional to the product of the strength of two charges, and inversely proportional to the square of the distance between the charges	5

Correct answers:

- 1 Attractive force 2 Weight 3 Magnetic force 4 Right hand rule
5 Coulomb's law

Exploration

_____ force is a type of non-contact force.

- ☐ Electrostatic
- ☐ Gravitational
- ☐ Magnetic
- ☐ All of the above



Inverse square forces are weak at close range but rapidly strengthen as the distance between the objects increases.

- ☐ True
- ☒ False

✓

Gravity is a(n) ____ force that acts on all objects with mass.

- ☒ attractive
- ☐ contact
- ☐ repulsive
- ☐ All of the above

✓

Electrostatic forces are ____ forces between charged objects.

- ☐ attractive
- ☐ repulsive
- ☒ either attractive or repulsive
- ☐ neither attractive nor repulsive

✓

Magnetic fields are illustrated with a series of lines originating from the north pole of the magnet and terminating at the south pole.

- ☒ True
- ☐ False

✓

The extended ____ indicates the direction a charges velocity when using the right hand rule.

- ☐ index finger
- ☐ palm
- ☒ thumb
- ☐ All of the above

✓

Exercise 1

Explain the similarities and differences between the gravitational force, electrostatic force, and electromagnetic force.

All 3 forces are non-contact forces. Gravitational and electrostatic forces are both inverse square forces. Electrostatic and electromagnetic forces can be either attractive or repulsive, but gravitational forces are always attractive. Electrostatic and electromagnetic forces affect all objects with electric charge, whereas gravitational forces affect all objects with mass.

Consider an object at position $x = 3.0$ m on Graph 1. How far must it move towards/away from Object 1 for the force between them to double? To halve?

For the force to double, the distance must decrease by a factor of $1/\sqrt{2}$; for it to halve it must increase by a factor of $\sqrt{2}$. Thus, to double, the object must move toward Object 1 such that the distance between them is 2.12 and it must move away from Object 1 to a distance of 4.24 in order for the force to halve.

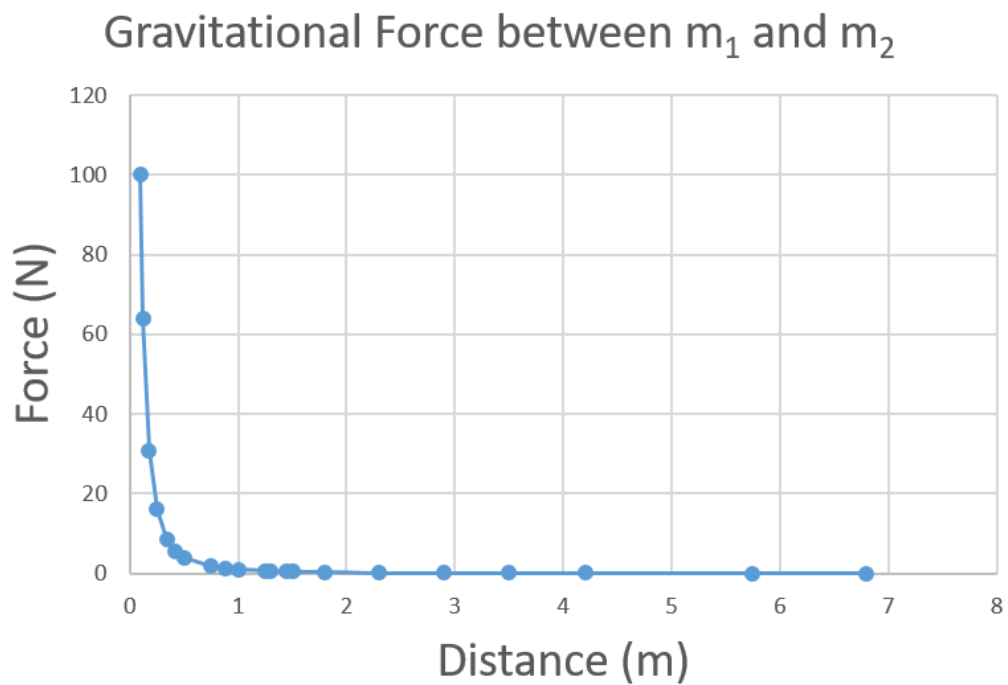
If Table 1 represented two charges instead of two masses, how would your answers to Question 2 change? Explain your answer.

The answers would be the same. The mathematical formula of the electrostatic force is the same as that of the gravitational force. The only difference would be whether the force was attractive or repulsive, but the distance would increase/decrease by $1/\sqrt{2}$ or $\sqrt{2}$ in order for the force to double/halve, just as in question 2.

If the charged object was positively charged, how would your answers in Data Table 2 change? Explain your answer.

The deflection would be the reverse (into the page). The positive charge would move in the opposite direction to the negative charge.

Graph 1: Gravitational Force Between m_1 and m_2
(SAMPLE ANSWER BELOW)



Panel 1: Explanation of Inverse Square Graph
(SAMPLE ANSWER BELOW)

This graph is an inverse square function. Any data points can be used to prove this, but the easiest are the data points at 0.1 and 0.25, which corresponds to values of 100 and 16: $0.1^2 = 0.01$, and the inverse is 100; $.25^2 = 0.0625$, and the inverse is 16.

Data Table 1: Gravitational Forces
(SAMPLE ANSWER BELOW)

Distance	Force
0.3	11.11
0.65	2.37
2.0	0.25
4.5	0.049

Data Table 2: Deflection Direction
(SAMPLE ANSWER BELOW)

Location	Direction of Deflection
X	Out of the page
Z	Out of the page

Competency Review

Inverse square forces are a type of ____ force.

- ☐ contact
- ☐ frictional
- ☒ non-contact
- ☐ All of the above

✓

The force of gravity is always positive since it is an attractive force.

- ☒ True
- ☐ False

✓

A negative electrostatic force is generated by the interaction between two objects that have ____.

- ☐ the same charge
 - ☒ opposite charges ✓
 - ☐ no charges
 - ☐ All of the above
-

Magnetic field lines emerge from ____ poles and end at ____ poles.

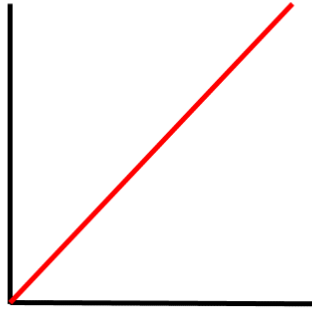
- ☒ north; south ✓
 - ☐ north;north
 - ☐ south, north
 - ☐ south; south
-

Negatively charged objects are deflected in the opposite direction of positively charged objects when encountering a magnetic field.

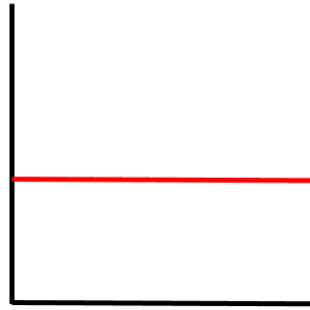
- ☒ True ✓
 - ☐ False
-

Graph ____ best represents an inverse square force data set.

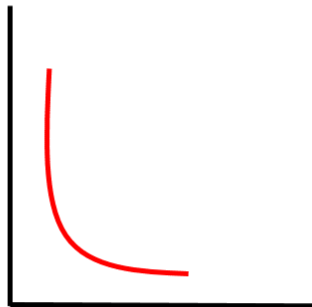
A



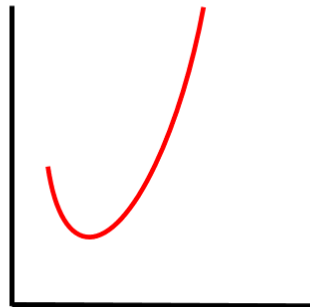
B



C



D



- ☐ A
- ☐ B
- ☒ C
- ☐ D

✓

The gravitational force between two objects is ____ if the mass of one of the objects is doubled.

- ☐ decreased by a factor of 4
- ☒ doubled
- ☐ halved
- ☐ increased by a factor of 4

✓

The electrostatic force between a positively charged object and a negatively charged object is ____ if the distance between the objects is doubled.

- ☒ decreased by a factor of 4 ✓
- ☐ doubled
- ☐ halved
- ☐ increased by a factor of 4

The electrostatic force between two uncharged objects is doubled as the distance between the objects is halved.

- ☐ True
- ☒ False ✓

The direction of a magnetic force is determined by the ____.

- ☐ direction of the magnetic field
- ☐ direction of the object's velocity
- ☐ sign of the charged object
- ☒ All of the above ✓

Extension Questions

Astronauts are often described as being weightless in space. When astronauts walked on the Moon, were they truly weightless? Explain your answer in terms of the concepts you have studied in this lesson. (SAMPLE ANSWER BELOW)

No, the astronauts were not weightless on the Moon. Weight is a measure of the force of gravity on an object, in this case, on the astronauts. Technically, because the functional form of the force of gravity is an inverse square law, which is never zero, there is no location in the known universe where an object's weight would be exactly zero. Because the force of gravity depends so strongly on distance, when the astronauts are on the Moon, the gravity they experience is dominated by the Moon's gravity, which is approximately 1/6th of the Earth's. Even though the Earth's gravity at its surface is much stronger than the Moon's, the force of gravity decreases rapidly enough with distance from Earth that it is essentially undetected by the astronauts on the Moon. The astronauts did feel the Moon's gravity, but it was six times less than they were used to on Earth. This decrease in the force of gravity (decrease in weight), led them to feel "weightless" even when they were still under the influence of gravity. It allowed them to jump higher and farther than they would be able to on Earth.

