**Practice - Newton's 3rd Law and Gravitation & Kepler's Laws**

**Name:** _____ **Date:** _____

1. A person kicks a 4.0-kilogram door with a 48-newton force causing the door to accelerate at 12 meters per second$^2$. What is the magnitude of the force exerted by the door on the person?

   A. 48 N B. 24 N C. 12 N D. 4.0 N

2. A mosquito flying over a highway strikes the windshield of a moving truck. Compared to the magnitude of the force of the truck on the mosquito during the collision, the magnitude of the force of the mosquito on the truck is

   A. smaller B. larger C. the same

3. The magnitude of the force that a baseball bat exerts on a ball is 50. newtons. The magnitude of the force that the ball exerts on the bat is

   A. 5.0 N B. 10. N C. 50. N D. 250 N

4. During a collision, an 84-kilogram driver of a car moving at 24 meters per second is brought to rest by an inflating air bag in 1.2 seconds. The magnitude of the force exerted on the driver by the air bag is approximately

   A. $7.0 \times 10^1$ N B. $8.2 \times 10^2$ N

   C. $1.7 \times 10^3$ N D. $2.0 \times 10^3$ N

5. A spring scale reads 20. newtons as it pulls a 5.0-kilogram mass across a table. What is the magnitude of the force exerted by the mass on the spring scale?

   A. 49 N B. 20. N C. 5.0 N D. 4.0 N

6. If the magnitude of the gravitational force of Earth on the Moon is $F$, the magnitude of the gravitational force of the Moon on Earth is

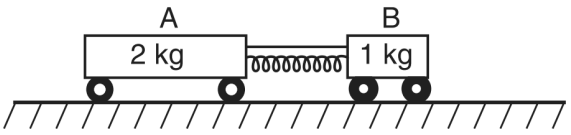
   A. smaller than $F$ B. larger than $F$

   C. equal to $F$

7. A carpenter hits a nail with a hammer. Compared to the magnitude of the force the hammer exerts on the nail, the magnitude of the force the nail exerts on the hammer during contact is

   A. less B. greater C. the same

8. The diagram below shows a compressed spring between two carts initially at rest on a horizontal, frictionless surface. Cart $A$ has a mass of 2 kilograms and cart $B$ has a mass of 1 kilogram. A string holds the carts together.




   The string is cut and the carts move apart. Compared to the magnitude of the force the spring exerts on cart $A$, the magnitude of the force the spring exerts on cart $B$ is

   A. the same B. half as great

   C. twice as great D. four times as great

9. A 50-kilogram student stands on the surface of the Earth. What is the magnitude of the gravitational force of the Earth on the student?

   A. 490 N B. 50 N

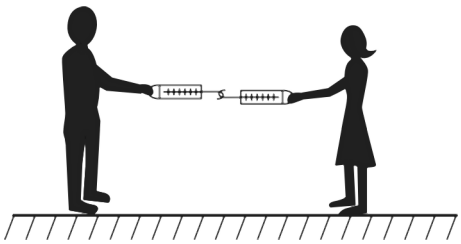
   C. 9.8 N D. $6.7 \times 10^{-11}$ N

10. A 50-kilogram student stands on the surface of the Moon where the acceleration due to gravity is 1.62 m/s$^2$. What is the magnitude of the gravitational force of the Moon on the student?

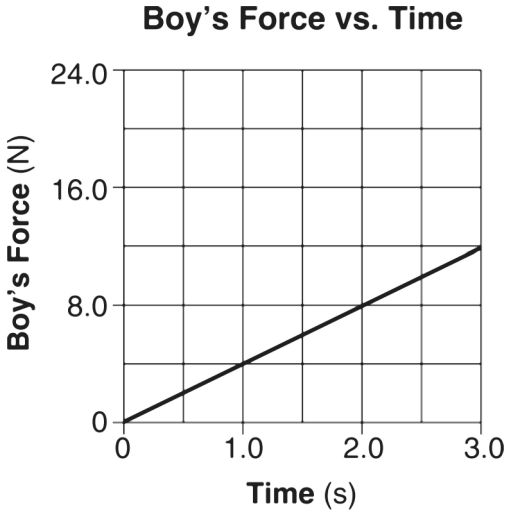
    A. $6.7 \times 10^{-11}$ N B. 50 N

    C. 9.8 N D. 81 N

11. A 100.0-kilogram boy and a 50.0-kilogram girl, each holding a spring scale, pull against each other as shown in the diagram below.

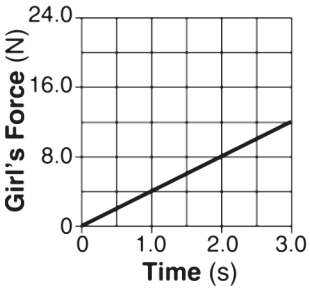


The graph below shows the relationship between the magnitude of the force that the boy applies on his spring scale and time.

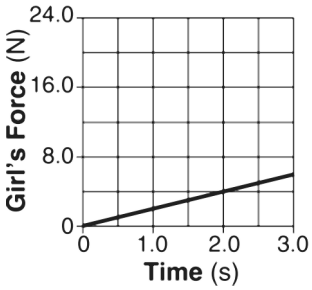



Which graph best represents the relationship between the magnitude of the force that the girl applies on her spring scale and time?

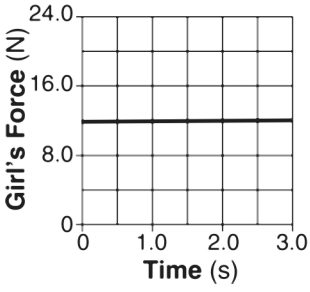
A.




B.




C.

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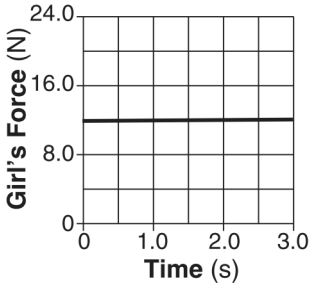


12. An astronaut drops a hammer from 2.0 meters above the surface of the Moon. If the acceleration due to gravity on the Moon is 1.62 meters per second$^2$, how long will it take for the hammer to fall to the Moon's surface?

A. 0.62 s B. 1.2 s C. 1.6 s D. 2.5 s

13. A 25.0-kilogram space probe fell freely with an acceleration of 2.00 meters per second$^2$ just before it landed on a distant planet. What is the weight of the space probe on that planet?

A. 12.5 N B. 25.0 N

C. 50.0 N D. 250. N

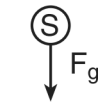
14. A 5.0-kilogram sphere, starting from rest, falls freely 22 meters in 3.0 seconds near the surface of a planet. Compared to the acceleration due to gravity near Earth's surface, the acceleration due to gravity near the surface of the planet is approximately

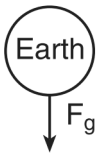
A. the same B. twice as great

C. one-half as great D. four times as great

15. Which diagram best represents the gravitational forces, $F_g$, between a satellite, $S$, and Earth?

A.

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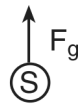
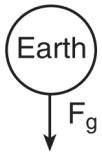
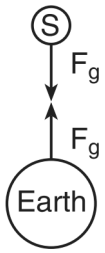
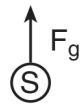


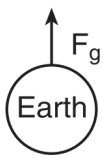




C.



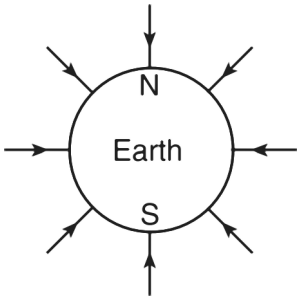

D.




16. In which diagram do the field lines best represent the gravitational field around Earth?

A.

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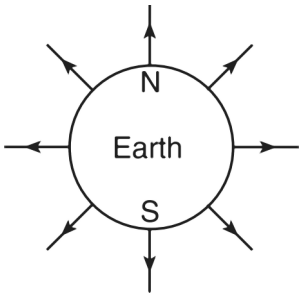


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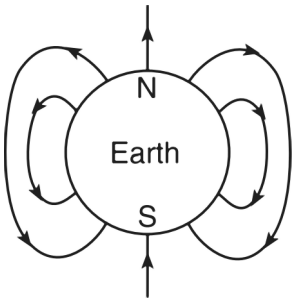


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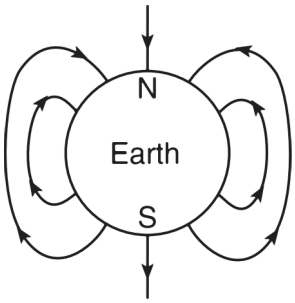



17. The centers of two 15.0-kilogram spheres are separated by 3.00 meters. The magnitude of the gravitational force between the two spheres is approximately

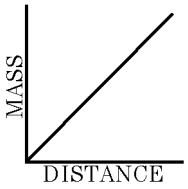
A. $1.11 \times 10^{-10}$ N B. $3.34 \times 10^{-10}$ N

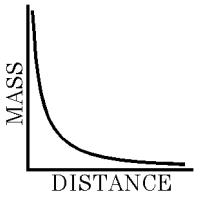
C. $1.67 \times 10^{-9}$ N D. $5.00 \times 10^{-9}$ N

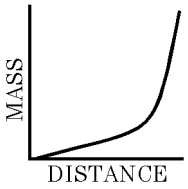
18. What is the magnitude of the gravitational force between two 5.0-kilogram masses separated by a distance of 5.0 meters?

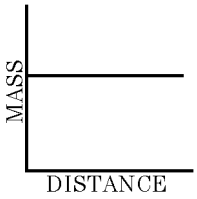
A. $5.0 \times 10^{0}$ N
B. $3.3 \times 10^{-10}$ N
C. $6.7 \times 10^{-11}$ N
D. $1.3 \times 10^{-11}$ N

19. Which graph best represents the relationship between the mass of an object and its distance from the center of the Earth?

A.



B.



C.



D.


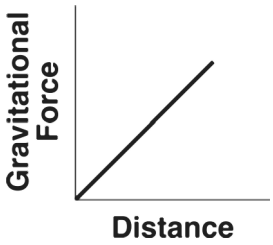

20. On the surface of Earth, a spacecraft has a mass of $2.00 \times 10^{4}$ kilograms. What is the mass of the spacecraft at a distance of one Earth radius above Earth's surface?

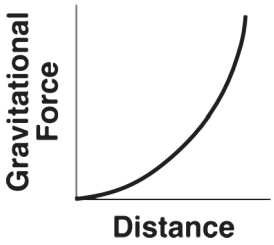
A. $5.00 \times 10^{3}$ kg
B. $2.00 \times 10^{4}$ kg
C. $4.90 \times 10^{4}$ kg
D. $1.96 \times 10^{5}$ kg

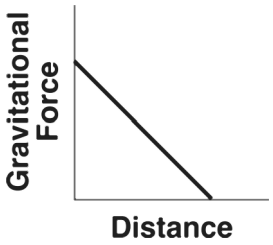
21. The gravitational force between two objects is inversely proportional to

A. mass squared
B. distance squared
C. mass
D. distance

22. Which graph represents the relationship between the magnitude of the gravitational force exerted by Earth on a spacecraft and the distance between the center of the spacecraft and center of Earth? [Assume constant mass for the spacecraft.]

A.



B.



C.



D.



23. An object weights 200 newtons at a distance of 100 kilometers above the center of a small uniform planet. How much will the object weigh 200 kilometers above the planet's center?

A. 400 newtons
B. 100 newtons
C. 50.0 newtons
D. 25.0 newtons

24. Gravitational force of attraction $F$ exists between two point masses $A$ and $B$ when they are separated by a fixed distance. After mass $A$ is tripled and mass $B$ is halved, the gravitational attraction between the two masses is

A. $\frac{1}{6}F$ B. $\frac{2}{3}F$ C. $\frac{3}{2}F$ D. $6F$

25. When a satellite is a distance $d$ from the center of the Earth, the force due to gravity on the satellite is $F$. What would be the force due to gravity on the satellite when its distance from the center of the Earth is $3d$?

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

26. On a small planet, an astronaut uses a vertical force of 175 newtons to lift an 87.5-kilogram boulder at constant velocity to a height of 0.350 meter above the planet's surface. What is the magnitude of the gravitational field strength on the surface of the planet?

A. 0.500 N/kg B. 2.00 N/kg

C. 9.81 N/kg D. 61.3 N/kg

27. At a certain location, a gravitational force with a magnitude of 350 newtons acts on a 70.-kilogram astronaut. What is the magnitude of the gravitational field strength at this location?

A. 0.20 kg/N B. 5.0 N/kg

C. 9.8 $m/s^2$ D. 25 000 N·kg

28. If the Earth were twice as massive as it is now, then the gravitational force between it and the Sun would be

A. the same B. twice as great

C. half as great D. four times as great

29. The shapes of the paths of the planets about the sun are all

A. circles with the Sun at the center

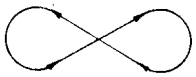
B. circles with the Sun off center

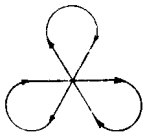
C. ellipses with the Sun at the center

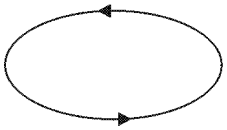
D. ellipses with the Sun at one focus

30. Which diagram best represents a natural space orbit?

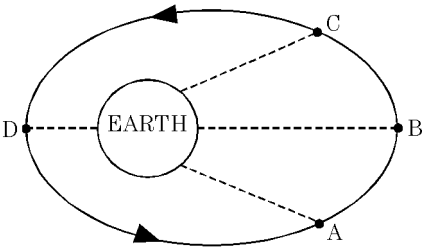
A. 

B. 

C. 

D. 

31. The diagram shows positions of a satellite as it orbits the Earth. At which position will the satellite achieve its highest velocity?




A. *A* B. *B* C. *C* D. *D*

32. The orbital period for a satellite in geosynchronous orbit around the Earth is

A. one hour B. one day

C. one month D. one year

33. Satellite $A$ has a circular orbit of radius $R$ and satellite $B$ has a circular orbit of radius $2R$. Compared to the period of satellite $A$, the period of satellite $B$ is

A. less B. greater C. the same

34. Weightlessness is a condition in which an astronaut and the astronaut's environment have the same

A. acceleration B. inertia

C. momentum D. mass

35. Base your answer(s) to the following question(s) on the passage and data table blelow

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.

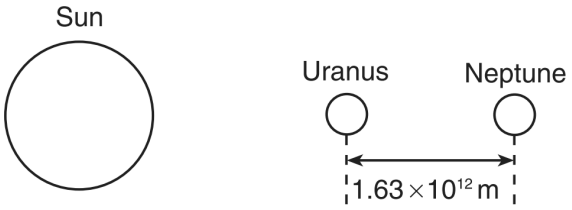
A small discrepancy between the calculated orbit and the observed orbit of the planet Uranus was noted. It appeared that the sum of the forces on Uranus did not equal its mass times its acceleration, unless there was another force on the planet that was not included in the calculation. Assuming that 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 | $1.99 \times 10^{30}$ kg |
| Mass of Uranus | $8.73 \times 10^{25}$ kg |
| Mass of Neptune | $1.03 \times 10^{26}$ kg |
| Mean distance of Uranus to the Sun | $2.87 \times 10^{12}$ m |
| Mean distance of Neptune to the Sun | $4.50 \times 10^{12}$ m |

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

36. The diagram below represents Neptune, Uranus, and the Sun in a straight line. Neptune is $1.63 \times 10^{12}$ 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.]

37. The magnitude of the force the Sun exerts on Uranus is $1.41 \times 10^{21}$ newtons. Explain how it is possible for the Sun to exert a greater force on Uranus than Neptune exerts on Uranus.

Practice - Newton's 3rd Law and Gravitation & Kepler's Laws 3/25/2020

1.
Answer: A
Points: 1

2.
Answer: C
Points: 1

3.
Answer: C
Points: 1

4.
Answer: C
Points: 1

5.
Answer: B
Points: 1

6.
Answer: C
Points: 1

7.
Answer: C
Points: 1

8.
Answer: A
Points: 1

9.
Answer: A
Points: 1

10.
Answer: D
Points: 1

11.
Answer: A
Points: 1

12.
Answer: C
Points: 1

13.
Answer: C
Points: 1

14.
Answer: C
Points: 1

15.
Answer: C
Points: 1

16.
Answer: A
Points: 1

17.
Answer: C
Points: 1

18.
Answer: C
Points: 1

19.
Answer: D
Points: 1

20.
Answer: B
Points: 1

21.
Answer: B
Points: 1

22.
Answer: D
Points: 1

23.
Answer: C
Points: 1

24.
Answer: C
Points: 1

25.
Answer: B
Points: 1

26.
Answer: B
Points: 1

27.
Answer: B
Points: 1

28.
Answer: B
Points: 1

29.
Answer: D
Points: 1

30.
Answer: D
Points: 1

31.
Answer: D
Points: 1

32.
Answer: B
Points: 1

33.
Answer: B
Points: 1

34.
Answer: A
Points: 1

35.
Answer: Gravity is the fundamental force to which the author is referring.
Points: 1

36.
Answer: $F = 2.26x10^{17}$ N
Points: 1

37.
Answer: Sun is larger in mass.
Points: 1