Problems

Set up ray-tracing diagrams to scale for the given lens and mirror configurations. Locate and characterize the images by ray tracing, and use the thin lens equation to find the image distances d_i and magnifications M.

Converging mirrors

For these, assume the focal length is 30 cm.

d_o, cm	$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$	d_i, cm	M
45	$\frac{1}{30} - \frac{1}{45} = \frac{3}{90} - \frac{2}{90} = \frac{1}{90}$	90	−2
60	$\frac{1}{30} - \frac{1}{60} = \frac{2}{60} - \frac{1}{60} = \frac{1}{60}$	60	−1
90	$\frac{1}{30} - \frac{1}{90} = \frac{3}{90} - \frac{1}{90} = \frac{2}{90} = \frac{1}{45}$	45	−½
10	$\frac{1}{30} - \frac{1}{10} = \frac{1}{30} - \frac{3}{30} = \frac{-2}{30} = -\frac{1}{15}$	−15	1.5
20	$\frac{1}{30} - \frac{1}{20} = \frac{2}{60} - \frac{3}{60} = \frac{-1}{60}$	−60	3

What does the sign of the image distance tell you about the image? + = real, − = virtual

What does the sign of the magnification tell you about the image? + = upright, − = inverted

Diverging mirrors

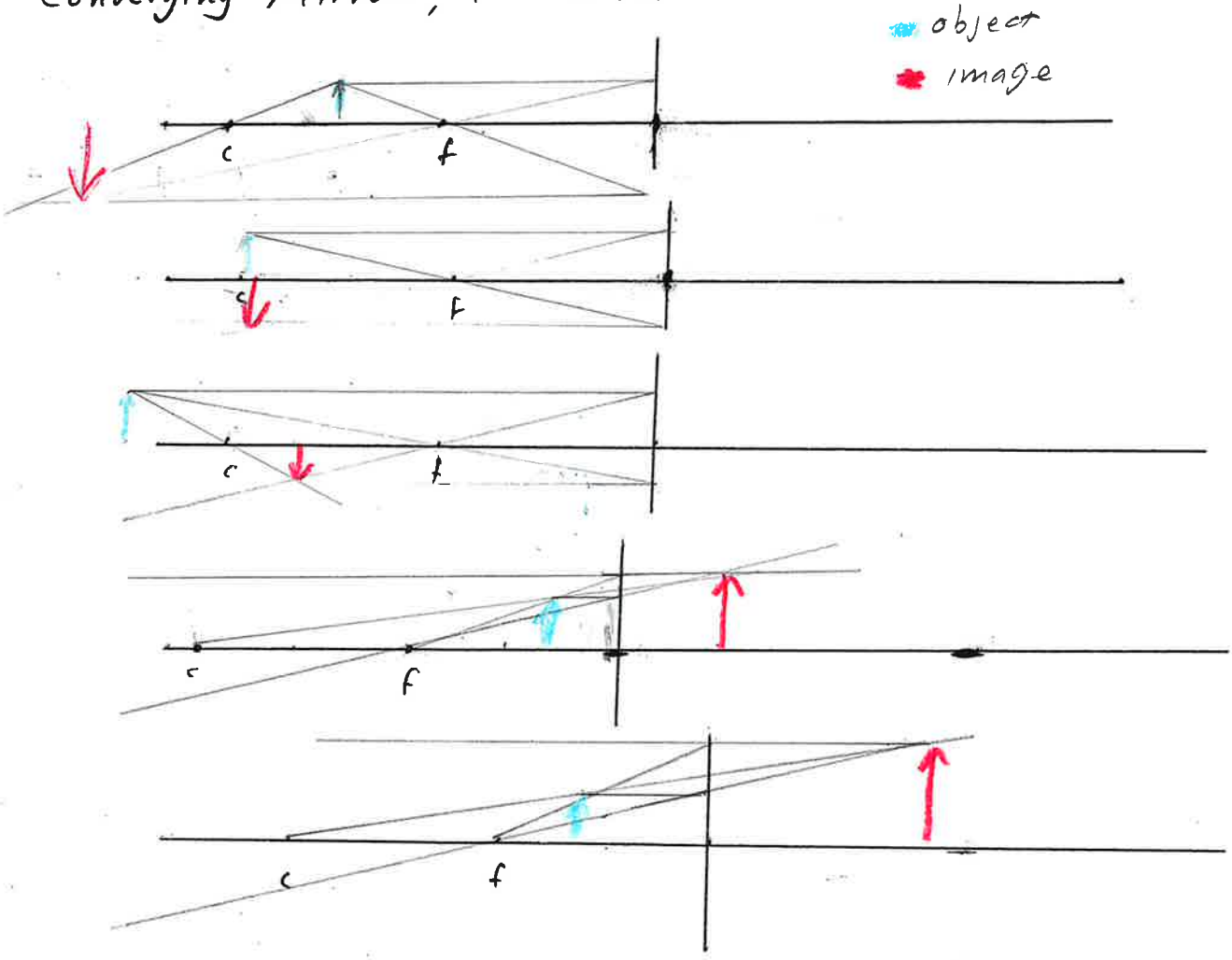
For these, assume the focal length is –30 cm.

d_o, cm	$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$	d_i, cm	M
15	$-\frac{1}{30} - \frac{1}{15} = \frac{-1}{30} - \frac{2}{30} = \frac{-3}{30} = -\frac{1}{10}$	−10	⅔
30	$-\frac{1}{30} - \frac{1}{30} = \frac{-2}{30} = \frac{-1}{15}$	−15	½
60	$-\frac{1}{30} - \frac{1}{60} = \frac{-2}{60} - \frac{1}{60} = \frac{-3}{60} = \frac{-1}{20}$	−20	⅓

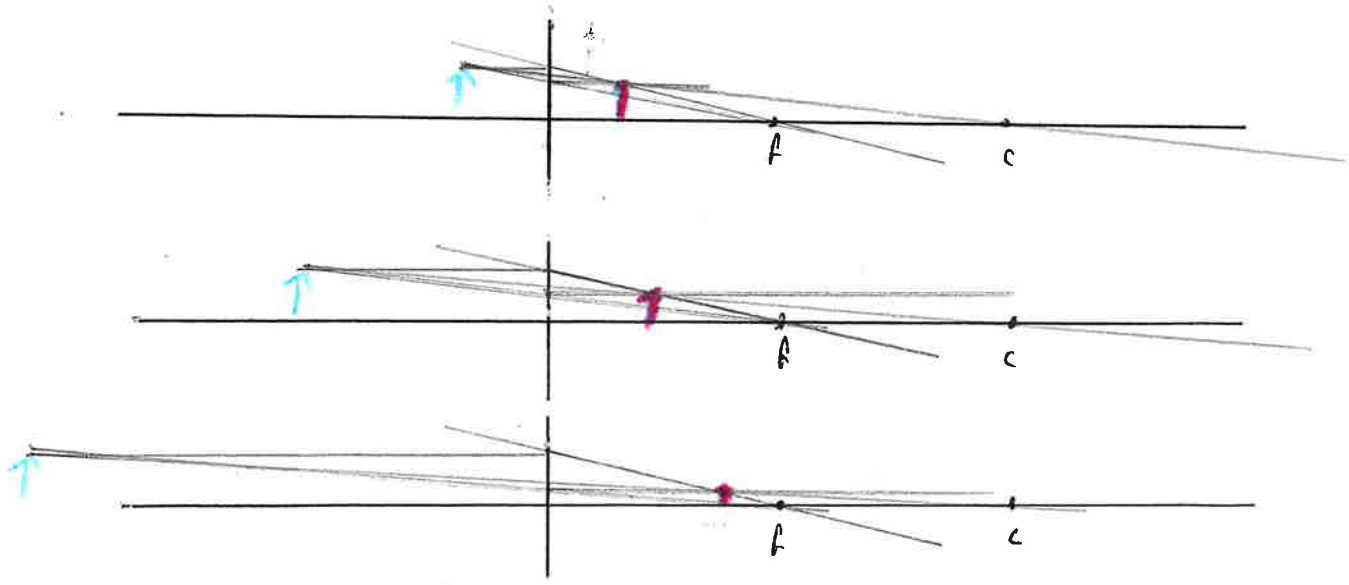
Converging and diverging lenses

Assume focal lengths of ±30 cm, and use the same object distances as with the mirrors. The equations are identical, so you don't need to repeat them. Do the ray tracing exercises, and answer the same questions.

Converging Mirrors, $f = 30$ cm

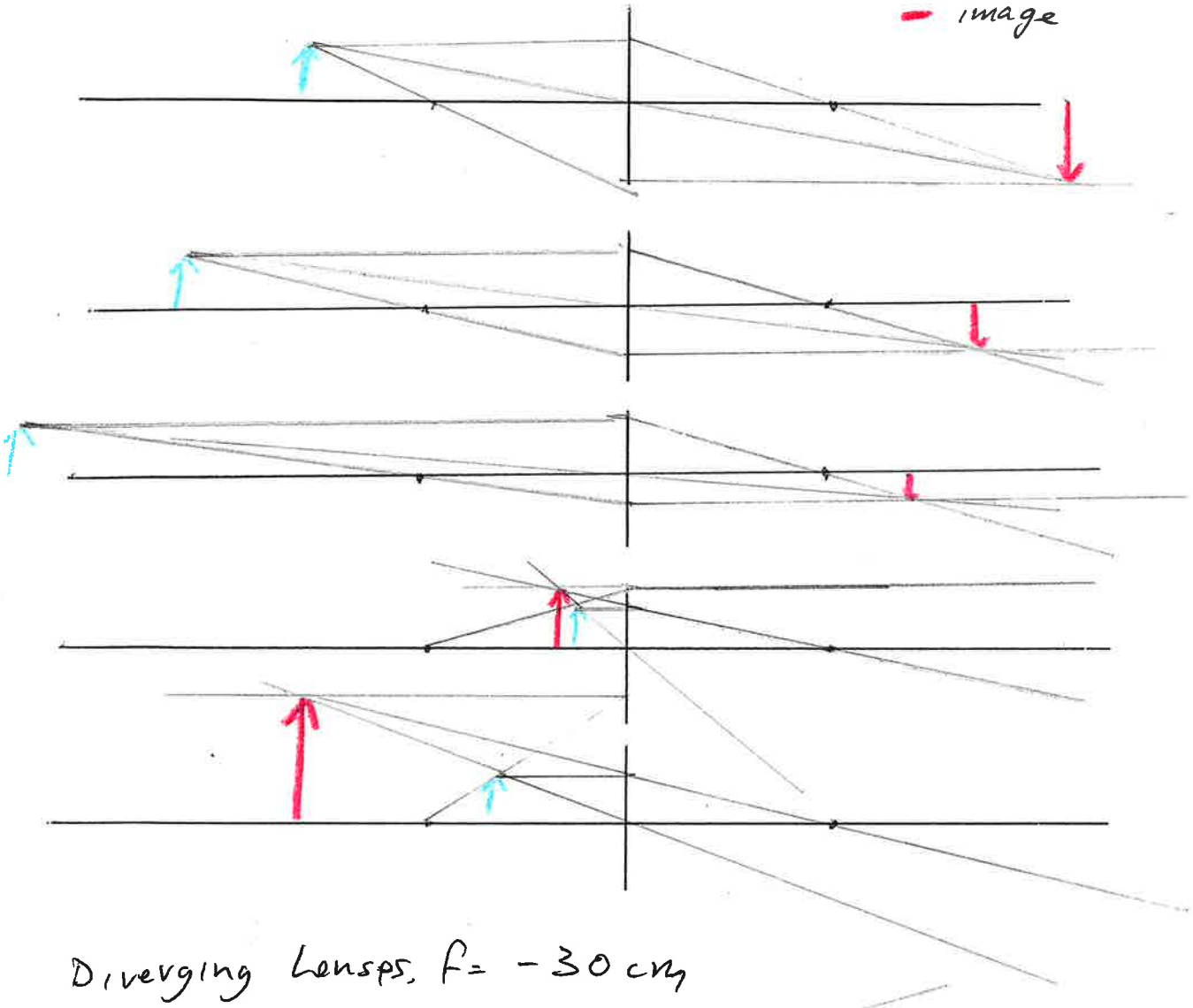


Diverging Mirrors, $f = -30$ cm



Converging Lenses. $f = 30$ cm

object
image



Diverging Lenses. $f = -30$ cm