UNIT 1: DC CIRCUITS

TUTORIAL SHEET: WEEK 1

Basic Electrical Quantities

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Tutorial (Poll 1)

- Which among the following expressions relate charge, voltage and capacitance of a capacitor?
  a) $Q=C/V$
  b) $Q=V/C$
  c) $Q=CV$
  d) $C=Q^2V$

Question No. 1

The current flowing through an element is

$$i = \begin{cases} 4\ \text{A}, & 0 < t < 1 \\ 4t^2\ \text{A}, & t > 1 \end{cases}$$

Answer: 13.333 C.

Calculate the charge entering the element from $t = 0$ to $t = 2$ s.

$$Q = \int i\,dt = \int_0^1 4A + \int_1^2 4t^2$$

$$= 4t + 4\frac{t^3}{3} = 4[1-0] + \frac{4}{3}\left[2^3 - 1^3\right]$$

$$= 4 + \frac{4}{3} \times 7 = 4 + \frac{28}{3} = \frac{40}{3} = 13.33$$

Tutorial (Poll 2)

- What is the voltage across a capacitor at the time of switching, that is, when t=0?
  a) Infinity
  b) 0V
  c) Cannot be determined
  d) 1V

Tutorial (Poll 3)

- Which of the following statements are true?
  a) Power is proportional to voltage only
  b) Power is proportional to current only
  c) Power is neither proportional to voltage nor to the current
  d) Power is proportional to both the voltage and current

Question No. 2

- A 250V bulb passes a current of 0.3A. Calculate the power in the lamp.
  a) 75W
  b) 50W
  c) 25W
  d) 90W
- Solution: Here, V = 250v and I = 0.3A. P=VI. Which implies that, P=250*0.3=75W.

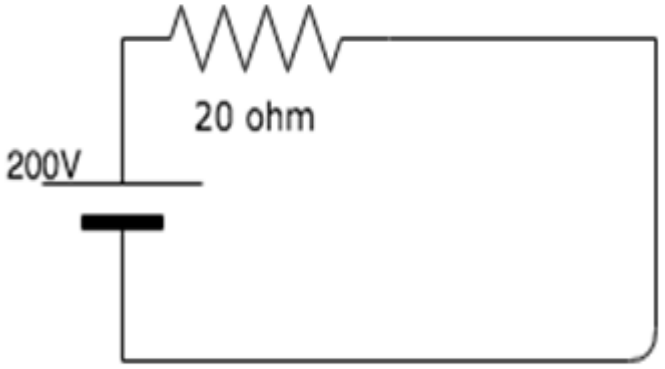
Tutorial (Poll 5)

- Kilowatt-hour(kWh) is a unit of?
  a) Current
  b) Power
  c) Energy
  d) Resistance

Question No. 3

- Calculate the power in the 20 ohm resistance.

a 2000kW
b) 2kW
c) 200kW
d) 2W



- Solution :Here V = 200v and Resistance(R) = 20ohm. $P=V^2/R= 200^2/20=2000W=2kW$.

Question No. 4

How much energy does a 100-W electric bulb consume in two hours?

Solution:

$$w = pt = 100\,(\text{W}) \times 2\,(\text{h}) \times 60\,(\text{min/h}) \times 60\,(\text{s/min})$$
$$= 720{,}000\,\text{J} = 720\,\text{kJ}$$

This is the same as

$$w = pt = 100\,\text{W} \times 2\,\text{h} = 200\,\text{Wh}$$

The electric power utility companies measure energy in watt-hours (Wh), where

$$1\,\text{Wh} = 3{,}600\,\text{J}$$

Question No. 5

- Two bulbs 100W,250V and 200W,250V are connected in series across a 500V line. Then what will happen??
- a)100W will fuse
- b)200W will fuse
- c)both will fuse
- d)no bulb will fuse

Solution Question No. 5

Power $= \frac{V^2}{R}$, so Resitance R= $\frac{V^2}{P}$

The 100W bulb has a resistance $= \frac{250 \cdot 250}{100}$ =625 ohms

The 200 W bulb resistance will be half above = 312.5ohms

Total resistance in series - 937.5 ohms

So total series current = $\frac{V}{R} = \frac{500}{937.5}$ =0.533A

Power dissipated in Bulb 1: $I^2 \cdot R = 0.533^2 \cdot 625$ =177.5W

Power dissipated in Bulb 2 wil be half above: 88.5 W

Bulb1 , a 100W unit, will eventually burnout.

Question No. 5

Does a Nickel-Cadmium(Ni-Cad) battery pack rated at 6 V and 950 mA-hours store more or less energy than a Li-Ion battery pack rated at 7.2 V and 900 mA-hours?

Solution

$E = V \times Q = V(It)$

We can directly compare the two by converting their respective energies into joules. The Ni-Cad battery pack stores $6 \times 950 \times 3600/1000 = 20520$ J, while the Li-Ion battery pack stores $7.2 \times 900 \times 3600/1000 = 23328$ J. Thus the Li-Ion battery pack stores more energy.

The electric power utility companies measure energy in watt-hours (Wh), where

$$1 \text{ Wh} = 3{,}600 \text{ J}$$

Question No. 6

- A 2 Volt cell is connected to a 1 Ω resistor. How many electrons come out of the negative terminal of the cell in 2 minutes?

Question No. 7

- A 100W, 250V bulb is put in series with a 40W, 250V bulb across 500V supply. What will be the current drawn, what will be the power consumed be each bulb and will such a combination work?

Question

- 1.Calculate the potential difference required across a conductor of resistance 10 Ω to pass electric current 1.5 A through it.
- 2.How many electrons pass through a lamp in one minute if the current be 220 mA?
- 3.A 2 Volt cell is connected to a 1 Ω resistor. How many electrons come out of the negative terminal of the cell in 2 minutes?
- 4.An electric motor takes 5 A from a 220 *V* line. Determine the power of the motor and the energy consumed in 2 hour.
- 5.A resistor **R** is connected in series with a parallel circuit comprising of two resistances 12 and 8 ohms respectively. The total power dissipated in the circuit is 96 watts when applied voltage is 24V. Calculate the value of **R.**