



SUBJECT and GRADE	Physical Sciences Grade 11
TERM 3	Week 6
TOPIC	Electrical Energy, Power and Cost.
AIMS OF LESSON	At the end of this lesson you should be able to know and be able to apply the following: Power, energy • Define power as the rate at which work is done or energy is transferred. • Solve problems using $P = \frac{W}{\Delta t}$. • Recall that $W = VQ$, and therefore, by substituting $V = IR$ in the equation, $W = VI\Delta t$, $W = I^2R\Delta t$ and $W = \frac{V^2}{R}\Delta t$ are obtained. • Deduce, by substituting $P = \frac{W}{\Delta t}$ into above equations, the following equations: $P = VI$, $P = I^2R$ and $P = \frac{V^2}{R}$. • Solve problems using $P = VI$, $P = I^2R$ and $P = \frac{V^2}{R}$. • Solve circuit problems involving the concepts of power and electrical energy. • Deduce that the kilowatt-hour (kWh) refers to the use of 1 kilowatt of electricity for 1 hour. Know that 1 kWh is an amount of electrical energy, also known as one unit of electricity. • Calculate the cost of electricity usage given the power specifications of the appliances used, the duration and the cost of 1 kWh.

RESOURCES	Paper based resources Text books, pen and paper. Mind the Gap page 108 and 109	Digital resources https://www.youtube.com/watch?v=41-37Kv_ljw https://www.youtube.com/watch?v=2cuNnN_Cop0 https://www.youtube.com/watch?v=nnsI-IIhdM https://www.youtube.com/watch?v=SMPhh8gT_1E
INTRODUCTION	Watch the videos and study the following concepts. 1 Electrical <u>Energy</u> 2 Electric <u>Power</u> 3 Electrical <u>Cost</u> Study the meaning and units of each of the following SYMBOLS: W, V, I, R, Δt and P Study the exam example and practice more questions. These questions are usually at the end of the question about electrical circuits.	
CONCEPTS AND SKILLS	7.5 Electric energy When current flows or charges move through a resistor: - electric energy is transferred from the moving charges to the particles in the resistor - the particles in the resistor gain kinetic energy - the temperature of the resistor increases as the kinetic energy of the particles increases. Formulas The work done (W) is equal to the energy (E) transferred. $W = E$ (in joule J) $W = VQ = VIt = I^2Rt = \frac{V^2t}{R}$ W: work done (J) joule V: potential difference (V) volt I: current (A) ampere R: resistance (Ω) ohm t: time (s) seconds <i>If you are asked to calculate the amount of energy transferred, use the correct formula to calculate the work done</i>	The following steps are recommended: 1 Read the question a few times. 2 Identify the given variables. 3 Select the appropriate formula. 4 Do the calculations. 5 Remember the unit in the final answer. 

CONCEPTS AND SKILLS

Power



DEFINITION

Power is the rate at which work is done or energy is transferred.

$$P = \frac{W}{\Delta t} = VI = I^2R = \frac{V^2}{R}$$

P:	power	(W) watt
W:	work done	(J) joule
V:	potential difference	(V) volt
I:	current	(A) ampere
R:	resistance	(Ω) ohm
t:	time	(s) seconds



The brightness of light bulbs

The brightness of a light bulb is determined by the rate at which energy is transformed in the bulb, that is, by the power (P).

- As the power increases, the brightness increases.
- For bulbs in series:
 - $P \propto R$ (power is directly proportional to the resistance of the bulb)
 - $\therefore$ if the resistance increases, the power increases and the brightness increases.

- For bulbs in parallel:
 - $P \propto \frac{1}{R}$ (power is inversely proportional to the resistance of the bulb)
 - $\therefore$ if the resistance decreases, the power increases and the brightness increases.

Note: the above applies to incandescent bulbs only (the type with a filament of wire).

Compact Fluorescent Lights (CFL) come in a range of power/wattages but they will simply blow if overpowered by a significant increase in voltage/ampereage.

CONCEPTS AND SKILLS

COST

Energy is provided and measured in kilowatt hour (kWh).

Units = Power (**kW**) x time (**hours**)

If the cost of 1 kWh is known, you can find the cost to run a kettle or other piece of apparatus.

Cost = Units x Price per unit.



ACTIVITIES/ ASSESSMENT	Copy the summary at the beginning (aim) of the lesson in your workbook. <i>Study example:</i> A geyser, labelled 2 000 W, is used for an average of 5 hours per day. The cost of electricity is 80 cents per kWh. 1 Calculate the energy used by the geyser for 5 hours per day. (4) 2 Calculate the cost of electricity to operate the geyser for a month with 30 days. (2) 1 $P = \frac{W}{\Delta t}$ ✓ $2\,000 \text{ ✓} = \frac{W}{18\,000} \text{ ✓}$ $W = 3,6 \times 10^7 \text{ J ✓}$ (4) 2 Cost = price x unit kWh / <i>Koste = prys x eenheid kWh</i> Cost = 80(2)(5)(30) ✓ Cost = 24 000 cents = R240 ✓ (answer can be given in rand or cents) (antwoord kan in rand of sent gegee word) (2) More questions available on the question papers. https://www.ecexams.co.za/ExaminationPapers.htm
CONSOLIDATION	<u>Do you know?</u> Definitions, Meaning and units of Symbols? <u>Will you be able to...</u> 1 Calculate Energy, Power and Cost? 2 Compare the brightness of light bulbs? The next lesson will have more consolidation exercises.
VALUES	<i>Electrical appliances are used daily and therefore these calculations of electrical energy are very important. The energy change per unit time (power) plays a role in the decisions you make when purchasing electrical appliances.</i> <i>(A 2kW hair dryer works faster than one with 1500 W power)</i> <i>Electrical appliances can be used with more responsibility if you understand the concept of Cost well.</i>