split ring = DC generator
slip ring = AC generator

Electricity Power Distribution

Power transmitted at the sending end

$$P_s = VI \quad (1.13)$$

Power received at the receiving end

$$P_r = P_s - I^2R \quad (1.14)$$

Since P_s is limited by the capacity of the power plant, a high V would give a small I, which would then maximize the power received at the receiving end.

Sound

$$v = f\lambda \quad (1.15)$$

where f depends on source, v, λ changes with medium

$$Intensity\ I = \frac{Power}{Area} \propto \frac{1}{r^2} \quad (1.16)$$

$$Power = \frac{Energy}{Time} \quad (1.17)$$

$$L(dB) = 10\log\frac{I}{I_0} \quad (1.18)$$

$$\frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2 = 10^{\frac{dB_1 - dB_2}{10}} \quad (1.19)$$

$$\left(\frac{r_2}{r_1}\right) = 10^{\frac{dB_1 - dB_2}{20}} \quad (1.20)$$

$$dB_1 - dB_2 = 10\log_{10}\left(\frac{I_1}{I_2}\right) = 20\log_{10}\left(\frac{r_2}{r_1}\right) \quad (1.21)$$

conversion of log scale to linear scale:

$$x = s^{1-a}e^a \quad (1.22)$$

where x is the linear scale, s = starting no., e = ending number, a = proportion (0<a<1)
e.g. s = 2000, e = 5000, then mid way a = 0.5, x = 3160

double intensity : +3 dB
half intensity : -3 dB
L = sound intensity level, I_0 is the reference sound intensity, usually taken as threshold of hearing ($1\times10^{-12} Wm^{-2}$) at 1000 Hz
Significant diffraction if

$$\frac{\lambda}{w} \geq 1 \quad (1.23)$$

where w = the size of the opening/obstacle
The **phon** is the unit of equivalent loudness of a sound.

Wave reflections

	Fixed end / closed end	Open /Loose End
Transverse wave (string)	Inverted	Not inverted
Sound (longitudinal)	Not inverted	Inverted

Open end : pressure node / displacement antinode
Closed end : pressure antinode / displacement node

Nth Harmonic = n x f_1 (1.24)

Instrument opened/closed at both ends: ***all*** harmonics possible

$$\lambda_n = \frac{2L}{n} \qquad n \in N$$
$$f_n = \frac{nc}{2L} \quad (1.25)$$

L = length of instrument, n = 1 for fundamental.
Instrument closed at one end: **Only odd** harmonics possible (n odd)

$$\lambda_{2n-1} = \frac{4L}{2n-1} \qquad n \in N$$
$$f_{2n-1} = \frac{(2n-1)c}{4L} \quad (1.26)$$

.n = 1 for fundamental.
Mic and Principle:

Name	Principle
Carbon microphone	Change resistance
Crystal / Piezoelectric mic	Piezoelectric effect
Velocity mic	Electromagnetic induction
Electret-condenser mic	Varying capacitance
Dynamic (Moving Coil) Mic	Electromagnetic induction

Loudspeaker baffles separate front of the speaker from back so that sound at the back won't interfere with sound at front. High freq speaker directional, low freq not. Dynamic loudspeaker : magnetic field of the moving coil changes according to the signal, interact with a fixed magnet to create the driving mechanical force.