Sample Problem — Calculating Acceleration

A runner racing in a 100 m dash accelerates from rest to a speed of 9.0 m/s in 4.5 s. What was his average acceleration during this time interval?

What to Think About	How to Do It
1. Determine the correct formula.	$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_o}{t_f - t_o}$
2. Solve for acceleration. Note that runner's average acceleration was 2.0 m/s/s, which is usually written 2.0 m/s^2	$= \frac{9.0\ m/s - 0\ m/s}{4.5\ s - 0\ s}$ $a = 2.0\ m/s^2$ The runner's average acceleration was 2.0 m/s^2.

Practice Problems — Calculating Acceleration

1. What is the average acceleration for the following?
   (a) A car speeds up from 0 km/h to 60.0 km/h in 3.00 s.

$v_i = 0\ m/s$

$v_f = 60.0\ km/h \div 3.6 = 16.67\ m/s$

$t = 3.00\ s$

$a = \frac{v_f - v_i}{t} = \frac{16.67\ m/s - 0\ m/s}{3.00\ s}$

$= 5.\overline{5}\ m/s^2$

$= 5.56\ m/s^2$

   (b) A runner accelerates from rest to 9.00 m/s in 3.00 s.

$v_i = 0\ m/s$

$v_f = 9.00\ m/s$

$t = 3.00\ s$

$a = \frac{v_f - v_i}{t}$

$= \frac{9.00\ m/s - 0\ m/s}{3.00\ s} = 3.00\ m/s^2$

2. What is the average acceleration of a truck that accelerates from 45.0 km/h to 60.0 km/h in 7.50 s?

$v_i = 45.0\ km/h \div 3.6 = 12.5\ m/s$

$v_f = 60.0\ km/h \div 3.6 = 16.67\ m/s$

$t = 7.50\ s$

$a = \frac{v_f - v_i}{t} = \frac{16.67\ m/s - 12.50\ m/s}{7.50\ s}$

$= 0.5556\ m/s^2 = 0.556\ m/s^2$

3. A car travelling 120 km/h brakes hard to avoid hitting a deer on the road, slowing to 60 km/h in 4.0 s. What is its acceleration? Why is it negative?

$v_i = 120\ km/h \div 3.6 = 33.33\ m/s$

$v_f = 60\ km/h \div 3.6 = 16.67\ m/s$

$t = 4.0\ s$

$a = \frac{v_f - v_i}{t}$

$= \frac{16.67\ m/s - 33.33\ m/s}{4.0\ s}$

$= -4.165\ m/s^2 = -4.2\ m/s^2$