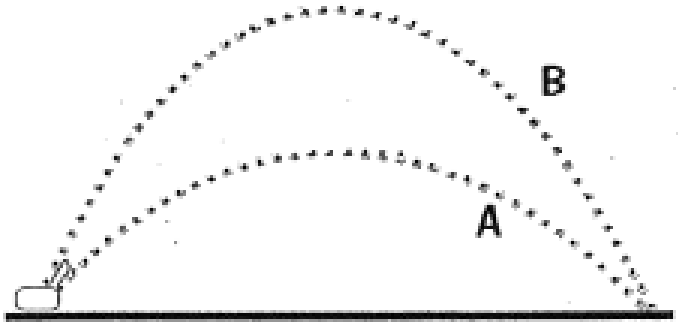
Conceptual Questions

1. A person sitting in an enclosed train car, moving at constant velocity, throws a ball straight up into the air in her reference frame.
   a) Where does the ball land?
   b) Where does the ball land if the car speeds up?
   c) Where does the ball land if the car rounds a curve?
   d) Where does the ball land if the car moves at constant velocity but is open to the air? [1]

2. Two rowers, who can row at the same speed in still water, set off across a river at the same time. One heads straight across and is pulled downstream somewhat by the current. The other one heads upstream at an angle so as to arrive opposite the starting point. Which rower reaches the opposite side first? Explain.[2]

3. Two cannonballs, ***A*** and ***B***, are fired from the ground with identical initial speeds, but with $\boldsymbol{\Theta_A}$ larger than $\boldsymbol{\Theta_B}$.
   a) Which cannonball reaches a higher elevation?
   b) Which stays longer in the air?
   c) Which travels further? [3]

4. A cannon shoots two cannon balls, ***A*** and ***B***, at the same time as shown to the right. The horizontal trajectories are the same, but the maximum altitude of ***B*** is about twice that of ***A***. Which ball is traveling faster horizontally at the beginning of its trajectory?[4]



   a) A b) B c) Same speed d) Not enough information

[1] Physics 6th Edition, Giancoli, Chapter 3 Questions, #15
[2] Physics 6th Edition, Giancoli, Chapter 3 Questions, #16
[3] Physics 6th Edition, Giancoli, Chapter 3 Questions, #20
[4] Peer Instruction – A User's Guide, Mazur

5. Suppose there is a wind blowing parallel to the ground and toward an American football kicker as he is about to kick the ball. The acceleration in the horizontal direction would then be non-zero. How would you expect the time of flight of the football to be affected, if at all? Explain. [5]

6. A child is playing on the floor of a recreational vehicle (RV) as it moves along the highway at a constant velocity. He has a toy cannon, which shoots a marble at a fixed angle and speed with respect to the floor. The cannon can be aimed toward the front or the rear of the RV. Is the range toward the front the same as, less than, or greater than the range toward the rear? Answer this question (a) from the child's point of view and (b) from the point of view of an observer standing still on the ground. Justify your answers.[6]

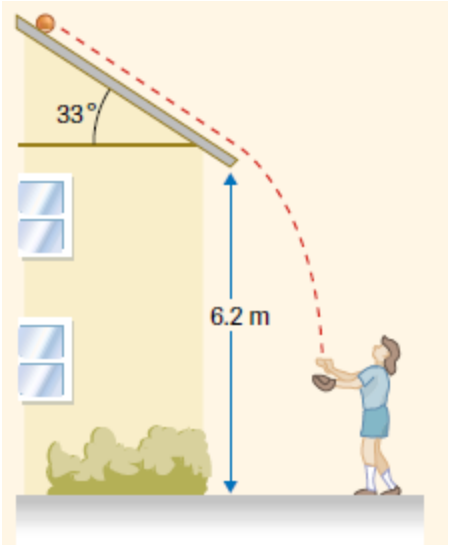
7. An object is thrown upward at an angle Θ above the ground, eventually returning to earth. (a) Is there any place along the trajectory where the velocity and acceleration are perpendicular? If so, where? (b) Is there any place where the velocity and acceleration are parallel? If so, where? In each case, explain.[7]

Problems

8. A cannon is set at an angle of 45° above the horizontal. A cannonball leaves the muzzle with a speed of 2.2×10^2 m/s. Air resistance is negligible. Determine the cannonball's
   (a) maximum height
   (b) time of flight
   (c) horizontal range (to the same vertical level)
   (d) velocity at impact[8]

[5] Physics, 7th Edition, Cutnell & Johnson, Chapter 3 Conceptual Questions, #6
[6] Physics, 7th Edition, Cutnell & Johnson, Chapter 3 Conceptual Questions, #15
[7] Physics, 7th Edition, Cutnell & Johnson, Chapter 3 Conceptual Questions, #2
[8] Physics 12, Nelson Education, Section 1.4 Practice, #9

9. A child throws a ball onto the roof of a house, then catches it with a baseball glove 1.0 m above the ground, as shown to the right. The ball leaves the roof with a speed of 3.2 m/s.



   (a) For how long is the ball airborne after leaving the roof?
   (b) What is the horizontal distance from the glove to the edge of the roof?
   (c) What is the velocity of the ball just before it lands in the glove?[9]

10. A bag of mail is catapulted from the top of a building 200.0 m above the ground with a velocity of 20.0 m/s at an angle of 15° above the horizontal. If the mail is to land on the roof of another building 100.0 m away, how tall is the second building?[10]

11. A stunt-man is trying to cross a piranha infested pool of water in his Humvee. He races up a ramp that is inclined 20° from the horizontal, at a speed of 30.0 m/s. There is an identical ramp on the other side of the pool. What is the maximum width of the pool that the stunt-man can successfully cross?[11]

12. A soccer ball is kicked from the ground at an angle θ above the horizontal. Show that the equation $h=0.25R\tan\theta$ represents the maximum height of the ball, where h is the height and R is the range.[12]

13. A baseball player makes perfect contact with the ball, striking it 45° above the horizontal at a point 1.3 m above the ground. His home-run hit just clears the 3.0-m wall 130 m from home plate. With what velocity did the baseball player strike the ball?[13]

[9] Physics 12, Nelson Education, Section 1.4 Questions, #5
[10] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #32
[11] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #34
[12] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #35
[13] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #36

14. A swimmer, who can swim at a maximum speed of 1.8 km/h, swims heading straight north across a river of width 0.80 km. If the river's current is 0.50 km/h
    a) how long does it take the swimmer to cross the river?
    b) how far downstream will the swimmer land?
    c) what is the swimmer's ground velocity?[14]

15. If the swimmer form problem #22 decided to change his direction so as to go straight north, determine
    a) his heading
    b) his ground velocity
    c) the amount of time it would take him to cross the river.[15]

16. A ship's captain wishes to sail his ship north-east. A current is moving his ship with a velocity of 5.0 km/h [S]. If the ship has a maximum speed of 30 km/h, what is the ship's required heading? [16]

17. A cruise ship is sailing north at a speed of 10 km/h. A passenger walks along the deck with a velocity of 0.5 m/s towards the stern of the ship. She then turns toward port and walks top the railing at the same speed. Determine the passenger's velocity for both motions
    a) relative to the ship
    b) relative to the water[17]

18. A rock is thrown horizontally from a height of 35 m from the roof of a library and travels through the air. A wind is blowing with a constant velocity of 11.5 m/s [N25°W]. The rock ends up breaking a window of a financial building, 3.5 m above the ground. If the thrower released the rock with a velocity of 18 m/s [E15°N], determine the location of the financial building in reference to the base of the library. [18]

[14] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #22
[15] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #23
[16] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #26
[17] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #27
[18] Almeida, F., Physics Department, Victoria Park C.I.