Optics

MAKE IT MAKE SENSE

All FRCOphth formulas:
Zero fluff. Maximum recall.

LENS POWER CALCULATION:
$D = \frac{1}{f\ (m)}$ $D = \frac{100}{f\ (cm)}$

[D = lens power (diopters), f = focal length]

VERGENCE FORMULA:
$V = \frac{n}{l\ (in\ air)}$ $U + D = V$

[U = object vergence, D = lens power(diopters), V = image vergence]

SNELL'S LAW:
$n_1 \sin \theta_1 = n_2 \sin \theta_2$

[n_1 = refractive index of the incident medium, θ_1 = Angle of incidence, n_2 = Refractive index of the refractive medium, θ_2 = Angle of refraction]

CRITICAL ANGLE:
$\sin C = \frac{n_2}{n_1}$ (where $n_1 > n_2$)

[C = critical angle, n_1 = refractive index of the denser medium, n_2 = refractive index of the rarer medium]

REFRACTIVE INDEX:
$n = \frac{C}{V}$

[n = refractive index, C = speed of light in vacuum, V = speed of light in medium]

- Common Values: Air is ≈1.0003, water 1.33 & glass ≈1.5.

POWER OF SPHERICAL REFRACTING SURFACE:
$D = \frac{n_2 - n_1}{r}$

[D = power (diopters), n_1 & n_2 = refractive indices, r = radius of curvature]

REFLECTING POWER OF SPHERICAL MIRROR:
$D = \frac{100}{f} = \frac{200}{r}$

[D = lens power (diopters), f = focal length (cm), r = radius of curvature (cm)]

Thin Lens Equation:
$\frac{1}{F} = \frac{1}{U} + \frac{1}{V}$

[F = focal length of the lens, U = object distance, V = image distance]

ACCOMMODATION:
Amplitude = 1 / Near point (m)

PRENTICE'S RULE:
PD = h × D

[PD = prism deviation (Δ), h = distance from optical center (cm), D = lens power (diopters)]

PRISM POWER:
1Δ = 1 cm deviation at 1 m

[Δ = dioptre]

IOL POWER CALCULATION:
D = A – 2.5 (axial length) – 0.9 (average K)

[D = IOL power, A = constant]

SPECTACLE TRANSPOSITION:
Change cylinder sign
Add cylinder to sphere
Change axis by ± 90°

SPHERICAL EQUIVALENT:
SE = Sphere + (Cylinder / 2)

EFFECTIVE POWER OF A LENS A:
$D_2 = \frac{D_1}{1 - s\ D_1}$

[D_1 = old lens power (diopters), D_2 = new lens power (diopters), s = distance lens moves toward eye (m)]

EFFECTIVE POWER OF A LENS B:

$power_{effective} = (1 / (1 - d\ F))$

[d = distance (m), F = Vertex Power]

- If a +ve lens is moved further from the eye (d increases), its effective power increases (becomes more plus).
- If a –ve lens is moved further from the eye (d increases), its effective power decreases (becomes less minus/more plus).

REDUCED EYE VALUES:
Total power ≈ +60D
Cornea ≈ +43D
Lens ≈ +17D

TRANSVERSE MAGNIFICATION:
$M = \frac{\text{image height}}{\text{object height}} = \frac{\text{image distance}}{\text{object distance}} = \frac{U}{V}$

[M = magnification, U = object vergence, V = image vergence]

ANGULAR MAGNIFICATION:
M = D / 4

[M = magnification, D = lens power]

MAGNIFICATION OF TELESCOPE:
$M = D_{eyepiece} / D_{objective}$

[M = magnification, $D_{eyepiece}$ = power of eyepiece, $D_{objective}$ = power of objective]

SPECTACLE MAGNIFICATION:
M ≈ 1 + (hF)

[*h*= idistance from the lens to the eye, back vertex power of the lens]

- Plus Lenses (+F): M>1 Magnifies the image. Retinal images are larger in corrected hyperopia.
- Minus Lenses (–F): M<1 Minifies the image. Retinal images are smaller in corrected myopia.

COMMON PITFALLS:
- Convert cm → m
- Watch sign conventions (+/– lenses)
- Axis always 0–180
- Decentration must be in cm for Prentice