

PHYS 1200 Physics of Everyday Experience

Review questions and exercises for Lecture 26 (E&M-4)

1. What is alternating of AC electrical power?
2. How is AC power produced?
3. What are the advantages of AC vs. DC power?
4. What energy sources are used to produce AC power?
5. What is the role of transformers in the electric power grid?
6. What is a Ground Fault Circuit Interrupter (GFCI)?
7. Why is AC power transmitted at high voltages?
8. When you pay your electricity bill, do you pay for power used or energy?
9. Why is it advantageous to replace conventional incandescent lights with compact fluorescent lights?
10. A light bulb operates at 2 A on a 100 V power line. What would it cost to operate this light bulb for an entire week in South Dakota, where electricity costs are 6 cents/KWH, and in Hawaii, where electricity costs are 17 cents/ KWH?

Answers and solutions:

1. With alternating current AC power the current reverses direction 60 times per sec.
2. AC power is produced in an electrical generator which consists of a coil of wire that is rotated in a magnetic field.
3. Voltages in an AC power system can be changed using transformers, and AC plants can be located far away from the cities they supply.
4. Steam produced in a fossil fuel burning plant or nuclear power plant, hydroelectric power, and wind power.
5. Transformers are used to step-up the voltages coming from the power plant for transmission and then stepped-down for distribution to homes.
6. A GFCI is an electrical safety device that detects small amounts of current flowing in the ground circuit. Its purpose is to prevent electric shocks.
7. The power transmitted P is the product of current and voltage. If large currents are transmitted this requires that the transmission lines use large diameter conductors to minimize losses. Power is more efficiently transmitted at high voltage and low currents.
8. Your electricity bill is the cost for the total amount of electrical energy used over a certain period.
9. Incandescent bulbs produce a lot of heat compared to the light energy. Compact fluorescent lights produce less heat and are more efficient and produce the same light output for considerably less electrical power.
10. The number of kWh used = the power in kW x time in hours.

The power $P = IV = 2 \text{ A} \times 100\text{V} = 200 \text{ W} = 0.2 \text{ kW}$.

So # kWh = $0.2 \times (7 \text{ days} \times 24 \text{ hr/day}) = 33.6 \text{ kWh}$

Cost = # kWh x \$/kWh

(a) SD: cost = $33.6 \text{ kWh} \times \$0.06/\text{kWh} = \$2.02$

(b) HI: cost = $33.6 \text{ kWh} \times \$0.17/\text{kWh} = \$5.71$