2023-24 ARCHIMEDEAN SATELLITE INVITATIONAL

OPTICS TEST

For the purposes of this test, assume the speed of light is exactly 300,000,000 m/s.
Be sure to mention any units necessary in your answers.

1. Nearsightedness is also known as _____.

2. When light moves from a vacuum to a certain substance, its velocity slows to 2.25 x 10^8 m/s. What is the substance's refractive index?

3. The period of a wave is 1 nanosecond. What is its wavelength in diopters^-1?

4. A light with a frequency of 6.1 x 10^14 Hz is being shone. What color is it?

- Magenta
- Cyan
- Blue
- Violet
- Red
- Yellow

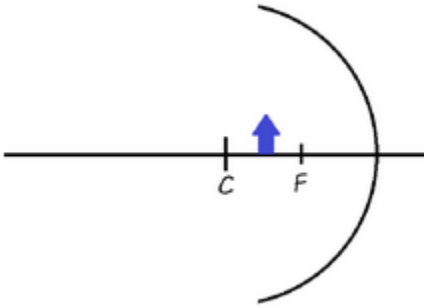
5. If I shine a red light and a green light at the same spot, what color should I expect to see?

- Yellow
- Cyan
- Magenta
- Red
- Green
- Blue

6. I mix Magenta and Yellow paint together in equal proportions. What color should I expect to see?

- Cyan
- Magenta
- Yellow
- Red
- Green
- Blue

7. An arrow is placed in front of a concave mirror between the center of curvature and the principal focus, as shown in the picture. Determine whether the resulting image is real or virtual, and whether it is inverted or not.



8. True or False: In the human eye, **rods** are used to detect brightness.

9. Which primary additive colors of light would a cyan shirt reflect? Which would be absorbed?

10. Given the refractive index in Question 2, what could the substance be?

- Water
- Glass
- Canola Oil
- Liquid Nitrogen
- Vacuum
- Air

11. A planar mirror makes what kind of image?

- Real
- Inverted
- Virtual
- Sideways
- Blurry
- No Image: mirrors don't reflect light.

12. When light travels from a vacuum through a certain substance, it slows down to 1 m/s. What is the index of refraction for this substance?

13. What is the optical power of a lens with a focal length of 7.4 meters?

- 0.14 diopters
- 3.7 diopters
- 2.7 diopters
- 1 diopter
- 2 diopters
- 7.4 diopters

14. Cyan + Magenta + Yellow = _____

15. What color would a light with a frequency of 1 GHz have?

- Red
- Yellow
- Green
- Blue
- Purple
- None of the above

16. True or False: A concave lens can make a real image.

17. A light hits a mirror at an angle of 15 degrees from the normal. What is the angle of reflection?

18. What is the refractive index of glass? Pick the closest option.

- 1
- 1.33
- 1.5
- 2.4

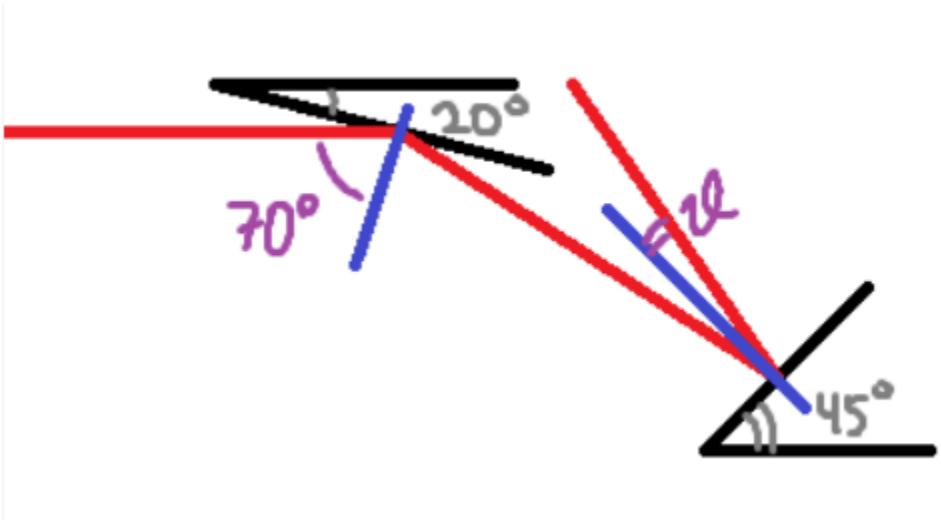
19. True or False: A cube is an optical prism

20. A light with a wavelength of 500 nm is pointed at a surface along with a red light. What color should you expect to see?

- Red
- Yellow
- Green
- Cyan
- Blue
- White

21. True or False: A concave mirror can make a real image.

22. A horizontal red light bounces off of two mirrors as shown in the picture. Find θ, the angle of reflection of the second mirror.



ALT TEXT: [The first mirror is at an angle of 20 degrees from the horizontal, and the light hits the mirror at an angle of 70 degrees from the normal. The second mirror is at an angle of 45 degrees from the horizontal.]

23. What is the sclera?

- The "whites" of the eyes
- The "color" of the eyes
- The clear outer layer of the eye
- The light-sensitive tissue at the back of the eye

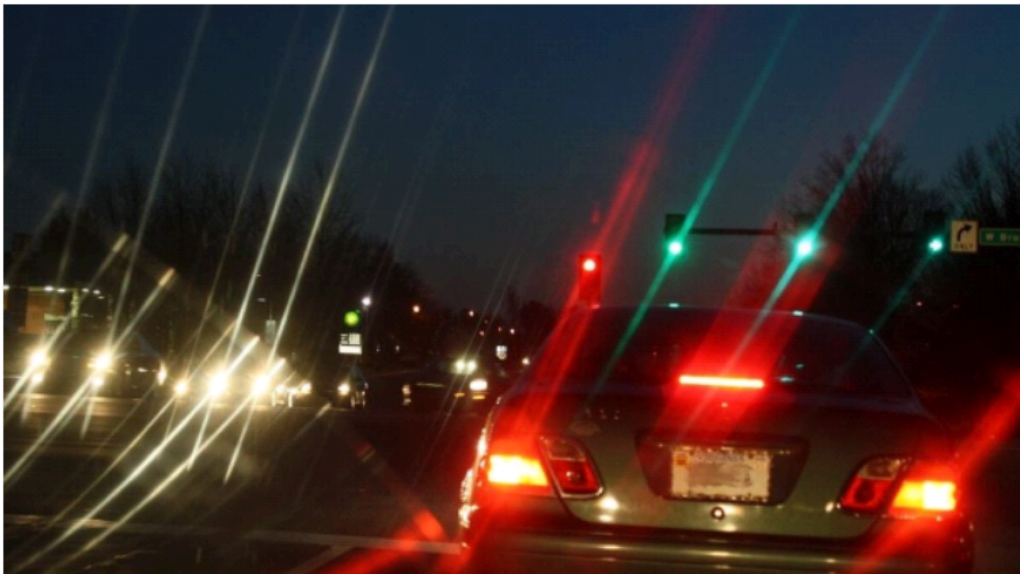
24. What is the condition where your eyes are different colors called?

25. True or False: There is an eye condition where a colored spot appears in a person's sclera. This condition is sometimes called "eye freckles."

26. What is the most common type of color blindness? Don't say "color-color colorblindness", give the actual name.

27. What is the condition where your eyes are the same color called?

28. Look at the following image. What eye condition causes lights to look like this?



29. When someone has farsightedness, what type of lens should their glasses be?

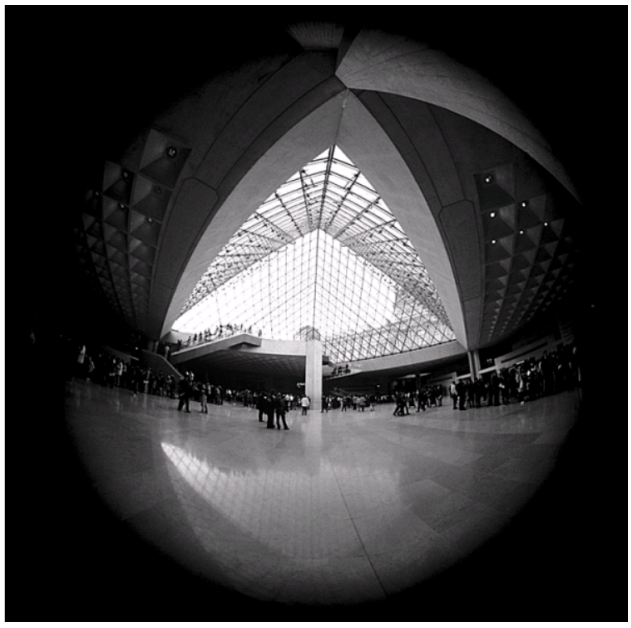
- Converging Lens
- Diverging Lens
- Planar Lens
- Inverted Lens
- Oblique Lens

30. Which of the following lenses are converging?

- Negative Meniscus
- Biconcave
- Positive Meniscus
- Plano-Concave

31. Explain the differences between Positive Meniscus and Negative Meniscus lenses.

32. Look at the following image. What type of camera lens was used to take this picture?



33. The unit ps/√km (picoseconds per square root kilometer) is used to measure what type of dispersion in optical fibers?

- Chromatic Dispersion
- Linear Dispersion
- Polarization Mode Dispersion
- Elliptical Dispersion

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OPTICS TEST ANSWER KEY

1. Myopia
2. 1.33 (or 1.3, 1.333, 4/3, etc.)
3. 0.3 diopters^-1
4. Cyan
5. Yellow
6. Red
7. Real; Inverted
8. True
9. Blue, Green reflected; Red absorbed.
10. Water

11. Virtual
12. 3 x 10^8 (or 300,000,000). No unit should be given.
13. 0.14 diopters
14. Black
15. None of the above
16. False
17. 15 degrees
18. 1.5
19. False
20. White

21. True
22. 5 degrees

23. The “whites” of the eyes
24. Heterochromia
25. True
26. Deuteranomaly
27. Homochromia
28. Astigmatism
29. Converging Lens
30. Positive Meniscus

31. Example: *In a Positive Meniscus Lens, the radius for the convex side is smaller than that of the concave side, whereas in a Negative Meniscus Lens, the opposite is true. Positive Meniscus Lenses are converging, while Negative Meniscus Lenses are diverging. Positive Meniscus Lenses are thicker in the middle than the edges, while Negative Meniscus Lenses are thinner in the middle than the edges.*
32. Fisheye Lens (also “whole-sky lens”, “sky camera”, “Nikkon-Fisheye lens”, “Nikon Sky Camera”, etc.)
33. Polarization Mode Dispersion