

Electrical Power and Energy (12.2)

Important Definitions:

- **Electrical Power** - The rate at which an appliance uses electrical energy. Measured in watts (W) or kilowatts (kW).
- **Electrical Energy** - The amount of energy used by an appliance, measured in kilowatt-hours (kW·h) or watt-seconds (W·s). Energy can also be expressed in joules (J). **1 Joule = 1 W·s.**

Consumer Energy Needs

1. Consumers are billed based on the amount of electrical energy (in kW·h) they consume. The amount of energy a customer uses depends on three factors:
 - A. the _____ rating of appliances used
 - B. the _____ of the appliances
 - C. the _____ (duration) of use



Power Ratings

Appliances that consume **more energy** have **higher power ratings**.

Example:	LCD Television	0.12 kW
	Stove	3.2 kW

2. Why do you think the stove consumes so much more energy? _____
3. Power can be measured in watts, but it is usually more suitable to use **kilowatts (kW)**.

What is the conversion between watts and kilowatts? Conversion: _____ W = 1 kW

Practice converting:

Watts (W)	Kilowatts (kW)
5500	
	6.25
275	

Appliance Settings

The actual power used may be different from the power rating. This is because the actual power will depend on the setting of the device.

4. Give two examples of devices with different settings

Device	Setting & Power



Amount of Use

The **longer** an appliance/load is used, the **more energy** it consumes!

Energy use is measured in kilowatt-hours (kW·h). It is obtained by multiplying the power rating of a device (in kW) by the number of hours it is used (in hours, h).

$$\begin{array}{ccccc}
 \mathbf{E} & = & \mathbf{P} & \times & \mathbf{t} \\
 \text{Energy used} & & \text{Power rating} & & \text{Time used} \\
 \text{(kW·h)} & & \text{(kW)} & & \text{(h)}
 \end{array}$$

Practice

5. A hair dryer is rated at 1200 W. On average, it used for 5 min each school day in the morning.

a) Convert 5 minutes to a time in hours.

5 min = _____ h

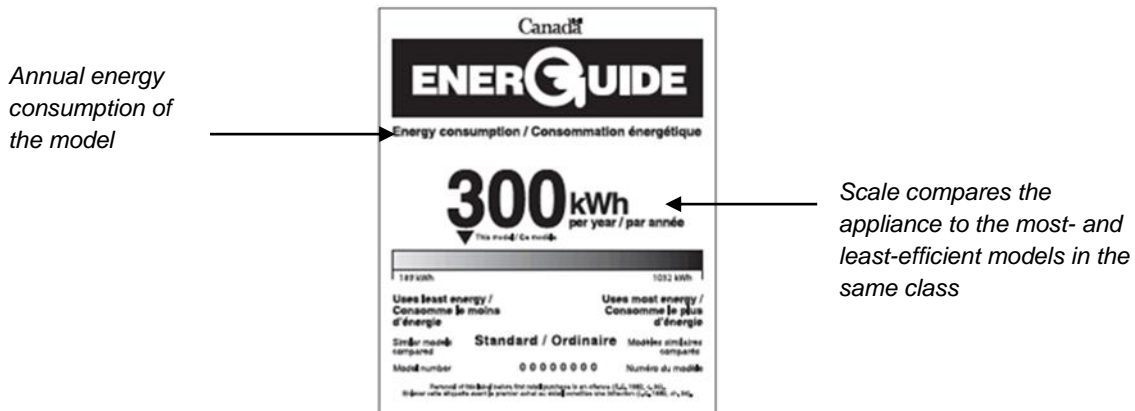
b) Calculate the amount of energy, in **kW·h**, that is consumed each school day by the hair dryer.

c) How much energy is consumed on all five school days in a week?

d) The cost of electrical energy is 10.9¢/kW·h. Calculate the cost of using the hair dryer for five days.

EnerGuide labels

All Canadian appliances have an EnerGuide label. This allows consumers to make informed decisions when purchasing appliances.



6. Interpret the graphic:

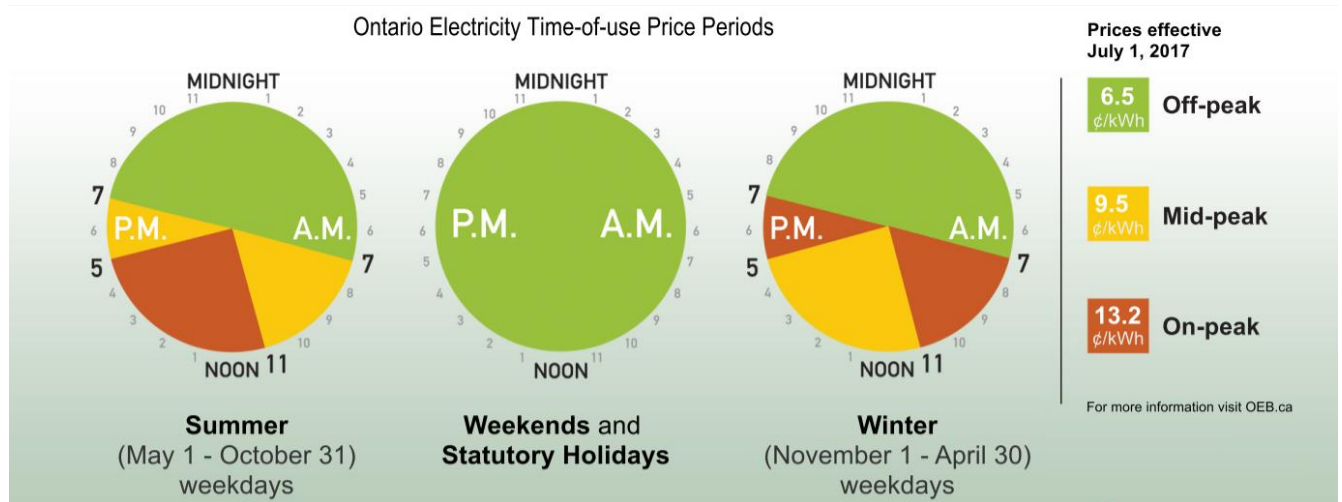
a. How much energy does this appliance consume, per year? _____

b. Approximately how much energy does it use, per **day**? (Round to two decimals) _____

c. In terms of energy consumption, how does this appliance compare to other, similar appliances? _____

Time-of-Use Pricing

- **Time-of-use pricing** - A system of pricing, where the price that is charged per kW-h of energy is different depending on the time of the day or week.
- three different time of use prices: off-peak, mid-peak, on-peak
- intervals are adjusted twice a year (summer and winter)
- Energy consumption is monitored by a **smart metre**, which records hourly energy usage.



7. Interpret the graphic. Use correct units, where appropriate.

	Summer weekdays	Winter weekdays	Price
Off-peak hours			
Mid-peak hours			
On-peak hours			

Phantom Loads

9. What is a phantom load? _____

Features of typical devices with phantom loads:

- remote controls
- feature rechargeable batteries
- continuous display
- external power supplies

Practice Problems: Power, Energy & Cost

1. Convert the following power ratings to kW:

- a. 1300 W _____ b. 60 W _____ c. 900 W _____

2. Convert the following times to hours:

- a. 5 min _____ b. 20 min _____ c. 70 min _____

3. How much energy is used when a 1.25 kW toaster oven is used for a total of 3 h in a month?

4. The estimated average energy that is used to operate a clothes dryer for a year is 912 kW·h. If the average rate to operate the dryer is 7.15¢/ kW·h, what is the average cost per year?

5. Calculate the cost of watching television for 3 hours at night at a rate of 8.8 ¢/kW·h. The television has a power rating of 150 W.

Answers:

(1a) 1.300 kW (b) 0.060 kW (c) 0.900 kW (2a) 0.08 h (b) 0.33 h (c) 1.2 h
(3) 3.75 kW·h (4) \$65.21 (5) 4 cents