Name _____ Class_____Date_____

Skills Worksheet

Math Skills

Acceleration

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

In 1970, Don "Big Daddy" Garlits set what was then the world record for drag racing. He started at rest and accelerated at 16.5 m/s^2 (about 1.68 times the free-fall acceleration) for 6.5 s. What was Garlits's final speed?

SOLUTION

Step 1: List the given and unknown values.

Given: acceleration, a = 16.5 m/s^2

time, t = 6.5 s

initial speed, *initial* v = 0 m/s

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

Step 2: Rearrange the acceleration equation to solve for final speed.

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time}} \qquad a = \frac{\Delta v}{t} = \frac{final\ v - initial\ v}{t}$$

$$at = \left(\frac{final\ v - initial\ v}{t}\right)t$$

$$at = final\ v - initial\ v$$

$$final\ v = at + initial\ v$$

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

final v = (16.5 m/s^2 × 6.5 s) + 0 m/s

final v = 110 m/s

PRACTICE

1. A bicyclist accelerates at 0.89 m/s^2 during a 5.0 s interval. What is the change in the speed of the bicyclist and the bicycle?

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2. A freight train, traveling at a speed of 18.0 m/s, begins braking as it approaches a train yard. The train's acceleration while braking is –0.33 m/s^2. What is the train's speed after 23 s?

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3. An automobile accelerates 1.77 m/s^2 over 6.00 s to reach the freeway speed at the end of an entrance ramp. If the car's final speed is 88.0 km/h, what was its initial speed when it began accelerating? Express your answer in kilometers per hour.

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PROBLEM

A child sleds down a steep, snow-covered hill with an acceleration of 2.82 m/s^2. If her initial speed is 0.0 m/s and her final speed is 15.5 m/s, how long does it take her to travel from the top of the hill to the bottom?

SOLUTION

Step 1: List the given and unknown values.

Given: acceleration, $a = 2.82$ m/s^2

initial speed, *initial v* = 0.0 m/s

final speed, *final v* = 15.5 m/s

Unknown: time, t = ? s

Step 2: Rearrange the acceleration equation to solve for time.

$$acceleration = \frac{change\ in\ speed}{time} \qquad a = \frac{\Delta v}{t} = \frac{final\ v - initial\ v}{t}$$

$$a\left(\frac{t}{a}\right) = \left(\frac{final\ v - initial\ v}{t}\right)\left(\frac{t}{a}\right) = \frac{final\ v - initial\ v}{a}$$

$$t = \frac{final\ v - initial\ v}{a}$$

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

$$t = \frac{15.5\ \text{m/s} - 0.0\ \text{m/s}}{2.82\ \text{m/s}^2} = \frac{15.5}{2.82}\ \text{s}$$

$$t = 5.50\ \text{s}$$

PRACTICE

4. Once the child in the sample problem reaches the bottom of the hill, she continues sliding along the flat, snow-covered ground until she comes to a stop. If her acceleration during this time is –0.392 m/s^2, how long does it take her to travel from the bottom of the hill to her stopping point?

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5. The "street" automobile with the greatest acceleration is the *Tempest.* It has an acceleration of 6.89 m/s^2. Suppose the car accelerates from rest to a final speed of 96.5 km/h. How long does it take the *Tempest* to reach this speed?

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6. The *Impact* was the first commercial electric car to be developed in over 60 years. During performance tests in 1994, the car reached a top speed of nearly 296 km/h. Suppose the car started at rest and then underwent a constant acceleration of 1.6 m/s^2 until it reached its top speed. How long did it take the *Impact* to reach its top speed?

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PROBLEM

An automobile manufacturer claims that its latest model can "go from 0 to 90" in 7.5 s. If the "90" refers to 90.0 km/h, calculate the automobile's acceleration.

SOLUTION

Step 1: List the given and unknown values.

Given: time, t = 7.5 s
initial speed, *initial* v = 0.0 km/h
final speed, *final* v = 90.0 km/h

Unknown: acceleration, a = ? m/s^2

Step 2: Perform any necessary conversions.

To find the final speed in meters per second, you must multiply the value for speed by the number of meters in a kilometer and divide by the number of seconds in an hour.

$$final\ v = 90.0\ \frac{\cancel{\text{km}}}{\cancel{\text{h}}} \times \frac{1000\ \text{m}}{1\ \cancel{\text{km}}} \times \frac{1\ \cancel{\text{h}}}{60\ \cancel{\text{min}}} \times \frac{1\ \cancel{\text{min}}}{60\ \text{s}}$$

$$final\ v = 25.0\ \text{m/s}$$

Step 3: Write out the equation for acceleration.

$$acceleration = \frac{change\ in\ speed}{time} \qquad a = \frac{\Delta v}{t} = \frac{final\ v - initial\ v}{t}$$

Step 4: Insert the known values into the equation, and solve.

$$a = \frac{\Delta v}{t} = \frac{final\ v - initial\ v}{t} = \frac{25.0\ \text{m/s} - 0.0\ \text{m/s}}{7.5\ \text{s}} = \frac{25.0\ \text{m/s}}{7.5\ \text{s}}$$

$$a = 3.3\ \text{m/s}^2$$

PRACTICE

7. The gravitational force between Mars and an object near its surface is much lower than the force between an object on Earth's surface and Earth. If the speed of a hammer, when dropped, increases from 0.0 m/s to 15.0 m/s in 4.04 s, what is the acceleration due to the gravitational force on the surface of Mars?

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8. A fighter jet lands on the flight deck of an aircraft carrier that has a length of 300.0 m. The jet must reduce its speed from about 153 km/h to exactly 0 km/h in 2.0 s. What is the jet's acceleration?

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9. A runner whose initial speed is 29 km/h increases her speed to 31 km/h in order to win a race. If the runner takes 5.0 s to complete this increase in speed, what is her acceleration?

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MIXED PRACTICE

10. A certain roller coaster accelerates its cars 6.35 m/s^2 up the first incline. If this acceleration happens during the first 7.0 s of the ride, how much does the coaster's speed increase?

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11. The solid-fuel rocket boosters used to launch a space shuttle can lift the shuttle 45 km above Earth's surface. During that time, the shuttle undergoes an almost constant total acceleration of 6.25 m/s^2, so that its speed increases from rest to about 750 m/s. How long does it take for the shuttle to reach this speed?

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12. In 1995, Bonnie Blair set the world record for skating 500.0 m in 38.69 s. Suppose that she coasted to a stop on the ice after she crossed the finish line. If her initial speed was 13 m/s and her acceleration was –2.9 m/s^2, how long did it take her to stop?

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13. The elevators in the Landmark Tower, in Yokohama, Japan, are among the fastest in the world. They accelerate upward at 3.125 m/s^2 for 4.00 s to reach their final speed. If these elevators start at rest, what is their final speed?

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14. A ship, with a mass of 5.22×10^7 kg, has engines that can accelerate to -0.357 m/s^2. Suppose the ship approaches the dock at a speed of 16.98 m/s. How much time does the ship need to stop?

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15. A dog runs on a waxed floor at an initial speed of 1.5 m/s. It slides to a stop with an acceleration of -0.35 m/s^2. How long does it take for the dog to stop?

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16. A certain type of rocket sled is used to measure the effects of sudden, extreme deceleration. The sled reaches a top speed of 320 km/h and then comes to a complete stop in 0.18 s. What is the acceleration that takes place in this time?

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17. The Sears Tower in Chicago is 110 stories (436 m) above street level, and the roof of the tower is 442 m above the street. Assume that a golf ball is thrown down from the roof of the Sears Tower. Neglecting air resistance, the golf ball accelerates at 9.8 m/s^2 and lands on the pavement after 9.2 s. If the ball's final speed is 93.0 m/s, what was the speed with which the ball was initially thrown?

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18. In the theory of *plate tectonics,* various segments of Earth's crust, called *plates,* move toward and away from each other. In one instance, the plate that consists of the Indian subcontinent drifted from southeastern Africa to its current position in Asia, traveling at a speed of 15 cm/y. This plate collided with Asia, forming the Himalayan mountain range in the process. Most of this formation occurred during the last 1.00×10^7 years, during which time the Indian subcontinent's motion has slowed to about 5 cm/y. What has been the acceleration, in units of cm/y^2, of the Indian subcontinent during this time period?

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