

HOMWORK 9

closer than they may appear

if the image was smaller than the object, the brain will perceive it as being farther away (or the image distance could be larger than the object distance)

try the flat mirror case first

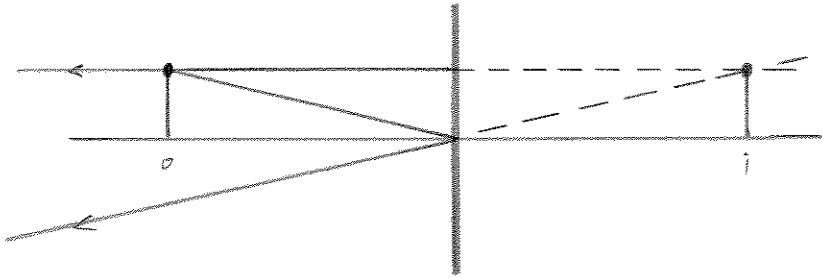


image same size and distance so this cannot be the case

for the convex or concave cases, since car mirrors are relatively flat, the radius of curvature must be very large and the object is between the focal point and the mirror

concave

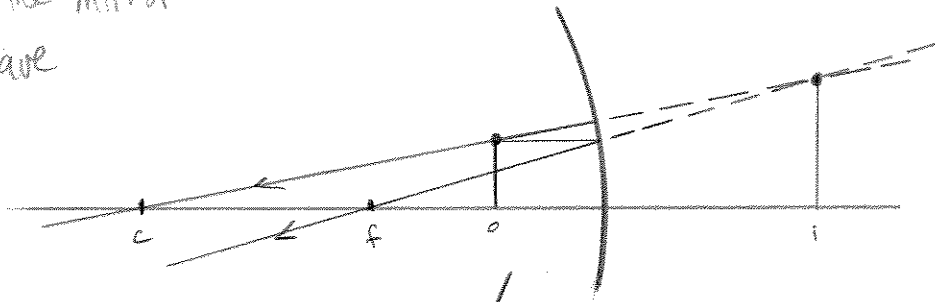


image is larger so this cannot be the case

convex

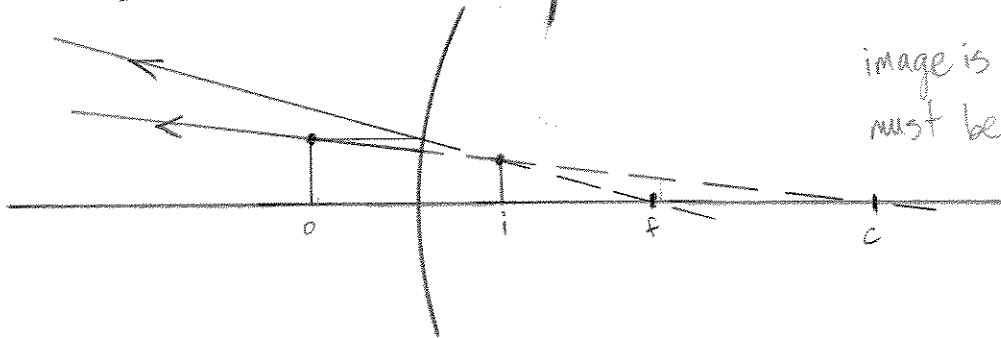
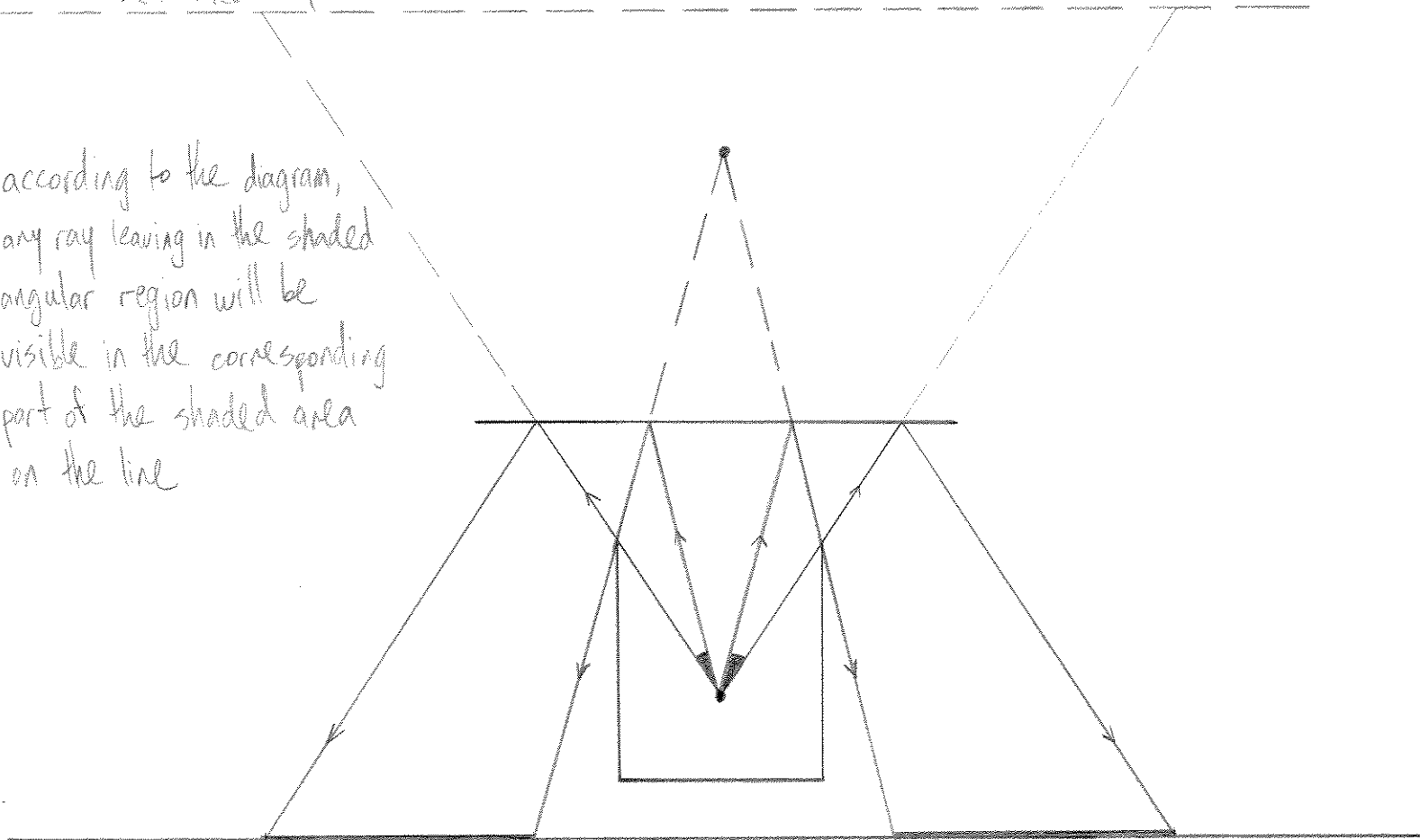


image is smaller, this must be the situation

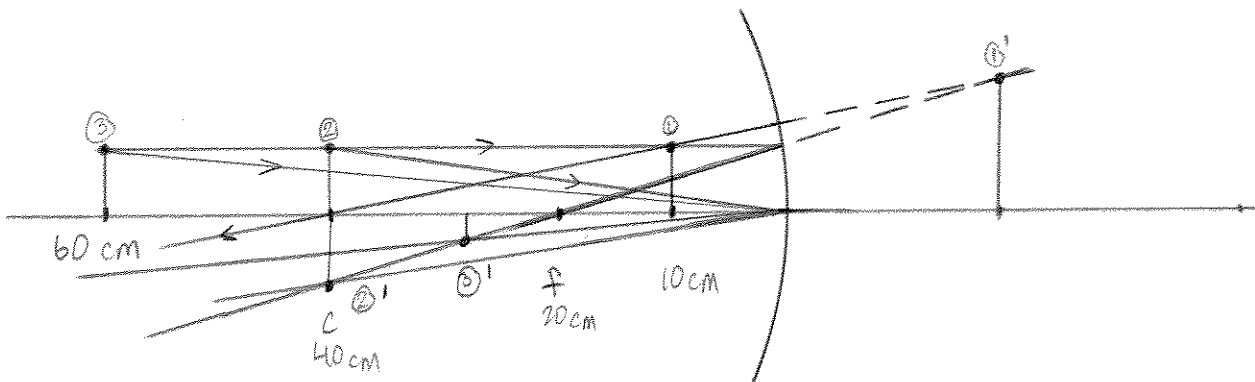
where can you see the bulb?

the trick of drawing a mirror image of the set up allows easy tracing of the reflected rays

according to the diagram,
any ray leaving in the shaded
angular region will be
visible in the corresponding
part of the shaded area
on the line



applying the mirror equation



10 cm - as can be seen from the ray diagram, the image is virtual, upright

$$\frac{1}{p} + \frac{1}{q} = \frac{2}{R} \quad \frac{1}{10} + \frac{1}{q} = \frac{2}{40} \Rightarrow q = -20 \text{ cm}$$

$$M = -\frac{q}{p} = -\frac{(-20)}{10} = 2$$

40 cm - real, inverted

$$\frac{1}{40} + \frac{1}{q} = \frac{2}{40} \Rightarrow q = 40 \text{ cm}$$

$$M = -\frac{q}{p} = -\frac{40}{40} = -1$$

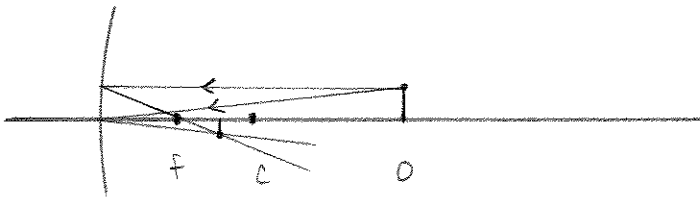
60 cm - real, inverted

$$\frac{1}{60} + \frac{1}{q} = \frac{2}{40} \Rightarrow q = 30 \text{ cm}$$

$$M = -\frac{q}{p} = -\frac{30}{60} = -\frac{1}{2}$$

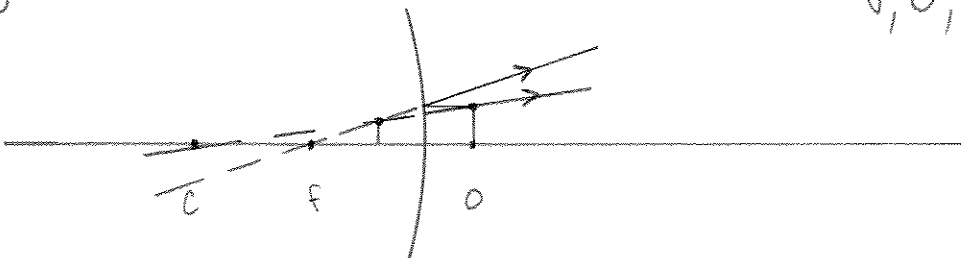
mirrors and lenses

a



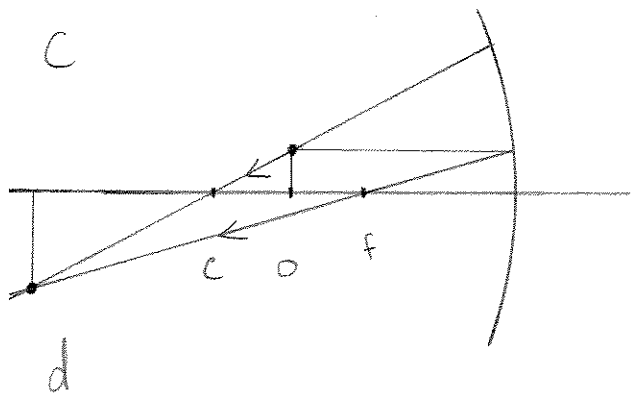
R, S, +

b

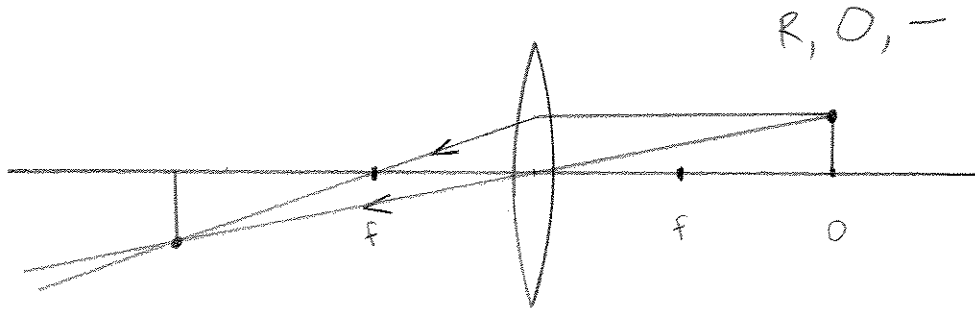


V, O, -

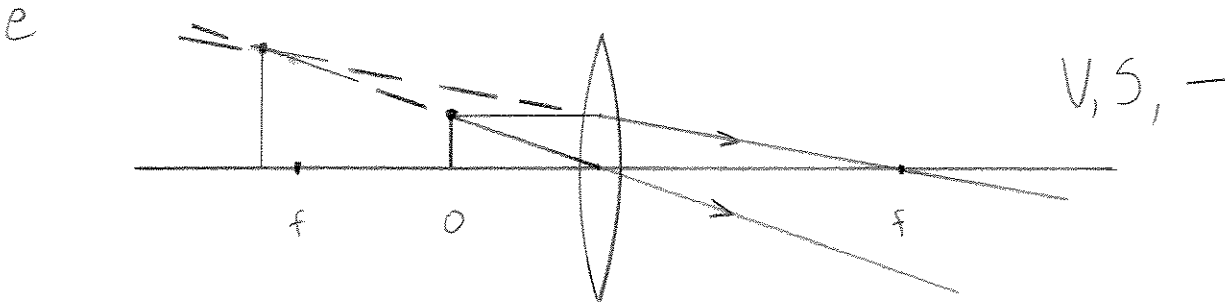
4



R, S, -



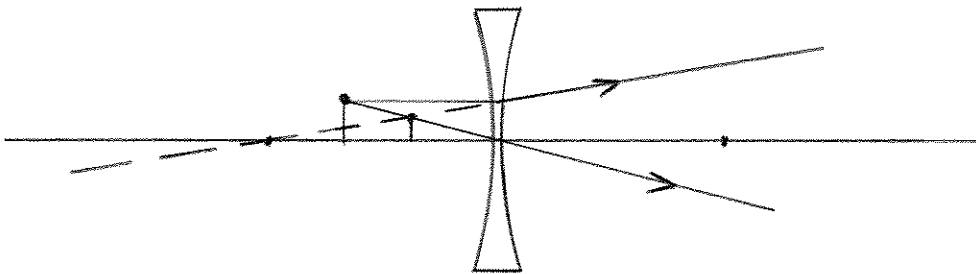
R, O, -



V, S, -

diverging lens

A



B $\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$ using the sign convention $-\frac{1}{8} = \frac{1}{6} + \frac{1}{q}$

$$\frac{1}{q} = -\frac{1}{8} - \frac{1}{6} \Rightarrow q = -\frac{24}{7} \approx -3.4 \text{ cm}$$

in this case negative means same side as the object

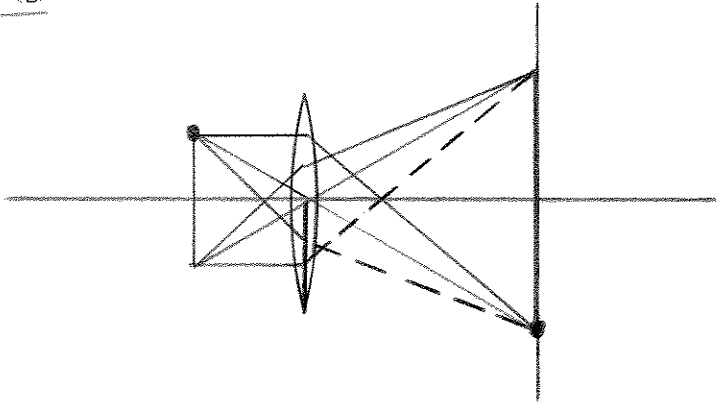
C $M = -\frac{q}{p} = -\frac{-\left(\frac{24}{7}\right)}{6} = \frac{4}{7} \approx 0.57$ hence image will be 0.57 cm tall

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D the image is virtual (a screen placed there will not show anything)

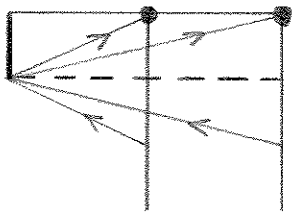
E on the right side of the lens

the half lens



c the image remains but is weaker - each point of the object emits rays in all directions and any that hit the lens are focused to the corresponding part of the image; as can be seen in the ray diagram, there are now blocked rays (dashed) but there are still rays from every part of the object that get through and are focused to the corresponding part of the image

alice and the looking-glass

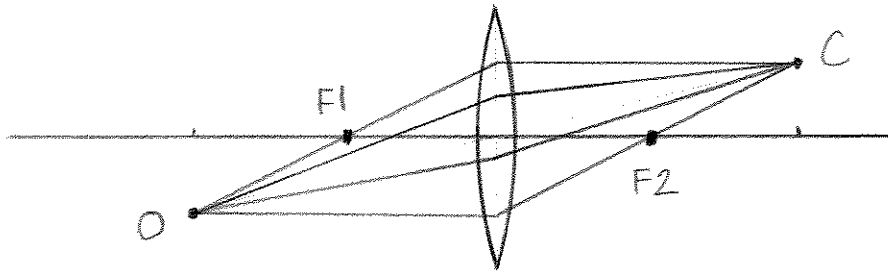


b she will see no change in how much of herself she can see - as can be seen in the ray diagram, using an isosceles triangle as an aid to make the angles of incidence and reflection also makes it clear that the base, and hence what she can see, remains the same

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a bigger lens

A



since rays from point O are focused at point C (and vice versa), the ray parallel to the axis will also be focused there but will first go through the focal point (a converging lens focuses parallel rays to the focal point); this locates F2 and a similar parallel ray from C locates F1

- B
- the distance of the image from the principal axis is same as with the smaller lens because that is determined only by the focal length
 - the brightness of the image with the larger lens is greater than with the smaller lens because the larger lens will collect and focus more of the rays from the light source

bizarre behavior with light

A this is a bad idea because the flash will illuminate the audience in front but will not have any effect on the distant band; consequently the picture will have the brightly illuminated audience and the band which will reduce the contrast and make the band hard to see

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B this is a bad idea because the room is darkened and consequently very little light is reflecting off of the audience hence the picture will not show anything

C this is a bad idea because most of the flash will reflect off of the window; consequently the picture will show a bright spot corresponding to the flash but none of the relatively much dimmer city lights