Fall '95

PHYSICS 115 – Problems

1) Consider a 100 *Watt*, 115 *Volt* incandescent lamp (light bulb).

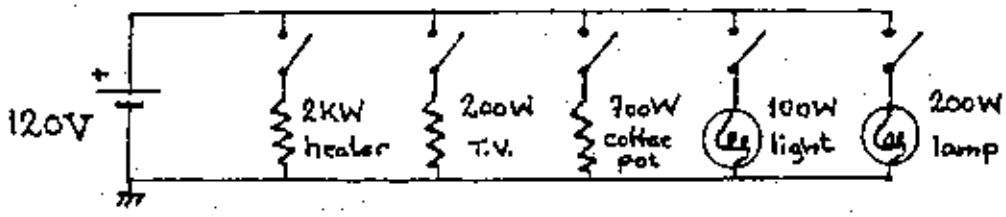
   a.) What is the current through the lamp?

   b.) What is the resistance of the lamp?

2) What is the cost (at \$.07 *per KWhr*) to leave a 100 *W* light on for 24 hours? How much energy did you use up?

3) How fast can a 10 *kg* object be raised, at constant speed, by power from 2 *Amp* current at 110 *V*?

4) Find the resistance of each appliance and the total current though the battery:



   a.) When each switch (alone) is closed.

   b.) When any two are closed.

   c.) When all five are closed.

6) A heat pump is used to warm a building. The outside temperature is $-10°C$ and the temperature inside the building is $+20°C$. Heat is to be supplied to the inside of the building at the rate of 1 Cal/sec (*i.e.* 1000 cal/sec). *Use the Carnot formulae as necessary to answer the questions below.*

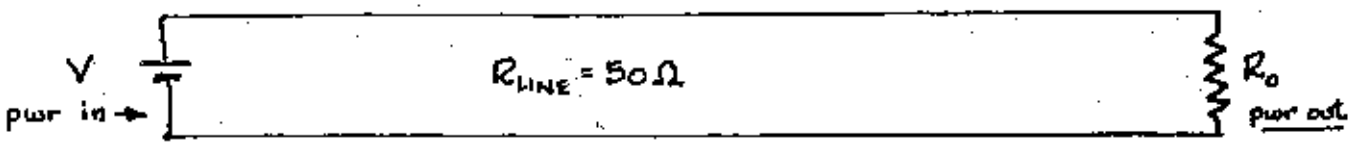
a.) What will be the rate at which heat is taken from the outside environment?

b.) What is the amount of heat taken from the outside environment per day?

c.) What electric power will be required to operate this heat pump?

d.) If the cost of electric power is \$0.07 *per* $KW\,hr$. what is the charge per mouth (30 days)?

30.) A long transmission line has a total (round trip) resistance of 50 Ω. The input power applied to one end of the line is 2 MW.



a.) If the voltage of the source is 40 KV, what fraction of the input power is dissipated by the resistance of the line?

b.) Answer the same question if the input voltage were 400 KV.

31.) A waterfall has a height of 60 meters and a total water flow of 1500 cubic meters per hour. How many amperes of current at a voltage of 50 KV could be generated by this fall?

32.) How many kilowatt hours of electric energy is required to heat 8 liters of water from $68^\circ F$ to $120^\circ F$?

33.) If a battery contains 10 *Kilomole* of energy storing chemical, (that is 6×10^{27} molecules); and if each molecule can store 0.2 electron volt of energy ($1\ eV = 1.6 \times 10^{-19}\ J$), for how long a time can this battery supply 25 KW of power?

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31. What area of ground is needed to supply a power of 2KW to each of 3×10^6 people?

The solar constant is 4/3 KW-m^{-2} at the top of the atmosphere. Assume the efficiency of conversion of sunlight energy to usable power is:

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{5} = \frac{1}{80}$$

- $\frac{1}{5}$ — photovoltaic efficiency
- $\frac{1}{2}$ — obliquity
- $\frac{1}{2}$ — weather
- $\frac{1}{2}$ — night and day
- $\frac{1}{2}$ — atmosphere