Power Problems Name Key - Mr. Sudbury Date_____ Block_____

The electric power (in Watts) represents the rate at which energy is converted from the electrical energy of the moving charges to some other form in an electric circuit or a circuit component. (For example, the electricity may be converted into heat, mechanical energy, or energy stored in electric or magnetic fields.)

The Power in a circuit or circuit component can be found with the formula: $P = IV$

Since you may not know the current every time, you can substitute Ohm's law (I=V/R) in for the current above.

Ohm's Law $I = \frac{V}{R}$ (Substitute) $P = IV$ so $P = \frac{V^2}{R}$

You will have to select which formula based on the information you know from the problem.

Remember that P is Power in Watts, V is voltage in volts, I is current in Amps, and R is resistance in Ohms (Ω)

*Show your work (**G.U.E.S.S.**) for full credit and make sure you answer has correct units.*

1. How much current (I) is used by a 150-W (P) light bulb that is connected to a 120-volt (V) circuit?

   $P = I \cdot V$ so $I = \frac{P}{V} = \frac{150\,W}{120\,V} = 1.25\,Amps$

   1.25 Amp

2. What is the power (P) rating of an appliance that is plugged into a 240-volt (V) socket and has 90 Ω (R) of resistance?

   $P = \frac{V^2}{R} = \frac{(240V)^2}{90\,\Omega} = 640\,Watts$

   640 W

3. What current does a 240 Watt (P) light fixture (four 60 W bulbs) operate if it is connected to a 120-volt (V) circuit?

   $P = I \cdot V$ so $I = \frac{P}{V} = \frac{240\,W}{120\,V} = 2\,Amp$

   2 Amp

4. How much power (P) is used by a calculator that operates on 8 volts (V) and 0.1 ampere (I)?

   $P = I \cdot V = 0.1A \times 8V = 0.8\,Watts$

   0.8 W

5. Will a 1200-Watt (P) hair dryer operate on a 120-volt (V) circuit if the current in the circuit is limited to 15 amps (I) by a safety fuse? *(Hint: Solve for current, if it is higher than 15A, it will shut off the circuit)*

   $P = I \cdot V$ so $I = \frac{P}{V} = \frac{1200\,W}{120\,V} = 10\,Amps$

   I= 10 Amp

   Circle one: (Yes you can use the hair dryer safely) **OR** No the fuse will activate shutting off the circuit.

6. Calculate the current in a 140-Watt (P) electric blanket connected to a 120-volt (V) outlet.

   $P = I \cdot V$ so $I = \frac{P}{V} = \frac{140\,W}{120\,V} = 1.17\,A$

   1.17 A

Calculating Electrical Energy Costs:

Electric company charge electricity consumers based on how much electricity they use. The quantity the sell electricity in is the kilowatt-hour (kWh). One kilowatt-hour is 1000 Watts used for one hour of time.

Example: A coffee pot operates on 2 amperes of current on a 110-volt circuit for 3 hours. Calculate the total kWh used.

1. Determine power: $P = V \times I$
   $= 110 \text{ volts} \times 2 \text{ amps}$
   $= 220 \text{ watts}$

   $kWh = P \times hours$

   $kWh = \frac{V \times I \times hours}{1{,}000}$

2. Convert watts to kilowatts:
   $220 \text{ watts} \times \frac{1 \text{ kilowatt}}{1{,}000 \text{ watts}} = 0.22 \text{ kW}$
3. Multiply by the hours given in the problem:
   $0.22 \text{ kW} \times 3 \text{ hrs} = 0.66 \text{ kWh}$

1. A microwave oven operates on 5 amps of current on a 110-volt circuit for one hour. Calculate the total kilowatt hours used.

   $P = I \cdot V = 5A \cdot 110V = 550 \text{ W}$ KhdBdcm $0.55 \text{ KW} \cdot 1\text{h}$

   0.55 kWh

2. How much would it cost to run the microwave in problem # 1 of the cost of energy is $0.12 per kWh?

   $0.55 \text{ kwh} \times \frac{\$0.12}{1 \text{ kwh}} = \$0.06$ or $6¢$

   $0.06

3. An electric stove operates on 20 amps of current on a 220-volt circuit for one hour. Calculate the total kilowatt hours used.

   $P = I \cdot V = 20A \cdot 220V = 4400 \text{ Watt}$ so $4.4 \text{ kW} \times 1\text{h} = 4.4 \text{ KWh}$

   4.4 kWh

4. What is the cost of using the stove in problem # 3 if the cost of energy is $0.10 per kWh?

   $4.4 \text{ kwh} \times \$0.10 = \$0.44$ or $44¢$

   $0.44

5. A refrigerator operates on 15 amps of current on a 220-v circuit for 18 hours per day. How many kWh are used per day?

   $P = I \cdot V = 15A \cdot 220V = 3300 \text{ W}$ $3.3\text{kw} \times 18\text{h} = 59.4 \text{ kWh}$

   59.4 kWh

6. If the electricity costs $0.13 per kWh, how much does it cost to run the refrigerator in problem # 5 per day?

   $59.4 \text{ kwh} \times \$0.13 = \$7.72$

   $7.72

7. The electric company had a "meter-reader" read your electric meter on June 1st. The reading was 84,502 kWh. On July 1st your meter read 87,489 kWh. How many kWh did you use in the month of June?

   $87{,}489 - 84{,}502 = 2{,}987 \text{ kwh}$

   2,987 kwh

8. Using the information from problem # 7 how much was your June electric bill if electricity costs you $0.12 per kWh.

   $2{,}987 \text{ kWh} \times \$0.12 = \$358.44$

   $358.44

9. A room in your house has a light fixture with three 100-Watt light bulbs which are on for an average of 5 hours per day. How much does it cost to have this light fixture on for a year? *(365 days in a year). Electricity costs $0.13 per kWh # 15 & 16.*

   $300 \text{ W} = 0.3 \text{ KW}$, $0.3 \text{ KW} \times 5\text{h} = 1.5 \text{ kwh/day} \times 365 \text{ days} = 547.5 \frac{\text{kwh}}{\text{year}} \times \$0.13$

   $71.18

10. You replace the 100-Watt bulbs from problem # 15 with energy efficient bulbs which use 40 Watts each. How much will it cost to have these on for an average of 5 hours per day for the year?

    $40 \times 3 = 120 \text{ kW}$, $120 \text{ kW} \times 5\text{h} = 600 \text{ kwh} \times 365 \text{ days} = 219 \frac{\text{kwh}}{\text{year}} \times \$0.13 = \$28.47$

    $28.47

11. How much money did you save per year by switching to energy efficient bulbs in this one light fixture?

    $\$71.18 - \$28.47$ $\$42.71$ saved

    $42.71 saved

TEKS: 5A, C, D CCRS: I2, 3, 4