

Chapter 2 Motion in Two Dimensions

Projectile Motion

Pre-Test - Post-Test

1. A stone is thrown horizontally from the top of a cliff. One second after it has left your hand its vertical distance below the cliff is _____.
 - A) 5 m.
 - B) 10 m.
 - C) 15 m.
 - D) depends on horizontal speed

2. Roll a ball off the edge of a table. As it falls it's horizontal component of its motion
 - A) decreases.
 - B) increases.
 - C) remains constant.
 - D) will vary.

3. When does a bullet fired from a high speed rifle begin to fall?
 - A) as soon as it leaves the barrel.
 - B) after air resistance reduces its speed.
 - C) depends on how fast it was shot.
 - D) not enough information to answer.

4. A bullet fired horizontally hits the ground in 0.5 seconds. If it had been fired with a much higher speed in the same direction, it would have hit the ground in
 - A) less than 0.5 sec.
 - B) more than 0.5 sec.
 - C) 0.5 sec.
 - D) not enough information to answer.

5. Which letter best describes the path of a ball that rolls off the edge of a table?
 - A) straight.
 - B) circular.
 - C) curved.
 - D) non of the above.

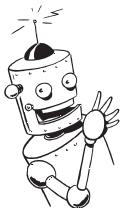
6. A pilot drops a heavy package from a plane that falls and strikes the ground. Where, approximately, is the plane at the moment the package hits the ground?
 - A) right above the package.
 - B) ahead of the package.
 - C) behind the package.
 - D) none of these.

7. An earth satellite is simply a projectile in free fall around the Earth.
 - A) true.
 - B) false.

8. What prevents satellites such as the space shuttle from falling?
 - A) they are outside Earth's gravity.
 - B) there is no air drag.
 - C) nothing, they are falling all the way around the Earth.

9. Earth satellites are typically more than 150 km high so as to be above the earth's
 - A) atmosphere.
 - B) gravitational field.
 - C) both a and b.
 - D) none of the above.

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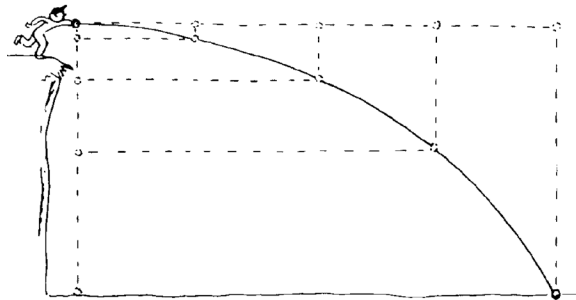
Leap Of Faith (the setup)

1. Doc Fizzix's dorm room was on the 32nd floor of his dormitory. There was a pool at the bottom of dormitory but the pool was located several meters away from the edge of the building. Draw the set-up in the space below

6. How does the velocity of an object moving horizontally compare at different points along it's journey?

7. How does the velocity of an object moving vertically compare at different points along it's journey?

8. Describe the components of projectile motion.



2. When Doc Fizzix drops a tennis ball from the balcony of his dorm room it takes 4 seconds to hit the ground. How high up is Doc Fizzix?

3. If Doc Fizzix wanted to land in the pool he would have to jump away from the building, would this change the time of fall?

9. Describe what happens to the horizontal component of an object's motion as it is projected off a cliff.

10. Describe what happens to the vertical component of an object's motion as it is projected off a cliff.

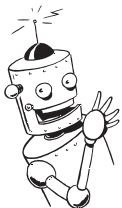
Projectile Motion

4. In which direction does gravity work? Vertical, horizontal, or both?

11. What is the shape of the projectile's path after it is projected horizontally off a cliff?

5. How is the motion of an object traveling horizontally affected by gravity?

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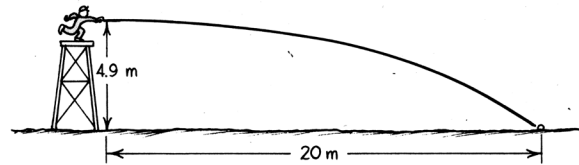


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12. A plane drops a package. Where does the package land in reference to the plane above? Draw a picture below.

The Base Ball Pitcher

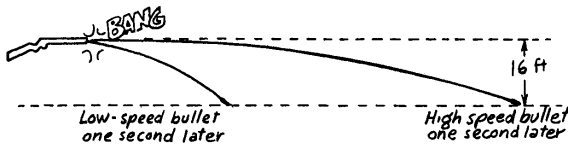
18. A baseball pitcher throws a ball horizontally from a tower 5 meters tall and the ball lands 20 meters downrange.



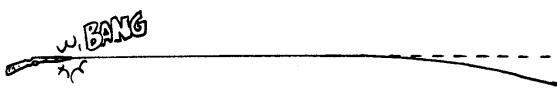
Projectiles Launched Horizontally

13. Which hits the ground first, a bullet dropped or a bullet fired simultaneously from the same height?

14. Does the horizontal speed of an object affect its time of fall?



15. There are some people that claim, if moving fast enough, a high-speed bullet will travel without dropping. Are they correct?



16. If an object is thrown horizontally from a cliff, what variable(s) would you need to know in order to predict how long the object will be in the air?

a) In 1 sec. how far will an object fall?

b) If the baseball was dropped from rest at the top of the tower, how long would it be in the air?

c) If the baseball is thrown horizontally how long will it be in the air?

d) At what speed was the ball thrown?

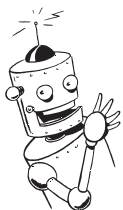
e) How long would it be in the air if it was thrown twice as fast?

f) If the ground at the far end of the field was sloped downward, would the ball be in the air for the same amount of time before it hits the ground?

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Leap Of Faith (the jump)

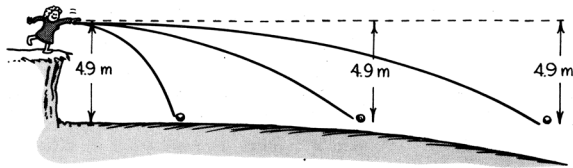
17. What measurements are important in determining if Doc Fizzix should attempt to make a leap of faith?



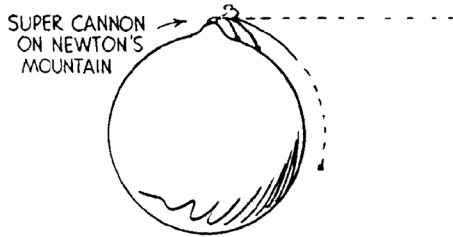
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Satellite Motion

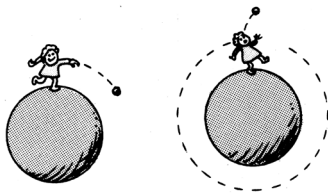
19. If you could throw an object fast enough, how would the curvature of the Earth effect the time an object was in the air?



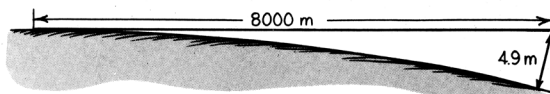
20. What is Newton's mountain?



21. Describe orbital/satellite motion.

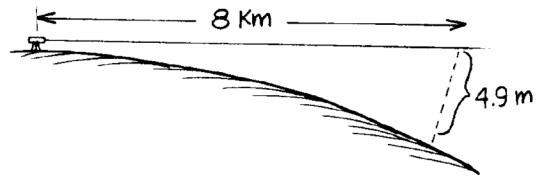


22. What is the curvature of the Earth?



23. In 1 sec. how far does an object fall?

24. Near the surface of Earth, how fast would a stone need to be thrown in order to orbit Earth?



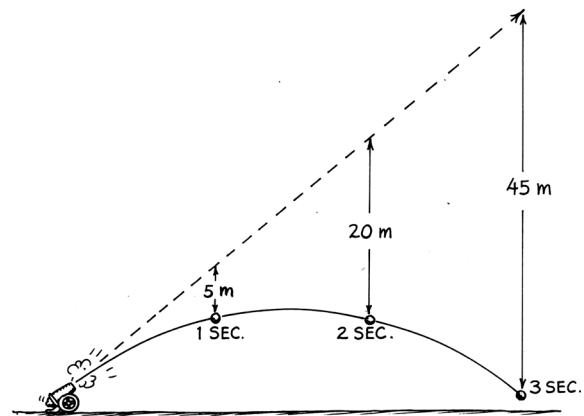
25. What is the lowest a satellite be placed into orbit without burning up?

26. Why does a satellite burn up when it descends back into the atmosphere but not burn up when it ascends up through the atmosphere?

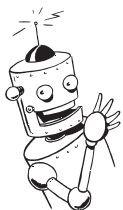
Projectiles at an Angles

27. When a rifle is being fired at a distant target, why isn't the barrel lined up so that it points exactly at the target?

28. How far below an initial straight- line path will a projectile fall in one second?



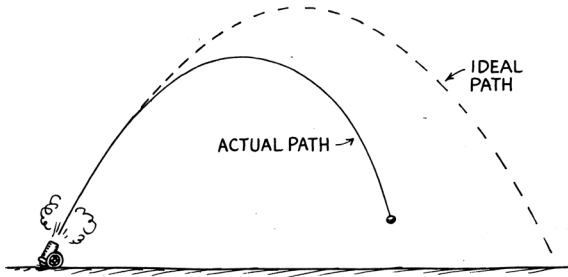
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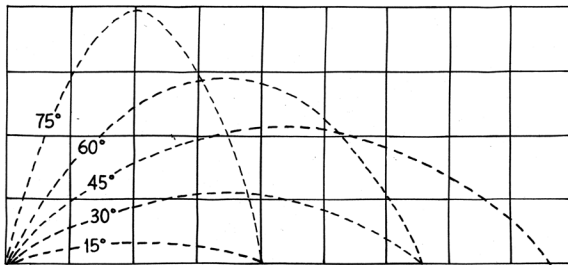
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29. Does your answer from the pervious question depend on the angle of launch or on the initial speed of the projectile?

30. Discuss how air resistance affects the actual path of a projectile launched into the air.



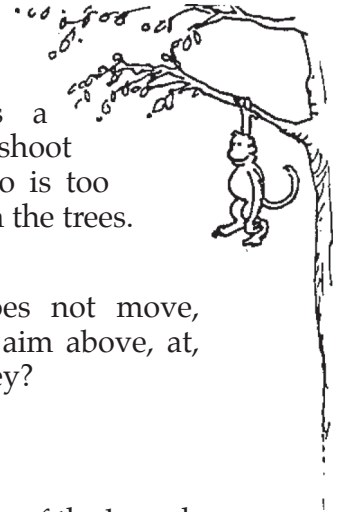
31. At what angle should you hold a garden hose so that the stream of water will go the farthest?



32. To bomb a tank factory the Flying Fortress should drop its bomb load:

- a) before it is over the target.
- b) when it is directly over the target.
- c) after passing over the target.

33. A zookeeper devises a rubber-band gun to shoot food to a monkey who is too shy to come down from the trees.



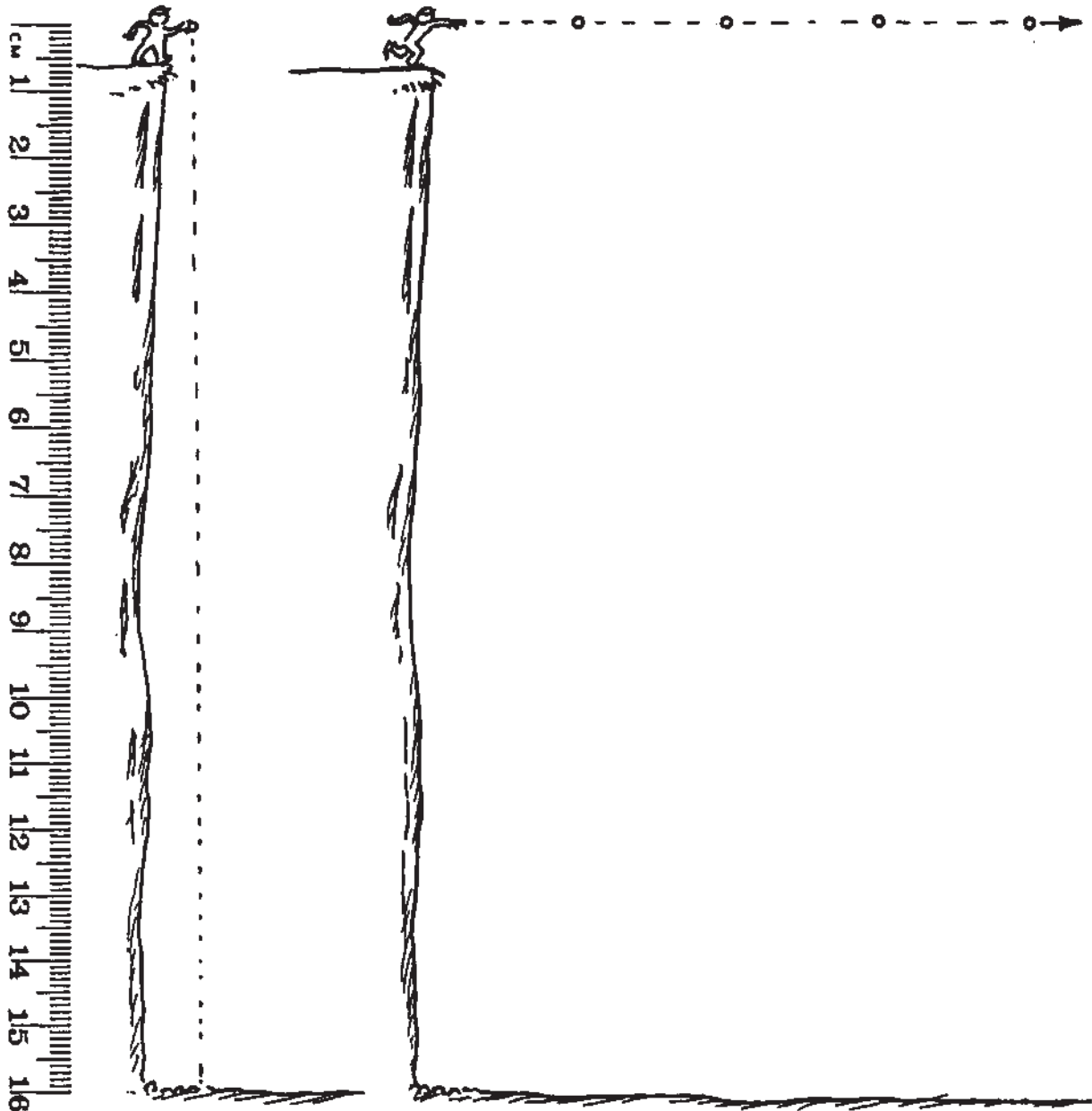
- a) If the monkey does not move, should the Keeper aim above, at, or below the monkey?
- b) If the monkey lets go of the branch at the instant the Keeper shoots the food, should the Keeper aim above, at, or below the monkey to get the food to the monkey in mid-air?

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1. Above left: Use the scale 1 cm:5 m and draw the positions of the dropped ball at 1-second intervals. Neglect air drag and assume $g = 10 \text{ m/s}^2$. Estimate the number of seconds the ball is in the air.

_____ seconds

2. Above right: The four positions of the thrown ball with *no gravity* are at 1-second intervals. At 1 cm:5 m, carefully draw the positions of the ball *with gravity*. Neglect air drag and assume $g = 10 \text{ m/s}^2$. Connect your positions with a smooth curve to show the path of the ball. How is the motion in the vertical direction affected by motion in the horizontal direction?

