

1.5 Problem Solving – Motion with Constant Acceleration

1. A cross-country skier is skiing along at 8.0 m/s. She stops pushing and simply glides along, slowing to a reduced speed of 6.0 m/s after gliding for 5.0 m. What is the magnitude of her acceleration as she slows?
2. Light-rail passenger trains that provide transportation within and between cities speed up and slow down with a nearly constant acceleration. A train travels through a congested part of town at 5.0 m/s. Once free of this area, it speeds up to 12 m/s in 8.0 s. At the edge of town, the driver again accelerates, with the same acceleration, for another 16 s to reach a higher cruising speed. What is the final speed?
3. Formula One racers speed up much more quickly than normal passenger vehicles, and they also can stop in a much shorter distance. A Formula One racer travelling at 100 m/s can stop in a distance of 150 m. What is the magnitude of the car's acceleration as it slows during breaking?
4. An eagle accelerates at 5 m/s^2 from rest for 90 metres. How fast is it going after 90 m? What is this in km/h?
5. A train is approaching a town at a constant speed of 12 m/s. The town is 1.0 km distant. After 30 seconds, the conductor applies the breaks. What acceleration is necessary to bring the train to rest exactly at the edge of town?
6. A driver has a reaction time of one second, and the maximum deceleration of her car is 10.0 m/s^2 . She is driving at 30 m/s when suddenly she sees an obstacle in the road 60 m in front of her. Can she stop the car in time to avoid a collision?
7. Chameleons catch insects with their tongues, which they can rapidly extend to great lengths. In a typical strike, the chameleon's tongue accelerates at a remarkable 250 m/s^2 for 20 ms, then travels at constant speed for another 30 ms. During this total time of 50 ms, $1/20$ of a second, how far does the tongue reach?

8. You're driving down the highway late one night at 20 m/s when a deer steps out onto the road 35 m in front of you. Your reaction time before stepping on the brakes is 0.50 s, and the maximum deceleration of the car is 10 m/s^2 . How much distance is between you and the deer when you come to a stop?
9. A car is travelling at a steady 80 km/h in a 50 km/h zone. A police motorcycle takes off at the instant the car passes it, accelerating at a steady 8.0 m/s^2 .
 - a. How much time elapses before the motorcycle is moving as fast as the car?
 - b. How far is the motorcycle from the car when it reaches this speed?
10. A simple model for a person running the 100 m dash is to assume the sprinter runs with constant acceleration until reaching top speed, then maintains that speed through the finish line. If a sprinter reaches his top speed of 11.2 m/s in 2.14 s, what will be his total time?