Wednesday, October 21, 2009
10:29 AM

Solution to Quiz 6: Section 0103

We have to first get Bill corrected for far vision, with involves seeing from relaxed eye. Ideally, he s'd be able to see objects REALLY far, i.e. at "∞".

Since he can only see objects 120 cm away, we want to have a lens that brings the image of an object at ∞ to 120 cm. (The eye picks up after that)

Further the image at 120 cm has to be virtual so that it is upright. The eye "sees" this image effectively, so it better be upright

We now use the lens formulae

$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$$

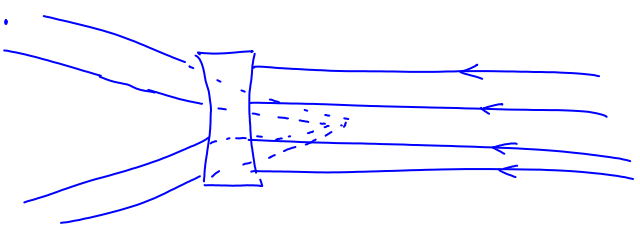
$s = \infty$

$s' = -120$ cm

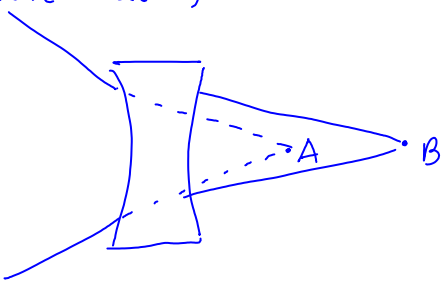
$$\Rightarrow \frac{1}{f} = \frac{1}{\infty} + \frac{1}{-120} \Rightarrow f = -120 \text{ cm}$$

Hence the lens is a diverging lens.

That also makes sense from simple ray tracing.



But this lens affects the near-vision. Since it is a diverging lens, we expect his near-point to move away from the eye, i.e. increase



he c'd focus at A earlier, but that shifts to B now.

So, again using the lens formulae

$$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$$

$$\Rightarrow \frac{1}{s} = \frac{1}{f} - \frac{1}{s'} = \frac{1}{-120} - \frac{1}{-20} = \frac{-1}{120} + \frac{1}{20}$$

$$= \frac{-1}{120} + \frac{6}{120} = \frac{5}{120} = \frac{1}{24} \Rightarrow s = 24\,\text{cm}$$

Bill's new near point will now be 24 cm.