SAMPLE PROBLEM C

Displacement with Constant Acceleration

PROBLEM

A racing car reaches a speed of 42 m/s. It then begins a uniform negative acceleration, using its parachute and braking system, and comes to rest 5.5 s later. Find the distance that the car travels during braking.

SOLUTION

Given: $v_i = 42$ m/s $\quad v_f = 0$ m/s
$\Delta t = 5.5$ s

Unknown: $\Delta x = ?$

Use the equation that relates displacement, initial and final velocities, and the time interval.

$$\Delta x = \tfrac{1}{2}(v_i + v_f)\Delta t$$

$$\Delta x = \tfrac{1}{2}(42 \text{ m/s} + 0 \text{ m/s})\ (5.5 \text{ s})$$

$$\boxed{\Delta x = 120 \text{ m}}$$

CALCULATOR SOLUTION

The calculator answer is 115.5. However, the velocity and time values have only two significant figures each, so the answer must be reported as 120 m.

TIP

Remember that this equation applies only when acceleration is constant. In this problem, you know that acceleration is constant by the phrase "uniform negative acceleration." All of the kinematic equations introduced in this chapter are valid only for constant acceleration.

PRACTICE C

Displacement with Constant Acceleration

1. A car accelerates uniformly from rest to a speed of 6.6 m/s in 6.5 s. Find the distance the car travels during this time.
2. When Maggie applies the brakes of her car, the car slows uniformly from 15.0 m/s to 0.0 m/s in 2.50 s. How many meters before a stop sign must she apply her brakes in order to stop at the sign?
3. A driver in a car traveling at a speed of 21.8 m/s sees a cat 101 m away on the road. How long will it take for the car to accelerate uniformly to a stop in exactly 99 m?
4. A car enters the freeway with a speed of 6.4 m/s and accelerates uniformly for 3.2 km in 3.5 min. How fast (in m/s) is the car moving after this time?