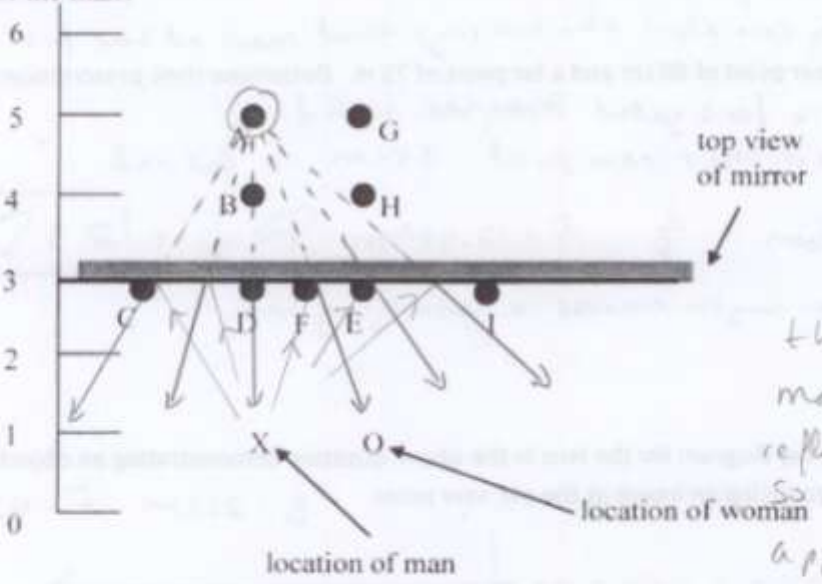
Exam 2 Review

Phys 221 – Spring 2013

Name: Solution

1. A man is standing two feet in front of a flat mirror. He is located at the X shown below. He is looking at his reflection in the mirror. There is a woman standing two feet to the right of the man. Her position is shown by the O below. At which point does she see the image of the man?



You can see that any ray that comes from the man to the mirror reflects with $\theta_i = \theta_r$ so that the image appears 2m behind the mirror.

b. Use the thin-lens equation (works for mirrors also) to show the location of the image mathematically.

Focal point of a plane mirror is ∞ $\quad \frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$

$\frac{1}{s} + \frac{1}{s'} = \frac{1}{\infty} = 0$ $\quad$ so $s = -s'$

$\boxed{s' = -2\,m}$

c. Does the thin lens equation include information about the location of the observer? Why?

No; it doesn't. Because the image location does not depend on the observer's location!

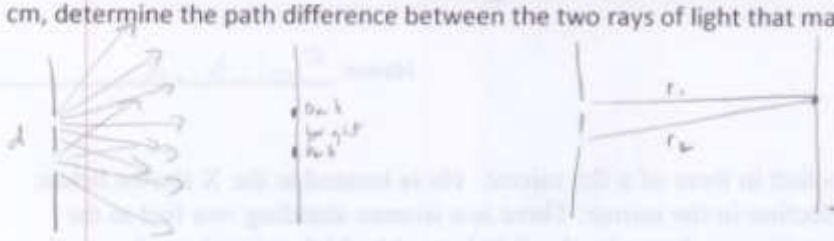
2. What is the difference between a double slit and a diffraction grating? Do they both cause diffraction and or interference?

Very little. A diffraction grating has hundreds or thousands of slits. A double slit has only two slits. The diffraction and subsequent interference of light happens the same for both.

Diffraction: Bending of light through a narrow (compared to λ) opening

Interference: When two waves overlap, they add or interfere. If they add constructively a bright spot is formed.

3. Light of 550 nm is shone through two narrowly spaced slits 0.044 mm apart. The slits are placed 0.96 meters from a wall. If the space between the central maximum and the first bright line is 1.20 cm, determine the path difference between the two rays of light that make the first order ***dark spot***.



r_2 travels a little further than r_1.
If this is the center of a dark spot the difference in Travel is $\frac{1}{2}\lambda$.

Lots of rays go through each slit. We only care about the two rays that meet at the first dark spot

$\lambda = 550\,nm$ so $\Delta r = 275\,nm$

4. A person has a near point of 60 cm and a far point of 75 m. Determine their prescription for glasses.

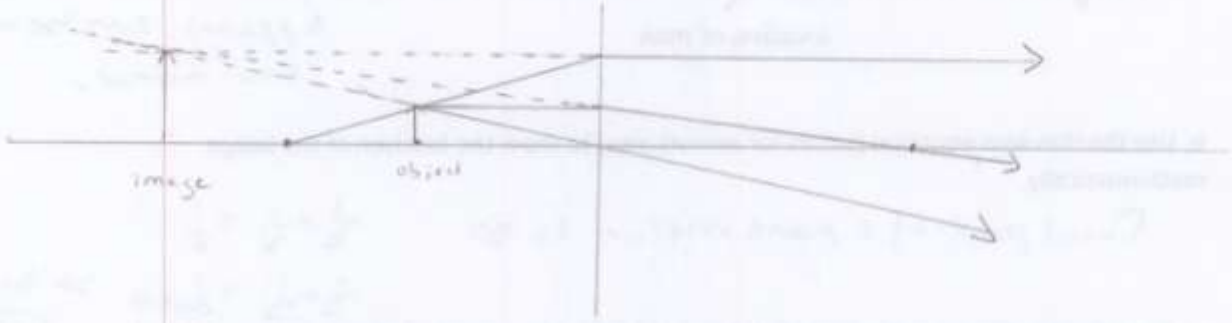
This person is farsighted (they see well far)
Need to correct their near point 25cm is desired

$\frac{1}{0.25} + \frac{1}{-0.60m} = \frac{1}{f}$ $f = 0.429\,m$ $P = \frac{1}{f} = 2.3\,D$

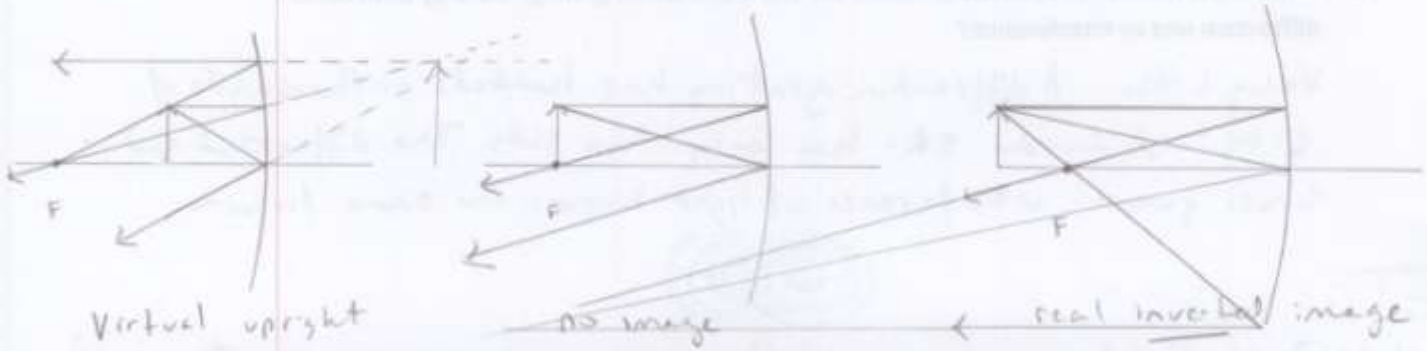
Positive focal length means a converging lens.

5. Draw an accurate ray diagram for the lens in the above question demonstrating an object at the new near point producing an image at the old near point.

$s = 25cm$ $f = 43cm$



6. Draw ray diagram(s) demonstrating what would happen if the mirror of a car were concave rather than convex. Assume that the typical mirror has a radius of curvature of 2.0 m. Describe what sort(s) of image(s) a driver would see and if this would be a viable alternative to the typical convex mirror.



This would be a disaster! As cars pass you they go from upright to inverted