

Microscope simple and compound · companion to the class notes of 28 September 2026

Reading note. The two coloured Hinglish boxes repeat points made in the English key ideas; readers who do not know Hindi can skip them without losing any physics.

Key ideas

- The eye sees the image on the retina.** It must be *large* (more cells, more detail — like pixels), *bright* (strong signal) and *sharp* (focused at the retina).
- Angular size** $\theta \approx h/d$ decides the size of the retinal image. What matters is angular size, not actual size.
- Near point** $D = 25$ cm (unless given): nothing the eye looks at may be closer than D . A device's job is to increase angular size while keeping what the eye looks at no closer than D .
- One method for every derivation:** without the device the best is $\alpha = h/D$, always. Find β with the device. $M = \beta/\alpha$.
- Simple microscope:** convex lens of short f , eye right at the lens (the angle, and so M , is largest there). Object between F and $O \rightarrow$ virtual, erect, enlarged image.
- Two settings for every device.** *Strained eye:* image at D , maximum M . *Relaxed eye = normal adjustment:* image at infinity, object at the focus, minimum M . The sacrifice is exactly 1.
- Compound microscope:** objective (object just outside $F_o \rightarrow$ real, inverted, magnified image) + eyepiece (used exactly as a simple microscope: that image at F_e or just inside). $M = m_o \times m_e$. Final image virtual, inverted.
- The tube:** keeps both lenses aligned on one axis at fixed L ; is moved as a whole to focus; cuts out other light.

Formula sheet

	Image at D (strained, max)	Image at infinity (normal adjustment)
Simple microscope	$M = 1 + \frac{D}{f}; \quad u = \frac{Df}{D+f}$	$M = \frac{D}{f}; \quad u = f$
Eyepiece	$m_e = 1 + \frac{D}{f_e} = \frac{D}{u_e}$	$m_e = \frac{D}{f_e}, \quad u_e = f_e$
Objective	$m_o = \frac{v_o}{u_o} = \frac{v_o}{f_o} - 1; \quad v_o = L - u_e \text{ (at } D)$	or $v_o = L - f_e \text{ (at infinity)}$
Compound, exact	$M = \left(\frac{v_o}{f_o} - 1\right) \left(1 + \frac{D}{f_e}\right)$	$M = \left(\frac{v_o}{f_o} - 1\right) \frac{D}{f_e} = \frac{L - f_e - f_o}{f_o} \cdot \frac{D}{f_e}$
Compound, approximate	$M \approx \frac{L}{f_o} \left(1 + \frac{D}{f_e}\right)$	$M \approx \frac{L}{f_o} \cdot \frac{D}{f_e}$

L = distance between the lenses = $v_o + u_e$. Large M needs small f_o , small f_e , large L . Usually $f_o < f_e$.

Special cases and traps

- Read the setting first.** "Normal adjustment / relaxed / least strain" $\Rightarrow$ infinity, no $+1$. "Near point / least distance of distinct vision / maximum" $\Rightarrow +1$.
- Virtual image** $\Rightarrow v = -D$ in the lens formula. Check: for a simple microscope or eyepiece the object distance must come out *less than* f .
- Image at D :** $u_e \neq f_e$. Find u_e from $u_e = D/m_e$ (or the lens formula) before writing $v_o = L - u_e$.
- Magnifying power is a ratio of angles**, not h'/h . They coincide only when the image is at D .
- Exact or approximate?** If u_o, v_o or image positions are given, work exactly. If only L, f_o, f_e are given, the approximate form is usually expected — but it overestimates when $f_o + f_e$ is not small beside L ; in an MCQ try both.
- Object never at F_o or inside it:** the objective's real image must fall inside the tube, so $v_o \leq L - f_e$.
- Sign:** the final image is inverted, so M may be printed negative. **Given** D (e.g. 20 cm, or a person's own near point): use it, not 25.

Seedhi baat. $\alpha = h/D$ hamesha same; har baar sirf β nikalna hai, $M = \beta/\alpha$. Compound microscope mein eyepiece wahi simple microscope hai; naya kaam sirf objective ka — $m_o = v_o/u_o$. Total = dono ka product.

Dhyaan rahe. Pehle setting pakdo — normal adjustment (infinity, $+1$ nahin) ya near point ($+1$). Virtual image ke liye $v = -D$. Aur image D par ho to u_e, f_e ke barabar nahin hota.