Name _____ Class_____Date_____

Skills Worksheet

Math Skills

Power

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

The world's most powerful tugboats, which are built in Finland, are capable of providing 8.17×10^6 W of power. How much work does one of these tugboats do in 12.0 s?

SOLUTION

Step 1: List the given and unknown values.

Given: *power*, $P = 8.17 \times 10^6$ W

time, $t = 12.0$ s

Unknown: *work*, $W = ?$ J

Step 2: Rearrange the power equation to solve for work.

$$power = \frac{work}{time} \qquad P = \frac{W}{t}$$

$$P \times t = \frac{W}{t} \times t = W$$

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

$W = (8.17 \times 10^6 \text{ W}) \times (12.0 \text{ s}) = (8.17 \times 10^6 \text{ J/s}) \times (12.0 \text{ s})$

$W = 9.80 \times 10^7$ J

PRACTICE

1. One horsepower (1 hp) is the unit of power based on the work that a horse can do in one second. This is defined, in English units, as a force of 550 lb that can move an object 1 ft in 1 s. In SI, 1 hp equals 745.7 W. Suppose you have a horse that has a power output of 750 W. How much work does this horse do in 0.55 s?

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2. A race car with a 255 hp (1.90×10^5 W) engine is able to accelerate from rest to its top speed in 9.00 s. How much work does the car's engine do in this interval of time?

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3. A ship's diesel engine has a power output of 13.0 W (13.0×10^6 W). How much work is done by this engine in 15.0 min?

PROBLEM

Suppose a weightlifter's power output is 178 W during the time he does 3,310 J of work on the weights. How long does it take the weightlifter to raise the weights?

SOLUTION

Step 1: List the given and unknown values.

Given: *power, P* = 178 W

work, W = 3,310 J

Unknown: *time, t* = ? s

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

$$power = \frac{work}{time} \qquad P = \frac{W}{t}$$

$$P \times \frac{t}{P} = \frac{W}{t} \times \frac{t}{P} = \frac{W}{P}$$

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

$$t = \frac{3310\ \text{J}}{178\ \text{W}} = \frac{3310\ \text{J}}{178\ \text{J/s}}$$

t = 18.6 s

PRACTICE

4. In order to sail through the frozen Arctic Ocean, the most powerful icebreaker ever built was constructed in the former Soviet Union. At the heart of the ship's power plant is a nuclear reactor with a power output of 5.60×10^7 W. How long will it take for this power plant to do 5.35×10^{10} J of work?

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5. The heaviest loads ever raised were part of the offshore Ekofisk complex in the North Sea. The 4.0×10^7 kg complex was raised 6.5 m by over a hundred hydraulic jacks. The work done on the complex during the raising was approximately 2.6×10^{11} J. Suppose the power output of all the jacks was 5.7×10^8 W. How long did it take the jacks to raise the complex?

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6. Borax was mined in Death Valley, California, during the nineteenth century. It was transported from the valley by massive88wagons, each pulled by a team of 21 mules. Suppose each mule's power output was 746 W (about 1 hp). If in a certain time interval the total work done by the team on the wagon was 2.35×10^7 J, how long was that interval of time?

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PROBLEM

A certain crane is able to lift 2.20×10^6 kg. If the crane is able to raise this mass a distance of 20.0 m by doing 4.32×10^8 J of work in 35.0 s, how much power has the crane provided?

SOLUTION

Step 1: List the given and unknown values.

Given: *work*, $W = 4.32 \times 10^8$ J

time, $t = 35.0$ s

The distance of 20.0 m and the mass of 2.20×10^6 kg are not needed to calculate power.

Unknown: *power*, $P = ?$ W

Step 2: Write out the equation for power.

$$power = \frac{work}{time} \qquad P = \frac{W}{t}$$

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

$$P = \frac{4.32 \times 10^8 \text{ J}}{35 \text{ s}} = 1.2 \times 10^7 \text{ J/s} = 1.2 \times 10^7 \text{ W}$$

$P = 12$ MW

PRACTICE

7. A certain steam turbine is designed to be used as both a power generator and as a pump. When used as a generator, the turbine provides enough power to do 3×10^{10} J of work in 1 min. What is the power output of the turbine?

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8. The space shuttle, which was first launched on April 12, 1981, is the world's first reusable space vehicle. The shuttle is placed in orbit by three engines that do 1.4×10^{13} J of work in 8.5 min. What is the power output of these engines?

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9. Lithuania's major nuclear power plant has one of the world's most powerful generators, which has a power output of 1.45×10^9 W. How long must this generator run if it is to provide the energy to do 4.35×10^{11} J of work?

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