CONTENTS

Unit 6 - Paying for Electricity

ELECTRICITY

Calculating the cost of using appliances

We pay for electricity in <u>Units</u>. One unit is one kilowatt-hour. To calculate how much it costs to run an appliance:

- Convert the power rating of the appliance into kilowatts. (Divide the amount in watts by 1000.)
- Convert the time the appliance is used into hours. (Divide the time in minutes by 60.)
- Multiply the power in kilowatts by the time in hours to find the total number of Units used.
- Multiply the number of Units used by the price per unit.

Example:
What is the cost of using a 2400 W heater for 5 hours if electricity costs 20c per Unit?

$$\text{power rating} = \frac{2400\ W}{1000}$$
$$= 2.400\ kW$$
$$\text{time used} = 5\ hours$$
$$\text{Units used} = 2.400\ kW \times 5\ hours$$
$$= 12\ Units$$
$$\text{Cost} = 12\ Units \times 20\ c\ per\ Unit$$
$$= 240\ c\ or\ \$2.40$$

For the problems below, assume that electricity costs 20c per Unit.

1 How much does it cost to use a 1500 W hair drier for 10 minutes?

2 A clothes drier has a power rating of 1800 W.

a How much does it cost to run the clothes drier for 90 minutes?

b How much does it cost to use the drier twice a week for a month (4 weeks)?

3 A computer and CRT monitor using 200 W is left on all day then put into standby mode at night when it uses 30 W.

a How much does it cost to run the computer all day (10 hours)?

b How much does it cost for 14 hours on standby?

c How much would be saved over a year if the computer were switched off instead of being put on standby each night?

4 'Energy efficient' light bulbs use about 1/5 the amount of electricity as standard bulbs. If 5 standard 100 W bulbs were replaced with energy efficient bulbs used for 4 hours per day, how much money would be saved over a year?

ELECTRICITY

Analysis of electricity meter readings

Answer these questions using the readings you took from your family's electricity meter, or use the figures your teacher will give you.

1 Record the number of units of electricity used each day (keep the readings from each meter separate).

Day	Units used (standard)	Cost (standard)	Units used (night rate)	Cost (night rate)	Total cost

2 Calculate the cost of each day's electricity using the cost per unit supplied by your teacher. Combine the cost of electricity recorded on each meter into the total cost per day.

Cost of electricity per unit: Standard rate _____ c Night rate _____ c

3 Calculate the average cost of electricity used on those days when you used electricity normally.

4 Calculate the average cost of electricity used on those days when you tried to save as much electricity as possible.

5 Calculate the amount of money saved (if any!) on those days when you tried to save electricity.

6 If you managed to keep up that saving for a year, how much money would you have saved?

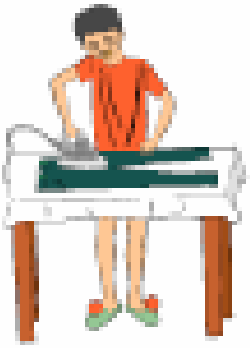
7 During times of electricity shortage, when the country is unable to generate, or unable to transport, enough electricity to meet demand, we are asked to reduce our electricity use by 10%.

a How much electricity would your family need to save (in Units)_____

b What percentage of your normal electricity use did you save?_____

8 What else could your family do to reduce your electricity usage?

Calculating cost



We must pay for each kilowatt-hour of electricity we use.

One kilowatt-hour is also known as a Unit.

The standard cost of a Unit of electricity to households is about 20 c.

Example

What is the cost of using a 1200 W iron for 45 minutes?

- Convert the power into kilowatts by dividing watts by 1000.

$$\text{Power} = \frac{1200\ \text{W}}{1000} = 1.200\ \text{kW}$$

- Convert the time into hours by dividing minutes by 60.

$$\text{Time} = \frac{45}{60} = 0.75\ \text{hours}$$

- Calculate the number of Units (kilowatt-hours) used.

$$\text{Units} = 1.200\ \text{kW} \times 0.75\ \text{hours} = 0.9\ \text{Units}$$

- Calculate the cost by multiplying the number of Units by the price per Unit.

$$\text{Cost} = 0.9\ \text{Units} \times 20\ c\ \text{per unit} = 18\ c$$

Sample meter readings

Day	Time	Reading 1 (standard rate)	Electricity Used	Reading 2 (night rate)	Electricity Used
Mon	4.45.pm	95968	------	38637	------
Tue	4.35.pm	95986	18	38650	13
Wed	3.55.pm	96007		38661	
Thur	4.12.pm	96024		38670	
Fri	4.40.pm	96040		38679	
Sat	5.05.pm	96057		38687	

To calculate the electricity used each day subtract the previous day's readings

Tuesday: 95986 – 95968 = 18 Units standard rate
38650 – 38637 = 13 Units night rate

ANSWERS

Calculating the cost of using appliances

We pay for electricity in Units. One unit is one kilowatt-hour. To calculate how much it costs to run an appliance:

- Convert the power rating of the appliance into kilowatts. (Divide the amount in watts by 1000.)
- Convert the time the appliance is used into hours. (Divide the time in minutes by 60.)
- Multiply the power in kilowatts by the time in hours to find the total number of Units used.
- Multiply the number of Units used by the price per unit.

Example
What is the cost of using a 2400 W heater for 5 hours if electricity costs 20 c per Unit?

power rating = $\frac{2400\ W}{1000}$
= 2.400 kW

time used = 5 hours

Units used = 2.400 kW × 5 hours
= 12 Units

Cost = 12 Units × 20 c per Unit
= 240 c or $2.40

For the problems below, assume that electricity costs 20 c per Unit.

1 How much does it cost to use a 1500 W hair drier for 10 minutes?

Power = $\frac{1500\ W}{1000}$ = 1.5 kW

Time = $\frac{10}{60}$ = 0.1667 h

Units = 1.5 kW × 0.1667 h = 0.25 Units

Cost = 1.25 Units × 20 c = 25 c

2 A clothes drier has a power rating of 1800 W.

a How much does it cost to run the clothes drier for 90 minutes?

Power = $\frac{1800\ W}{1000}$ = 1.8 kW

Time = $\frac{90}{60}$ = 1.5 h

Units = 1.8 kW × 1.5 h = 2.7 Units

Cost = 2.7 Units × 20 c = 54 c

b How much does it cost to use the drier twice a week for a month (4 weeks)?

2 times × 4 weeks = 8 times

54 c × 8 times = $4.32

3 A computer and CRT monitor using 200 W is left on all day then put into standby mode at night when it uses 30 W.

a How much does it cost to run the computer all day (10 hours)?

Power = $\frac{200\ W}{1000}$ = 0.2 kW

Units = 0.2 kW × 10 h = 2.0 Units

Cost = 2.0 Units × 20 c = 40 c

b How much does it cost for 14 hours on standby?

Power = $\frac{30\ W}{1000}$ = 0.030 kW

Units = 0.030 kW × 14 h = 0.42 Units

Cost = 0.42 Units × 20 c = 8.4 c

c How much would be saved over a year if the computer were switched off instead of being put on standby each night?

8.4 c × 365 days = $30.66

4 "Energy efficient" light bulbs use about 1/5 the amount of electricity as standard bulbs. If 5 standard 100 W bulbs were replaced with energy efficient bulbs used for 4 hours per day, how much money would be saved over a year?

5 ES bulbs = a saving of 400 W.

Power = $\frac{400\ W}{1000}$ = 0.400 kW

Time = 4 hours × 365 = 1460 hours

Units = 0.4 kW × 1460 h = 584 Units

Cost = 584 Units × 20 c = $116.80

ANSWERS

Analysis of electricity meter readings

Answer these questions using the readings you took from your family's electricity meter, or use the figures your teacher will give you.

1 Record the number of units of electricity used each day (keep the readings from each meter separate).

Day	Units used (standard)	Cost (standard)	Units used (night rate)	Cost (night rate)	Total cost
Tuesday	18	2.88	13	1.04	3.92
Wednesday	21	3.36	11	0.88	4.24
Thursday	17	2.72	9	0.72	3.44
Friday	16	2.56	9	0.72	3.28
Saturday	17	2.72	8	0.64	3.36

2 Calculate the cost of each day's electricity using the cost per unit supplied by your teacher. Combine the cost of electricity recorded on each meter into the total cost per day.

Cost of electricity per unit: Standard rate 16 c Night rate 8 c

3 Calculate the average cost of electricity used on those days when you used electricity normally.

(Tue/Wed): (3.92 + 4.24) ÷ 2 = $4.08

4 Calculate the average cost of electricity used on those days when you tried to save as much electricity as possible.

(Thur–Sat): (3.44 + 3.28 + 3.36) ÷ 3 = $3.36

5 Calculate the amount of money saved (if any!) on those days when you tried to save electricity.

Saving = $3.36 – $4.08 = $0.72 per day

6 If you managed to keep up that saving for a year, how much money would you have saved?

Saving per year = $0.72 × 365 days = $262.80

7 During times of electricity shortage, when the country is unable to generate, or unable to transport, enough electricity to meet demand, we are asked to reduce our electricity use by 10%.

a How much electricity would your family need to save (in Units)? 3 units per day

b What percentage of your normal electricity use did you save? 4.5 units per day

8 What else could your family do to reduce your electricity usage?

Suggestions: unplugging all appliances not in actual use, using energy efficient light bulbs, better home insulation, closing curtains at night, trimming trees shading windows in winter, low-water shower heads, not wasting hot water, reducing moisture in the home, using draft stoppers around doors/windows...

PAYING FOR ELECTRICITY

Specific learning objectives

By the end of this unit students should be able to:

- Calculate the cost of electricity used in a home from electricity meter readings.
- Calculate the cost of running an appliance for a given time period using suitable data.

Discussion

More able students should be able to complete the worksheet analysing their own household electricity use at home, while younger or less able students will probably need to be taken through the calculations in class. We have provided a set of sample data for those students unable (or unwilling) to collect their own readings.

The calculations of the cost of using an appliance for a given time period are suitable for more able classes. Some teachers may choose to combine this material with the appliance labels exercise in Unit 1 or the standby losses table in the Teacher's Notes for Unit 5.

It is worth emphasising the correct setting out of these calculations – with a new line used for each part of the calculation. It is much easier to train students in the correct setting out of scientific calculations in junior science than to break them of old habits in Year 11 or 12 physics and chemistry. Also check that students are putting the correct units in their answers.