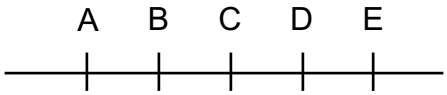
HOW TO QUALITATIVELY SOLVE MIRROR/LENS MCAT PROBLEMS

Firstly, if the problem asks for actual numerical answers, you need to use the Lens equation for that, this is the wrong place for approaching those type of problems. This guide is primarily helpful for solving problems that look like "Is the image real or virtual?" and other qualitative problems.

Draw diagrams for mirrors and lens problems like this:

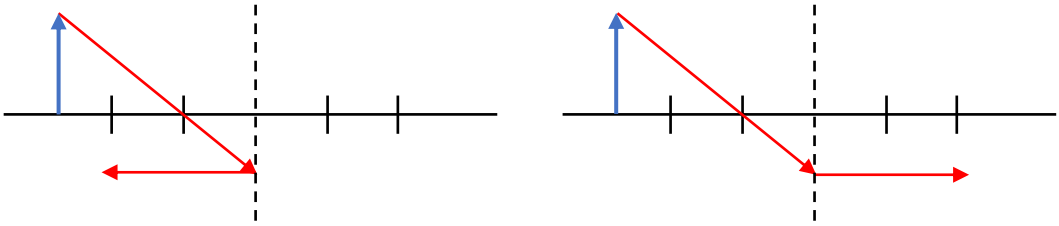


Point C is where the mirror or lens is. Points B and D are the focal points, which are each a distance f away from Point C, where f is the focal length. Points A and E are each a distance $2f$ away from Point C. When drawing such diagrams on the actual MCAT, there's no need to draw the actual mirror or lens at point C. A couple tips:

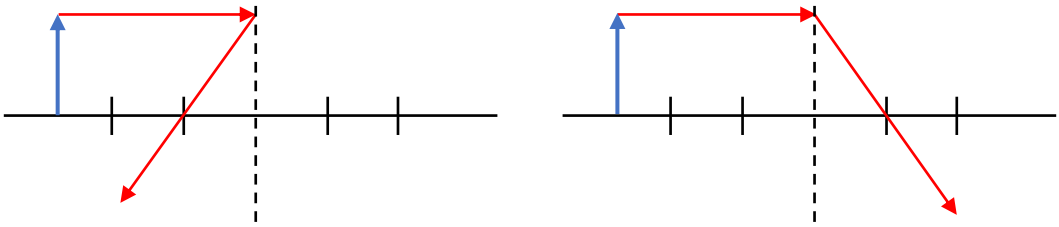
1. Make your diagrams **big**. There's no need to conserve space, you have a bunch of scratch paper and even if you run out, just ask for more.
2. Make your diagrams **accurate**. Be efficient but draw your spacings between points accurately. Literally why waste your time drawing a shitty diagram if it's not going to be helpful.
3. Feel free to **exaggerate** distances. This is especially for converging systems where the resulting image depends on how far you are from the mirror/lens. Remember, your goal in drawing these diagrams is to understand *qualitative* properties about the image. For example, if you know the object is further than $2f$ away from the mirror, draw it *really* far away so it's easy to see if the image is enlarged or reduced.

There are three main rules for mirrors and lens questions. An example of each rule is shown for mirrors (left) and lens (right). Blue arrow is the object, and red arrows are the light rays.

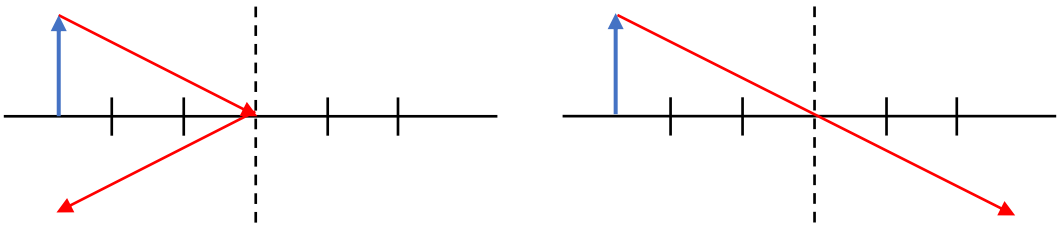
1. Any light ray initially going through a focal point will become parallel after the mirror/lens.



2. Any light ray initially parallel will go through a focal point after the mirror/lens.



3. Any light ray going through the center of the mirror/lens will either continue going in the same direction (lens) or be reflected at an angle equal to the incident angle (mirror).

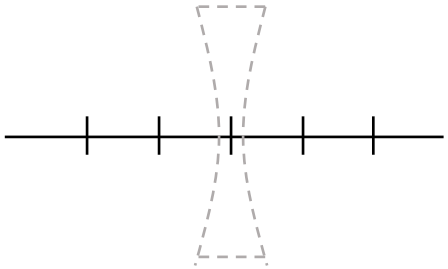


Use these rules to find out where different rays emanating from the same point intersect. *(You only need to draw two rays, typically the ones generated from Rules (2) and (3) are easiest to draw, but they should all yield the same answer.)* This will tell you what the corresponding point in the image will look like. From there, you can generate the rest of the image.

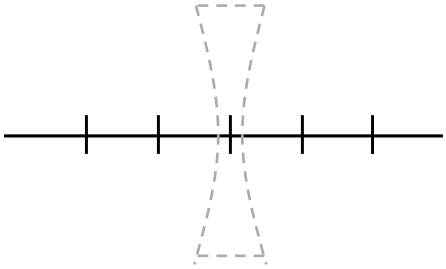
Problem 1: Concave (Converging) Mirror

Draw ray diagrams for the following cases of an object a certain distance d from a converging mirror with focal length f. Describe the resulting image for each case using one of the following terms from each category: (i) enlarged or reduced; (ii) upright or inverted; (iii) real or virtual.

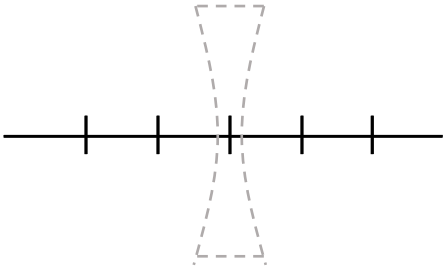
a. $d > 2f$



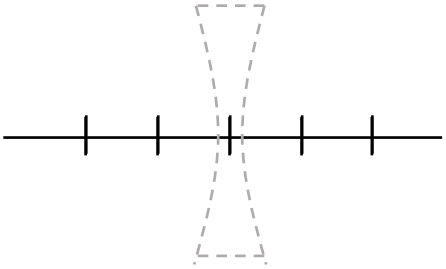
b. $d = 2f$



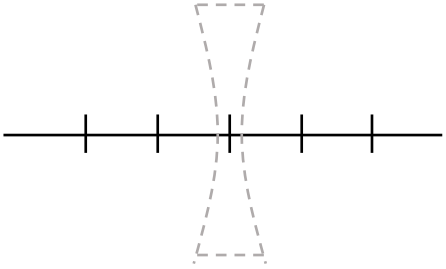
c. $f < d < 2f$



d. $d = f$



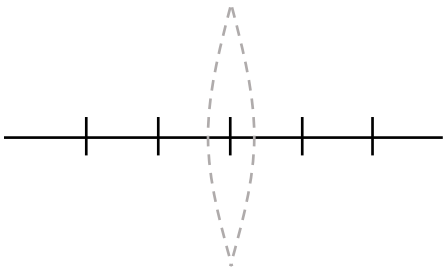
e. $d < f$



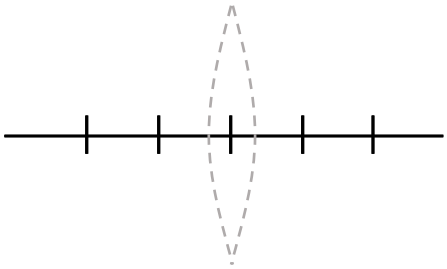
Problem 2: Convex (Diverging) Mirror

Draw ray diagrams for the following cases of an object a certain distance d from a converging mirror with focal length f. Describe the resulting image for each case using one of the following terms from each category: (i) enlarged or reduced; (ii) upright or inverted; (iii) real or virtual.

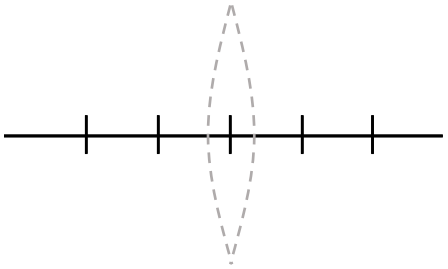
a. $d > 2f$



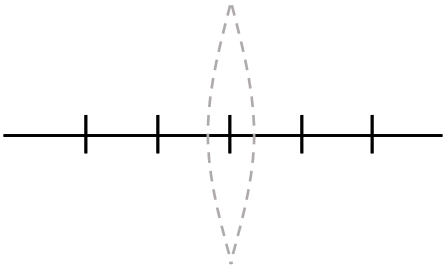
b. $d = 2f$



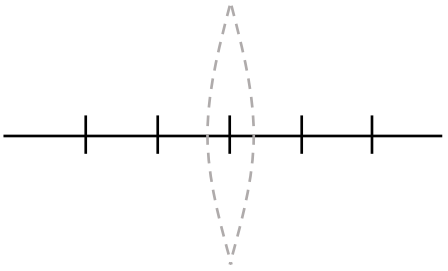
c. $f < d < 2f$



d. $d = f$



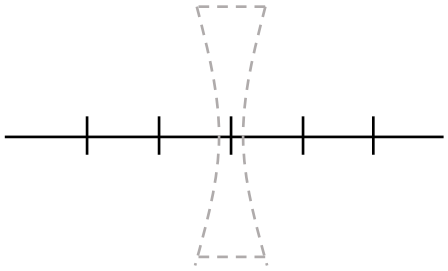
e. $d < f$



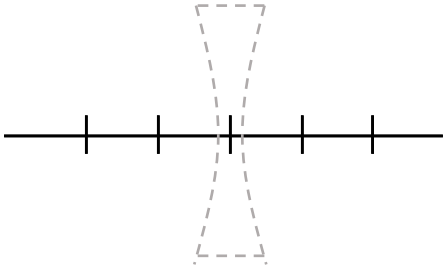
Problem 3: Concave (Diverging) Lens

Draw ray diagrams for the following cases of an object a certain distance d from a converging lens with focal length f. Describe the resulting image for each case using one of the following terms from each category: (i) enlarged or reduced; (ii) upright or inverted; (iii) real or virtual.

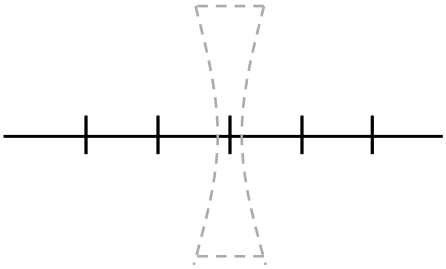
a. $d > 2f$



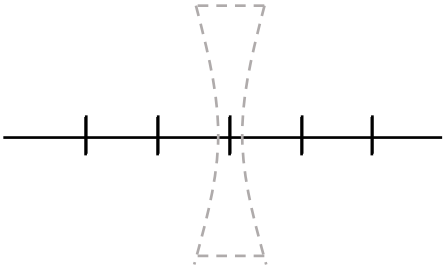
b. $d = 2f$



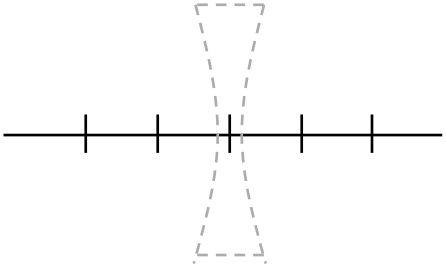
c. $f < d < 2f$



d. $d = f$



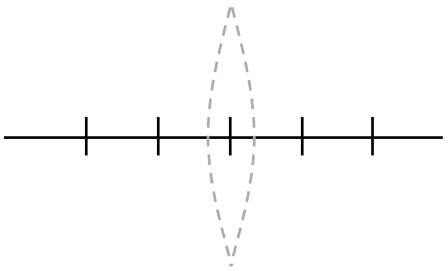
e. $d < f$



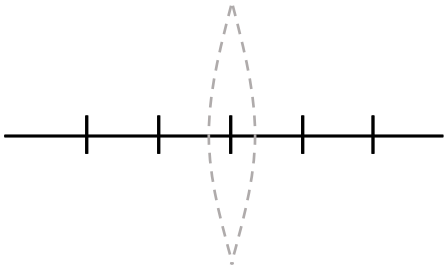
Problem 4: Convex (Converging) Lens

Draw ray diagrams for the following cases of an object a certain distance d from a converging lens with focal length f. Describe the resulting image for each case using one of the following terms from each category: (i) enlarged or reduced; (ii) upright or inverted; (iii) real or virtual.

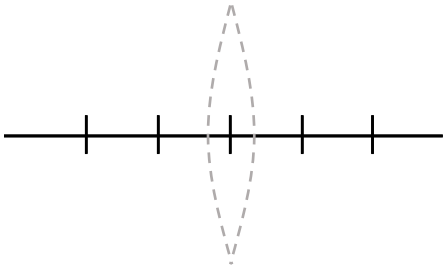
a. $d > 2f$



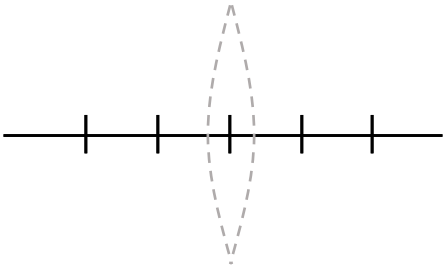
b. $d = 2f$



c. $f < d < 2f$



d. $d = f$



e. $d < f$