

2.1 Practice Problems on Projectiles (borrowed with thanks from Perrone – preAP Physics)

Sub-topic 2.1 – Motion

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$s = \frac{(v + u)t}{2}$$

Please show all work neatly on a separate sheet of paper.

1. A ball is launched from flat ground with $u_x = 15.2$ m/s and $u_y = 19.6$ m/s. How long is the ball in the air and how far away does it land?
2. A ball is launched from flat ground with a speed of 22.5 m/s at an angle of 55° .
 - a. When and where does it land?
 - b. What is the ball's position (both horizontal and vertically) at $t = 2.1$ seconds?
3. A ball is launched from flat ground with $u_x = 31.1$ m/s and $u_y = 24.0$ m/s.
 - a. When and where does it land?
 - b. What is the velocity of the ball at $t = 1.0$ second?
 - c. What is the velocity *and speed* of the ball at $t = 4.0$ seconds?
 - d. At what time is the y-component of the velocity 0 m/s? (This marks the ball reaching its maximum height above the ground.)
4. A ball is launched from flat ground with a speed of 35.5 m/s at an angle of 60° .
 - a. When and where does it land?
 - b. What is the ball's position at $t = 5.0$ seconds?
 - c. What is the ball's velocity at $t = 5.0$ seconds?
 - d. What is the ball's position when it reaches its maximum height above the ground?

5. A ball is launched horizontally from the edge of a cliff with $u_x = 18.4$ m/s. The ball falls 200.0 m to the ground below.

- a. When and where does it land?
- b. What is the ball's position at $t = 3.8$ seconds?
- c. What is the ball's velocity *and speed* at $t = 3.8$ seconds?
- d. What is the ball's velocity at the moment it reaches the ground?

6. A ball is launched horizontally from the edge of a cliff with $u_x = 25.0$ m/s. The ball falls 180.0 m to the ground below.

- a. When and where does it land?
- b. What is the ball's position at $t = 4.2$ seconds?
- c. What is the ball's velocity *and speed* at $t = 4.2$ seconds?
- d. What is the ball's velocity at the moment it reaches the ground?

7. A ball is launched from the edge of a cliff with $u_x = 18.4$ m/s and $u_y = -13.2$ m/s. The ball falls 150.0 m to the ground below.

- a. When and where does it land?
- b. What is the ball's position at $t = 1.0$ seconds?
- c. What is the ball's velocity at $t = 1.0$ seconds?
- d. What is the ball's velocity *and speed* at the moment it reaches the ground?

8. A ball is launched from the ground with a speed of 26.6 m/s at an angle of 65° . It lands on a small plateau, at a height 4.0 meters above its starting height.

- a. When and where does it land?
- b. What is the ball's velocity at the moment it reaches its maximum height above the ground?
- c. What is the ball's acceleration at the moment it reaches its maximum height above the ground?

9. A ball is launched from a tabletop, exactly 1.5 meter above flat ground, with a horizontal velocity $u_x = 37.6$ m/s.

- a. When and where does it land?

10. A ball is launched from a tabletop, exactly 1.5 meter above flat ground, with a velocity $u_x = 22.6$ m/s.

- a. When and where does it land?
- b. Does the x-component of the initially velocity affect the time it takes a projectile to land?
Explain your answer.

11. CHALLENGE: A ball is launched from flat ground with a speed of 48.5 m/s. It lands 225.55 meters away. At what angle was the ball launched?