

Projectile Motion Problems

1. A student tosses an eraser to his friend. The initial horizontal velocity of the eraser was 4.5 m/s and the initial vertical velocity was 5.36 m/s. The friend catches the eraser at the same level from which it was tossed.
 - a. How long was the eraser in the air?

 - b. How far apart were the two friends?

 - c. What was the maximum height of the eraser?

 - d. What were the components of the velocity at the top of its flight?

2. A kangaroo is jumping across a field in the outback. The kangaroo jumps with an initial horizontal velocity of 8 m/s and an initial vertical velocity of 5 m/s.
 - a. What was the initial speed of the kangaroo?

 - b. How long was the kangaroo in the air?

 - c. What was the maximum height of the kangaroo?

 - d. What was the horizontal distance of the kangaroo's jump?

3. Mary throws a ball to Suzy, who is standing 25 meters away. Suzy catches the ball from the same height at which it was thrown. If the ball was in the air for 4 seconds, calculate the following:
 - a. Horizontal velocity.

 - b. Initial vertical velocity.

 - c. Maximum height of the ball.

 - d. What happens to the components of the velocity and the acceleration as the ball flies through the air?

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4. Larry tosses a volleyball to his wife, Lise, who catches it at the same height from which it was tossed. The volleyball has an initial velocity of 15 m/s at an angle of 30° above the horizontal.
- What are the components of the initial velocity?
 - How many seconds does it take the volleyball to reach its maximum height?
 - How far apart are Lise and Larry?
 - What was the acceleration of the volleyball after 1 second? Give the magnitude and direction.
- *5. An astronaut on the moon tosses a rock with an initial velocity of 3 m/s at an angle of 35° above the horizontal. The acceleration due to gravity on the moon is 1.7 m/s^2 .
- What were the components of the initial velocity of the rock?
 - How long was the rock "in the air"?
 - What was the maximum height of the rock?
 - What was the horizontal distance traveled by the rock?

Answers:

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|---|--------------|-----------|---|
| 1. a) 1.07 s | b) 4.82 m | c) 1.44 m | d) $v_x = 4.5 \text{ m/s}$ & $v_y = 0 \text{ m/s}$ |
| 2. a) $v = 9.43 \text{ m/s}$ | b) 1.0 s | c) 1.25 m | d) 8 m |
| 3. a) 6.25 m/s | b) 20 m/s up | c) 20 m | d) $v_x = \text{constant} = 6.25 \text{ m/s}$ & acceleration = constant = 10 m/s^2 down & v_y starts positive 20 m/s (up) decreases to 0 m/s at top and continues to decrease to -20 m/s (down) when finally caught |
| 4. a) $v_x = 13 \text{ m/s}$ & $v_y = 7.5 \text{ m/s}$ | b) 0.75 s | c) 19.5 m | d) acceleration = gravity = 10 m/s^2 down |
| 5. a) $v_x = 2.46 \text{ m/s}$ & $v_y = 1.72 \text{ m/s}$ | b) 2.02 s | c) 0.87 m | d) 4.97 m |