

Chapter 10 Review Questions pg. 188; 11th ed.

1. Why does a horizontally moving projectile have to have a large speed to become an Earth satellite?

Ans. Please ask in class.

3. Why does the vertical component of velocity for a projectile change with time, whereas the horizontal component of velocity doesn't?

Ans. The force of gravity acts in the down direction, changing the vertical(up-down) component of velocity.

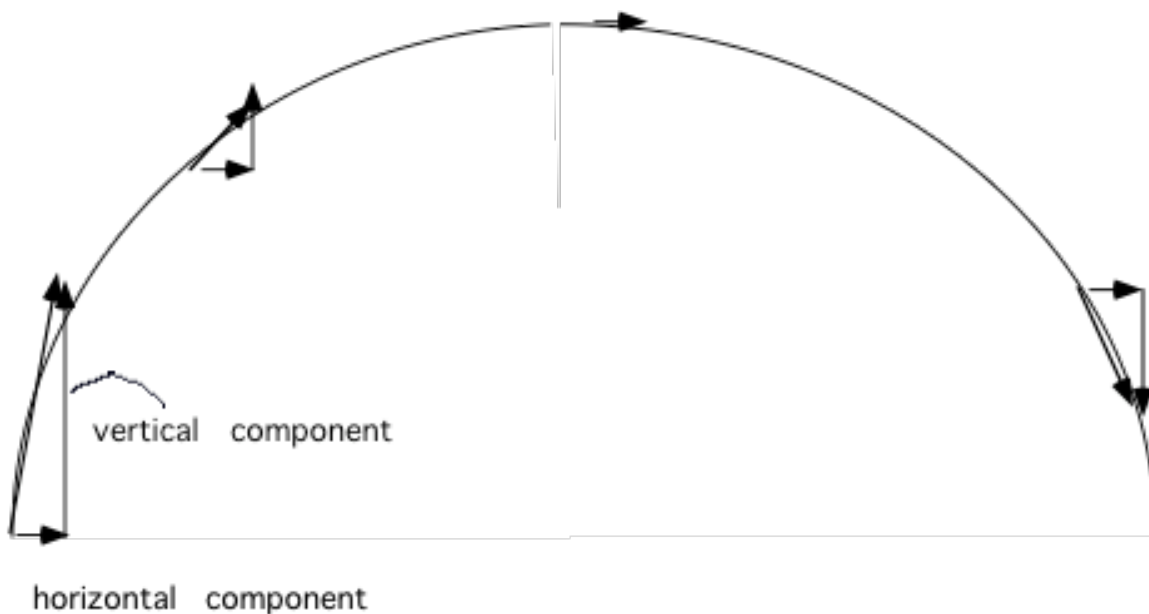
Extra question: True or false. When air resistance does not affect the motion of a projectile, its horizontal and vertical components of velocity remain constant.

Ans. False. Although the horizontal component doesn't change, the vertical component is changed by the downward pull of gravity.

4. A rock is thrown upward at an angle. What happens to the horizontal component of its velocity as:
a) it rises? b) it falls?

Ans. The horizontal component of the velocity of an object in free fall never changes (as long as we are disregarding air friction).

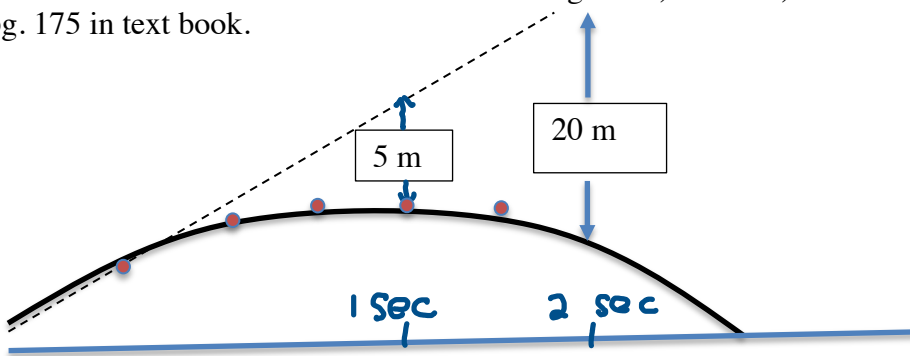
5. A rock is thrown upward at an angle. What happens to the vertical component of its velocity as:
a) it rises? b) it falls?



Ans. a) As the rock rises, the vertical component of its velocity gets smaller.
b) As the rock falls, the vertical component of its velocity gets larger.

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6. A projectile falls beneath the straight-line path it would follow if there were no gravity. How many meters does it fall below this line if it has been traveling for: a) 1 sec? b) 2 seconds? See fig. 10.8, below or pg. 175 in text book.



Ans. a) 5 meters. b) 20 meters

Compare these answers to the distance an object in free fall would drop in 1 sec. In 2 sec. See table 3.3 page 43. Distance fallen in free fall

Time of fall (seconds)	Distance fallen (meters)
0	0
1	5
2	20
3	45
4	80

7. Does your answer to the last question depend on the angle at which the projectile is launched?

Ans. No.

9 A projectile is launched vertically at 100 m/s. If air resistance can be neglected, at what speed will it return to its initial level?

Ans. 100 m/s(the same speed with which it left).

11. Why will a projectile that moves horizontally at 8 km/s follow a curve that matches the curvature of the earth?

Ans. Every second the projectile will travel a horizontal distance of 8 km and drop a vertical distance of 5 meters. The Earth curves 5 meters for every 8 km of surface, so the object never changes its distance from the Earth's surface.

13. Why doesn't the force of gravity change the speed of a satellite in circular orbit?

Ans. Gravity is pulling at right angles to the direction that the satellite in circular orbit is moving. The force at right angles changes the direction of the satellite's motion, not its speed.

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5. A heavy crate accidentally falls from a high-flying airplane just as it flies directly above a shiny red Porsche smartly parked in a car lot. Relative to the Porsche, where will the crate crash? Look at the diagram in the text.

Ans. The crate lands behind the Porsche, in the direction that the plane was heading

10. A friend claims that bullets fired by some high-powered rifles travel for many meters in a straight-line path without dropping. Another friend disputes this claim and states that all bullets from any rifle drop beneath a straight-line path a vertical distance given by the equation $\Delta X = V_0 t + \frac{1}{2} at^2$ and that the curved path is apparent at low velocities and less apparent at high velocities. Now it's your turn. Will all bullets drop the same vertical distance in equal times? Explain.

Ans. Yes. All objects in free fall, near the Earth's surface accelerate down at 10 m/s/s when we disregard air friction.

12. 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?

Ans. When the bullet leaves the barrel of the gun, it is in free-fall and will begin accelerating down at approximately 10 m/s/s and will fall below a straight-line path.

14. A park ranger shoots a monkey hanging from a branch of a tree with a tranquilizing dart. The ranger aims directly at the monkey, not realizing that the dart will follow a parabolic path and thus fall below the monkey. The monkey, however, sees the dart leave the gun and lets go of the branch to avoid being hit. Will the monkey be hit anyway? Does the velocity of the dart affect your answer, assuming it is great enough to travel to the tree before hitting the ground? Defend your answer.

Ans. Please see the monkey and hunter video.

Extra. Assuming no air resistance, why does an 8-km/s horizontally fired projectile not strike the earth's surface?

Ans. Please do your best to answer this question.

20 When the space shuttle coasts in a circular orbit at constant speed about the earth, is it accelerating?

Ans. Yes it is accelerating toward the center of the earth. An acceleration toward the center of the orbit is called centripetal acceleration. All objects that move in a circle at constant speed accelerate toward the center of the circle.

27. A satellite can orbit 5 kilometer above the moon, but not at 5 kilometer above the Earth. Why?

Ans. The moon does not have an atmosphere to slow the satellite down and the Earth does.

51. If you stop an Earth satellite dead in its tracks, it would simply crash into the Earth. Why don't the communications satellites that "hover motionless" above fixed positions over the same spot on the Earth crash?

Ask this one in class.

Extra: True or false. When air resistance does not affect the motion of a projectile, it covers equal horizontal distances in equal time intervals.

Ans. True.

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2. An airplane is flying horizontally with speed 280 m/s when an engine falls off—don't you hate when that happens. Neglecting air resistance, if it takes 30 seconds for the engine to hit the ground: a) How high was the plane?

Ans. a) $\Delta X = V_0 t + \frac{1}{2} a t^2$

Since the initial velocity V_0 vertically is zero, the equation reduces to:

$$\Delta X = 0 + \frac{1}{2} a t^2 = \frac{1}{2} (10 \text{ m/s}^2)(30 \text{ sec})^2 = \underline{\mathbf{4500 \text{ meters}}}$$

b) Calculate how far horizontally the engine travels while it falls.

Since the engine is not accelerating in the horizontal direction, the acceleration is zero in the horizontal direction.

$$\Delta X = V_0 t + \frac{1}{2} a t^2 = V_0 t + \frac{1}{2} 0 t^2.$$

Ans. b) **The equation reduces to: $\Delta X = V_0 t = 280 \text{ m/s} (30 \text{ s}) = 8400 \text{ m}$**

c) If the plane continues flying in a straight line at 280 m/s, where is the engine relative to the plane when the engine hits the ground?

Ans. c) The engine is 4500 meters directly below the plane. Directly below because it continued flying horizontally at 280 m/s for 30 seconds and was always directly below the plane.