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The world of entertainment thrives on our passion for thrill and adventure. Many movies provide experiences that make you feel as though you are part of the action. Why do you get that sick feeling in your stomach when a car in a movie races up to the edge of a cliff, giving you a sudden panoramic view over the edge? How do live theatre productions such as the one in the photograph create the impression that an actor is travelling in relation to the other actors and audience? How are cartoons created to look like free-flowing action, when they are simply a series of individual pictures? How do cartoonists design a series of pictures so that they will simulate someone speeding up, slowing down, or travelling at a steady pace?

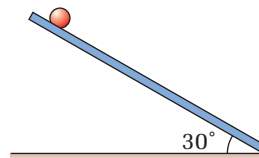
In this chapter, you will begin a detailed analysis of motion, which will lead you to the answers to some of the questions above. You will learn to apply models developed by physicists for understanding different types of motion.

TARGET SKILLS

- Identifying variables
- Performing and recording
- Analyzing and interpreting

The Tortoise and the Hare

Assemble a 1 m long ramp that has a groove to guide a marble that will roll down the ramp. For example, you may use a curtain track or tape two metre sticks together in a “V.” Stabilize the ramp so it is at an angle of 30° with the horizontal. Hold one marble (the hare) at the top of the ramp. Roll another marble (the tortoise) along the bench beside the ramp. Start the “tortoise” rolling from behind the ramp. Release the “hare” when the “tortoise” is rolling along beside the ramp. Change the angle of the ramp in an attempt to find an angle at which the “hare” will beat the “tortoise” and win the race.



Analyze and Conclude

1. How is the motion of the “hare” different from the motion of the “tortoise?”
2. Did the “hare” ever win the race?
3. Give a possible explanation for the outcome of all of the races.

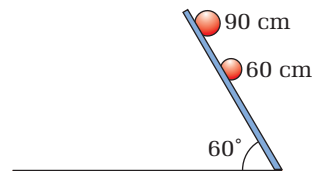
Caught in a Rut

Use the same ramp as above. Mark points on the ramp that are 60 cm and 90 cm from the base of the ramp as shown in the figure. Stabilize the ramp at an angle of 60° with the horizontal. Hold one marble at the 90 cm mark and another at the 60 cm mark. Observe the motion of the marbles under the following conditions.

CAUTION Do not drop the marbles from a greater height.

- use marbles of same mass; release at same time
- use marbles of same mass; release marble at 90 cm first; release 60 cm marble when first marble has rolled 10 cm
- use larger marble at 90 cm than at 60 cm; release both marbles at same time
- use larger marble at 90 cm than at 60 cm; release 90 cm marble first; release 60 cm marble when first marble has rolled 10 cm

Choose another angle for the ramp and repeat the procedure.



Analyze and Conclude

1. Describe any effect that the starting position of the marbles had on the rate at which their speed increased.
2. Was there any case in which the 90 cm marble caught up with the 60 cm marble? Give a possible reason for these results.
3. Describe any way in which the mass of the marble affected the outcome of the race.
4. Describe any way in which the angle of the ramp influenced the outcome of the race.
5. Write a summary statement that describes the general motion of marbles rolling, from rest, down a ramp.