Physics 102 (F16)

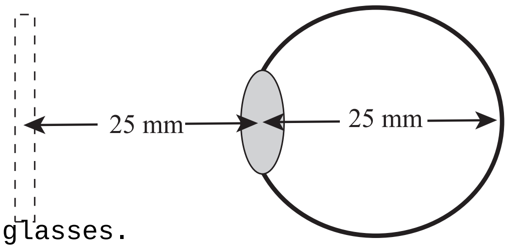
Q11B

Name: ________________ **Section:** ________ **Score:** ________/20

1. For a ‘presbyopic’ (farsighted due to aging) professor the distance between the middle of his lens and his retina is 25 mm as illustrated below.

(1) He needs a pair of glasses with focal length $f = 32$ cm to read books held 25 cm away from his own eyes. Where is his uncorrected near point, if the lenses of the glasses are held 2.5 cm from his own lenses? [5]

Principle of eye correction =
place virtual image
where you can see it clearly

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f = 320 mm
The object (book) is 250-25 =225 mm from the glasses.
Its virtual image is placed at his uncorrected near point.
1/f = 1/320 = 1/225 + 1/di -> 1/di = 1/320 -1/225 = -1/758 -> di = 758 mm.

Note that this is the distance from the glasses: 758 mm to the left of the glasses,
so 758 + 25 = 783 mm is the location of his uncorrected nearpoint.
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(2) With the above glasses where is the far point of this professor? [5]

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His uncorrected far point is, needless to say, infinity: d_i = \infty

1/320 = 1/do + 0 -> do = 320 mm
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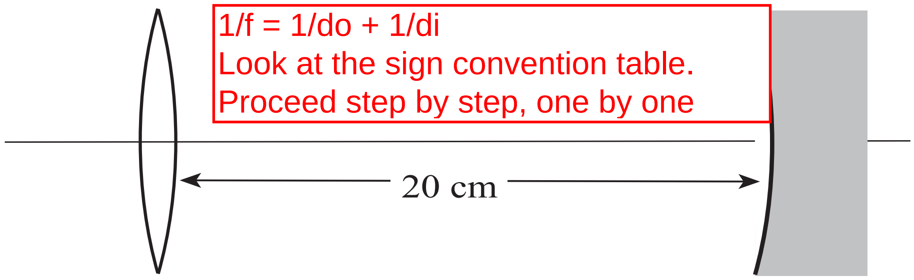
2. A convex lens is located 20 cm in front of a concave mirror. The focal length of the lens is $|f_1| = 5$ cm and that of the mirror is $|f_2| = 7$ cm.



(1) An object of height 2 cm is placed 3 cm to the left to the lens. Where is the final image by the mirror? You must tell whether the image is real or virtual. [You must solve this problem step by step, starting from the left lens.] [5]

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the first lens: f = +5cm, do = +3 cm
Therefore, 1/d_i = 1/f - 1/do = 1/5 - 1/3 = -2/15.  di = -15/2 = -7.5 cm, virtual image.
This means the image is 7.5 cm to the left of the lens. The location is obtained by
extrapolating back the rays going to the right.  Thus, this image acts as a real object
for the mirror. 20 + 7.5 = 27.5 cm is the distance from the mirror.

Mirror: f = +7 cm, do = 27.5 cm
Therefore, 1/d_i = 1/f - 1/do = 1/7 - 2/55 = (55 - 14)/385 = 41/385=1/9.39
That is, the image is 9.4 cm in front of the mirror (real).
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(2) What is the size of the image? Is it upright or inverted?[5]

m = -di/do
compute this for each element
and multiply all.

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lens m = -(-7.5)/3 = 2.5
mirror m = -(9.4)/27.5 = -0.34

Therefore, 2.5 x -0.34 = -0.85 is the overall magnification.
1.7 cm height, inverted.
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