Worksheet 1.5 – Projectiles

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**HINT**: the gatekeeper between the horizontal and vertical components of projectile motion is ***TIME***!

1. A golf ball was struck from the first tee at Lunar Golf and Country Club. It was given a velocity of 48 m/s at an angle of 40˚ to the horizontal. On the moon, g = -1.6 m/s2.
2. What are the vertical and horizontal components of the ball's initial velocity? **vx = 36.8 m/s and vy =30.9 m/s**
3. For what interval of time is the ball in flight? **38.6 s**
4. How far will the ball travel horizontally? **1420 m**
5. A batter hits a ball giving it a velocity of 48 m/s at an angle of 50˚ above the horizontal.
6. What are the vertical and horizontal components of the ball's initial velocity? **vx = 30.9 m/s and vy =36.8 m/s**
7. How long is the ball in the air? **7.51 s**
8. What is the horizontal distance covered by the ball while in flight? **232 m**
9. What velocity does the ball have at the top of its trajectory? **30.9 m/s – only has the x component of velocity**
10. An archer standing on the back of a pickup truck moving at 28 m/s fires an arrow straight up at a duck flying directly overhead. The archer misses the duck! The arrow was fired with an initial velocity of 49 m/s relative to the truck.
11. For how long will the arrow be in the air? **Only the vy matters … 10.0 s**
12. How far will the truck travel while the arrow is in the air? **280 m**
13. Where, in relation to the "duckless" archer, will the arrow come down? Will the archer have to 'duck'? **The arrow should come straight back into the truck (theoretically right back to the archer)**
14. A ball is thrown with a velocity of 24 m/s at an angle of 30˚ to the horizontal.
15. What are the vertical and horizontal components of the initial velocity? **vx = 20.8 m/s and vy = 12 m/s**
16. How long is the ball in the air? **2.45 s**
17. How far away will the ball land? **51.0 m**
18. To what maximum height will the ball rise? **7.35 m**
19. With what velocity will the ball land? **24 m/s 30˚ from the horizontal**
20. A pebble is fired from a slingshot with a velocity of 30 m/s. If it is fired at an angle of 30˚ to the horizontal, what height will it reach? **11.5 m** If its flight is interrupted by a vertical wall 12 m away, at what height will it hit the wall? **Since vx = 26.0 m/s, the time that the pebble would hit the wall would be 0.46 s after launch, using d = vit+1/2at2, the distance traveled upwards would be 5.86 m.**
21. A diver takes off with a speed of 8.0 m/s from a 3.0 m high diving board at 30˚ above the horizontal. How much later does she strike the water? **Use d = vit+1/2at2, the displacement is –3.0 m and vy = +4.0 m/s, solve the quadratic equation using quad formula to find t = 1.29 s**
22. On level ground, a ball is thrown forward and upward. The ball is in the air 2.0 s and strikes the ground 30 m from the thrower. What was the ball's initial velocity?
23. A golf ball was struck from the first tee at Lunar Golf and Country Club, a private golf course for astronauts stranded on the moon. It was given a velocity of 48 m/s at an angle of 40o to the horizontal. On the Moon, the magnitude of g = 1.6 m/s2.



* 1. What is the verticle component of the golf ball’s initial velocity?
	2. For what interval of time is the ball in flight?
	3. How far will the ball travel horizontally? **The time for the ball to go upwards to the top of its trajectory must be 1.0 s so viy = 9.8 m/s,** **vx = 15 m/s (based upon how far it traveled in 2.0 s). Finding the resultant vector, v = 17.9 m/s at an angle of 33.2˚ to the horizontal.**
1. A girl throws a rock horizontally from the top of a cliff 98 m high, with a horizontal velocity of 27 m/s.
	1. How many seconds will the rock be in the air?
	2. How far out from the base of the cliff does the rock land?
2. A daredevil BMX rider rides his bike off a cliff with a horizontal velocity of 4.5.0 m/s, and lands in the water 12.0 m from the base of the cliff.
	1. How long does it take the rider to hit the water?
	2. How high is the cliff?



**Worksheet 1.5 ANSWERS**

1. Vx = 36.8 m/s; Vyo = 30.8 m/s
2. a. Vx = 30.8 m/s; Vyo = 36.8 m/s b. 7.50 s c. 231 m d. 30.8 m/s horizontal
3. 5) a. 10.0 s b. 279 m c. Oh Yeah!
4. a. Vx = 20.8 m/s; Vyo = 12 m/s b. 2.45 s c. 50.9 m d. 7.34 m e. 24 m/s 30o below horiz
5. 11 m High
6. 1.28 s
7. 17.9 m/s 33o above horiz
8. a. 31/ m/s b. 39 s c. 1.4 x 103 m (1.4 km)
9. a. 4.5 s b. 1.2 x 102 m
10. a. 2.67 s b. 34.8 m