PHYSICS LESSON NOTE FOR SS ONE
DATE: 27th APRIL, 2020
TOPICS: ELECTRICAL ENERGY AND POWER, BUYING AND SELLING OF ELECTRIC POWER
SUB-TOPICS: ELECTRICAL WORK/ ENERGY AND POWER.

OBJECTIVES: At the end of the lessons, Students should be able to:
1 define electrical work
2.define electrical power
3.derive equations on electrical power and work.
4.solve equations on electrical work and power.

INTRODUCTION

ELECTRICAL WORK
Work is said to be done when electricity flows from one to point to another of different potential. If Q coulomb of electricity flows between the two points whose difference in potential is V volts. Then work (W) done is given by

W = QV----------(1)

Quantity of charge is given by Q= It--------(*)

Substitute eqtn (*) into (1), we have W = Ivt----------(2)

From Ohm's law V= IR---- (#)

Substitute (#) into (2), we have W= I^2Rt----------(3)

ELECTRICAL POWER
Power is defined as rate of doing.

$$P = \frac{work\ done}{time} \text{ (Joule)/sec.}$$

Electrical Power: Is the amount of electrical work done per second.

From eqtn (2) i.e. W = Ivt

$P = \frac{w}{t} = \frac{Ivt}{t} = \therefore \boldsymbol{p = IV}$**--------(4)**

Also, from V= IR, I = $\frac{V}{R}$-------(a)

Substitute eqtn (a) into 4, we have $P = V^2/R$------(5)

From V= IR, substitute it into eqtn (5), we have

$P = I^2R$.----------(6)

Unit of power is watt. Other units of watt are

1 KW = 1000W = 10^3W

1 MW = $10^6 = 10^3$KW

Example 1: A heater is marked 10v, 5A, calculate the electrical power of the heater.

Data

Voltage = 10V

I = 5A

P= ?

Using P = IV we have P = 5 x 10 = 50 Watt

Example 2: Calculate the energy expended by a car head light if gives a current of 6A in 10mins and has a resistance of 5Ω.

Data

I = 6A

t = 10mins= 10 x 60= 600 secs

R = 5Ω.

Using $W = I^2Rt = 6^2 \times 5 \times 600 = 108000J$

Example 3: find the resistance of a filament bulb that draws a current of 2A if it is has an electrical power of 40W.

Data

I = 2A

P = 40W

R = ?

Using $P = I^2R$

$40 = 0.5^2 \times R = R = 40/2^2 = 40/4 = 10\Omega$.

BUYING AND SELLING OF ELECTRIC POWER

Electric energy consumption is measured and sold by NEPA in units of kilowatt-hour (Kwh).

Units of electrical energy

1Kwh = 1000W

Ikwh = 3.6×10^6J

Example 1: An electric bulb marked 60W lights up a room for 20hrs, the number of kilowatt consumed is ------

Solution

Energy = $\frac{60}{1000} Kw$ x 20hr = 1.2Kwh

If Nepa charges at 10K per kwh, the cost is 1.2 x 10 = 12kobo.

Example 2: A bulb marked 60W is used to light up a room for 10hrs. What is the cost of energy, if Nepa charges at ₦2 per kwh.

Solution

Power = 60W

In Kwh $\frac{60}{1000}$ x 10= 0.6Kwh

Example 3: A heater rated 5Ω boils water for 2hrs. If the heater supplies current of 5A, What is the cost of consuming energy if Nepa charges at 3Kobo per kWh.

Solution

$P = I^2 R = 5^2 \times 5 = 25 \times 5 = 125$Watt

In Kwh= $\frac{125}{1000}$ x 2 = $\frac{250}{1000}$ = 0.25Kwh

cost = 0.25 x 2 = 0.5K **ans**

Assignment

1. Define Electrical Power
2. Derive the three equations of power and that of Electrical work.
3. Calculate the Electrical power of a lamp rated 5A and 240V
4. Find the work done by a heater dissipating
5. What is the cost of lightening 240W lamp that lights up a house for 4 hours. If Nepa charges at the rate of 2 kobo per kwh.
6. Convert 800 watt to kwh.
7. What is the cost of lightening 200W lamp that lights up a house for 6 hours? If Nepa Charges at the rate of 4 kobo per kwh.