How Happy are You and Your Family with the Electricity Bill?

Notes for the Teacher

- It is useful to collect electricity bills (at least 4) from households of one and four persons, with at least one for the winter period and another for a summer period.
- It is useful to have on display different equipment that need electric power to function. (e.g. T.V., iron, electric boiler, computer, electric oven, lights) (Alternatively students can check these apparatus at home, when parents can guide them to find the labelling indicate power consumption).
- Access to an electricity meter (this could be by means of a video/CD)

Student Handout

The following steps /questions are to help you to complete your project successfully:

1. Which criteria will you choose for selecting the house equipment ?
2. Are you sure that you are measuring the consumption of only one piece of equipment at a time? How do you determine this?
3. Measure, for a time duration of 5 minutes, the energy consumption of each equipment on the house electric meter.
4. Notice the units which are used to measure energy.
5. Calculate the energy consumption using the theoretic type (find it in your textbook), for the same equipment and the same period of time. Use the prospectus of the equipment for the power, etc. NOTICE: This step is omitted in the first grades.
6. Calculate the amount of money needed to be paid the consumption for each equipment
7. Which of the equipment consume more and which the less?
8. What is the energy transformation for each piece of equipment?
9. Is there a connection between the energy transformation taking place and the consumption?

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Institute: International Council of Associations for Science Education (ICASE)
Country: UK

Student Handout 2

Exercise to Aid the Understanding of the Concept of Power

Answer the following:

1. On which of the following does the electricity we consume depends ? (there may be more than one correct response)
   (a) the voltage of the appliance;
   (b) the size of the appliance;
   (c) the type of plug used;
   (d) the current supplied to the appliance;
   (e) how long the appliance is in use;
   (f) the age of the appliance.

2. For each of those selected in question 1, give the name of the units in which it is measured, both as (a) the base unit and (b) when multiplied by 1000.
3. Look at the information supplied on an electrical appliance. Which of the units given in question 2 are observed ?
4. As the manufacturer of the appliance does not know when, where or how long the appliance will be used, it can only indicate the power of the appliance. What units (by deduction or otherwise) represent the power of the appliance ?
5. Link the units of power to the other units indicated in question 2.
6. If an appliance is plugged into the usual mains supply and had a rating of 0.25 amps, what power rating would you see written on the appliance ?
7. If the power rating was given as 10 watts, what was the current drawn when the appliance was plugged into the mains supply ?
8. The electricity meter needs to record the power of the appliance and the time for which it is used. What units does it use to do this ? What are the units of electricity consumed which are written on the electricity bill ?

Explanation of the numbers on the electricity bill

1. Your **ACCOUNT NUMBER** is a unique number that identifies the location of the place where you are consuming electricity.

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2. CUSTOMER NUMBER: This is a unique number assigned to each customer. A customer may have more than one account number, but an account can have only one customer number. Your customer number will never change.

3. BILLING DATE: This is the date that the bill is prepared and sent out to you

4. TOTAL AMOUNT DUE

5. ARREARS OVER DUE are the previous months' charges which have not yet been paid.

6. CURRENT AMOUNT DUE is the total of electricity charges for current period consumption

7. CURRENT AMOUNT DUE DATE is the latest date on which the Current Amount Due should be paid in order to avoid disconnection

8. The **CYCLE/ROUTE/WALK** is a numbering sequence used to assist BEL in locating the address where electricity is being consumed.

9. METER NUMBER is a unique number used to identify each meter.

10. RATE is the charge per unit of electricity consumed.

11. PREVIOUS READING is the reading on your meter when it was read in the second to last reading period.

12. PRESENT READING is the reading on the meter when it was read in the last reading period.

13. The **METER MULTIPLIER** (shortened 'METER MULTI') is a factor used to arrive at actual consumption when calculating consumption of large customers.

14. NO. DAYS is the number of days over which current consumption is metered.

15. CONSUMPTION is the actual consumption of electricity for the period and is calculated as (present - previous) x meter multiplier.

16. PEAK DEMAND is the largest amount of electrical power utilized at any point in time during the current period.

17. CHARGES are the charges for electricity consumed during the current period and is calculated by multiplying Rate by Consumption.

18. SERVICE LOCATION is the address of the location where you are consuming electricity. This may therefore be different from your mailing address.

19. BILLING DETAILS give a summary of charges, other than those for current electricity consumption, which are included in the Current Amount Due.

20. ELECTRICAL USAGE HISTORY gives a rolling 12-month summary of electricity consumed. Customers can use this to better understand how the

21. **READING DATES** are the last and second to last dates on which the meter for the customer's account was read. These dates will coincide with the present and previous readings.

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Watt

The watt (symbol: W) is the SI derived unit of power, equal to one joule of energy per second.
A human climbing a flight of stairs is doing work at the rate of about 200 watts. A first class athlete can work at 375 watts for 30 minutes before exhaustion. An automobile engine produces mechanical energy at a rate of 25,000 watts (approximately 30 horsepower) while cruising. A typical household incandescent light bulb uses electrical energy at a rate of 40 to 100 watts, while the energy-saving compact fluorescent lights which are replacing them use 8 to 20 watts to yield the same light output.

Definition

One watt is one joule (the SI unit of energy) per second, that is 1 newton metre per second. It may be visualized simply as the amount of energy expended by a single candle.

$$1\ \mathrm{W} = 1\ \frac{\mathrm{J}}{\mathrm{s}} = 1\ \frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^3} = 1\frac{\mathrm{N}\cdot\mathrm{m}}{\mathrm{s}}.$$

In electrical terms, it follows that:

$$1\mathrm{W} = 1\mathrm{V}\cdot 1\mathrm{A}.$$

That is, if 1 volt of potential difference is applied to a resistive load and a current of 1 ampere flows, then 1 watt of power is dissipated.[2]

Origin and adoption as an SI unit

The **watt** is named after James Watt for his contributions to the development of the steam engine, and was adopted by the Second Congress of the British Association for the Advancement of Science in 1889 and by the 11th General Conference on Weights and Measures in 1960 as the unit of power incorporated in the International System of Units (or "SI").

Confusion of watts and watt-hours

Power and energy are frequently confused in the general media, for instance when a device is said to be rated at "100 watts per hour", which does not make any sense since a watt is a rate of doing work or using energy of 1 joule of energy per second. As a rate itself, a watt does not need to be followed by a time designation, unless one is talking about a change in power over time, analogous to an acceleration or deceleration.
Because a joule as a quantity of energy does not have a readily-imagined size to the layperson, the non-SI unit watt-hour, or rather its multiple the kilowatt-hour, is frequently used as a unit of energy, especially by energy-supply companies (electricity and natural gas suppliers) which often quote charges by the

kilowatt-hour. A kilowatt-hour is the amount of energy equivalent to a power of 1 kilowatt running for 1 hour (3.6 MJ).

The watt-hour (symbol W·h or Wh) is a unit of energy. It is most commonly used on household electricity meters in the form of the kilowatt-hour (kW·h or kWh), which is 1,000 watt-hours.

It is not used in the International System of Units (SI), despite being based on the watt, as the hour is not an SI unit. The SI unit of energy is the joule (J), equal to one watt-second. It is, however, a commonly used unit, especially for measuring electric energy.

1 watt-hour is equivalent to 3,600 joules (1 W x 3600 s), the joule being the canonical SI unit of energy. Thus a kilowatt-hour is 3,600,000 joules or 3.6 megajoules.

Pricing for kilowatt-hours

Power companies sell energy in units of kilowatt-hours. In general, energy (E) is equivalent to power (P) multiplied by time (t). To determine E in kilowatt-hours, P must be expressed in kilowatts and t must be expressed in hours. Suppose a 1.5-kW electric heater runs for 3 h. Then P = 1.5 and t = 3, so the energy E in kilowatt-hours is: E = Pt = 1.5 x 3 = 4.5 kWh If P and t are not specified in kilowatts and hours respectively, then they must be converted to those units before determining E in kilowatt-hours. Consider a set-up with one 100 W light bulb (0.1 kW) left on for 10 hours per day. This will consume 1 kilowatt-hour per day (0.1 kW x 10 h). If a power company charges $0.10/kW·h, then this light bulb will cost $0.70 to operate over the course of a week (0.1 kW x 10 h x $0.10/kW·h x 7 days in a week) (see unit juggling for more information).

Conversions

from / to	Joule	Watt-hour	Electronvolt	Calorie
1 J = 1 kg m^2 s^{-2} =	1	0.278×10^{-3}	6.241×10^{18}	0.239
1 W·h =	3600	1	2.247×10^{22}	859.8
1 eV =	1.602×10^{-19}	4.45×10^{-23}	1	3.827×10^{-20}
1 cal =	4.1868	1.163×10^{-3}	2.613×10^{19}	1

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