

Chapter 12 Universal Gravitation

# Universal Gravitation

## Pre-Test - Post-Test

1. Newton hypothesized that the moon \_\_\_\_\_.
  - A) is a projectile.
  - B) is actually attracted to Earth the same as the apple.
  - C) has a force acting on it since it follows a curved path.
  - D) has tangential velocity that prevents it from falling into Earth.
  - E) all of the above
  
2. Gravitational forces are the weakest forces found in nature. Because of this
  - A) we cannot observe the gravitational effects between the earth and a pencil.
  - B) there is no gravitational force acting on two 1-kg masses.
  - C) small objects in space are not influenced by gravitational interactions.
  - D) we only observe gravitational effects when one of the masses involved is large.
  
3. Inside a freely-falling elevator, there would be no \_\_\_\_\_.
 

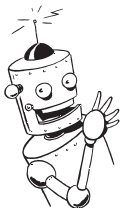
A) gravitational force acting on you.	C) both A and B.
B) apparent weight for you.	D) none of these.
  
4. If you were to weigh yourself in an elevator that is accelerating upward, compared to your ordinary weight you would weigh \_\_\_\_\_.
 

A) more.	C) less, but more than zero.
B) the same.	D) zero.
  
5. Passengers in a high flying passenger jet feel their normal weight in flight, while astronauts in an orbiting space shuttle do not. This is because the astronauts
  - A) are beyond the main pull of Earth's gravity.
  - B) are above the Earth's atmosphere.
  - C) are without a supporting force.
  - D) all of the above.
  
6. Suppose the gravitational force between two massive balls is 10 N. If the distance between the balls is cut in half, what is the force between the masses?
 

A) 2.5 N	C) 20 N
B) 5 N	D) 40 N
  
7. A woman who normally weighs 400 N stands on top of a very tall ladder so she is one earth radius above the earth's surface. How much does she weigh there?
 

A) zero.	C) 200 N
B) 100 N	D) 400 N

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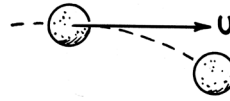
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# Universal Gravitation

## Newton's Law of Universal Gravitation

1. How many stars are there in the night time sky?
2. What law does the movement of every object in the universe follow?
3. Who discovered gravity?
4. What was it that Newton discover about gravity?
5. What role did the apple play in Newton's discovery?
6. Why did Newton reason that the Moon was falling?

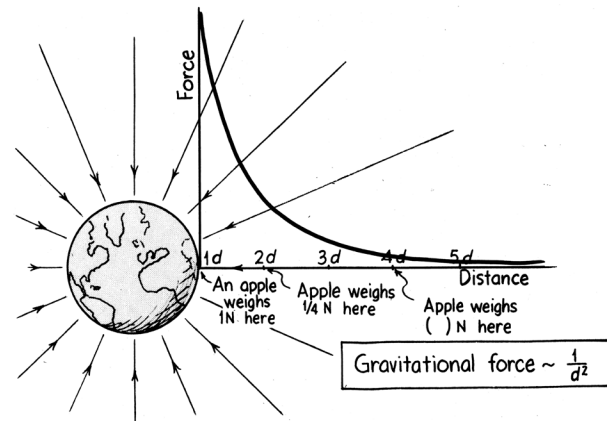
7. Why doesn't the Moon hit Earth?



8. What is Newton's formula for universal gravitation?

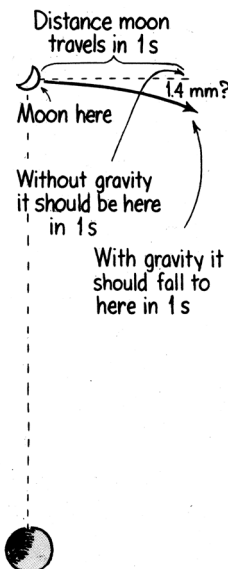
## Inverse-Square Law

9. How does the force of gravity change with distance?

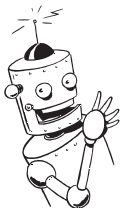


10. What happens to the gravitational force between two objects if one of the masses doubles? Triples? Quadruples?

11. What happens to the gravitational force between two objects if the distance between them doubles? Triples? Quadruples?



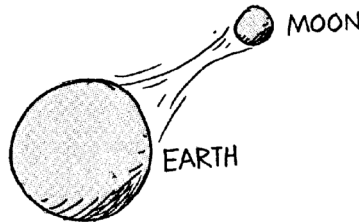
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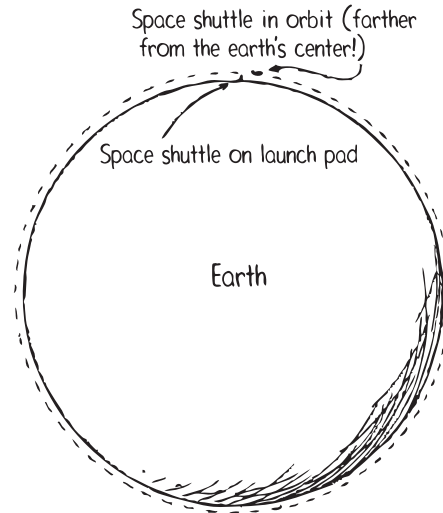
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12. Imagine a person (400 N), standing on a ladder that is exactly one earth-radius tall. By how much would their weight change?

13. Which pulls harder, the Earth or the Moon?



19. True or false. Your friend says that the reason astronauts in orbit feel weightless is because they are beyond the gravitational pull of the Earth.



**Weight and Weightless**

14. Why do we experience weight?

20. How far from the Earth would you have to travel to escape the Earth's gravity?

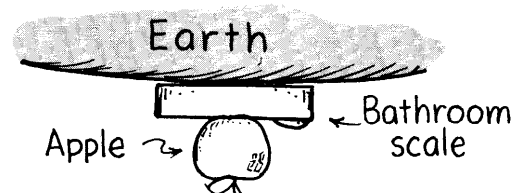
15. Why don't you feel your weight during free-fall?

21. Where would you have to travel to find true weightlessness?

16. Distinguish between true and apparent weightlessness.

22. The weight of an apple near the surface of the Earth is 1 N. What is the weight of the Earth in the gravitational field of the apple?

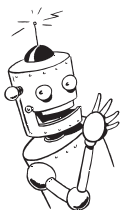
17. You are in a freely falling elevator and you drop a pencil, the pencil appears to hover. Is the pencil falling? Explain.



18. Why do passengers in a high-altitude jet feel the sensation of weight while passengers in an orbiting space vehicle such as the space shuttle do not?

23. How much does the Earth weigh in your gravitational field?

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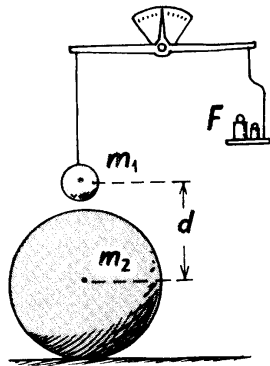
- 24. Is the Earth's weight constant? Explain.
- 25. What would happen to your weight if the mass of the Earth or your mass doubled? What if both doubled?
- 26. Every day the Earth gains mass from objects colliding with the Earth, how does this effect your weight?
- 27. Explain the difference between little "g" and big "G".
- 28. What did Henry Cavendish discover?
- 29. What is the gravitational constant?
- 30. What is the magnitude of the gravitational force between two 1 kilogram masses that are 1 meter apart?
- 31. Explain the importance of Henry Cavendish's famous experiment.
- 32. Show the calculation for finding the mass of the earth.

**Big "G" and Little "g"**

27. Explain the difference between little "g" and big "G".

**Finding Big "G"**

28. What did Henry Cavendish discover?



29. What is the gravitational constant?

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