Name: _____

Newton's Law of Gravitation Worksheet

1) The centers of two 15.0-kilogram spheres are separated by 3.00 meters. The magnitude of the gravitational force between the two spheres is approximately

2) What is the magnitude of the gravitational force between two 5.0-kilogram masses separated by a distance of 5.0 meters?

A) 6.7×10^{-11} N B) 1.3×10^{-11} N C) 5.0×10^{0} N D) 3.3×10^{-10} N

3) The gravitational force of attraction between Earth and the Sun is 3.52×10^{22} newtons. Calculate the mass of the Sun. [*Show all work, including the equation and substitution with units.*]

Questions 4 through 6 refer to the following:

The net force on a planet is due primarily to the other planets and the Sun. By taking into account all the forces acting on a planet, investigators calculated the orbit of each planet.

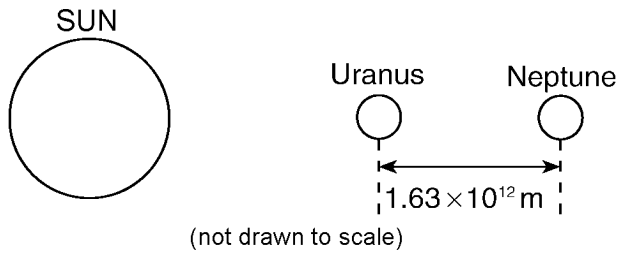
A small discrepancy between the calculated orbit and the observed orbit of the planet Uranus was noted. It appeared that the sum of the forces on Uranus did not equal its mass times its acceleration, unless there was another force on the planet that was not included in the calculation. Assuming that this force was exerted by an unobserved planet, two scientists working independently calculated where this unknown planet must be in order to account for the discrepancy. Astronomers pointed their telescopes in the predicted direction and found the planet we now call Neptune.

DATA TABLE:

Mass of the Sun	1.99×10^{30} kg
Mass of Uranus	8.73×10^{25} kg
Mass of Neptune	1.03×10^{26} kg
Mean distance of Uranus to the Sun	2.87×10^{12} m
Mean distance of Neptune to the Sun	4.50×10^{12} m

4) What fundamental force is the author referring to in this reading passage as a force between planets?

5) The diagram below represents Neptune, Uranus, and the Sun in a straight line. Neptune is 1.63×10^{12} meters from Uranus.

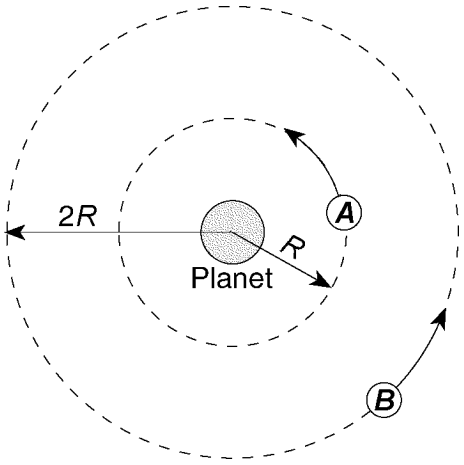


(not drawn to scale)

Calculate the magnitude of the interplanetary force of attraction between Uranus and Neptune at this point. [*Show all work, including the equation and substitution with units.*]

6) The magnitude of the force the Sun exerts on Uranus is 1.41×10^{21} newtons. Explain how it is possible for the Sun to exert a *greater* force on Uranus than Neptune exerts on Uranus.

7) The diagram below represents two satellites of equal mass, *A* and *B*, in circular orbits around a planet.



Compared to the magnitude of the gravitational force of attraction between satellite *A* and the planet, the magnitude of the gravitational force of attraction between satellite *B* and the planet is

A) twice as great B) four times as great C) one-fourth as great D) half as great

8) A 2.0-kilogram object is falling freely near Earth's surface. What is the magnitude of the gravitational force that Earth exerts on the object?

A) 20. N B) 2.0 N C) 0.0 N D) 0.20 N

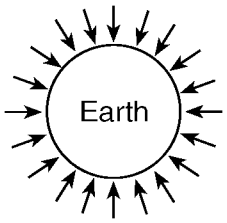
9) Gravitational force *F* exists between point objects *A* and *B* separated by distance *R*. If the mass of *A* is doubled and distance *R* is tripled, what is the new gravitational force between *A* and *B*?

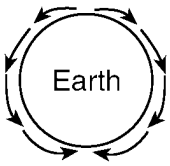
A) $\frac{9}{2}F$ B) $\frac{2}{3}F$ C) $\frac{2}{9}F$ D) $\frac{3}{2}F$

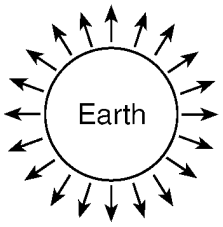
10) When a satellite is a distance *R* from the center of Earth, the force due to gravity on the satellite is *F*. What is the force due to gravity on the satellite when its distance from the center of Earth is 3*R*?

A) $\frac{F}{9}$ B) $9F$ C) F D) $\frac{F}{3}$

11) Which diagram *best* represents the gravitational field lines surrounding Earth?

A) 

C) 

B) 

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