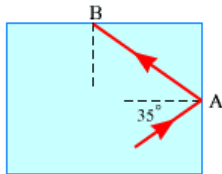


Instructions:

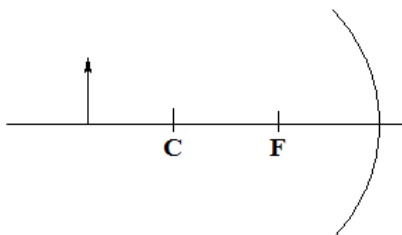
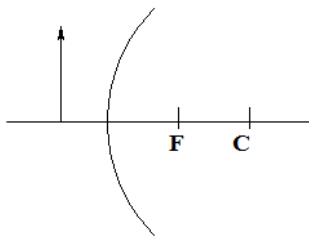
1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your **answers in a box**.
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

- a. Suppose you look into a concave mirror.
  - a) A real image will always be formed.
  - b) If you are between the center of curvature and the focal point, you will not be able to see your image.
  - c) Your image will always be inverted.
  - d) Your image will be diminished in size.
  - e) None of these is always true.
  
- b. What electromagnetic wave in the list has the largest wavelength? \_\_\_\_\_  
 a) red light; b) violet light; c) x-rays; d) radio waves;
  
- c. A ray of light starts out within a block of amber ( $n = 1.55$ ) and travels toward point A. At which point(s) does some of the light escape the glass into air? \_\_\_\_\_  
 a) A. b) B. c) Both A and B. d) Neither

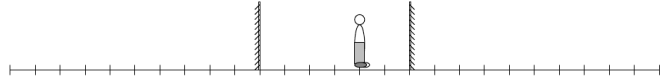


2. **Ray Diagrams (4 pts)** Sketch the ray diagrams for the following mirrors. Clearly show the images and indicate if they are **real or virtual**.



3. **Problems (13 pts)**

- a. A person stands 2.0 m from one two parallel plane mirrors separated by 6.0 m. Determine the image distances for the first two images in each of the mirrors. Draw and label these four images.



- b. An object is 10.0 cm in front of a concave mirror. It forms a real image at 25.0 cm from the mirror.
  - i. What is the mirror's focal length?
  
  - ii. What is the magnification?
  
- c. Green light has a wavelength of 510 nm in a vacuum. What is its frequency?
  
- d. An olive is at the bottom of a glass of alcohol ( $n = 1.36$ ), 6.00 cm beneath the surface. To a person who is directly above the olive, what is the apparent depth of the olive?
  
- e. An electromagnetic wave, traveling in a certain medium at  $2.25 \times 10^8$  m/s, is incident to an interface with air at  $45^\circ$  to the normal. At what angle does the beam emerge?
  
- f. My image appears one-ninth its size in a 6.0 inch diameter reflecting sphere. How far away is my face?

