Reflection and Mirrors Learning Guide

1. State the law of reflection. *The angle of incidence equals the angle of reflection*
2. Describe the difference between specular and diffused reflection in terms of the reflective surface and image formation. *A rough surface (like paper) will scatter the light that is reflected causing a diffused reflection. A smooth surface reflects light in the same arrangement as the incident light so an image can be seen*
3. Is the frequency of light changed by reflection? How can you tell? *NO—colors do not change*
4. Describe the characteristics of virtual images in terms of location and orientation. *Virtual images are formed by diverging light. They form behind the mirror where the light never reaches. They are upright if only 1 mirror or lens is involved in their formation.*
5. Describe the characteristics of real images in terms of location and orientation. *Real images are formed by converging light. The will appear in front of the mirror and will be inverted if only one mirror or lens is used.*
6. Which image type is formed by diverging light and which by converging light? *See #4 and #5*
7. With a plane (flat) mirror, how do object distance and image distance compare? *They are equal.*
8. Sketch a ray diagram for an object (arrow or pencil) and its reflection with a plane mirror by drawing two light rays from the tip of the object and their reflected rays. Extend the reflected rays behind the mirror using dashed lines, drawing the image where it forms. Draw normal lines at the point of reflection showing angles of incidence and reflection for any rays that do not strike the mirror perpendicular. Label image distance, object distance, object height and image height on the diagram. *See Figure 14-8 on page 528 in the text.*
9. Describe the images formed by a concave (converging) mirror with respect to where the object is located. Image description should include size, location and image type. *Between F and the mirror, images are magnified virtual images forming behind the mirror. Between F and C, images are real, magnified and appear inverted beyond C. At C image and object are the same height and location. If object is beyond C, image is reduced insize, real, inverted and form between C and F*
10. An object 5 cm high is placed 20 cm from the surface of a concave (converging) mirror with a focal length of 10 cm. Describe the image height, location and orientation. You may calculate this or support your answer in other ways. *Image will also be 5 cm in height located 20 cm from the mirror because if the focal length is 10 cm, 20 cm is the center of curvature. The image will be inverted.*

    $\left[10cm^{-1} - 20cm^{-1} \right]^{-1} = 20cm$
11. The same 5 cm object is moved to a point 15 cm from the mirror. Calculate the image location and height. What type of image is it? *real* $\left[10cm^{-1} - 15cm^{-1} \right]^{-1} = 30cm$ *in front of the mirror;*

    $h_i = \frac{30cm}{15cm} 5cm = 10cm$
12. The 5 cm object is now moved to a point 8 cm from the mirror. Calculate the image location and height. What type image is it? *virtual* $\left[10cm^{-1} - 8cm^{-1} \right]^{-1} = -40cm$ *behind the mirror*

    $h_i = \frac{40cm}{8cm} 5cm = 25cm$ *(If negative sign is used here it gives a negative height which means a virtual, upright image.)*
13. Describe the images formed by a convex (diverging) mirror in terms of size, location and type. *All images are virtual, upright and reduced in size, forming behind the mirror between the mirror and F*
14. What is special about the focal length of a diverging mirror? *It is negative because F is behind the mirror.*
15. Using the information in question 10, calculate the image size and location if the mirror is diverging (convex) instead of converging. What type image is it? *virtual*

$\left[-10cm^{-1} - 20cm^{-1} \right]^{-1} = -6.7cm$ *behind the mirror* $h_i = \frac{6.7cm}{20cm} 5cm = 1.7cm$ *Again, if the negative sign is used, the height will be negative indicating a virtual, upright image.*

16. Complete the curved mirror ray diagrams on the worksheet.

Multiple Choice Questions (from old tests)

B 1. When you look at the image of yourself in a plane mirror, you see (A) a real image (B) a virtual image (C) a magnified image.

C 2. When drawing a ray diagram, a ray that is parallel to the principal axis that strikes a concave mirror will (A) be reflected through C (B) pass through the mirror without being reflected (C) be reflected through F (D) be reflected straight back along the same path

A 3. A line perpendicular to a surface is called (A) a normal line (B) a true line (C) a plumb line (D) a natural line

A 4. An image of a distant object formed by a single concave (converging) mirror (A) is real (B) is virtual (C) is magnified (D) is right side up

A 5. An image formed by a single convex (diverging) mirror (A) is virtual (B) is upside down (C) can be projected on a screen (D) is larger than the object

B 6. Ray diagrams are used to (A) draw pretty pictures (B) figure out where an image will be located (C) find the focal point of a lens (D) figure out what kind of lens is being used (E) all of the above

C 7. If an object is located between the focal point and a converging mirror, the image will be (A) upside down (B) real (C) larger than the object (D) all of the above (E) none of the above

B 8. Which of the following is not true? (A) Real images made by a single mirror are always inverted (B) virtual images are always magnified (C) real images can be projected on a card or screen (D) virtual images made by a single mirror are always right side up.

D 9. The law of reflection says that (A) all waves incident on a mirror are reflected (B) waves incident on a mirror are partially reflected (C) the angle a ray is reflected from a mirror is random (D) the angle of reflection from a mirror equals the angle of incidence

C 10. The reason we can read print from any direction is that (A) letters emit black light in all directions (B) letters absorb black light from all directions (C) the white part of a page reflects light in all directions (D) all of the above