1. (-110), (2-31), (01-1) because $hu+kv+lw=0$

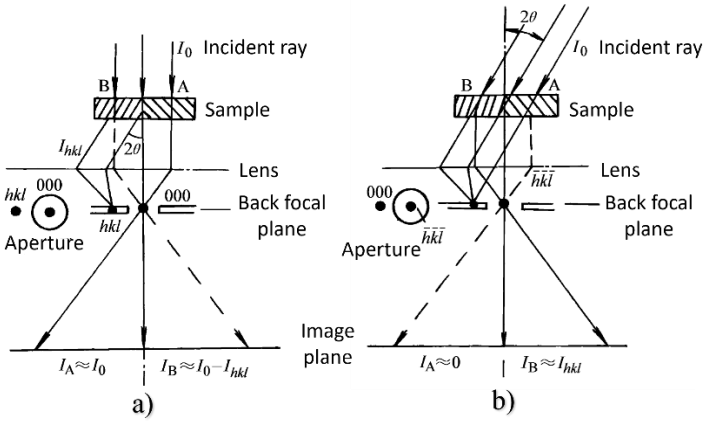
2. Aberration is divided into **spherical aberration**, **astigmatism,** and c**hromatic aberration**.
   - Spherical aberration is caused by the difference in the **refractive ability** of electrons between the central area and the edge area of the magnetic lens. Increasing the excitation current of the lens can reduce spherical aberration.
   - Astigmatism is caused by the **non-rotational symmetry** of the circumferential magnetic field of the electromagnetic lens. It can be compensated by introducing a corrective magnetic field with adjusted intensity and orientation.
   - Chromatic aberration is caused by a certain change in the **wavelength or energy** of electron waves. Stabilizing the accelerating voltage and lens current can reduce chromatic aberration.

3. The resolving power of optical microscopes mainly depends on the **wavelength** of the illumination source; **diffraction effects** and **aberrations** impact the resolution of electromagnetic lenses. Reducing the wavelength can reduce the diffraction effect. Considering the comprehensive effect of diffraction, the optimal aperture half angle is used.

4. (1). A wave spectrometer is an instrument used to detect the characteristic **wavelength** of X-rays, while an energy spectrometer is an instrument used to detect the characteristic **energy** of X-rays.
   (2). Advantages: 1) The energy spectrometer has **high efficiency** in detecting X-rays; 2) The energy of X-ray photons of all elements in the analysis point is **measured and counted at the same time**, and qualitative analysis results can be obtained within a few minutes, while the spectrometer can only measure the characteristic wavelength of each element one by one. 3) The structure is simple, and the stability and reproducibility are very good; 4) There is no need to focus; there are no special requirements for the sample surface, and it is suitable for rough surface analysis.
   (3). Disadvantages: 1) **Low resolution**; 2) The energy spectrometer can **only analyze elements with atomic numbers greater than 11**, while the wave spectrometer can measure all elements with atomic numbers from 4 to 92; 3) The Si (Li) probe of the energy spectrometer must be kept at a low temperature, so it must be cooled with liquid nitrogen from time to time.

5. (1). Due to the strong interaction between the diffracted beam and the transmission, the **intensity** of the transmitted wave and the incident wave in the crystal **oscillates periodically** in the **depth direction** of the crystal. The **depth period** of this oscillation is called the **extinction distance**.
   (2). Influencing factors: crystal characteristics, imaging lens parameters.

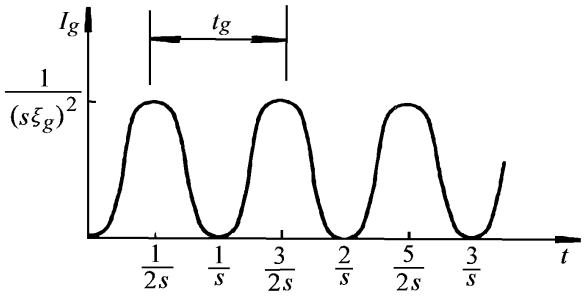
6. There are two types of crystal grains, A and B. Only grain B can produce diffraction. The intensity of the incident ray is I_0.
   For bright-field imaging, the diffracted ray of grain B is blocked. The intensity of I_A and I_B are: $I_A = I_0$, $I_B = I_0 - I_{hkl}$. The diffraction contrast can be calculated as $(I_A - I_B) / I_A = I_{hkl} / I_0$.
   For center dark-field imaging, only the diffracted ray can pass through the aperture. The intensity of I_A and I_B are: $I_A = 0$, $I_B = I_{hkl}$.



7. For equal thickness fringes, the deviation parameter ***s*** is constant, so we have:

$$I_g = \frac{1}{(s\xi_g)^2}\sin^2(\pi st)$$

The I_g changes periodically with sample thickness ***t*** with period $t_g = 1/s$.



For equal inclination fringes, the sample thickness ***t*** is constant. I_g changes with deviation parameter ***s***.

$$I_g = \frac{(\pi t)^2}{\xi_g^2}\frac{\sin^2(\pi ts)}{(\pi ts)^2}$$