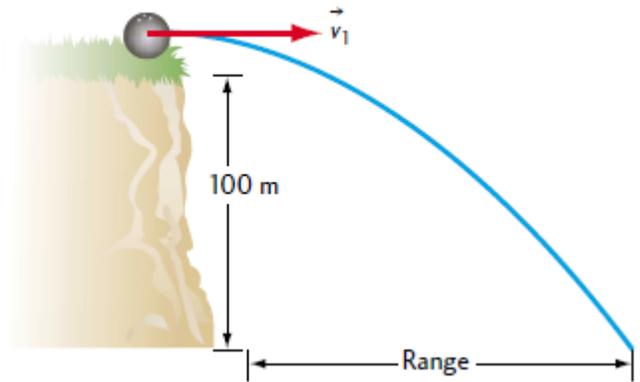


## 2-D Horizontal Projectile Problems

1. A bowling ball is rolled off the top of a cliff with an initial horizontal velocity of  $6.0 \text{ m/s}$  [E]. If the cliff is  $100. \text{ m}$  above the ground, determine

- the ball's time of flight
- the ball's range



2. A helicopter flying horizontally at a velocity of  $25 \text{ m/s}$  drops a mailbag from a height of  $15\text{m}$  to a letter carrier waiting on the ground below.

- How long will the bag take to fall to the ground?
- How far in advance of the letter carrier must the bag be released so that it lands at her feet?
- What will be the mailbag's final velocity?

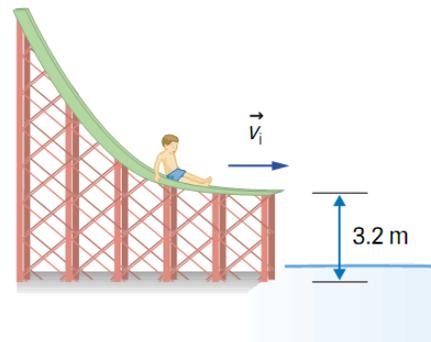
3. Ms. Swanson throws a tomato horizontally out of an open window with a velocity of  $3.0 \text{ m/s}$ . If the window is  $10. \text{ m}$  above the ground, how far away from the building must Ms. Reichling stand to catch the ball at ground level?

4. A rock thrown horizontally from the top of a water tower lands  $20.0 \text{ m}$  from the base of the tower. If the rock was initially thrown at a velocity of  $10.0 \text{ m/s}$ ,

- how high is the water tower?
- with what final velocity will the rock strike the ground?

5. A child travels down a waterslide, leaving it with a velocity of  $4.2\text{m/s}$  horizontally, as in the picture below. The child then experiences projectile motion, landing in a swimming pool  $3.2\text{m}$  below the slide.

- For how long is the child airborne?
- Determine the child's horizontal displacement travelling through in the air.



6. A helicopter, travelling horizontally, is 82m above the ground. The pilot prepares to release a relief package intended to land on the ground 96 m horizontally ahead. Air resistance is negligible. The pilot does not throw the package, but lets it drop.

- a) What is the initial velocity of the package relative to the ground?
- b) What is the final velocity of the package relative to the ground?

7. A child throws a snowball with a horizontal velocity of 18 m/s directly toward a tree, from a distance of 9.0 m and a height above the ground of 1.5 m.

- a) After what time interval does the snowball hit the tree?
- b) At what height above the ground will the snow-ball hit the tree?
- c) What is the final velocity of the snowball?

8. A stone is thrown horizontally with an initial speed of 8.0 m/s from a cliff. Air resistance is negligible.

- a) Determine the horizontal and vertical components of displacement at  $t = 1.0$  s and 3.0 s.
- b) Determine the total displacement at  $t = 1.0$  s, and 3.0 s.

9. Explain why an airplane moving through the air is not an example of projectile motion.