Assignment 2
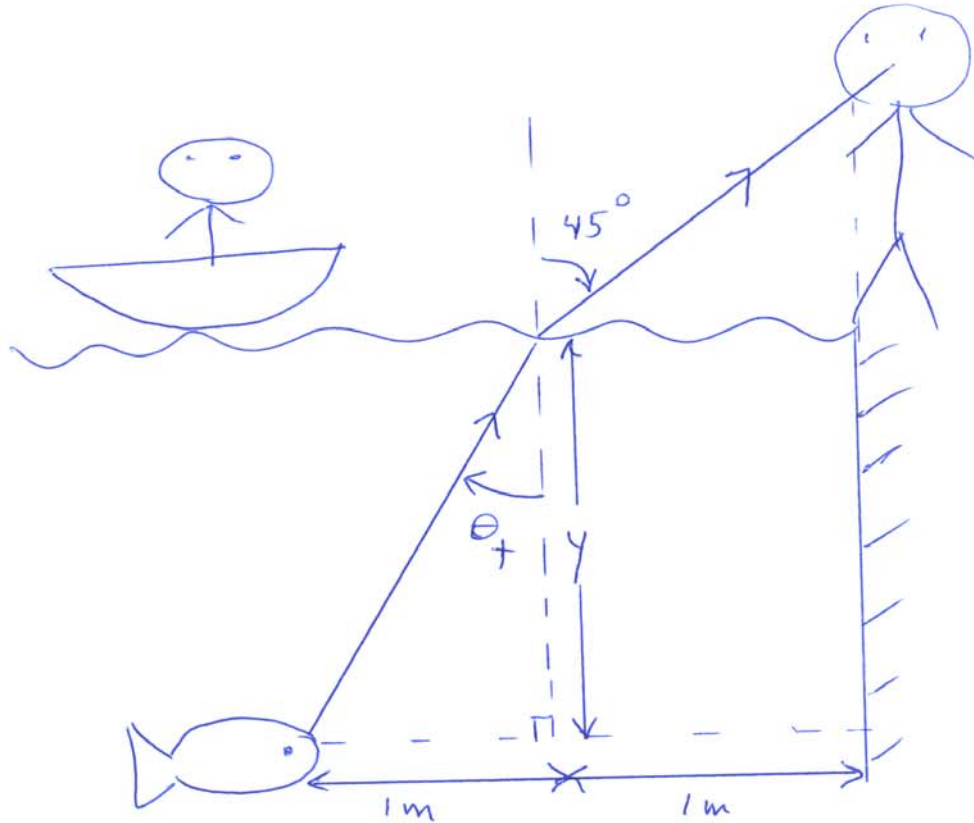
1. A fisherman 2 meters from shore sees a fish directly below. His one meter tall partner stands next to shore. He sees the fish and measures an angle of 45° for the light ray from the fish exiting the water surface. How deep should the fisher in the boat quickly cast his net to catch the fish?
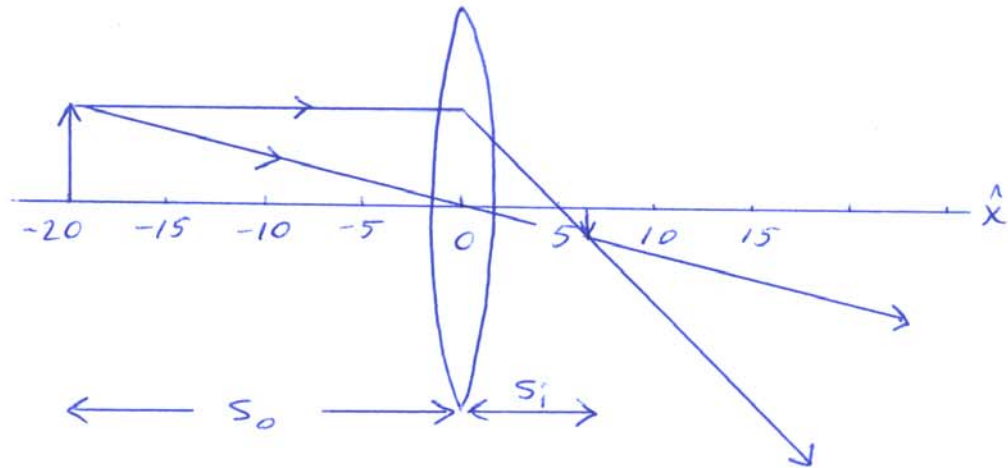

$$n_w \sin\theta_+ = \sin 45°$$

$$\sin\theta_+ = \frac{1}{\sqrt{2} \times 1.33}$$

$$\theta_+ = 32°$$

$$\tan\theta_+ = \frac{1}{y}$$

$$\therefore y = \frac{1}{\tan 32°} = 1.59m \text{ is depth of fish.}$$

2. Consider a 1 cm high object placed in front of a lens having a focal length of 5 cm. For object positions of 20, 7.5 and 2.5 cm, find:
   a) the image position
   b) the magnification
   c) draw a neat diagram showing the directions of the light rays
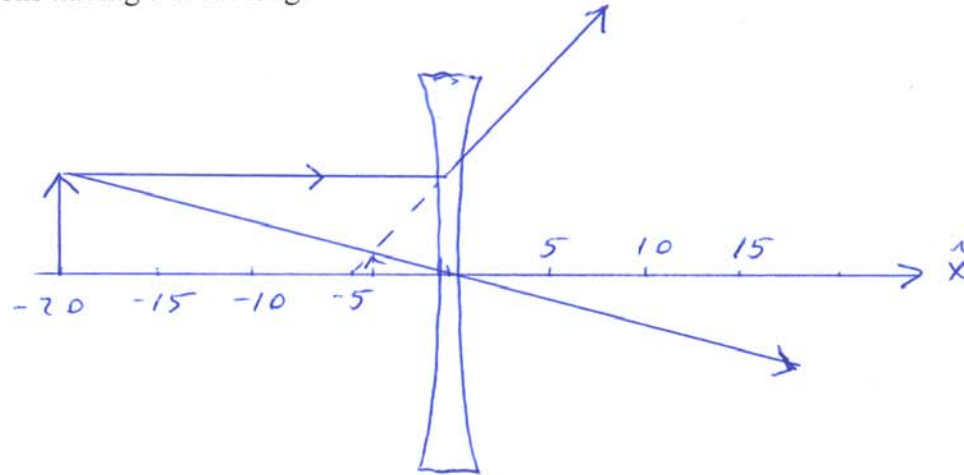   d) Is the image real or virtual, erect or inverted?

a) $\dfrac{1}{S_o} + \dfrac{1}{S_i} = \dfrac{1}{f}$

$\dfrac{1}{S_i} = \dfrac{1}{5} - \dfrac{1}{20}$

$S_i = 6.67\,cm.$

b) $M_T = \dfrac{|y_i|}{y_o}$

$= \dfrac{S_i}{S_o}$

$= 0.33\,cm.$

d) Image is real & inverted.

Object Position	Image Position	M_T	Image
20 cm.	6.67 cm.	0.33	Real Inverted
7.5	15	2	Real Inverted
2.5	-5	2	Virtual Erect

3.   Repeat question 2 for the same object if it is placed 20 cm in front of a concave
      lens having a focal length of 5 cm.

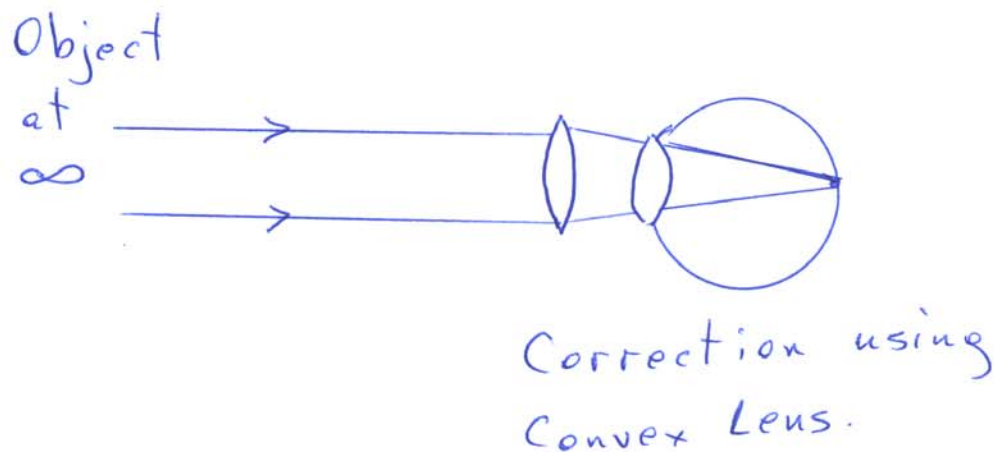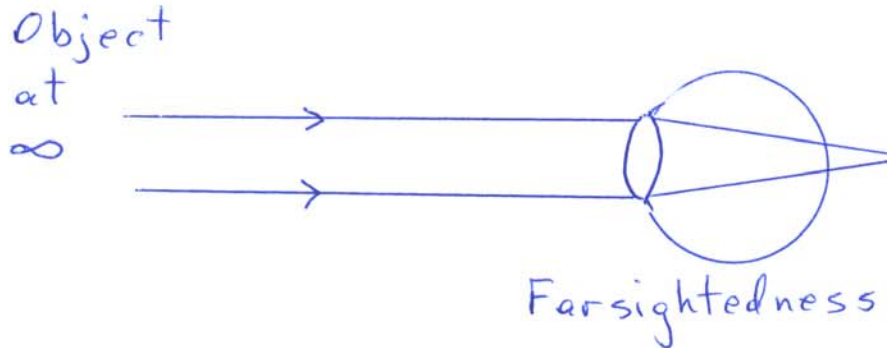a) $\dfrac{1}{20} + \dfrac{1}{s_i} = \dfrac{1}{-5}$

   $s_i = -4 \text{ cm}.$
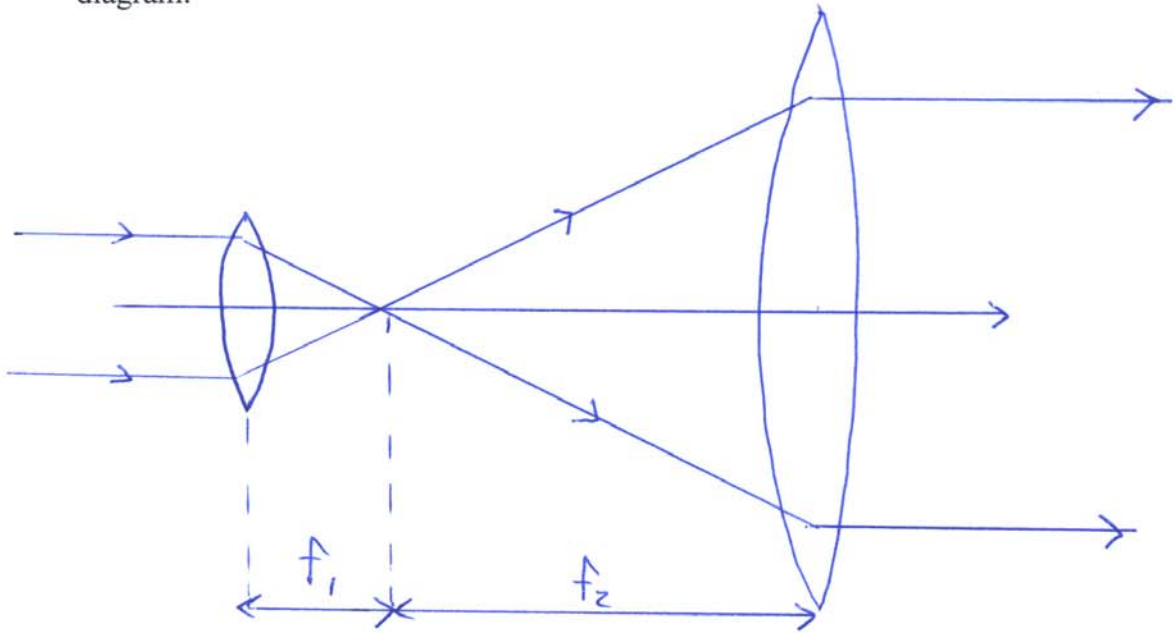
b) $M_T = \left|\dfrac{s_i}{s_0}\right|$

   $= \dfrac{1}{5}$

d) Image is
   Virtual & Erect

4.   Explain using a diagram what farsightedness is and how it is corrected with
      glasses.

Object
at
∞

Farsightedness

Object
at
∞

Correction using
Convex Lens.

5. A laser beam having a diameter of 2 mm is to be expanded by a factor of 4. Draw a diagram of how one can create a beam expander using two convex lenses. Specify the focal length of the lenses and their positions using a diagram.

$$M_T = \frac{f_2}{f_1} = 4$$

$$\therefore f_2 = 4 f_1$$

eg. $f_1 = 2.5 \, cm \implies f_2 = 10 \, cm.$