Name _____ Class_____Date_____

Skills Worksheet

# Math Skills

## Velocity

**After you study each sample problem and solution, work out the practice problems on a separate sheet of paper. Write your answers in the spaces provided.**

### PROBLEM

**Polar bears are extremely good swimmers and can travel as long as 10 hours without resting. If a polar bear is swimming at an average speed of 2.6 m/s, how far will it have traveled after 10.0 hours?**

### SOLUTION

**Step 1: List the given and the unknown values.**

**Given:** speed, $v$ = 2.6 m/s

time, $t$ = 10.0 h × 3,600 s/h = 3.6 ×$10^4$ s

**Unknown:** distance, $d$ = ? m

**Step 2: Rearrange the speed equation to solve for distance.**

$$speed = \frac{distance}{time}$$

$$v = \frac{d}{t}$$

$$d = vt$$

**Step 3: Insert the known values into the equation, and solve.**

$$d = \frac{2.6\ \text{m}}{\text{s}} \times (3.6 \times 10^4\ \text{s})$$

$$d = 9.4 \times 10^4\ \text{m} = 94\ \text{km}$$

### PRACTICE

1. Suppose the polar bear was running on land instead of swimming. If the polar bear runs at a speed of about 8.3 m/s, how far will it travel in 10.0 hours?

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2. Like the polar bear, the walrus is a strong swimmer, although it does not have the same endurance. For short periods of time, a walrus can swim at an average speed of 9.7 m/s. How far would a walrus swim at this speed in 3.4 minutes?

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3. The maximum posted speed limit on the U.S. Interstate Highway System is found in rural areas of several western states. This maximum speed is 75 mi/h, or 121 km/h. What is the distance, in kilometers, that a car a travels if it moves continuously at this speed for 3 hours and 20 minutes?

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4. For normal situations, the minimum speed limit throughout the U.S. Interstate Highway System is 45 mi/h, or 72 km/h. How far, in kilometers, will a car travel if it moves continuously at this speed for 3 hours and 20 minutes?

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## PROBLEM

**A baseball is pitched at a speed of 35.0 m/s. How long does it take the ball to travel 18.4 m from the pitcher's mound to home plate?**

## SOLUTION

**Step 1: List the given and the unknown values.**

**Given:** speed, $v = 35.0$ m/s

distance, $d = 18.4$ m

**Unknown:** time, $t = ?$ s

**Step 2: Rearrange the speed equation to solve for time.**

$$speed = \frac{distance}{time} \qquad v = \frac{d}{t}$$

$$tv = d \qquad \frac{t\cancel{v}}{\cancel{v}} = \frac{d}{v}$$

**Step 3: Insert the known values into the equation, and solve.**

$$t = \frac{18.4\ \text{m}}{35.0\ \text{m/s}}$$

$$t = 0.526\ \text{s}$$

## PRACTICE

5. Various types of tree sloths share the honor of being the slowest-moving mammals. An average tree sloth moves at a speed of 0.743 m/s. How long does it take a sloth moving at this speed to travel 22.30 m?

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6. The longest stretch of straight railroad tracks lies across the desolate Nullarbor Plain, between the Australian cities of Adelaide and Perth. The tracks extend a distance of 478 km without a curve. How long would it take a train, moving at a constant speed of 97 km/h, to travel this length of track?

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7. The Concorde is the fastest supersonic passenger jet. How long would the Concorde take to travel 6,265 km between New York City and London, assuming that the jet travels at its maximum speed of $2.150 \times 10^3$ km/h during the entire trip?

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8. The longest distance in a track-and-field event is the 10 km run. The record holder for the women's 10 km run is Wang Junxia of China. Assuming that she ran 10.00 km at an average speed of 5.644 m/s, what was her time?

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## PROBLEM

**Florence Griffith-Joyner set the women's world record for running the 200.0 m race in 1988. At the 1988 Summer Olympics in Seoul, South Korea, she completed the distance in 21.34 s. What was Griffith-Joyner's average speed?**

## SOLUTION

**Step 1: List the given and the unknown values.**

**Given:** distance, $d = 200.0$ m

time, $t = 21.34$ s

**Unknown:** speed, $v = ?$ m/s

**Step 2: Write out the equation for speed.**

$$speed = \frac{distance}{time} \qquad v = \frac{d}{t}$$

**Step 3: Insert the known values into the speed equation, and solve.**

$$v = \frac{d}{t} = \frac{200.0 \text{ m}}{21.34 \text{ s}}$$

$$v = 9.372 \text{ m/s}$$

## PRACTICE

9. The cheetah, the fastest of land animals, can run 274 m in 8.65 s at its top speed. What is the cheetah's top speed?

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10. In 1985, Matt Biondi set a record for the men's 100 m freestyle event in swimming. He took 49.17 s to swim the 50.0-m length of the pool and swim back. Assume that half of Biondi's record time was spent traveling the length of the pool. What was his speed?

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11. The fastest crossing of the Atlantic Ocean by an ocean liner was made on July 7, 1952. The ship, the SS *United States*, traveled 4,727 km east by northeast in 3 days, 10 hours, and 40 minutes. Assume that the ship had traveled the same speed, but directly east. What would the velocity of the SS *United States* be in kilometers per hour?

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12. The bird that migrates the farthest is the Arctic tern. Each year, the Arctic tern travels 32,000 km between the Arctic Ocean and the continent of Antarctica. Most of the migration takes place within two four-month periods each year. Assume that an Arctic tern completes the second half of its annual migration distance in 122 days. Also assume that during this time the tern flies directly north. If the tern flies the same distance each day, what is its velocity in kilometers per day?

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**MIXED PRACTICE**

13. The typical snail doesn't cover very much ground even when it is moving at its maximum speed, which is $5.0 \times 10^{-2}$ m/h. How far will a snail travel if it moves at its top speed for 45 minutes?

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14. Motion pictures typically are filmed and shown at a speed of 24 frames per second, where a frame is a single photographic image in the film. A motion-picture camera that moves the film at $2.4 \times 10^{5}$ frames per second is used in high-speed photography. When the film is shown again at 24 frames per second, the filmed object seems to move very slowly. This technique is used to analyze the motion of objects, like bullets, that move too quickly to be observed by the human eye. If a frame of 16-mm film is 0.75 cm in length, how fast does the film move through the high-speed camera when the film is being exposed?

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15. In 1926, Gertrude Ederle was the first American woman to swim across the English Channel. At that time, she set the world record for crossing the channel with an average speed of 0.725 m/s. Assuming that the distance Ederle swam was 37.9 km (the shortest distance between England and France), how long did it take her to swim the channel?

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16. Bonnie Blair set the world record for women's speed skating in 1995 with an average speed of 12.9 m/s. How far would Blair have traveled at this speed in 5.00 minutes?

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17. Although they seem to remain unchanged, many mountains undergo steady growth. If erosion and weathering are ignored, some mountains, like the San Gabriels in southern California, grow as much as 1.0 cm in a year. If a year is considered to be exactly 365 days, what is the speed at which the San Gabriel Mountains grow in kilometers per hour?

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18. The Trans-Siberian Railroad is the longest single railroad in the world. Starting in Moscow, the tracks stretch 9,354 km across the Siberian frontier to Vladivostok, located at the edge of the Pacific Ocean. If you were to leave Moscow and travel on the railroad at an average speed of 90.0 km/h, how long would it take for you to reach Vladivostok?

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19. The largest sheep and cattle ranches in the world are in Australia. Because some of these ranches are as large in area as Connecticut, the fences needed to protect the livestock from dingos and other predators are extensive. The world's longest "dingo-proof" fence is 5,530 km long. Suppose you were to travel around this fence in a car at an average speed of 45 km/h. How long would it take you to return to your starting point?

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20. Stars do not appear to move because they are so far away. In truth, stars actually move at fairly high speeds. Consider the relatively close star Sirius, which is moving away from our solar system at a speed of about 17.8 km/s. How far will this star travel in 2,590 years, the time it takes for Sirius to move 1º across the sky?

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