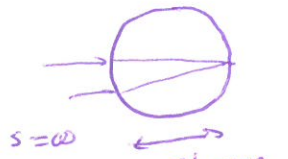
Class 15 34 – 75, 77, 80 handout

77: $m = \frac{-s'}{s}$ so $s' = 2s$ $\quad \frac{1}{s} + \frac{1}{s'} = \frac{3}{2}\frac{1}{s} = \frac{1}{f} = \frac{1}{35}$

$s = 52.5$ cm

virtual $\Rightarrow s' = -2s \Rightarrow \frac{1}{2}\frac{1}{s} = \frac{1}{f} \Rightarrow s = f/2$ $\quad s > 0$ so $f > 0$

75



$$\frac{1}{s} + \frac{n}{s'} = \frac{n-1}{R}$$

$$0 + \frac{n}{2R} = \frac{n-1}{R}$$

$$\frac{n}{2} = n - 1$$

$$1 = \frac{n}{2}$$

$$\boxed{2 = n}$$

so fact that image & object in same side $\Rightarrow$ virtual

$\frac{h}{s} = \frac{h'}{s'} \Rightarrow h' = 6.5\frac{3}{8} = 2.44$ mm

$\frac{1}{8} + \frac{1}{-3} = \frac{1}{f}$ $\quad f = -4.8$ cm $\quad \square$

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157, 60, 63, old exam

45: $\frac{1}{s} + \frac{1}{20\text{ m}} = \frac{1}{200}$ $\quad s = 1.02\times10^4\text{ mm} = 10.2\text{ m}$

57 $\frac{1}{s} + \frac{1}{-25} = \frac{1}{8}$ $\quad s = 6.06$

$M = \frac{-s'}{s} = \frac{25}{6.06} = 4.125 \Rightarrow 4.125\text{ mm}$

note: angular mag $= \frac{25}{8} + 1 = 4.125$ — note generally the same — eg for relaxed eye $s' = \infty$ so $M = \infty$

60 160 mm; $s' = 165$, $s = ?$, $f = 5$

$\frac{1}{s} + \frac{1}{165} = \frac{1}{5} \Rightarrow s = 5.156$

$M = \frac{-s'}{s}\frac{25}{f_e} = -\frac{165}{5.156}\frac{25}{2.6} = 308$

$\frac{\Delta h'}{f_e} = \frac{.01\text{ cm}}{25\text{ cm}}$ $\quad \Delta h = \frac{s}{s'}\Delta h' = \frac{5.156}{165}\,26\text{ mm}\,\frac{.01}{25} = 3.25\times10^{-4}\text{ mm}$

$= .3\,\mu\text{m}$

63 $s_{ep} = f_o + f_e = .65 + .011 = .661\text{ m}$

$\text{mag} = \frac{f_o}{f_e} = \frac{.65}{.011} = 59.1$

old exam $s' = ?$, $s = .51$, $f = .5$ $\quad \frac{1}{s'} + \frac{1}{s} = \frac{1}{f}$ $\quad s' = 25.5$ → s for eyepiece = 1.5

$\frac{1}{1.5} + \frac{1}{s'} = \frac{1}{1.6}$

$s' = -24\text{ cm}$ (apparent near point)

unaided: $\theta = \frac{1\,\mu\text{m}}{25\text{ cm}} = 4\times10^{-6}\text{ rad} = 2.3\times10^{-4}{}^\circ$

angular size $= \frac{1\,\mu\text{m}\cdot\frac{25.5}{.51}}{1.5\text{ cm}}$

$3.33\times10^{-3}\text{ rad} = .19^\circ$

ratio of angles = 833

image of objective is real, inverted

image of eyepiece is virtual, upright } 2 inverted overall