5) A point source S is located on the axis and 30 cm from a plano-convex thin lens. Suppose that the glass lens is immersed in air (n l = 1.5) and that it has a radius of 5 cm. Determine the location of the image (a) when the flat surface is toward S and (b) when the curved surface is toward S.

a) $\frac{1}{30} + \frac{1}{s_i} = (1.5-1)\left(\frac{1}{\infty} - \frac{1}{-5}\right)$ so $s_i = 15\text{cm}$

b) $\frac{1}{30} + \frac{1}{s_i} = (1.5-1)\left(\frac{1}{5} - \frac{1}{\infty}\right)$ so $s_i = 15\text{cm}$

6) A thin bi-convex glass lens (n = 1.5) has radii of curvature of 30 cm and 60 cm. If it is to form a half-sized image of a ceiling lamp on a screen, what must the lens-lamp and lens-screen distances?

$\frac{1}{f} = (1.5-1)\left(\frac{1}{30} - \frac{1}{-60}\right) \Rightarrow f = 40\text{cm}$

since $\text{mag} = \frac{i}{o} = 1/2$ and $\frac{1}{o} + \frac{1}{i} = \frac{1}{40}$

$\frac{1}{2i} + \frac{1}{i} = \frac{1}{40}$ so $\frac{3}{2i} = \frac{1}{40}$ and $i = 60\text{cm}$, $o = 120\text{cm}$

as a check $\frac{1}{120} + \frac{1}{60} = \frac{1}{40}$ ✓

7) Imagine a compound lens consisting of a thin positive lens followed at an interval of 20 cm by a thin negative lens. If these lenses have focal lengths of 40 cm and -40 cm, respectively, determine the value of f and the back focal length (b.f.l).

F.l. of thin lens combination: $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

$= \frac{1}{40} + \frac{1}{-40} - \frac{20}{-(40)(40)}$

$= \frac{20}{1600}$

$f = 80\text{cm}$

B.f.l.: 1: $\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$ so for $o = \infty$ $i = f$

2: $o = d - i = -20\text{cm}$ $\frac{1}{-20} + \frac{1}{i} = -\frac{1}{40}$ so $i = 40\text{cm}$ B.f.l. $= 40\text{cm}$