ANDRETTI FASTTRACK XPERIENCE | Official Partner

LESSON 1:
POWER

NEXT GENERATION SCIENCE STANDARDS

4-PS3-1 Use evidence (e.g., measurements, observations, patterns) to construct an explanation.

4-PS3-4 Apply scientific ideas to solve design problems.

Time: 1 50-60 minute class period

Begin this lesson by watching the video about power and electric cars. Have a short discussion about what the students learned from the video.

Next, we will help students to better understand and calculate the cost of electrical power. Most adults can relate to this cost when they open their monthly bill from the power company. Unfortunately, most students are unaware of this monthly charge and how it's calculated and more importantly the impact they can have in lowering this bill and helping the environment.

Start by reviewing the concept of Work and Power. Remember, $$Power = \frac{Work}{time}$$

Let's apply this formula:

- A student pushes a shopping cart and does 300 Joules of work in 10 s. What is her power? The answer should be (300 J)/(10 s) = 30 J/s. Ask students to explain the units. What does 30 J/s actually mean? (A good answer is the student does 30 Joules of work every second) Explain that Joules/second is the same thing as Watt.

$$Watts = \frac{Joules}{second} \qquad 30\ \frac{J}{s} = 30\ Watts$$

- A lightbulb is rated at 60 Watts. What does this mean? (60 Joules of work each second is required to light the bulb) How much work would the lightbulb require in order to be turned on for 10 s? **ANSWER:** ((60 J/s)(10 s) = 600 J of work)

- Have students answer the following questions:
  1. How much work needs to be done in order to turn on a 1000 W toaster for 2 minutes? **ANSWER:** ((1000 J/s)(120 s) = 120,000 J)
  2. How much work needs to be done in order to power a 200 W TV for 30 minutes? **ANSWER:** ((200 J/s)(1800 s) = 360,000 J)
  3. The Kia electric car can produce 430 KW of power. If 1000 Watts = 1 KW (Kilowatt), how much work can the electric car do in 5 seconds? **ANSWER:** ((430,000 J/s)(5 s) = 2,150,000 J)

Student Worksheet

COST OF POWER - KILOWATT·HOUR: The Kilowatt·hour is another way of expressing the amount of energy used. For example, if a 300 W TV is used for 2 hours, the amount of energy in Kilowatt·hours can be found by multiplying Kilowatts by hours as shown below.

300 W = 0.300 KW (divide by 1000 to get KW)
(0.300 KW)(2 hours) = 0.6 KW·hr

Find the energy (KW·hr) required for the following:

1) A 1200 Watt heater is used for 4 hours.

2) A 2000 Watt oven is used for 3 hours.

3) An electric car uses 15 KW for 2 hours.

THE COST FOR ELECTRICITY is measured in terms of Kilowatt·hours (KW·hr). The average price per KW·hr is about $0.13. The cost for electricity can be found as follows:

Cost of Electricity = (Number of KW·hr)($0.13/KW·hr)

Find the cost for each of the following appliances. We'll use the same cost for electricity of $0.13/KW·hr.

1) A 1200 Watt heater is used for 4 hours.

2) A 2000 Watt oven is used for 3 hours.

3) An electric car uses 15 KW for 2 hours.

Student Worksheet

ANSWER KEY

COST OF POWER - KILOWATT·HOUR: The Kilowatt·hour is another way of expressing the amount of energy used. For example, if a 300 W TV is used for 2 hours, the amount of energy in Kilowatt·hours can be found by multiplying Kilowatts by hours as shown below.

300 W = 0.300 KW (divide by 1000 to get KW)
(0.300 KW)(2 hours) = 0.6 KW·hr

Find the energy (KW·hr) required for the following:

1) A 1200 Watt heater is used for 4 hours.

4.8 KW·hr

2) A 2000 Watt oven is used for 3 hours.

6 KW·hr

3) An electric car uses 15 KW for 2 hours.

30 KW·hr

THE COST FOR ELECTRICITY is measured in terms of Kilowatt·hours (KW·hr). The average price per KW·hr is about $0.13. The cost for electricity can be found as follows:

Cost of Electricity = (Number of KW·hr)($0.13/KW·hr)

Find the cost for each of the following appliances. We'll use the same cost for electricity of $0.13/KW·hr.

1) A 1200 Watt heater is used for 4 hours.

(4.8 KW·hr)($0.13) = $0.62

2) A 2000 Watt oven is used for 3 hours.

(6 KW·hr)($0.13) = $0.78

3) An electric car uses 15 KW for 2 hours.

(30 KW·hr)($0.13) = $3.90

Student Worksheet

COST OF POWER PROBLEMS

For the following problems you can assume that the cost for electricity is $0.13 /KW·hr.

Find the energy (KW·hr) required for the following:

1) A water heater with a power rating of 3600 W heats water for 8 hours. Determine the cost for electricity.

2) A laptop (100 W) is used for 2 hours a day for 30 days. Determine the cost for electricity.

3) A cell phone charger (6W) charges a cell phone overnight for 10 hours. Determine the cost for electricity.

4) A lightbulb (60 W) is left on for 30 days straight. Determine the cost for electricity.

5) An electric car (15,000 W) is driven for 3 hours. The cost for electricity at charging stations is $0.40/KW·hr. Determine the cost for electricity.

Student Worksheet

ANSWER KEY

COST OF POWER PROBLEMS

For the following problems you can assume that the cost for electricity is $0.13 /KW·hr.

Find the energy (KW·hr) required for the following:

1) A water heater with a power rating of 3600 W heats water for 8 hours. Determine the cost for electricity.

$3.74

2) A laptop (100 W) is used for 2 hours a day for 30 days. Determine the cost for electricity.

$0.78

3) A cell phone charger (6W) charges a cell phone overnight for 10 hours. Determine the cost for electricity.

$ 0.008

4) A lightbulb (60 W) is left on for 30 days straight. Determine the cost for electricity.

$5.62

5) An electric car (15,000 W) is driven for 3 hours. The cost for electricity at charging stations is $0.40/KW·hr. Determine the cost for electricity.

$18.00