Name _____ Class_____Date_____

Skills Worksheet

Math Skills

Efficiency

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 diesel engine with an efficiency of 0.39 requires 750 J of work to be done on its pistons. How much useful work is done by the diesel engine?

SOLUTION

Step 1: List the given and unknown values.

Given: *efficiency* = 0.39

work input = 750 J

Unknown: *useful work output* = ? J

Step 2: Write the efficiency equation, and rearrange it to solve for useful work output.

$$efficiency = \frac{useful\ work\ output}{work\ input}$$

$$efficiency \times work\ input = \frac{useful\ work\ output}{work\ input} \times work\ input$$

$$= useful\ work\ output$$

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

useful work output = (0.39) × (750 J)

useful work output = 290 J

PRACTICE

1. The resistance of water to an oar in a rowboat limits the oar's efficiency to 0.450. If the rower does 145 J of work on the oar with each stroke, how much useful work is done by the oar?

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2. A jack requires 808 J of work to be done in raising a load, and ideally would do this amount of useful work. However, internal friction reduces the jack's efficiency to 0.625. How much useful work is done by the jack?

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PROBLEM

A block and tackle does 1.25×10^5 J of useful work, but friction limits the block and tackle to an efficiency of 0.45. What is the amount of work that must be done on the block and tackle?

SOLUTION

Step 1: List the given and unknown values.

Given: *efficiency* = 0.45

useful work output = 1.25×10^5 J

Unknown: *work input* = ? J

Step 2: Use the efficiency equation, and rearrange it to solve for work input.

$$efficiency = \frac{useful\ work\ output}{work\ input}$$

$$efficiency \times \frac{work\ input}{efficiency} = \frac{useful\ work\ output}{work\ input} \times \frac{work\ input}{efficiency}$$

$$work\ input = \frac{useful\ work\ output}{efficiency}$$

Step 3: Substitute the values for the useful work done by the machine and the efficiency into the equation, and solve.

$$work\ input = \frac{1.25 \times 10^5\ \text{J}}{0.45}$$

work input = 2.8×10^5 J

PRACTICE

3. An automobile gasoline engine is able to do 225 J of useful work with each stroke of its pistons. If the engine has an efficiency of 29.0 percent, what is the amount of work that must be done on the pistons in the engine?

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4. The most efficient type of steam engine is a steam turbine, which in practice can have an efficiency as high as 30.0 percent. If the useful work done each second by a steam turbine with this efficiency is 2.64×10^6 J, how much work must the steam do on the turbine?

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PROBLEM

An inclined plane allows you to do 280 J of useful work on a refrigerator that you are sliding upward along the plane. If the work that you have to do is 760 J, what is the efficiency of the plane?

SOLUTION

Step 1: List the given and unknown values.

Given: *work input* = 760 J

useful work output = 280 J

Unknown: *efficiency* = ?

Step 2: Write the equation for efficiency.

$$efficiency = \frac{useful\ work\ output}{work\ input}$$

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

$$efficiency = \frac{280\ \text{J}}{760\ \text{J}} = 0.37$$

To express this as a percentage, multiply by 100 and add the percent sign, "%."

efficiency = 0.37 × 100 = 37%

PRACTICE

5. A forklift developed in Sweden is able to do 1.8×10^6 J of useful work in lifting a heavy load. Suppose 7.6×10^6 J must be done by the lift's motors on the load in order to accomplish this task. What is the efficiency of the for102lift?

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MIXED PRACTICE

6. A steam engine does 2,500 J of useful work to move a wheel through half a rotation. The energy provided to the steam engine by heat for this work equals 7,576 J. Noting that the amount of energy provided to a machine, either by heat or by work, is equivalent to the amount of work that must be done on a machine, calculate the efficiency of the engine.

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7. A pennyfarthing bicycle has an efficiency of 62 percent. How much work is done by the bicycle if a cyclist does 5.4×10^3 J of work on the bicycle?

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