Name _____ Class_____Date_____

Skills Worksheet

Math Skills

Kinetic Energy

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

A 725 kg automobile has a kinetic energy of J as it travels along a highway. What is the car's speed?

SOLUTION

Step 1: List the given and unknown values.

Given: *mass*, m = 725 kg

kinetic energy, $KE = 3.02 \times 10^5$

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

Step 2: Write the kinetic energy equation, and rearrange it to solve for speed.

$$kinetic\ energy = \frac{1}{2} \times mass \times speed\ squared \qquad KE = \frac{1}{2}mv^2$$

$$KE \times \frac{2}{m} = \frac{1}{\cancel{2}}\cancel{m}v^2 \times \left(\frac{\cancel{2}}{\cancel{m}}\right) = v^2$$

$$v = \sqrt{v^2} = \sqrt{\frac{2KE}{m}}$$

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

$$v = \sqrt{\frac{2(3.02 \times 10^5\ \text{J})}{725\ \text{kg}}} = \sqrt{\frac{2(3.02 \times 10^5\ \text{kg} \cdot \text{m}^2/\text{s}^2)}{725\ \text{kg}}}$$

v = 28.9 m/s

PRACTICE

1. When a 65 kg skydiver jumps from a plane, her speed steadily increases until air resistance provides a force that balances the force due to free fall. How fast is the skydiver falling if her kinetic energy at the moment is 7.04×10^5 J?

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2. The kinetic energy of a golf ball is measured to be 143.3 J. If the golf ball has a mass of about 47 g, what is its speed?

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PROBLEM

The greatest speed that a meteoroid can have and still be pulled down to Earth's surface is 70.0 km/s. If a meteoroid traveling with this speed has a kinetic energy of 2.56×10^{13} J, what is its mass?

SOLUTION

Step 1: List the given and unknown values.

Given: *speed*, $v = 70.0 \text{ km/s} = 7.00 \times 10^4 \text{ m/s}$

kinetic energy, $KE = 2.56 \times 10^{13} \text{ J}$

Unknown: *mass*, $m = ?$ kg

Step 2: Write the kinetic energy equation, and rearrange it to solve for mass.

$$kinetic\ energy = \frac{1}{2} \times mass \times speed\ squared \qquad KE = \frac{1}{2}mv^2$$

$$KE \times \left(\frac{2}{v^2}\right) = \frac{1}{\cancel{2}}mv^{\cancel{2}} \times \left(\frac{\cancel{2}}{v^{\cancel{2}}}\right) = m$$

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

$$m = \frac{2 \times (2.56 \times 10^{13} \text{ J})}{(7.00 \times 10^4 \text{ m/s})^2} = \frac{2 \times (2.56 \times 10^{13} \text{ kg} \cdot \text{m}^2/\text{s}^2)}{(7.00 \times 10^4 \text{ m/s})^2}$$

$m = 1.04 \times 10^4$ kg

PRACTICE

3. The most massive Shinkansen bullet trains are the series-200 trains. This type of train also has one of the highest operating speeds: 76.4 m/s. If a series-200 train has a maximum kinetic energy of 2.78×10^9 J, what is its mass?

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4. The largest airplane built that has flown more than once is the Ukrainian-built Antonov-225 *Mriya*. With a length of 85 m and a wingspan of 88 m, the *Mriya (Dream)* was designed to carry the space shuttle of the Soviet Union's space program. Unloaded, the top speed of *Mriya* is 236 m/s, at which its kinetic energy is 9.76×10^9 J. What is its mass?

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5. The vehicle land-speed record has long been held by rocket cars. These vehicles resemble the high-speed rocket planes that were used in the early days of the space program, but they have heavy metal wheels. On September 5, 1997, the world land-speed record was set by the British-built Thrust SSC rocket car, which had a top recorded speed of 341 m/s. The kinetic energy of the car at this speed is 5.289×10^8 J. What is the car's mass?

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PROBLEM

A baseball is pitched with a speed of 35 m/s. If the baseball has a mass of 0.146 kg, what is its kinetic energy?

SOLUTION

Step 1: List the given and unknown values.

Given: *mass, m* = 0.1499 kg

speed, v = 35 m/s

Unknown: *kinetic energy, KE* = ? J

Step 2: Write the equation for kinetic energy.

$$kinetic\ energy = \frac{1}{2} \times mass \times speed\ squared \qquad KE = \frac{1}{2}mv^2$$

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

$$KE = \frac{1}{2}(0.146\ \text{kg}) \times (35\ \text{m/s})^2 = 89\ \text{kg} \cdot \text{m}^2/\text{s}^2$$

` KE = 89 J

PRACTICE

6. A cheetah can run briefly with a speed of 31 m/s. Suppose a cheetah with a mass of 47 kg runs at this speed. What is the cheetah's kinetic energy?

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7. A table tennis (ping-pong) ball has a mass of about 2.45 g. Suppose the ball is hit across the table with a speed of about 4.0 m/s. What is its kinetic energy?

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MIXED PRACTICE

8. The largest land predator is the male polar bear, which typically has a mass of around 5.00×10^2 kg. If the maximum kinetic energy for a polar bear with this mass is 6.05×10^4 J, what is its top speed?

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9. Though slow on land, the leatherback turtle holds the record for the fastest water speed of any reptile: 9.78 m/s. It is also among the largest of reptiles. Suppose the largest leatherback yet discovered were to swim at a speed of 9.78 m/s. If its kinetic energy was 6.08×10^4 J, what was its mass?

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