

Projectile Motion - Worksheet

13 Free-Response Questions

Organic Chemistry Tutor

1. A ball rolls horizontally off a cliff at 20 m/s. It takes 10 seconds for it to hit the ground. Calculate the height of the cliff and the horizontal distance traveled by the ball.

3. A ball is released from rest and drops straight down starting at a height of 800 m. (a) How long will it take to hit the ground? (b) How long will it take to reach the ground if the ball was thrown down with an initial speed of 30 m/s?

2. A ball rolls off a cliff that is 200 m high. Calculate the time it takes for the ball to hit the ground.

4. A ball is kicked horizontally from the roof of a building that is 300 m tall and lands about 400 m from the base of the building. (a) Calculate the initial speed of the ball. (b) Calculate the final speed of the ball just before it hits the ground. (c) Find the angle of the ball relative to the positive x-axis.

5. What angle between 0° and 90° will yield the maximum range of a projectile? (b) If a ball is launched at 20° , what acute angle will yield the same range? (c) What if the angle was 10° or 30° ?

7. A ball is kicked off the ground at 40 m/s at an angle of 60 degrees. (a) Find the maximum height. (b) Calculate the time it takes to hit the ground. (c) Determine the range of the ball.

6. A ball is kicked from the ground at a speed of 40 m/s at an angle of 30° . Calculate the horizontal (V_x) and vertical velocity (V_y) as well as the acceleration components (A_x, A_y) when the ball was kicked and when it reaches its maximum height.

8. A ball is thrown straight up with an initial speed of 50 m/s. (a) How high will it go? (b) How long will it be in the air?

9. A ball is kicked off the ground reaching a maximum height of 100 m and lands 200 m away. Calculate the initial speed V_0 and the angle above the horizontal of the ball when it was kicked.

11. A runner jumps off the ground at a speed of 8 m/s. At what angle did he jump from the ground if he landed 3 meters away?

10. A golf ball is hit at angle of 30° and travels 130 m. What was the initial speed of the ball?

12. A ball is kicked from a 200 m cliff at a speed of 60 m/s at an angle of 30° . (a) Find the maximum height of the ball above the ground. (b) Find the time it takes for the ball to hit the ground. (c) Find the horizontal and vertical components of the ball's velocity just before it hits the ground. (d) Find the final speed and angle of the ball just before it hits the ground.

13. A ball is launched from a 300 m cliff and lands 380 m away from the base of the cliff in 9 seconds. Calculate the initial speed and the angle of the ball when it was launched.

Answers:

1. Height = 490 m, Range = 200 m.
2. 6.39 s
- 3a. 12.778 s
- 3b. 10.1 s
- 4a. 51 m/s
- 4b. 92 m/s
- 4c. 56° below the +x-axis or 304° counterclockwise from the +x-axis.
- 5a. 90°
- 5b. 70°
- 5c. 80° and 50°
- 6a. $V_x = 34.6$ m/s, $V_y = 20$ m/s, $A_x = 0$, $A_y = -9.8$ m/s². (When the ball was kicked)
- 6b. $V_x = 34.6$ m/s, $V_y = 0$ m/s, $A_x = 0$, $A_y = -9.8$ m/s². (At the maximum height)
- 7a. 61.2 m
- 7b. 7.07 s
- 7c. 141 m
- 8a. 128 m
- 8b. 10.2 s
9. Initial speed = 49.5 m/s, angle = 63.4° above the +x-axis.
10. 38.4 m/s
11. 13.7°
- 12a. 246 m
- 12b. 10.1 s
- 12c. $V_x = 52.0$ m/s, $V_y = -69.4$ m/s
- 12d. 86.7 m/s at 53.2° below the +x-axis or 307° above the +x-axis.
13. 43.6 m/s at an angle of 14.3° above the +x-axis.