# Kinematic Practice Problems

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# Contents

# 1 Chapter 2: 1D Motion

## 1.1 Problem 34: Page 34

A red car and a green car, identical except for the color, move toward each other in adjacent lanes and parallel to an $x$ acis. At time $t = 0$, the red car is at $x_r = 0$ and the green car is at $x_g = 200\,\text{m}$. If the red car has a constant velocity of $20\,\text{km/h}$, the cars pass each other at $x = 44.5\,\text{m}$, and if it has a constant velocity of $40\,\text{km/h}$, they pass each other at $x = 76.6\,\text{m}$. What are:

(a) the initial velocity

(b) the constant acceleration

of the green car?


**Figure 2-27** Problems 34 and 35.

### 1.1.1 Solution

# 2 Chapter 3: Vectors

## 2.1 Problem 29: Page 58

Typical backyard ants often create a network of chemical trails for guidance. Extending outward from the nest, a trail branches (*bifurcates*) repeatedly, with 60° between the branches. If a roaming ant chances upon a trial, it can tell the way to the nest at any branch point: If it is moving awat from the nest, it has two choices of path requiring a small turn in its travel direction, either 30° leftward or 30° rightward. If it is moving toward the nest, it has only one such choice. Figure 3-29 shows a typical ant trial, with lettered straight sections of 2.0 cm length and symmetric bifurcation of 60°. Path $v$ is parallel to the $y$ axis. What are the:

(a) magnitude

(b) angle

(relative to the positive direction of the superimposed $x$ axis) of an ant's displacement from the nest (find it in the figure) if the ant enters the trail at point $A$? What are the:

(c) magnitude

(d) angle

if it enters at point $B$?

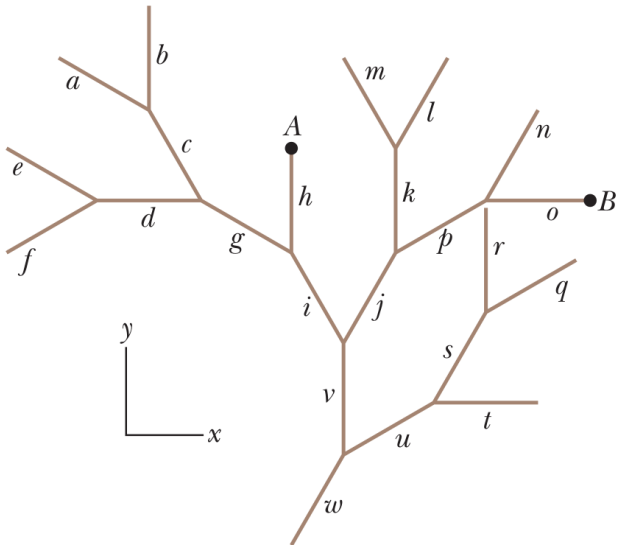



Figure 1: 3-29

### 2.1.1 Solution

## 2.2 Problem 31: Page 58

In Fig. 3-30, a vector $\vec{\mathbf{a}}$ with a magnitude of 17.0 m is directed at angle $\theta = 56.0°$ counterclockwise from the $+x$ acis. What are the components (a) $a_x$ and (b) $a_y$ of the vector? A second coordinate system is inclined by angle $\theta' = 18.0°$ with respect to the first. What are the components (c) $a'_x$ and (d) $a'_y$ in this primed coordinate system?

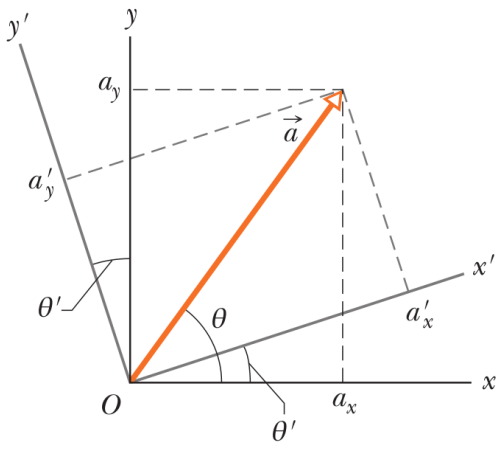



Figure 2: 3-30

### 2.2.1 Solution

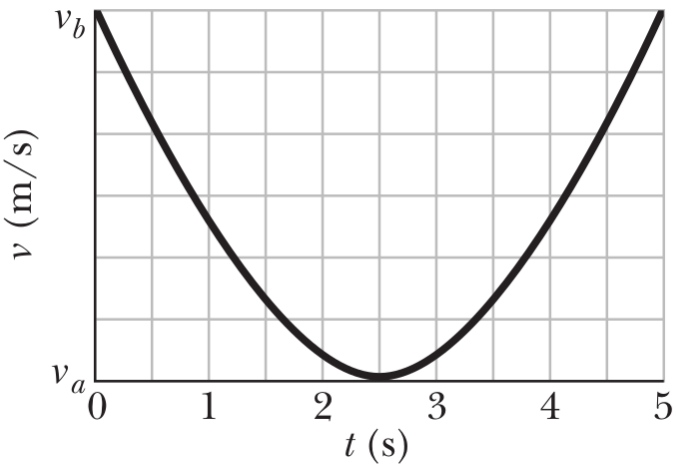
# 3 Chapter 4: 2D and 3D Motion

## 3.1 Problem 38: Page 86

A golf ball is struck at ground level. The speed of the golf ball is a function of the time is shown in Fig. 4-36, where $t = 0$ at the instant the ball is struck. The scaling on the vertical axis is set by $v_a = 19\,\text{m/s}$ and $v_b = 31\,\text{m/s}$.

(a) How far does the golf ball travel horizontally before returning to ground level?

(b) What is the maximum height above the ground level attained by the ball?




### 3.1.1 Solution

## 3.2 Problem 71: Page 88

A suspicious-looking man runs as fast as he can along a moving sidewalk from one end to the other, taking 2.50 s. Then security agents appear, and the man runs as fast as he can back along the sidewalk to his starting point, taking 10.0 s. What is the ratio of the man's running speed to the sidewalk's speed?

### 3.2.1 Solution

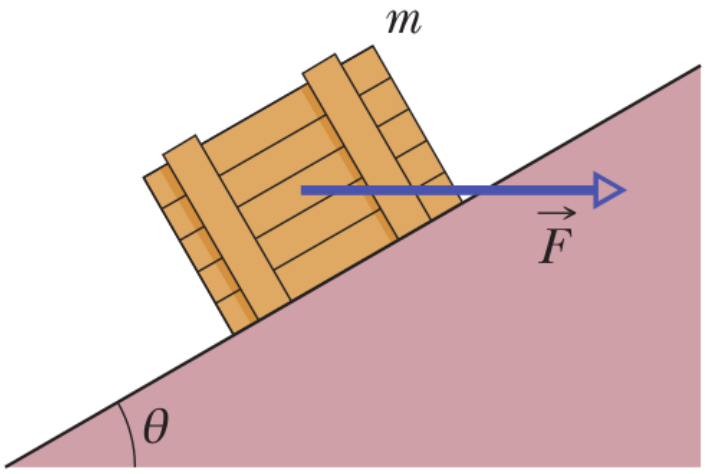
# 4 Chapter 5: Force and Motion

## 4.1 Problem 34: Page 119

In Fig. 5-40, a crate of mass $m = 100\,\text{kg}$ is pushed at constant speed up a frictionless ramp ($\theta = 30.0°$) by a horizontal force $\vec{\mathbf{F}}$. What are the magnitudes of:

(a) $\vec{\mathbf{F}}$

(b) the force on the crate from the ramp?




### 4.1.1 Solution

## 4.2 Problem 39: Page 119

A sphere of mass $3.0x10^{-4}$ kg is suspended from a cord. A steady horizontal breeze pushes the sphere so that the cord makes a constant angle of 37° with the vertical. Find:

(a) the push magnitude

(b) the tension in the cord

### 4.2.1 Solution

## 4.3 Problem 40: Page 119

A dated box of dates, of mass 5.00 kg, is sent sliding up a frictionless ramp at an angle of $\theta$ to the horizontal. Figure 5-41 gives, as a function of time $t$, the component $v_x$ of the box's velocity along an $x$ axis that extends

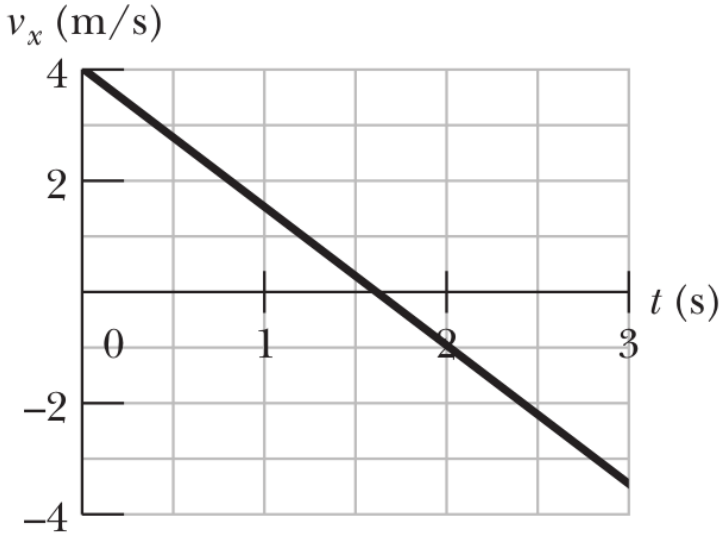



Figure 3: 5-41

directly up the ramp. What is the magnitude of the normal force on the box from the ramp?

### 4.3.1 Solution