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?

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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?

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.
   a. What are the components of the initial velocity?

   b. How many seconds does it take the volleyball to reach its maximum height?

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c. How far apart are Lise and Larry?

d. 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.
a. What were the components of the initial velocity of the rock?

b. How long was the rock "in the air?'

c. What was the maximum height of the rock?

d. What was the horizontal distance traveled by the rock?

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Answers:

1. *a) 1.07 s b) 4.82 m c) 1.44 m d) v_x = 4.5 m/s & v_y = 0 m/s*
2. *a) v = 9.43 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 = constant = 6.25 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 m/s & v_y = 7.5 m/s b) 0.75 s c) 19.5 m*
   d) acceleration = gravity = -10 m/s^2 so magnitude is 10 m/s^2 and direction is down
5. *a) v_x = 2.46 m/s & v_y = 1.72 m/s b) 2.02 s c) 0.87 m d) 4.97 m*