Team Number:

Team Names:

Student Names:

Optics

By Draksis314

Part 1 – Geometric Optics

1. A light bulb is placed infinitely far from a spherical concave mirror which has a radius of curvature of 10 cm. Would the light rays converge? If so, where?

2. A light bulb is placed infinitely far from a convex lens which has a focal length of 10 cm. Would the light rays converge? If so, where?

3. A light bulb is placed infinitely far from a concave lens which has a focal length of 15 cm. Would the light rays converge? If so, where?

4. An object is placed 75 cm away from a concave lens which has a focal length of 2 meters.

    a. Is there an image formed? If not, you may leave the rest of the letters in this question blank. Choose: **yes** or **no**

    b. Where would the image appear, relative to the lens and the object? (You may wish to draw a picture to best describe this)

    c. What type of image would it be? Choose: **real** or **virtual**

    d. Describe the orientation of the image.

    e. Calculate the distance between the lens and the image. Circle your final answer.

    f.   What is the magnification of this image?

5.   An object is placed 1 m away from a convex mirror which has a focal length of 35 cm.

    a.   Is there an image formed? If not, you may leave the rest of the letters in this question blank. Choose: **yes** or **no**

    b.   Where would the image appear, relative to the mirror and the object? (You may wish to draw a picture to best describe this)

    c.   What type of image would it be? Choose: **real** or **virtual**

    d.   Describe the orientation of the image.

    e.   Calculate the distance between the lens and the image. Circle your final answer.

    f.   What is the magnification of this image?

6.   An object is placed 25 cm away from a biconvex lens which has a radius of curvature of 50 cm on both sides.

    a.   Is there an image formed? If not, you may leave the rest of the letters in this question blank. Choose: **yes** or **no**

b. Where would the image appear, relative to the lens and the object? (You may wish to draw a picture to best describe this)

c. What type of image would it be? Choose: **real** or **virtual**

d. Describe the orientation of the image.

e. Calculate the distance between the lens and the image. Circle your final answer.

f. What is the magnification of this image?

7. Light travels at a rate 2×10^8 m/s in a rectangular piece of Pyrex. You set up an apparatus in a vacuum which shines light into the glass in a way such that the beam and the side of the Pyrex rectangle make a 40 degree angle.

a. What is the angle of incidence?

b. What is the angle of refraction?

8. A certain fiber optic cable is made of material that has an index of refraction of 2.23. What must the angle of incidence for a beam of light be so that the light remains in the cable?

9. A light ray hits a surface and reflects at an angle of 40 degrees from the normal to the mirror. What angle did the ray make with the mirror when it first struck it?

10. Describe the difference between specular and diffuse reflection.

11. How does a prism work?

12. A thin, biconcave lens with a focal length of 10 cm is desired. What must the radius of curvature be for such a lens if it is made out of Pyrex? Circle your final answer.

Part 2 – Physical Optics

13. Arrange these in order of photon energy, lowest energy first:

    a. X-Rays

    b. Microwaves

    c. Gamma Rays

    d. Orange light

    e. Radio waves

    f. Ultraviolet light

    g. Green light

    h. Long-waves

    i. TV waves

For questions 12 – 15, assume the room is dark and has white walls

14. A blue object has red light shined on it. What color does the object appear?

15. A black object has magenta light shined on it. What color does the object appear?

16. A cyan object has green light shined on it. What color does the object appear?

17. A white object has cyan light shined on it. What color does the object appear?

18. List the primary and secondary colors. **Make sure you label which are which!**

19. A light wave with a wavelength of 10 Å passes.

    a. Classify this wave as one of the types listed in #11

    b. Find the photon energy, frequency, and period of this wave

20. Fill in this diagram of the eye:

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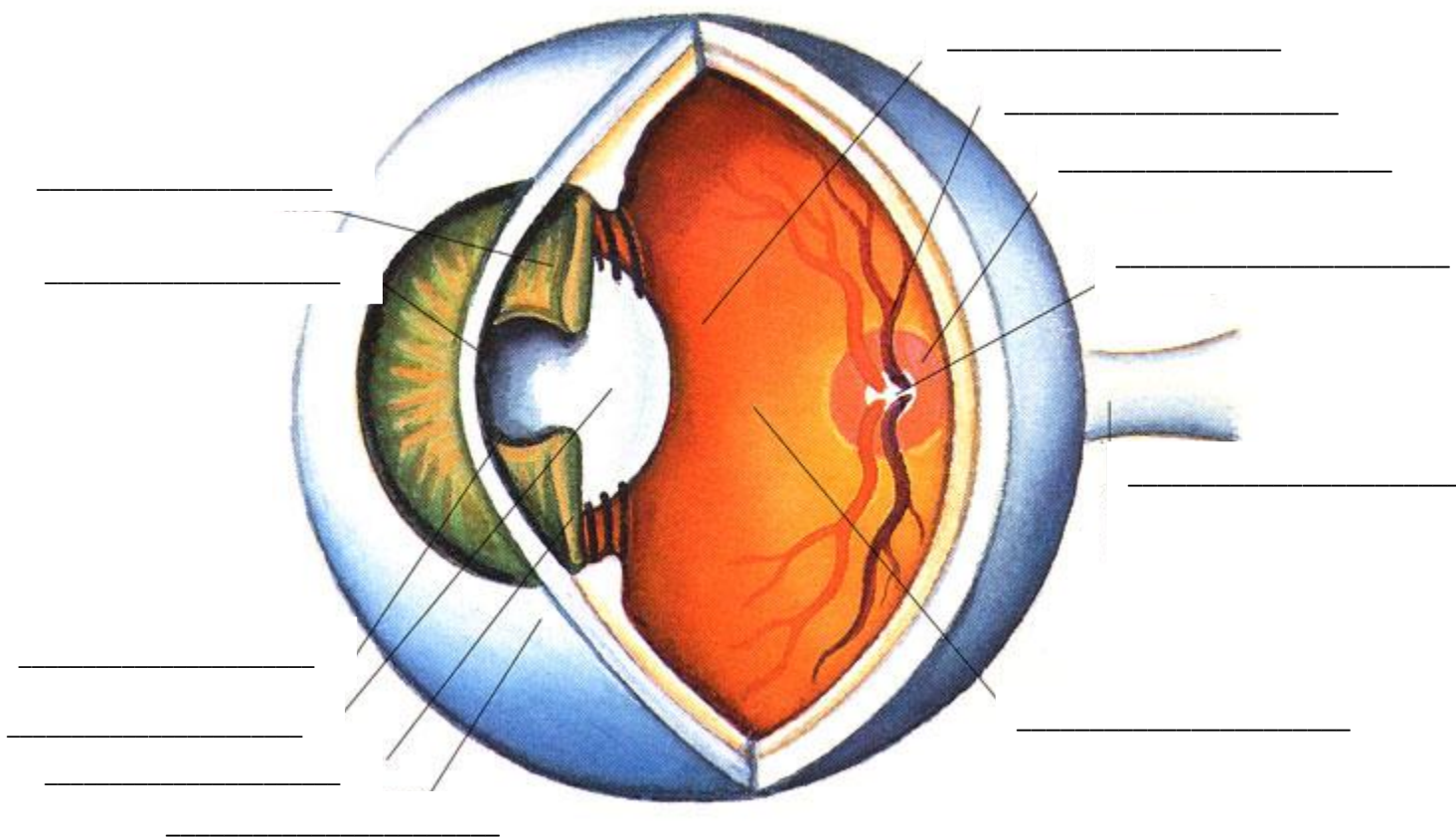
21. What type of lens does a nearsighted person need? Choose: **concave** or **convex**

22. What type of contact lens does a farsighted person need? Choose: **concave** or **convex**

23. Observatories on Earth found light with a frequency of 6.1×10^{14} Hz coming from a certain faraway star. However, this type of star is known to produce light with a frequency of 6.0×10^{14} Hz. How fast is the star moving away or toward Earth?

24. What is a bright line spectrum? What is an absorption spectrum? Why do they occur?