Topics

1. Two dimensional motion
   a. Projectiles
   b. Two dimensional vector problems

\[
a = \frac{V_f - V_i}{t} \quad V_f^2 = V_i^2 + 2ad \quad d = V_i t + \frac{1}{2} at^2 \quad \ddot{V} = \frac{V_i + V_f}{2}
\]

Multiple Choice Questions

1. A machine launches a tennis ball at an angle of 25° above the horizontal at a speed of 14 meters per second. The ball returns to level ground. Which combination of changes must produce an increase in time of flight of a second launch?
   (a) decrease the launch angle and decrease the ball’s initial speed.
   (b) decrease the launch angle and increase the ball’s initial speed.
   (c) increase the launch angle and decrease the ball’s initial speed.
   (d) increase the launch angle and increase the ball’s initial speed.

2. A plane flying horizontally above Earth’s surface at 100 meters per second drops a crate. The crate strikes the ground 30 seconds later. What is the magnitude of the horizontal component of the crate’s velocity just before it strikes the ground?
   (a) 0 m/s  (b) 294 m/s
   (c) 100 m/s  (d) 394 m/s

3. A golf ball is hit with an initial velocity of 15 meters per second at an angle of 35 degrees above the horizontal. What is the vertical component of the golf ball’s initial velocity?
   (a) 8.6 m/s  (b) 12 m/s
   (c) 9.8 m/s  (d) 15 m/s

4. A projectile is fired with an initial velocity of 120 meters per second at an angle, \( \theta \), above the horizontal. If the projectile’s initial horizontal speed is 55 meters per second, then \( \theta \) measures approximately
   (a) 13°  (b) 63°
   (c) 27°  (d) 75°

5. A golf ball is hit at an angle of 45° above the horizontal. What is the acceleration of the golf ball at the highest point in its trajectory? [neglect friction]
   (a) 9.8 m/s² up
   (b) 9.8 m/s² down
   (c) 6.9 m/s² horizontal
   (d) 0.0 m/s²
6. A ball is thrown horizontally at a speed of 24 meters per second from the top of a cliff. If the ball hits the ground 4.0 seconds later, approximately how high is the cliff?

(a) 6.0 m  (b) 78 m  (c) 39 m  (d) 96 m

7. A golf ball is propelled with an initial velocity of 60 meters per second at 37° above the horizontal. The horizontal component of the golf ball’s initial velocity is

(a) 30 m/s  (b) 40 m/s  (c) 36 m/s  (d) 48 m/s

8. A ball is kicked with and initial velocity of 8.5 m/s at an angle of 35° above the horizontal. The ball’s horizontal component of its initial velocity is

(a) 3.6 m/s  (b) 7.0 m/s  (c) 4.9 m/s  (d) 13 m/s

9. A ball is kicked with and initial velocity of 8.5 m/s at an angle of 35° above the horizontal. What is the maximum height that the ball reaches?

(a) 1.2 m  (b) 4.9 m  (c) 2.5 m  (d) 8.5 m

10. A 0.20 kg red ball is thrown horizontally at a speed of 4 meters per second from a height of 3 meters. A 0.40 kg green ball is thrown horizontally from the same height at a speed of 8 meters per second. Compared to the time it takes the red ball to reach the ground, the time it takes the green ball to reach the ground is

(a) one-half as great  (b) twice as great  (c) the same  (d) four times as great

Short Answer Questions (Show all work)

11. A hunter aims directly at a target on the same level as the gun. If the target is 120 m away and the bullet leaves the gun at a speed of 250 m/s, by how much does the bullet miss the bull’s eye of the target and in what direction?
12. A fireman is trying to put out a fire in a building. He is located 12 m from the base of the building and the window he wants to squirt the water into is 10 m above the ground. The fireman wants the water to go into the window with only a horizontal velocity. What is the horizontal velocity of the water when going into the window?

13. A gun is fired at an angle of 25° above horizontal from the top of a cliff 50 m above the ground. If the muzzle velocity of the gun was 200 m/s, how far from the base of the cliff does the bullet hit the ground?
14. An airplane is heading due south at a speed of 500 km/h. If a wind begins to blow from the west at 100 km/h, what will be the plane's speed and direction?

15. A cannon is fired at an angle of 30°, 45° and 60° above horizontal on a level field. Draw a picture that qualitatively describe the path and landing points of the cannon balls that were fired at these angles, assuming that each ball had the same initial muzzle velocity.
Answers

1. D
2. C
3. A
4. B
5. B
6. B
7. D
8. B
9. A
10. C
11. 1.1 m directly below the target.
12. 8.6 m/s
13. 940 m from the base.
14. 510 km/h at 11° west of south
15.