

Section 2.3: Solving Simple Problems Using Kinematics Formulae

Steps for Problem Solving

1. Read the problem at least 2 times.
2. List the givens and state what you need to find.
3. Plan strategy.*
4. Carry out plan.
5. Communicate. (statement)

Examples: (MC on test)

1. A boat, initially moving at 2.0 m/s to the right, accelerates to the right at 0.80 m/s^2 for 4.0s. Calculate the
 - a) final velocity of the boat.
 - b) displacement of the boat.

2. A ball rolling down a hill at 4.0 m/s accelerates at 2.0 m/s². What is its velocity 5.0s later?

3. A car, initially moving at 5.0 m/s, accelerates at 2.0 m/s² until it reaches 11 m/s.

A) Calculate the car's displacement.

$$\begin{aligned}
 v_1 &= 5.0 \text{ m/s} & 2ad &= v_2^2 - v_1^2 \\
 a &= 2.0 \text{ m/s}^2 & \checkmark d &= \frac{v_2^2 - v_1^2}{2a} \\
 v_2 &= 11 \text{ m/s} \\
 d &=? \\
 & & \checkmark d &= \frac{(11 \text{ m/s})^2 - (5.0 \text{ m/s})^2}{2(2.0 \text{ m/s}^2)} \\
 & & & \\
 (11^2 - 5^2) \div (2 \times 2) & & d &= \frac{121 \text{ m}^2/\text{s}^2 - 25 \text{ m}^2/\text{s}^2}{4 \text{ m/s}^2} \\
 & & d &= \frac{96 \text{ m}^2/\text{s}^2}{4 \text{ m/s}^2} \\
 \checkmark d &= 24 \text{ m} & & \left[\frac{\text{m}^2/\text{s}^2}{\text{m/s}^2} = \frac{\text{m}^2}{\cancel{\text{s}^2}} \times \frac{\cancel{\text{s}^2}}{\text{m}} = \text{m} \right]
 \end{aligned}$$

B) Calculate the time required.

$$\begin{aligned}
 t &=? & a &= \frac{v_2 - v_1}{t} \\
 & & t &= \frac{v_2 - v_1}{a} \\
 & & &= \frac{11 \text{ m/s} - 5 \text{ m/s}}{2 \text{ m/s}^2} \\
 & & &= \underline{\underline{3.0 \text{ s}}}
 \end{aligned}$$

4. A car accelerating at 5.0 m/s^2 has a displacement of 114 m in 6.0 s. What was its velocity at the beginning of the interval?

$$a = 5.0 \text{ m/s}^2$$

$$d = 114 \text{ m}$$

$$t = 6.0 \text{ s}$$

$$v_i = ?$$

$$d = v_i t + \frac{1}{2} a t^2$$

$$\frac{d - \frac{1}{2} a t^2}{t} = \frac{v_i t}{t}$$

$$\checkmark \frac{d - \frac{1}{2} a t^2}{t} = v_i$$

$$\checkmark \frac{114 \text{ m} - \frac{1}{2} (5.0 \text{ m/s}^2) (6.0 \text{ s})^2}{6.0 \text{ s}} = v_i$$

$$\frac{114 \text{ m} - 90 \text{ m}}{6.0 \text{ s}} = v_i$$

$$\frac{24 \text{ m}}{6.0 \text{ s}} = v_i$$

$$\checkmark 4.0 \text{ m/s} = v_i$$

$$(114 - 0.5 \times 5 \times 6^2) \div 6.0$$

5. A ball rolls up a hill with an initial velocity of 4.0 m/s. Five seconds later, it is rolling down the hill at 6.0 m/s. Find its
 (a) acceleration.
 (b) displacement.

(a)

$$v_i = 4.0 \text{ m/s}$$

$$t = 5.0 \text{ s}$$

$$v_f = 6.0 \text{ m/s}$$

$$a = ?$$

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

$$a = \frac{-6 \text{ m/s} - 4 \text{ m/s}}{5.0 \text{ s}}$$

$$a = -2.0 \text{ m/s}^2$$

(b)
$$d = \left(\frac{v_i + v_f}{2} \right) t$$

$$d = \left(\frac{4 \text{ m/s} - 6 \text{ m/s}}{2} \right) (5.0 \text{ s})$$

$$d = -5.0 \text{ m}$$